Minto Creek Sediment, Periphyton and Benthic Invertebrate Community Assessment - 2015

Report Prepared For:
Capstone Mining Corp. Minto Mine
13-151 Industrial Road
Whitehorse, YT
Y1A 2V3

Prepared By:
Minnow Environmental Inc.
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Victoria, BC
V8T 2A2

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1.0 INTRODUCTION

1.1 Site Description

The Minto Mine is a high-grade copper mine located within Selkirk First Nation (SFN) Category A Settlement Land Parcel R-6A approximately 240 km northwest of Whitehorse, Yukon Territory (62°37'N latitude and 137°15'W longitude; Figure 1.1). It is owned and operated by Minto Explorations Ltd. (MintoEx), a wholly owned subsidiary of Capstone Mining Corporation (Capstone). Mine development was initiated in 1997, commercial operations started in October 2007, and the anticipated operating life is to the year 2022. The facility is permitted to conduct open pit and underground mining with milling at a rate of 4,200 tonnes of copper/gold/silver ore per day, and produced 37.2 million pounds of copper in 2014. Copper reserves are approximately 440 million pounds. Mill tailings are stored in a dry stack Tailings Storage Facility (TSF) and in mined-out open pits (Figure 1.2). Mine-impacted seepage from the TSF and under the Mill Valley Fill Expansion (MVFE) is collected at the Minto Creek Detention Structure at the toe of the MVFE and pumped to the main pit (Figure 1.2). Non-impacted water and treated mine-impacted water are collected in a Water Storage Pond (WSP; Figure 1.2). Effluent from the WSP is periodically discharged to Minto Creek under conditions specified in Water Use Licence (WUL) QZ14-031 (August 2015). Minto Creek, in turn, discharges to the Yukon River approximately 7.7 km south-east of the WSP (Figure 1.2).

1.2 Background

Under the WUL, the Minto Mine implements an Environmental Monitoring, Surveillance and Reporting Plan (EMSRP) that includes a routine water quality surveillance program in Minto Creek and reference tributaries at sampling frequencies that vary from weekly to monthly during the ice-free period (typically from April to October or November). In accordance with the WUL, the Minto Mine submits water quality data to the Yukon Water Board as original laboratory reports and monthly summary reports within 30-days of month-end. Water quality monitoring data have indicated that total suspended solids (TSS) concentrations can increase dramatically during high flow events and that concentrations of a number of metals (including aluminum, chromium, copper and iron) are generally concurrently higher than national water quality guidelines for the protection of aquatic life even under background and reference conditions (e.g., HKP 1994; Minnow 2009a, 2010a, 2010b).

The Minto Mine also implements biological monitoring under the EMSRP, including Environmental Effects Monitoring (EEM) in accordance with federal requirements and an Aquatic Environmental Monitoring Plan (AEMP). Biological monitoring under EEM is

N
W E
S

160 0 160

Kilometers

MAP INFORMATION
Datum: NAD 83 Map Projection: UTM Zone 8V
Data Source: Department of Natural Resources Canada

Creation Date: March 2016
Project No. 157202.9073

Map of Canada

Figure 1.1: Location of the Minto Mine

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A Trinity Consultants Company

Features

- Final Effluent Discharge Point
- Waterbody
- Water Treatment Plant
- Minto Creek Detention Structure
- Building
- Watercourse
- Mine Road
- Water Flow Direction

N W E S

0 175 350 700
Meters

MAP INFORMATION
Datum: NAD 83 Map Projection: UTM Zone 8V
Data Source: National Topographic Data Base (NTDB) compiled by Department of Natural Resources Canada at a scale of 1:50,000. All rights reserved.

Mine infrastructure data provided by Access Mining Consultants Inc.
Mine site contours derived from 2012 aerial imagery obtained from Challenger Geomatics.

Creation Date: March 2016
Project No. 157202.9073

Figure 1.2: Minto Mine Site Layout and Receiving Environment

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implemented every three years, with the third and most recent EEM completed in 2014 (Minnow 2015a). The EEM biological monitoring implemented in 2014 was an Investigation of Cause (IOC) study into differences in benthic invertebrate community structure of upper Minto Creek (relative to reference) observed in the first two EEM studies. The IOC study documented some mine influence on Minto Creek water quality. Conductivity, hardness, nitrate, arsenic and copper were higher in Minto Creek than at reference areas but analytes were below Canadian Water Quality Guidelines (CWQG) for the protection of aquatic life, except for copper. Concentrations of nitrate were most strongly associated with the release of water from the Water Storage Pond, but remained below the CWQG. Despite the differences in water quality, a Reference Condition Approach (RCA) benthic invertebrate community survey indicated that the benthic invertebrate community of upper Minto Creek was within reference condition (Minnow 2015a).

Biological monitoring under the AEMP is implemented annually, and includes monitoring of water, sediment, periphyton, benthic invertebrates, fish and fish habitat. The biological monitoring program has been modified over time, but data from 1994 (baseline) and 2006-2014 have been reported previously (e.g., Minnow 2015b). AEMP water quality monitoring has indicated that fluoride and copper were the only two analytes elevated above the CWQG and/or WUL objectives, but similar exceedences were observed at reference areas as well. Sediment sampling conducted in September 2014 demonstrated that arsenic and copper concentrations were greater than Interim Sediment Quality Guidelines (ISQGs) for the protection of aquatic life at Minto Creek, but only copper in upper and lower Minto Creek was elevated to concentrations greater than the ISQG, baseline and reference (Minnow 2015b). In 2014, the periphyton community of lower Minto Creek had higher taxon richness, Simpson's Diversity ("D") and Simpson's Evenness ("E") than that of reference lower Wolverine Creek. These parameters are considered positive attributes. Differences in erosional benthic invertebrate community composition were apparent based on higher density and higher Bray-Curtis (BC) index at lower Minto Creek than at the reference area (lower Wolverine Creek). Lower Minto Creek had greater diversity, greater dominance of EPT taxa (Ephemeroptera [mayfly], Plecoptera [stonefly], Trichoptera [caddisfly] taxa) and greater dominance of oligochaetae, compared to lower Wolverine Creek. Greater diversity and dominance of EPT taxa are considered indicative of a healthy community and, along with the periphyton community findings, suggest limited mine-related impact to Minto Creek.

1.3 Objectives

The objectives of this study and report are to characterize and interpret current (2015) sediment quality, periphyton community, benthic invertebrate community and benthic invertebrate tissue quality of Minto Creek relative to reference conditions and conditions documented in previous years. Additional data on the quality of periphyton tissues and supporting environmental data are also reported.

1.4 Report Overview

This report is presented in nine sections, the first of which is this introduction. Section 2.0 presents the methods used in sample collection, sample analysis and data analysis. Section 3.0 provides a description of the sampling areas and a summary of supporting physical and chemical data collected in the field. Sediment, periphyton community, benthic invertebrate community and tissue chemistry results are presented in Sections 4.0 – 7.0, respectively. Conclusions and recommendations of the study are provided in Section 8.0. All the references cited throughout this report are listed in Section 9.0.

2.0 METHODS

Minnow Environmental Inc. implemented the Minto Creek sediment, periphyton and benthic invertebrate assessment from September 9th to 15th, 2015 with the assistance of Minto Mine staff. The study was completed in accordance with specifications of the Minto Mine Water Use Licence (QZ14-031). In response to recent additions to the WUL (Clause 101), additional sampling was completed in 2015. This included sediment toxicity testing and benthic invertebrate tissue chemistry analysis. Sediment sampling was undertaken in upper Minto Creek, lower Minto Creek and corresponding reference areas (Table 2.1; Figure 2.1). Toxicity tests were run on sediment from lower Minto and lower Wolverine creeks (Table 2.1; Figure 2.1). Periphyton and benthic invertebrate community sampling were undertaken in erosional habitat of lower Minto Creek and their corresponding reference areas (Table 2.1; Figure 2.1). Tissue sampling (periphyton and benthic invertebrate) was also undertaken in lower Minto Creek and corresponding reference areas (Table 2.1; Figure 2.1). Supporting measures (e.g., field meter measures, water quality samples, depth, flow, habitat observations) were collected at all sampling stations.

2.1 Supporting Measures

2.1.1 Field Collection

A number of environmental variables were measured to support the sediment quality, periphyton community, benthic invertebrate community and tissue chemistry data collected for the Minto Creek assessment. The location of each station was recorded using a handheld Geographic Positioning System (GPS) with coordinates recorded in Universal Transverse Mercator (UTM) units (using the North American Datum of 1983).

Supporting measures collected concurrent with sediment sampling (i.e., at depositional areas) included: core penetration depth (lower creek areas only), sample texture, and the presence or absence of organic detritus. *In situ* measurements including temperature, dissolved oxygen, conductivity, and pH were taken at each station using either a YSI 650 MDS (Multiparameter Display System) field meter equipped with a YSI 6600 Sonde (Yellow Springs Instruments, Yellow Springs, OH) or a Hanna 4M multiparameter meter (Woonsocket, RI).

At each periphyton and benthic invertebrate station (for the community and tissue samples), *in situ* water quality measurements were taken using a field meter (described above), water depth was measured using a meter stick and water velocity was measured using a Marsh-McBirney Flo-Mate 2000 portable flow meter (Marsh-McBirney Ltd., Frederick, MD). Creek wetted and bankfull widths were measured at each sampling station using a tape measure or

Table 2.1: Minto Mine Water Use Licence sediment, periphyton and benthic invertebrate monitoring program overview - September 2015.

Area Type	Area	Station	Minto Mine Water Use Licence (QZ14-031, Amendment 10)								Selenium	
			Water	Sediment by Spoon[1]	Sediment by Hand Corer/Petite Ponar[2]	Sediment Toxicity Testing	Periphyton Chlorophyll 'a'	Periphyton Community	Benthic Community by Hess Sampler[3]	Benthic Invertebrate Tissue	Periphyton Tissue[4]	Benthic Invertebrate Tissue[4]
Lower Creek Areas	Lower Wolverine Creek (Reference)	LWC-1			✓	✓	✓	✓	✓	✓	Target 5 periphyton tissue samples	Target 5 benthic invertebrate tissue samples
		LWC-2			✓	✓	✓	✓	✓	✓		
		LWC-3	✓		✓	✓	✓	✓	✓	✓		
		LWC-4			✓	✓	✓	✓	✓	✓		
		LWC-5			✓	✓	✓	✓	✓	✓		
	Lower Big Creek (Reference)	LBC-1							✓		Target 5 periphyton tissue samples	Target 5 benthic invertebrate tissue samples
		LBC-2							✓			
		LBC-3	✓						✓			
		LBC-4							✓			
		LBC-5							✓			
	Lower Minto Creek (Exposed)	LMC-1			✓	✓	✓	✓	✓	✓	Target 5 periphyton tissue samples	Target 5 benthic invertebrate tissue samples
		LMC-2			✓	✓	✓	✓	✓	✓		
		LMC-3	✓		✓	✓	✓	✓	✓	✓		
		LMC-4			✓	✓	✓	✓	✓	✓		
		LMC-5			✓	✓	✓	✓	✓	✓		
Upper Creek Areas	Upper McGuinty Creek (Reference)	URC-1		✓								
		URC-2		✓								
		URC-3	✓	✓								
		URC-4		✓								
		URC-5		✓								
	Upper Minto Creek (Exposed)	UMC-1		✓								
		UMC-2		✓								
		UMC-3	✓	✓								
		UMC-4		✓								
		UMC-5		✓								

[1] Top 2 centimeters collected; minimum 3-grab composite

[2] Top 2 centimeters collected; 3-grab composite

[3] 500 µm mesh; 3-grab composite

[4] Productivity permitting; in some cases, replication (of 5) may not be achieved with reasonable effort

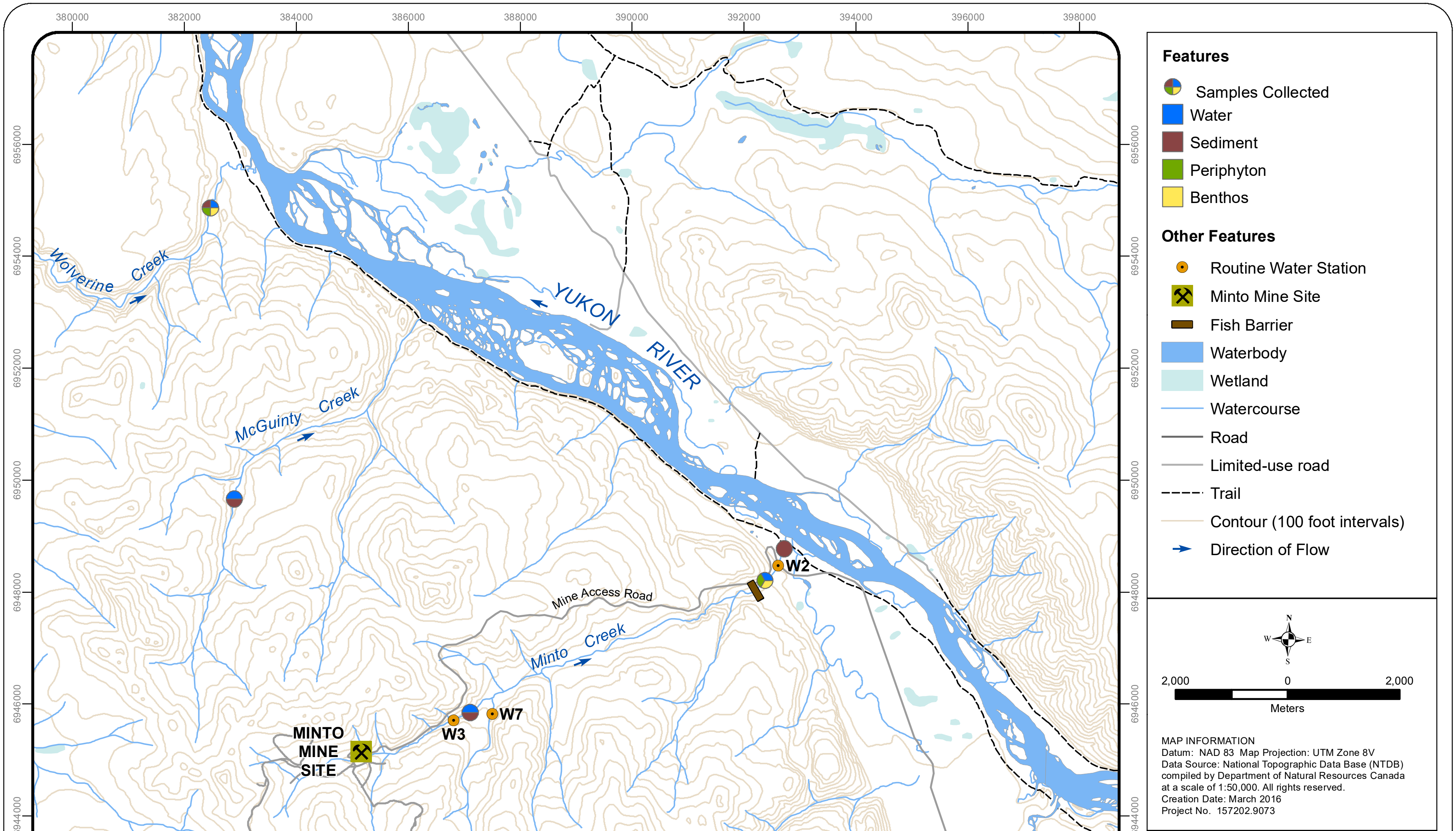

Figure 2.1: Monitoring Areas for the Minto Creek Sediment, Periphyton and Benthic Invertebrate Community Assessment - 2015

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a range finder. Additional data collected to characterize each periphyton and benthic invertebrate sampling station included: elevation, gradient, water appearance, creek morphology, bank condition, substrate texture, instream cover, instream features, overhead canopy, aquatic vegetation, riparian vegetation, surrounding land use and anthropogenic disturbance. In addition, at each benthic invertebrate station, the intermediate axis length of 100 rocks that were washed during the benthic invertebrate sampling were measured and recorded, and the percent embeddedness of ten randomly selected rocks were evaluated and recorded. This type of substrate characterization is similar to that recommended under the Canadian Aquatic Biomonitoring Network (CABIN) protocol (CABIN 2012) for characterizing benthic invertebrate habitat and provided additional information to assess and standardize habitat conditions among sampling stations and areas. Summary statistics of intermediate axis lengths (including the median and geometric mean) and median embeddedness were calculated for each station as per CABIN protocol.

Water samples for chemical analysis were collected at each periphyton and benthic invertebrate sampling area. Samples were collected using a master bottle from which the collected water was poured into pre-labeled sample bottles. Preservatives were added to the sample bottles, as required. A duplicate sample was collected from one site by using a split sample method; water from the master bottle was poured into one bottle and then into a duplicate bottle. Water samples for dissolved organic carbon (DOC) and for dissolved ICP-MS (Inductively Coupled Plasma-Mass Spectrometry) metals were filtered in the field using 0.45 µm polypropylene filters. Immediately after collection, water samples were placed in a cooler, and later placed in a refrigerator at approximately 4°C until they were submitted to ALS Environmental in Whitehorse, YT, for analysis of alkalinity by auto titration, anions by ion chromatography, total and dissolved organic carbon by combustion, total inorganic carbon by CO_2 purge, total cyanide by Continuous Flow Analyzer (CFA), conductivity by electrode, hardness by calculation, total and dissolved mercury by Cold Vapour Atomic Fluorescence Spectrophotometry (CVAFS [low]), total and dissolved metals by Collision Cell Mass Spectrometry (CCMS) and Inductively Coupled Plasma-Optical Emission Spectrophotometry (ICPOES), total and dissolved phosphorus by colour, total dissolved and suspended solids by gravimetrics, pH and turbidity by meter, and ammonia by fluorescence.

The productivity of lower Minto Creek and lower Wolverine Creek was evaluated using measurements of chlorophyll *α* in periphyton. Chlorophyll *α* is the primary photosynthetic pigment of all oxygen-evolving photosynthetic organisms (Wetzel 2001) and therefore provides an indicator of the standing stock of photosynthetic organisms representing the lowest trophic level. Minto Creek is a lotic system, so measuring chlorophyll *α* in periphyton is considered to be more representative of productivity than measuring it in water. A stainless steel razor blade was used to scrape periphyton from five rocks and transfer periphyton to labeled sampling jars. The surface area sampled was measured and recorded. All samples were maintained in coolers with ice packs during transport and then kept frozen on site until submission to the ALS Environmental (Whitehorse, YT).

2.1.2 Data Analysis

The quality of the data were evaluated by comparing laboratory detection limits to target detection limits, which are ideally ≤ 1/10th of guideline values. The laboratory conducted Quality Assurance/Quality Control (QA/QC) analysis on a subset of samples, including method blanks, laboratory duplicates, matrix spikes and certified reference materials. Field duplicates were also collected and analyzed. These QA/QC samples were evaluated to characterize data quality in a formal Data Quality Assessment (DQA; Appendix A). Water quality of Minto Creek was evaluated relative to WUL objectives, concentrations measured at reference areas, applicable water quality guidelines, and historical water quality.

Supporting field measures (temperature, dissolved oxygen, pH and specific conductivity) and chlorophyll *α* results were tested for differences between lower Minto Creek and reference (lower Wolverine Creek) using t-tests. Prior to the t-test, data were tested for normality and homogeneity of variance (equal variance). Data that were not found to be normal were log transformed. If, after transformation, data could not be normalized, a non-parametric Mann-Whitney U-test was applied. The significant p-value was set at 0.05 for all tests of supporting field measures. Statistical comparisons were conducted using SPSS software (SPSS 2003). Chlorophyll *α* was also compared to British Columbia water quality guidelines. Creek productivity was also characterized by comparing chlorophyll *α* concentration to the Dodds et al. (1998) productivity classification system for temperate streams.

2.2 Sediment Quality

2.2.1 Sample Collection and Laboratory Analysis

Sediment samples were collected for particle size and chemical analysis at depositional areas within Minto Creek and reference creeks (Table 2.1; Figure 2.1). At lower Minto Creek and lower Wolverine Creek, sediment samples for particle size analysis were collected using a 15.24 cm x 15.24 cm (6" x 6") stainless steel petite ponar grab sampler (0.023 m^2 sampling area). A composite sample was created by collecting the surficial two centimeters of sediment from each of three acceptable grabs (i.e., full to each edge of the sampler) using a stainless steel spoon. Sediment samples for physical characterization were then placed into pre-labeled Ziploc™ bags. Sediment samples for chemical analyses were collected using a 4.7 cm (2") (inside diameter) Lexan™ core tube, which was carefully inserted into sediment deposits, capped using a fitted plastic cap and retrieved by hand. From each acceptable core (i.e., each core containing an intact, representative sediment-water interface), the surficial two centimeters of sediment was manually extruded upwards into a graded core collar, cut with a stainless steel core knife, and placed into a pre-labeled Ziploc™ bag. Samples from three cores treated in this manner were composited to form a single sample from each station. At upper Minto Creek and upper McGinty Creek, sediment deposits were rare and were typically very shallow (i.e., deposits were less than three centimeters in depth). Accordingly, collection by ponar or by coring, as described above, was not effective in the upper creek areas and sediments were collected using a stainless steel spoon. Specifically, at locations of sediment deposition, surficial sediment was carefully collected by slowly spooning the sediment into a Ziploc™ bag, with care taken to avoid the loss of fine material. In order to be as consistent as possible with the sediment collected in the lower creek areas, samples included no more than the top 2 centimeters of deposited sediment. Immediately after collection, sediment samples were placed in a cooler, and later placed in a refrigerator at approximately 4°C until they were submitted to the ALS Environmental in Burnaby, BC or Whitehorse, YT, for analysis of particle size by dry and wet sieving and pipette sedimentation method, total organic carbon and loss on ignition by combustion, inorganic carbon is derived from a calculation, metals by collision/reaction cell - inductively coupled plasma mass spectrometry (CRC ICPMS), mercury by CVAFS, total Kjeldahl nitrogen is by colorimetric analysis and pH by probe.

Two sediment toxicity tests were added to the 2015 monitoring program; a 10 day *Chironomus dilutus* test and a 14 day *Hyalella azteca* test (Environment Canada 1997, 2013). Both tests are of survival and growth. At lower Minto Creek and lower Wolverine Creek, sediment was collected using a 15.24 cm x 15.24 cm (6" x 6") stainless steel petite ponar grab sampler (0.023 m^2 sampling area). The top 2 cm from three grabs were collected as a composite from each of five stations (which form the replicates in the toxicity tests). Samples from each station were placed into a 1L jar and mixed with a stainless steel spoon. Immediately after collection, samples were placed in a cooler, then later transferred to a refrigerator and stored at approximately 4°C until they were submitted to Nautilus Environmental Inc. in Burnaby, BC for sediment toxicity testing.

2.2.2 Data Analysis

The method detection limits (MDL) achieved by the laboratory were compared to target limits, generally ≤1/10th guideline values. Laboratory QA/QC analysis included method blanks, laboratory duplicates, matrix spikes and certified reference materials (Appendix A). Sediment quality data were evaluated relative to sediment quality guidelines (SQGs) for the protection of aquatic life (e.g., CCME 1999) and reference concentrations to identify metals with the potential to adversely affect aquatic life and/or whose concentrations were elevated due to mine activity. Sediment quality data were also compared to results obtained in previous years of sampling (1994 and 2006-2014). Interpretation was conducted with careful consideration of a significant methodological change made in 2010 and carried through to 2015 (sediments collected as described in Section 2.2.1) relative to previous years. Due in part to these methodological changes, relationships between analytes of concern and percent TOC were investigated. Analytes of concern were also normalized to percent TOC and lithium concentrations to help bridge the gap between these methodological changes. If values were less than MDL, statistics were calculated by substituting the detection limit (i.e., if value was < 0.10 mg/kg, the value 0.10 mg/kg was used). Sediments collected in all years previous to 2010 were collected within the active channel of the creek using an aluminum or Teflon scoop. Samples were submitted whole for analysis of particle size distribution, which generally included significant quantities of gravel and sand. Only material passing through a 230 mesh sieve (< 63 µm; silt and clay) was digested and analyzed for metals. While this approach does result in the analysis of geochemically-relevant fine sediment (e.g., Horowitz 1991), it represents an impediment to the interpretation of the biological significance of sediment chemistry as organisms are exposed to whole sediment (not just fines) and sediment quality guidelines (SQGs) for the protection of aquatic life (e.g., CCME 1999) apply to whole sediment.

The laboratory performed QA/QC on the sediment toxicity tests by comparing results to reference toxicant tests. Results were within the acceptable criteria for performance and organisms tested were appropriate (Appendix A). Ammonia was monitored in lower Wolverine Creek treatments to ensure that the concentrations did not exceed 0.20 mg/L of un-ionized ammonia (as N). Sediment from lower Minto Creek was compared to lower Wolverine Creek sediment, laboratory control sediment and to sediment toxicity testing conducted in 2011. Statistical analysis were conducted and summarized in a report by Nautilus Environmental (Appendix C).

2.3 Periphyton Community

2.3.1 Sample Collection and Laboratory Analysis

Periphyton is the assemblage of algae, bacteria, fungi, and meiofauna attached to submerged substrate in freshwaters. However, periphyton communities are generally characterized on the basis of the attached algae community. Attached algal communities are representative of the lowest trophic level and are indicators of primary productivity. Periphyton community samples were collected in erosional habitat of lower Minto Creek, lower Wolverine Creek and lower Big Creek (Table 2.1; Figure 2.1). Periphyton was collected from five replicate stations per area, with each sample collected from five randomly selected rocks with the use of a stainless steel razor blade. Five rocks were selected for periphyton community analysis and the area sampled was recorded. Samples were preserved with Lugol's iodine solution and placed in a cooler. Samples were subsequently transferred to a refrigerator and stored at approximately 4 °C until they were shipped to Plankton R Us Inc. (Winnipeg, MB) for analysis to species level.

2.3.2 Data Analysis

Laboratory duplicate samples were collected on 10% of the periphyton community samples and are described in the DQA (Appendix A). Periphyton communities were evaluated using summary metrics including number of cells per unit area (density), biomass per unit area, number of taxa, Simpson's Diversity, Simpson's Evenness and Bray-Curtis index (Environment Canada 2012). Additional non-statistical comparisons were made on the basis of percent community composition of dominant taxa (calculated as the abundance of each respective taxon group relative to the total number of organisms in the sample).

Total organism density (cells/cm^2) and biomass (µg/cm^2) were calculated for periphyton community samples. The diversity metric "number of taxa" (also known as taxon richness) included all separate taxa identified to the species level. Simpson's Diversity and Simpson's Evenness indices were computed according to formulae presented by Smith and Wilson (1996) and recommended by Environment Canada (2012). These indices take into account both the relative abundance of taxa, and the number of taxa, with values ranging from 0 (low diversity or evenness) to 1 (high diversity or evenness). The Bray-Curtis index was also calculated according to Environment Canada (2012). This metric takes into account the abundance of each taxon at each station compared to the median abundance computed from the reference stations (lower Wolverine Creek), to compute an index of the relative "dissimilarity" of each station from the hypothetical reference median station. Larger Bray-Curtis index values indicate greater dissimilarity from reference.

Periphyton community endpoints were summarized by reporting mean, median, minimum, maximum, and standard deviation for each study area. Differences among effluent-exposed and reference areas were tested using ANOVA, with a p-value < 0.10. Prior to ANOVA, data were tested for the assumptions of normality and homogeneity of variance. If data were not found to be normal or variances were not equal, a non-parametric Mann-Whitney U-test was conducted. All statistics were conducted using SPSS (SPSS 2003).

Periphyton data collected in 2015 were compared to data collected in baseline studies (HKP 1994) and in 2011-2014. Due to differences in reporting of periphyton community in the 1994 report (e.g., taxa were only identified as present, common or dominant), a non-statistical comparison was performed against 1994 data using proportional abundances at the taxonomic level of Phylum.

2.4 Benthic Invertebrate Community

2.4.1 Sample Collection and Laboratory Analysis

Benthic invertebrate community samples were collected in erosional habitat of lower Minto Creek, lower Wolverine Creek and lower Big Creek as required under the WUL (Table 2.1; Figure 2.1). Benthic invertebrate community samples were collected from riffle/run habitat with cobble and gravel substrate using a Hess sampler (0.10 m^2) outfitted with 500 µm mesh. Five replicate samples (stations), consisting of a three grab composite each (0.30 m^2 area in total) were collected at each sampling area. For each grab, the substrate within the sampler was disturbed and scrubbed (by hand and nail brush) with care taken to ensure that all dislodged organic material was swept into the sampler collection net. The substrate was disturbed to a depth of approximately 5 cm over a period of approximately ten minutes. This procedure was repeated for the second and third grab, following which all of the material contained in the collection net was carefully transferred to a pre-labeled 2 L wide-mouth plastic jar using a stainless steel spoon and a wash bottle while working over a plastic tub to avoid any potential loss of organisms. Any organisms that adhered to the sieve bag were removed by hand and added to the sample. All samples were labeled internally (using wooden sticks) and externally with the station number, area identifier, Minnow project number, date and field personnel in order to ensure correct identification at the laboratory. Samples were preserved within six hours of collection using buffered formalin solution to a nominal concentration of 10% in ambient water.

All benthic invertebrate samples were shipped to Cordillera Consulting in Summerland, BC. Each sample was elutriated to remove sand, gravel and clay, and the remaining organic material was preserved in 70% ethanol. Elutriate was examined for any mollusc or trichopteran cases, then each sample was examined to estimate the total number of invertebrates. If the estimated number of organisms were greater than 600 and the sample was fine and non-clumping, a subsample was taken using a Folsom Plankton Splitter (Motodo 1959; Van Guelpen et al. 1982). Empty snail or bivalve shells, empty caddisfly cases, invertebrate fragments such as legs, gills, antennae etc. were not removed or counted. When organism fragments were encountered, only the heads were counted towards the total. Larval and pupal exuviae were not counted while terrestrial stages and terrestrial drop-ins were indicated as such and do not contribute to the total count. Benthic invertebrates were identified to the “lowest practicable taxonomic level” (which in most cases was genus) and counted. Following identification and counting, representative specimens of each taxon were preserved in a museum quality vial with a polyseal lid to create a voucher collection. Internal labels were used to identify the taxa, the client, date collected, site code and the project.

2.4.2 Data Analysis

Laboratory QA/QC included an assessment of sub-sampling error and sorting efficiency on at least 10% of the samples (Appendix A). Benthic invertebrate communities were evaluated using summary metrics including invertebrate density (number of organisms per m^2, calculated based on a sample area of 0.3 m^2), number of taxa, Simpson’s Diversity, Simpson’s Evenness and Bray-Curtis Index. These endpoints were calculated after the exclusion of either non-benthic organisms, organisms that could not be conclusively identified as separate taxa or taxa smaller than 500 µm in size, including, Collembola, Ostracods, Nemata and Turbellaria. Total organism density (individuals/m^2), taxon richness, Simpson’s Diversity, Simpson’s Evenness and Bray-Curtis index were calculated in the same manner as periphyton community data (Section 2.3.2). Bray-Curtis index was calculated based on the median of each reference area as well as the combined reference median. The combined reference median was presented within the text as this is the optimal method for determination of potential effluent effects, due to the fact that using a reference median value calculated from only one area biases the outcome toward detecting a difference between two areas regardless of potential anthropogenic stressors. This occurs because the area used to calculate the median is inherently more similar to itself than any other area (Huebert et al. 2011), even if the two areas in question are ‘natural-pristine’ areas.

The relative proportions of the most abundant taxa were calculated relative to the total number of organisms in the sample. Dominant taxon groups were defined as groups representing greater than 10% of total organism abundance in one or more areas or any groups considered to be important indicators of environmental stress. In this study, relative proportions of the major groups, such as chironomids and EPT taxa were examined. It is often possible to relate low relative abundance of sensitive taxonomic groups (e.g., EPT taxa) to environmental stress (e.g., Taylor and Bailey 1997). Similarly, high relative abundance of tolerant taxonomic groups (e.g., oligochaetes) may also indicate higher environmental stress (Chapman et al. 1982a,b).

All benthic invertebrate community endpoints were summarized by reporting mean, median, minimum, maximum, standard deviation, standard error and sample size for each study area. Differences among effluent-exposed and reference areas were tested using ANOVA with a post hoc test, with significance set at a p-value of < 0.10. Either the Bonferroni (if equal variance was achieved) or Tamhane's (if data had unequal variance) post hoc tests were used. Prior to ANOVA, all data were transformed as necessary to meet assumptions of normality and homogeneity of variance. If data failed the assumptions of normality and homogeneity of variance, then a non-parametric Mann-Whitney U-test was conducted. All statistical comparisons were conducted using SPSS software (SPSS 2013). Magnitudes of difference between effluent-exposed and reference area means were calculated for each benthic invertebrate community metric where a significant difference was detected. If a significant difference between areas was not detected, then the minimum effect size that could be detected was calculated.

Benthic invertebrate community data were also evaluated in comparison to results obtained in previous years of sampling (1994, 2006, 2008 and 2010-2014). Summary metrics from earlier years were previously re-calculated (Minnow 2011) to ensure consistency and appropriate comparisons over time.

2.5 Tissue Chemistry

2.5.1 Sample Collection and Laboratory Analysis

Periphyton and benthic invertebrate tissue samples were collected from lower Minto Creek (exposed), lower Wolverine Creek (reference) and lower Big Creek (reference; Table 2.1; Figure 2.1). Periphyton samples were collected by scraping submerged cobble-size rocks using a stainless steel razor blade. Scraped material (periphyton) was placed in pre-labelled sample jars. Benthic invertebrate tissue samples were collected in areas with cobble substrate using a kick-net and by overturning rocks and collecting organisms by hand. Periphyton and benthic invertebrate tissue samples were placed into pre-labelled Whirl-Pak™ bags until the desired sample size (2-5 grams) was achieved. A total of five periphyton and benthic invertebrate samples were collected at each area. Immediately after collection, all tissue samples were placed in a cooler, and later in a freezer until they were submitted to ALS Environmental in Burnaby, BC. Samples were analyzed for percent moisture and for metals by High-Resolution ICP-MS, and later converted to dry weight using percent moisture.

2.5.2 Data Analysis

Periphyton and benthic invertebrate tissue data were analyzed to determine if the data quality was acceptable. Method detection limits achieved were compared to the detection limits quoted by the laboratory. Method blanks, laboratory duplicates and certified reference materials were included in the DQA for both tissue types (Appendix A).

The primary objective of tissue collection was to support a selenium assessment reported under separate cover. Accordingly, data are reported herein for future reference with limited interpretation. Tissue quality data were interpreted by statistically comparing metal concentrations at the exposed area to those collected at the reference areas using ANOVA with post-hoc testing. Either the Bonferroni (if equal variance was achieved) or Tamhane's (if data had unequal variance) post hoc tests were used. Data were first tested for normality and equality of variance. If normality was not achieved, data were transformed by either log, square root, or inverse transformations. Some analytes could not be normalized, and a non-parametric Mann-Whitney U-test was conducted instead. All statistical tests were interpreted using p-values of 0.05.

3.0 SUPPORTING MEASURES

3.1 Field Measures

Mean temperature at the sediment sampling area of upper Minto Creek (2.07°C) was slightly, but significantly, lower than in upper McGinty Creek (2.92°C; Figure 3.1; Appendix Table B.3). Specific conductance was substantially higher in upper Minto Creek (524 µS/cm) than in lower Minto Creek (339 µS/cm). In both upper and lower Minto Creek, specific conductance was significantly higher than at the respective reference areas (Figure 3.1). Dissolved oxygen was significantly higher at lower Minto Creek (96.7% saturation) than at lower Wolverine Creek (67.1% saturation). Lower dissolved oxygen at lower Wolverine Creek could be attributed to sampling in back eddies, which were the only areas to support sediment deposition, but where dissolved oxygen was expected to be low. Upper Minto Creek had significantly lower dissolved oxygen (87.5%) than upper McGinty Creek (95.2%). At upper Minto Creek, pH was significantly lower (7.97) compared to upper McGinty Creek (7.62) but in all areas pH was well within water quality guidelines and WUL objectives (Figure 3.1; Appendix Table B.3).

Physico-chemical measurements were also taken in erosional areas of lower Minto Creek, lower Wolverine Creek and lower Big Creek in support of benthic invertebrate community sampling. Temperatures were similar among all areas (Figure 3.2). Specific conductance was the only measure that was significantly higher at lower Minto Creek (324 µS/cm) than at both reference areas, lower Wolverine Creek (140 µS/cm) and lower Big Creek (160 µS/cm), which was consistent with the measures supporting the sediment collections and suggest a mine influence on water quality. All areas were well oxygenated with slightly, but significantly lower dissolved oxygen at lower Minto Creek (98.4% saturation) than at lower Wolverine Creek (100.0% saturation; Figure 3.2; Appendix Table B.4). Lower Minto Creek had significantly higher pH (8.24) than lower Wolverine Creek (7.91) but it did not differ significantly from lower Big Creek (7.98). All areas were within range of the WUL objectives for pH.

3.2 Water Chemistry and Chlorophyll *α*

Water chemistry data quality was assessed prior to data analysis and interpretation, and was judged to be of good quality (Appendix A). A number of analytes (total suspended solids, turbidity, fluoride, total aluminum, copper and iron) exceeded guidelines in Minto Creek, but also at reference areas (Table 3.1). There were no analytes that exceeded WUL water quality objectives (Table 3.1). Concentrations of dissolved copper (a metal of particular interest at the Minto Mine) at upper Minto Creek were slightly higher than reference (upper McGinty Creek), but at lower Minto Creek were lower than both references (lower Wolverine Creek and

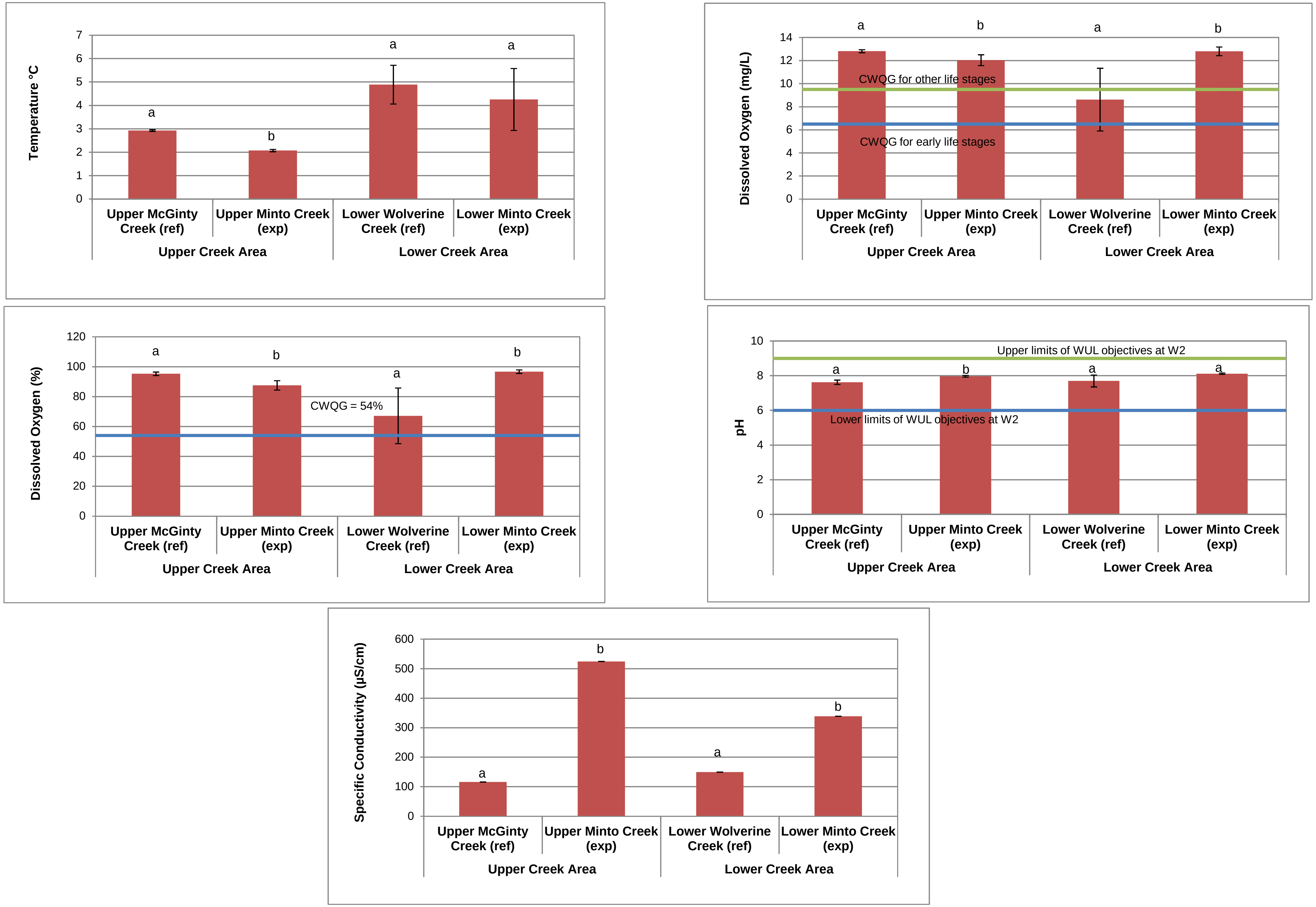

Figure 3.1: Physico-chemical measurements in depositional areas of upper and lower Minto Creek relative to reference areas, Minto Mine, 2015. Data presented as mean ± standard deviation. Sample sizes were n = 5 in all areas. Different letters represent a significant difference between areas within each creek area.

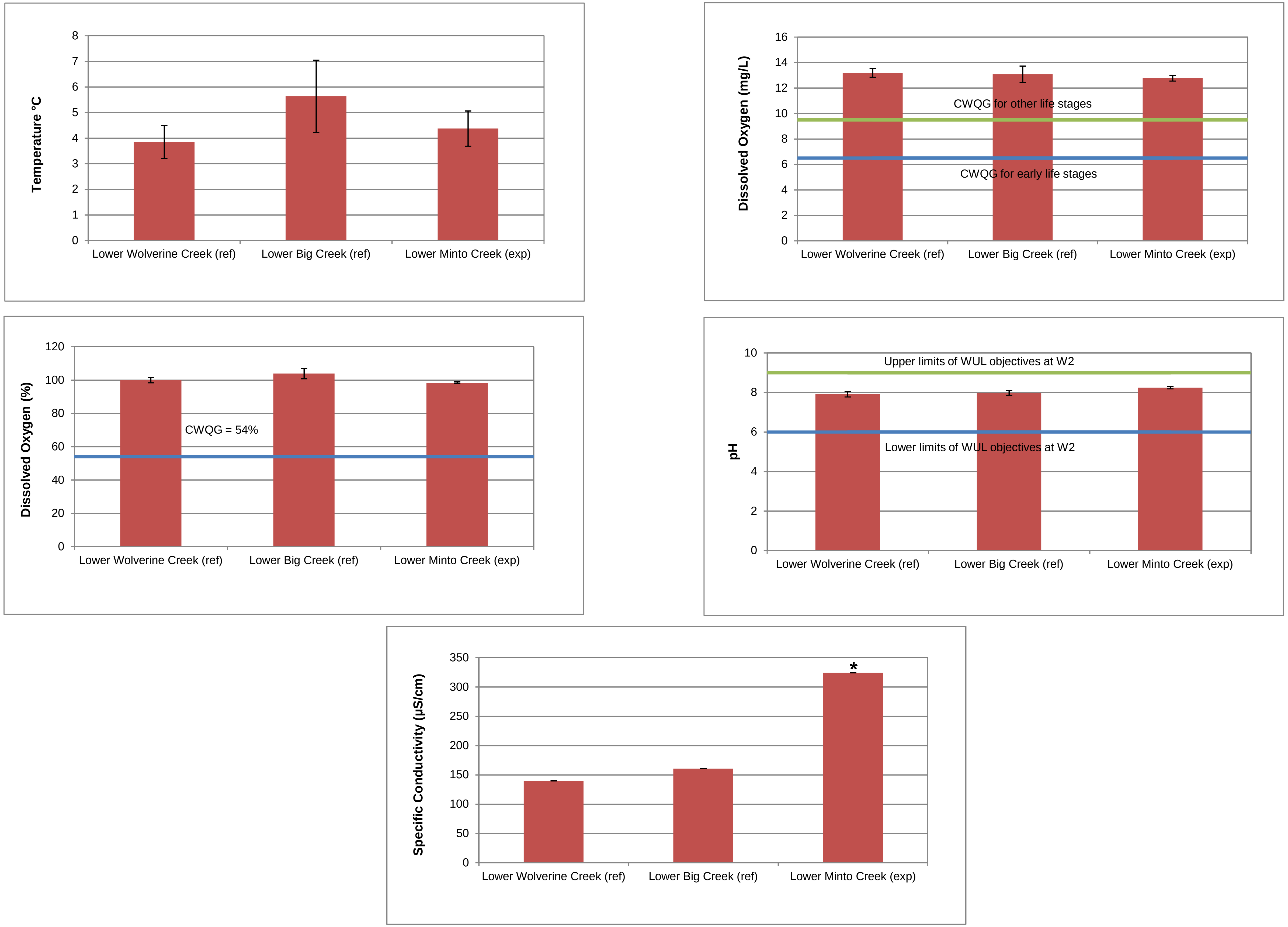

Figure 3.2: Physico-chemical measurements in erosional areas in lower Minto Creek and reference areas, Minto Mine, 2015. Data presented as mean ± standard deviation and n = 5. Asterisk (*) indicate when lower Minto Creek was significantly different to lower Wolverine and lower Big creeks.

Table 3.1: Water quality results at exposure and reference areas, Minto Mine WUL, September 2015.

	Analyte	Units	CCME Water Quality Guidelines[1]		WUL Objectives at W2	Upper McGinty Creek (reference)	Upper Minto Creek (exposure)	Lower Wolverine Creek (reference)	Lower Big Creek (reference)	Lower Minto Creek (exposure)
			30 Day	Max						
Physical Tests	Conductivity	µS/cm	-	-	-	109	512	140	161	328
	Hardness (as $CaCO_3$)	mg/L	-	-	-	58	262	73	82	170
	pH	ph Units	6.5 - 9.0	-	6.0 - 9.0	7.87	8.26	7.94	8.06	8.27
	Total Suspended Solids	mg/L	12[a]	32[a]	-	5.3	21	6.0	13	8.7
	Total Dissolved Solids	mg/L	-	-	-	124	332	143	135	233
	Turbidity	NTU	3.2[b]	9.2[b]	-	1.6	0.59	3.5	4.1	0.81
Anions and Nutrients	Total Alkalinity	mg/L	-	-	-	55	230	77	87	164
	Total Ammonia (as N)	mg/L	1.5[c]	-	0.25	0.0085	0.0064	0.010	0.0052	0.0054
	Chloride (Cl)	mg/L	120	640	-	< 0.50	4.4	< 0.50	< 0.50	1.4
	Fluoride (F)	mg/L	0.12		-	0.20	0.56	0.11	0.11	0.38
	Nitrate (as N)	mg/L	3.0	124	6.7	0.022	0.20	0.041	0.097	0.038
	Nitrite (as N)	mg/L	0.060	-	0.060	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
	Total dissolved Phosphorus (P)	mg/L	-	-	-	0.015	0.0048	0.010	0.0055	0.0088
	Total Phosphorus (P)	mg/L	-	-	0.020	0.011	0.010	0.012	0.0069	0.0072
	Sulfate (SO_4)	mg/L	-	-	-	6.4	54	9.1	11	18
Other	Total Cyanide	mg/L	-	-	-	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
	Dissolved Organic Carbon	mg/L	-	-	-	22	5.6	21	11	12
	Total Organic Carbon	mg/L	-	-	-	22	5.6	22	11	12
	Total Inorganic Carbon	mg/L	-	-	-	9.3	49	12	15	33
Total Metals	Total Aluminum (Al)	mg/L	0.10[d]	-	-	0.074	0.085	0.28	0.31	0.077
	Total Antimony (Sb)	mg/L	-	-	-	0.00010	< 0.00010	< 0.00010	0.00020	< 0.00010
	Total Arsenic (As)	mg/L	0.0050	-	-	0.00065	0.00038	0.00062	0.0017	0.00066
	Total Barium (Ba)	mg/L	-	-	-	0.034	0.079	0.035	0.058	0.065
	Total Beryllium (Be)	mg/L	-	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Total Bismuth (Bi)	mg/L	-	-	-	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
	Total Boron (B)	mg/L	1.5	2.9	-	< 0.010	0.026	< 0.010	< 0.010	< 0.010
	Total Cadmium (Cd)	mg/L	0.00010[e]	0.0012[e]	-	< 0.0000050	< 0.0000050	0.0000080	0.000016	< 0.0000050
	Total Calcium (Ca)	mg/L	-	-	-	16	56	15	20	45
	Total Chromium (Cr)	mg/L	0.0010 Cr(VI)	-	-	0.00069	0.00026	0.0012	0.00076	0.00044
	Total Cobalt (Co)	mg/L	-	-	-	0.00015	0.00010	0.00025	0.00023	0.00011
	Total Copper (Cu)	mg/L	0.0020[e]	-	-	0.0022	0.0043	0.0032	0.0040	0.0022
	Total Iron (Fe)	mg/L	0.30	-	-	0.50	0.15	0.50	0.44	0.24
	Total Lead (Pb)	mg/L	0.0010[e]	-	-	< 0.000050	0.000088	0.00011	0.00029	< 0.000050
	Total Lithium (Li)	mg/L	-	-	-	0.0013	0.0043	0.0023	0.0024	0.0024
	Total Magnesium (Mg)	mg/L	-	-	-	4.5	27	7.8	7.8	15
	Total Manganese (Mn)	mg/L	-	-	-	0.027	0.051	0.019	0.021	0.010
	Total Mercury (Hg)	mg/L	0.000026	-	-	0.0000084	< 0.0000050	0.000011	0.0000080	< 0.0000050
	Total Molybdenum (Mo)	mg/L	0.073	-	-	0.00060	0.0051	0.00040	0.0012	0.0015
	Total Nickel (Ni)	mg/L	0.025[e]	-	-	0.0014	0.0010	0.0024	0.0015	0.0013
	Total Phosphorus (P)	mg/L	-	-	-	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30
	Total Potassium (K)	mg/L	-	-	-	0.39	2.3	0.52	0.75	1.4
	Total Selenium (Se)	mg/L	0.0010	-	-	0.00026	0.00034	0.00011	0.000069	0.00012
	Total Silicon (Si)	mg/L	-	-	-	6.7	6.4	5.9	7.3	6.9
	Total Silver (Ag)	mg/L	0.00025		-	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
	Total Sodium (Na)	mg/L	-	-	-	3.5	18	5.1	5.7	9.4
	Total Strontium (Sr)	mg/L	-	-	-	0.10	0.72	0.14	0.21	0.43
	Total Thallium (Tl)	mg/L	0.00080	-	-	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
	Total Tin (Sn)	mg/L	-	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Total Titanium (Ti)	mg/L	-	-	-	< 0.010	< 0.010	0.012	0.012	< 0.010
	Total Uranium (U)	mg/L	0.015	0.033	-	0.00020	0.0026	0.00040	0.0016	0.0014
	Total Vanadium (V)	mg/L	-	-	-	0.0012	0.0010	0.0022	0.0020	0.0013
	Total Zinc (Zn)	mg/L	0.030	-	-	< 0.0030	< 0.0030	< 0.0030	< 0.0030	< 0.0030
Dissolved Metals	Dissolved Aluminum (Al)	mg/L	-	-	0.10	0.054	0.0028	0.047	0.035	0.010
	Dissolved Antimony (Sb)	mg/L	-	-	-	< 0.00010	< 0.00010	< 0.00010	0.00015	< 0.00010
	Dissolved Arsenic (As)	mg/L	-	-	0.0050	0.00053	0.00028	0.00045	0.00081	0.00055
	Dissolved Barium (Ba)	mg/L	-	-	-	0.034	0.077	0.032	0.053	0.061
	Dissolved Beryllium (Be)	mg/L	-	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Dissolved Bismuth (Bi)	mg/L	-	-	-	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
	Dissolved Boron (B)	mg/L	-	-	-	< 0.010	0.022	< 0.010	< 0.010	< 0.010
	Dissolved Cadmium (Cd)	mg/L	-	-	0.15	< 0.0000050	< 0.0000050	< 0.0000050	0.0000069	< 0.0000050
	Dissolved Calcium (Ca)	mg/L	-	-	-	16	58	16	20	44
	Dissolved Chromium (Cr)	mg/L	-	-	0.0010	0.00056	0.00013	0.00063	0.00032	0.00025
	Dissolved Cobalt (Co)	mg/L	-	-	-	0.00012	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Dissolved Copper (Cu)	mg/L	-	-	0.020/0.013[f]	0.0021	0.0026	0.0026	0.0024	0.0019
	Dissolved Iron (Fe)	mg/L	-	-	1.1	0.39	0.020	0.17	0.071	0.12
	Dissolved Lead (Pb)	mg/L	-	-	0.0040	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
	Dissolved Lithium (Li)	mg/L	-	-	-	< 0.0010	0.0038	0.0016	0.0017	0.0020
	Dissolved Magnesium (Mg)	mg/L	-	-	-	4.5	29	8.0	7.8	15
	Dissolved Manganese (Mn)	mg/L	-	-	-	0.024	0.042	0.0071	0.0091	0.0027
	Dissolved Mercury (Hg)	mg/L	-	-	-	< 0.0000050	< 0.0000050	0.000010	< 0.0000050	< 0.0000050
	Dissolved Molybdenum (Mo)	mg/L	-	-	0.073	0.00054	0.0050	0.00041	0.0011	0.0015
	Dissolved Nickel (Ni)	mg/L	-	-	0.11	0.0013	0.00088	0.0019	0.0011	0.0011
	Dissolved Phosphorus (P)	mg/L	-	-	-	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30
	Dissolved Potassium (K)	mg/L	-	-	-	0.37	2.3	0.53	0.69	1.4
	Dissolved Selenium (Se)	mg/L	-	-	0.0020	0.00022	0.00033	0.00012	0.000058	0.00012
	Dissolved Silicon (Si)	mg/L	-	-	-	6.6	6.4	5.5	6.8	6.5
	Dissolved Silver (Ag)	mg/L	-	-	0.00010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
	Dissolved Sodium (Na)	mg/L	-	-	-	3.3	18	5.3	5.6	9.1
	Dissolved Strontium (Sr)	mg/L	-	-	-	0.099	0.72	0.14	0.21	0.42
	Dissolved Thallium (Tl)	mg/L	-	-	-	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
	Dissolved Tin (Sn)	mg/L	-	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Dissolved Titanium (Ti)	mg/L	-	-	-	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
	Dissolved Uranium (U)	mg/L	-	-	-	0.00020	0.0025	0.00036	0.0016	0.0013
	Dissolved Vanadium (V)	mg/L	-	-	-	0.00069	< 0.00050	0.0012	0.00093	0.00073
	Dissolved Zinc (Zn)	mg/L	-	-	0.030	0.0017	< 0.0010	< 0.0010	< 0.0010	< 0.0010

Water use licence objectives exceeded

Water quality guideline exceeded

[1] CCME 1999. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

[a] Based on the median of background levels plus 5 mg/L for 30 day and 25 mg/L for max guidelines

[b] Based on the median of background levels plus 2 NTU for 30 day and 8 NTU for max guidelines

[c] Based on lowest guideline using highest temperature and pH

[d] Based on lowest guideline using highest pH

[e] Based on lowest guideline using lowest hardness

[f] Copper water quality objective depends on concentration of dissolved organic carbon (DOC). If DOC is > 10 mg/L/ DOC is≤ 10 mg/L

lower Big Creek; Table 3.1) suggesting limited mine influence at the time of sampling (September 2015) as was also observed in September 2014 (Minnow 2015b; Appendix Table B.7).

Chlorophyll *α* data quality was assessed prior to data analysis and interpretation, and was judged to be of good quality (Appendix A). Concentration of chlorophyll *α* in periphyton was significantly higher at lower Minto Creek than at lower Wolverine Creek (Figure 3.3). Chlorophyll *α* concentrations at both areas were well below the British Columbia Water Quality Guideline (BCWQG) of 100 mg/m^2 for the protection of aquatic life (BCMOE 1985). Production of both creeks are classified as low (oligotrophic) based on the classification system of Dodds et al. (1998), which sets the oligotrophic-mesotrophic boundary for benthic chlorophyll at 20 mg/m^2. Based on only total phosphorus, both creeks would be defined as oligotrophic as well (Dodds et al. 1998). There was little temporal change in periphyton chlorophyll *α* concentration from 2014 to 2015 (Appendix Figure B.1).

3.3 Summary

Supporting measures collected in September 2015 indicated good Minto Creek water quality. An influence of the Minto Mine was evident in higher specific conductance than in reference creeks, however, there were no water quality parameters with concentrations greater than WUL water quality objectives. Furthermore, parameters with concentrations in Minto Creek greater than guidelines were also elevated at reference areas, in apparent association with suspended solids/turbidity. Even though concentrations of chlorophyll *α* in periphyton were significantly higher at lower Minto Creek than lower Wolverine Creek, these concentrations were below the BCWQG of 100 mg/m^2 for the protection of aquatic life (BCMOE 1985) and both creeks were oligotrophic according to the classification system of Dodds et al. (1998). Overall, there was limited evidence of an influence of the Minto Mine at the time of sampling (September 2015).

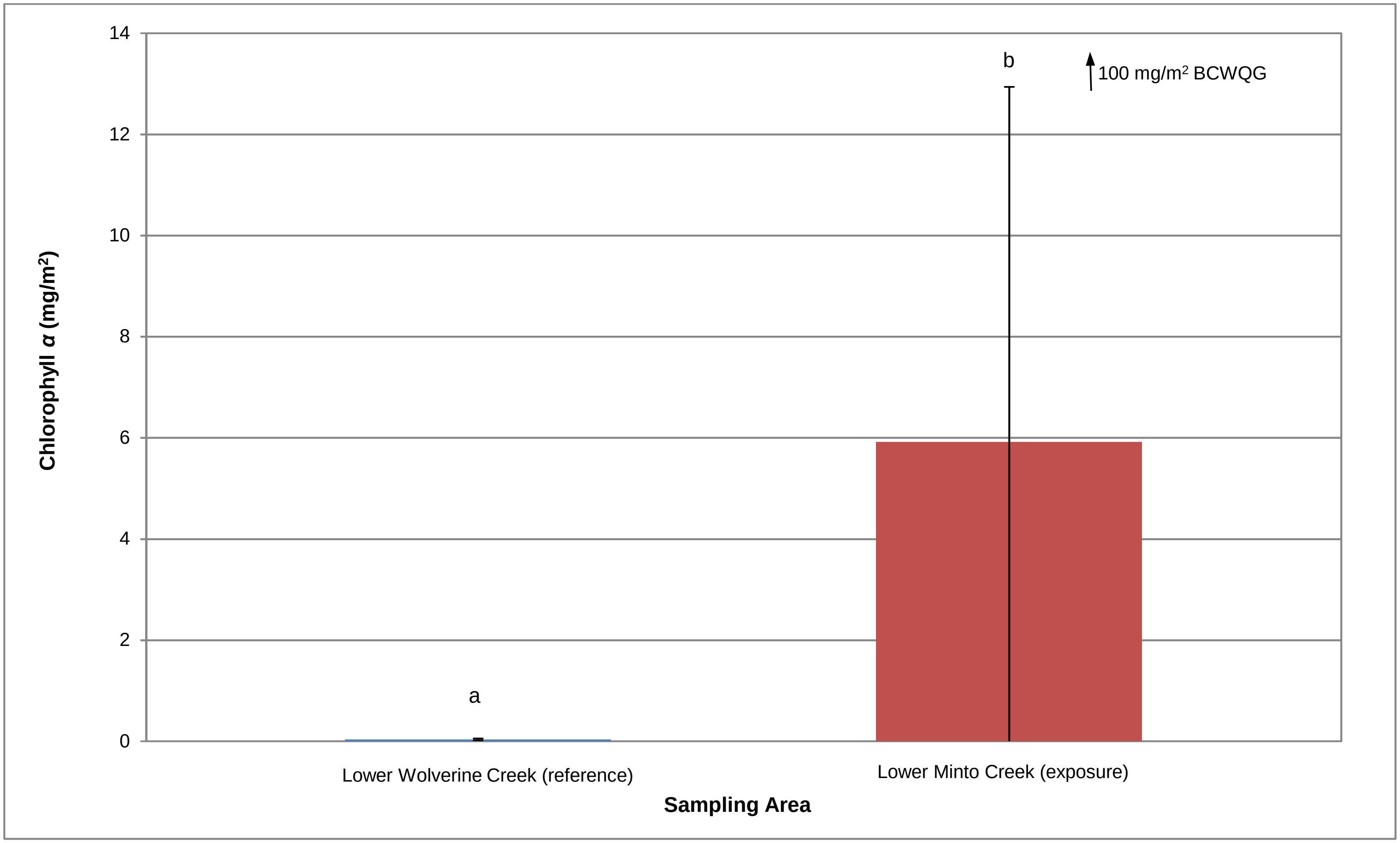

Figure 3.3: Concentrations of chlorophyll *α* in periphyton measured at five benthic stations in lower Wolverine and lower Minto Creeks, Minto Mine WUL, 2015. Data presented as mean ± standard deviation. Different letters represent significant differences between sites.

4.0 SEDIMENT QUALITY

4.1 Sediment Particle Size and Chemistry

Sediment data quality was assessed prior to data analysis and interpretation, and was judged to be of good quality (Appendix A). Sediments collected in 2015 were largely composed of fine particles in the silt and sand size categories (Figure 4.1; Table 4.1; Appendix Table C.1). Mean total organic carbon (TOC) content of sediment collected from lower Minto Creek (3.9%) and upper Minto Creek (2.3%) were lower than the comparable reference areas; lower Wolverine Creek (7.2%) and upper McGinty Creek (5.8%; Table 4.1). Arsenic and copper were the only analytes with mean concentrations greater than Interim Sediment Quality Guidelines for the protection of aquatic life (ISQG; CCME 1999) in an effluent-exposed area (upper and/or lower Minto Creek; Table 4.1; Appendix Table C.1). However, mean arsenic concentrations in upper Minto Creek were below ISQG and lower than the reference area, upper McGinty Creek (which was greater than ISQG). This suggests that arsenic concentrations were not mine-related. Mean copper concentrations in lower and upper Minto Creek were greater than the ISQG and the corresponding reference areas, which were not greater than the ISQG (Figure 4.2; Table 4.1). With progression from upper to lower Minto Creek, sediment copper concentrations decreased from a mean of 147 to 43 mg/kg, respectively, indicating improvement with distance downstream.

Due to the predominantly erosional habitat in upper Minto Creek, there are relatively few areas where sediment is deposited and even this occurs only in small quantities that likely wash away each year during freshet. Therefore, elevated sediment copper in fine sediment in the upper reaches of Minto Creek may be of limited importance in terms of exposure and potential effects to biota. In lower Minto Creek, fine sediment deposits are somewhat more common and therefore more relevant to aquatic life.

4.2 Temporal Comparisons

Sediment particle size distribution in 2015 was similar to 2010-2014 but was notably different from data collected prior to 2010 which used different sampling methodology (Figure 4.1). Mean concentration of copper in Minto Creek was compared to earlier data to detect any increasing or decreasing trends in sediment quality. Mean copper concentration at upper Minto Creek in 2015 was greater than the guideline, but was also greater than guideline in all previous years including the 1994 baseline (Figure 4.2). At lower Minto Creek, mean copper concentrations have been greater than guidelines during most of the sampling events, and the mean concentration observed in 2015 was similar to a number of previous years but greater

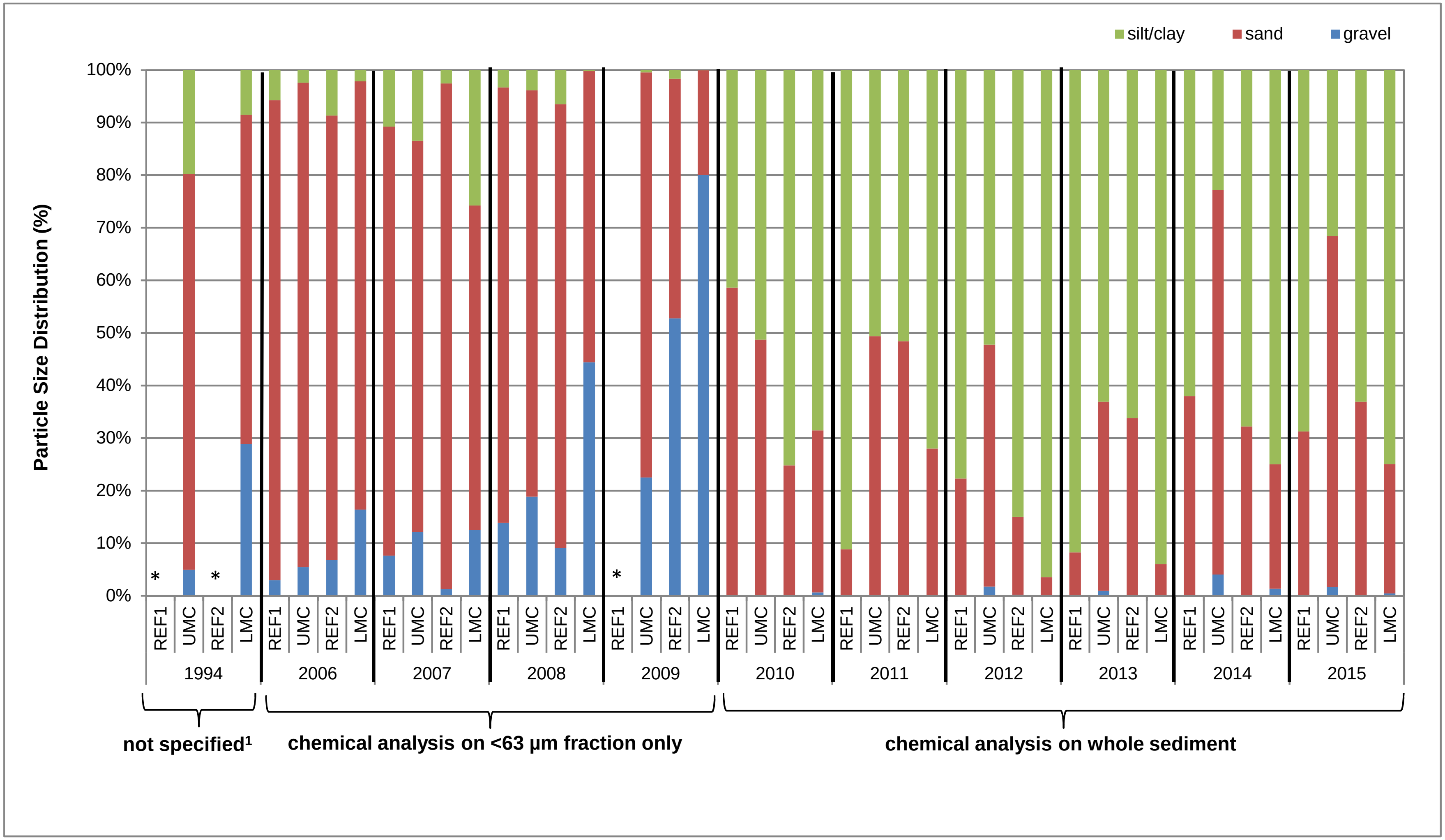

Figure 4.1: Particle size distribution of sediment collected in Minto Creek and reference locations, 1994-2015[a]

[1] Methods were not specified, fine sediment was collected in triplicate in the mainstem of Minto Creek (HKP 1994)

[a] REF1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2015; UMC = Upper Minto Creek; REF2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2015; LMC = Lower Minto Creek

[*] No data

Table 4.1: Sediment chemistry data collected at exposed and reference areas, Minto Mine WUL, 2015[a].

	Analytes	Units	CSQG [1]		Upper McGinty Creek (Reference)				Upper Minto Creek (Exposure)				Lower Wolverine Creek (Reference)				Lower Minto Creek (Exposure)			
			ISQG	PEL	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
Particle size, TKN, carbon analytes and pH	Loss on Ignition	%	-	-	12	6.4	4.0	22	4.6	1.5	3.0	6.0	13	5.7	6.0	22	7.2	3.3	4.0	12
	pH (1:2 soil:water)	pH units	-	-	6.68	0.36	6.33	7.26	7.62	0.13	7.40	7.76	6.92	0.22	6.56	7.10	7.86	0.06	7.82	7.94
	% Gravel (>2mm)	%	-	-	-	-	-	-	-	-	-	-	< 0.1	0	< 0.1	< 0.1	**0.41**	0.49	0.10	**1.3**
	% Sand (2.0mm - 0.063mm)	%	-	-	-	-	-	-	-	-	-	-	35	23	7.4	69	23	6.6	13	30
	% Silt (0.063mm - 4um)	%	-	-	-	-	-	-	-	-	-	-	60	22	29	87	70	6.5	64	80
	% Clay (<4um)	%	-	-	-	-	-	-	-	-	-	-	4.5	1.2	2.8	5.8	6.9	0.88	6.2	8.4
	Total Kjeldahl Nitrogen	%	-	-	0.28	0.16	0.067	0.52	0.11	0.028	0.082	0.15	0.30	0.13	0.14	0.51	0.20	0.092	0.11	0.32
	Inorganic Carbon	%	-	-	< 0.10	0	< 0.10	< 0.10	< 0.10	0	< 0.10	< 0.10	< 0.10	0	< 0.10	< 0.10	< 0.10	0	< 0.10	< 0.10
	Inorganic Carbon (as CaCO3 Equivalent)	%	-	-	< 0.80	0	< 0.80	< 0.80	< 0.80	0	< 0.80	< 0.80	< 0.80	0	< 0.80	< 0.80	< 0.80	0	< 0.80	< 0.80
	Total Carbon by Combustion	%	-	-	5.8	3.5	1.4	11	2.3	0.8	1.3	3.0	7.2	2.5	4.1	11	3.9	1.8	2.0	6.2
	Total Organic Carbon	%	-	-	5.8	3.5	1.4	11	2.3	0.8	1.3	3.0	7.2	2.5	4.1	11	3.9	1.8	2.0	6.2
Total Metals	Aluminum (Al)	mg/kg	-	-	12,066	3,494	6,630	16,400	10,330	1,863	8,950	13,400	13,840	2,176	10,400	15,800	12,980	1,272	11,400	14,300
	Antimony (Sb)	mg/kg	-	-	0.45	0.14	0.25	0.64	0.38	0.065	0.32	0.48	0.49	0.087	0.35	0.56	0.46	0.048	0.39	0.50
	Arsenic (As)	mg/kg	5.9	17	9.2	2.9	5.3	13	5.3	0.65	4.6	6.3	6.5	0.88	5.3	7.3	6.3	0.87	5.4	7.5
	Barium (Ba)	mg/kg	-	-	239	73	127	319	192	28	163	238	219	43	147	247	212	29	176	243
	Beryllium (Be)	mg/kg	-	-	0.37	0.12	0.19	0.51	0.39	0.057	0	0.48	0.80	0.12	0.60	0.88	0.40	0.055	0.34	0.47
	Bismuth (Bi)	mg/kg	-	-	< 0.20	0	< 0.20	< 0.20	< 0.20	0	< 0.20	< 0.20	< 0.20	0	< 0.20	< 0.20	< 0.20	0	< 0.20	< 0.20
	Boron (B)	mg/kg			< 5.0	0	< 5.0	< 5.0	< 5.0	0	< 5.0	< 5.0	< 5.0	0	< 5.0	< 5.0	< 5.0	0	< 5.0	< 5.0
	Cadmium (Cd)	mg/kg	0.60	3.5	0.18	0.070	0.076	0.27	0.19	0.033	0.16	0.23	0.29	0.093	0.15	0.38	0.16	0.035	0.12	0.20
	Calcium (Ca)	mg/kg	-	-	8,516	2,527	4,630	11,700	7,038	1,236	5,530	8,890	11,688	2,711	7,340	13,600	10,162	2,001	7,430	12,300
	Chromium (Cr)	mg/kg	37	90	26	7.5	15	35	23	5.1	18	31	46	7.4	34	52	30	3.2	26	34
	Cobalt (Co)	mg/kg	-	-	10	2.2	6.7	13	9.7	1.0	9.0	11	14	1.3	12	15	10	0.87	9.4	12
	Copper (Cu)	mg/kg	36	197	24	9.4	10	37	**147**	37	93	**191**	30	7.2	18	35	43	7.4	33	53
	Iron (Fe)	mg/kg	-	-	26,880	6,319	16,600	32,700	22,560	1,885	20,700	25,700	27,280	1,746	24,600	28,900	23,500	1,772	21,700	25,900
	Lead (Pb)	mg/kg	35	91	4.9	1.3	2.8	6.5	5.5	0.72	4.6	6.4	6.5	0.86	5.0	7.1	5.5	0.49	4.8	6.1
	Lithium (Li)	mg/kg	-	-	6.7	1.8	3.8	8.8	7.1	1.0	5.7	8.4	9.6	1.6	8.1	12	8.7	1.2	7.4	10
	Magnesium (Mg)	mg/kg	-	-	4,638	868	3,110	5,240	6,052	815	5,270	7,360	8,788	933	7,190	9,450	6,648	613	5,890	7,430
	Manganese (Mn)	mg/kg	-	-	642	126	460	792	**1,684**	398	1,120	**2,170**	685	138	488	799	777	149	629	946
	Mercury (Hg)	mg/kg	0.17	0.49	0.048	0.022	0.016	0.076	0.022	0.0040	0.018	0.028	0.051	0.015	0.025	0.061	0.031	0.0058	0.025	0.037
	Molybdenum (Mo)	mg/kg	-	-	0.56	0.096	0.44	0.70	**1.5**	0.34	1.1	**2.0**	0.60	0.055	0.54	0.66	0.59	0.089	0.48	0.68
	Nickel (Ni)	mg/kg	-	-	19	4.8	11	24	24	4.0	21	30	38	4.7	30	42	27	2.5	24	30
	Phosphorus (P)	mg/kg	-	-	985	202	687	1,220	893	89	793	1,010	1,003	66	909	1,090	806	30	775	848
	Potassium (K)	mg/kg	-	-	804	142	550	880	1,338	207	1,180	1,690	984	92	870	1,070	1,114	133	1,000	1,330
	Selenium (Se)	mg/kg	-	-	0.55	0.17	0.29	0.69	0.38	0.10	0.30	0.54	0.45	0.16	0.20	0.59	0.39	0.11	0.25	0.49
	Silver (Ag)	mg/kg	-	-	0.11	0.013	0.10	0.13	0.10	0.0045	0.10	0.11	0.12	0.016	< 0.10	0.13	< 0.10	0	< 0.10	< 0.10
	Sodium (Na)	mg/kg	-	-	332	87	181	399	343	60	270	422	481	56	387	531	360	31	332	411
	Strontium (Sr)	mg/kg	-	-	69	17	42	82	80	14	70	104	112	19	82	125	89	18	65	105
	Thallium (Tl)	mg/kg	-	-	0.078	0.018	0.050	0.099	0.082	0.017	0.063	0.11	0.084	0.016	0.057	0.098	0.093	0.010	0.083	0.11
	Tin (Sn)	mg/kg	-	-	< 2.0	0	< 2.0	< 2.0	< 2.0	0	< 2.0	< 2.0	< 2.0	0	< 2.0	< 2.0	< 2.0	0.0	< 2.0	< 2.0
	Titanium (Ti)	mg/kg	-	-	713	119	509	813	619	102	523	781	790	69	687	872	742	71	679	854
	Uranium (U)	mg/kg	-	-	1.2	0.39	0.60	1.6	0.74	0.19	0.59	1.1	3.4	1.1	1.7	4.5	0.89	0.20	0.64	1.1
	Vanadium (V)	mg/kg	-	-	54	11	37	66	50	6.3	43	60	70	6.3	60	76	51	4.7	47	59
	Zinc (Zn)	mg/kg	123	315	48	10	31	59	59	6.7	55	71	59	6.8	48	65	56	4.4	50	62

Indicates sediment concentration exceeding CSQG ISQG

Indicates sediment concentration exceeding CSQG PEL

bold Indicates sediment concentration exceeding the higher reference mean by more than two times

[a] If value was < method detection limit, summary statistics were calculated using detection limit, i.e. if value was < 0.0048, summary statistics were calculated using the value 0.0048

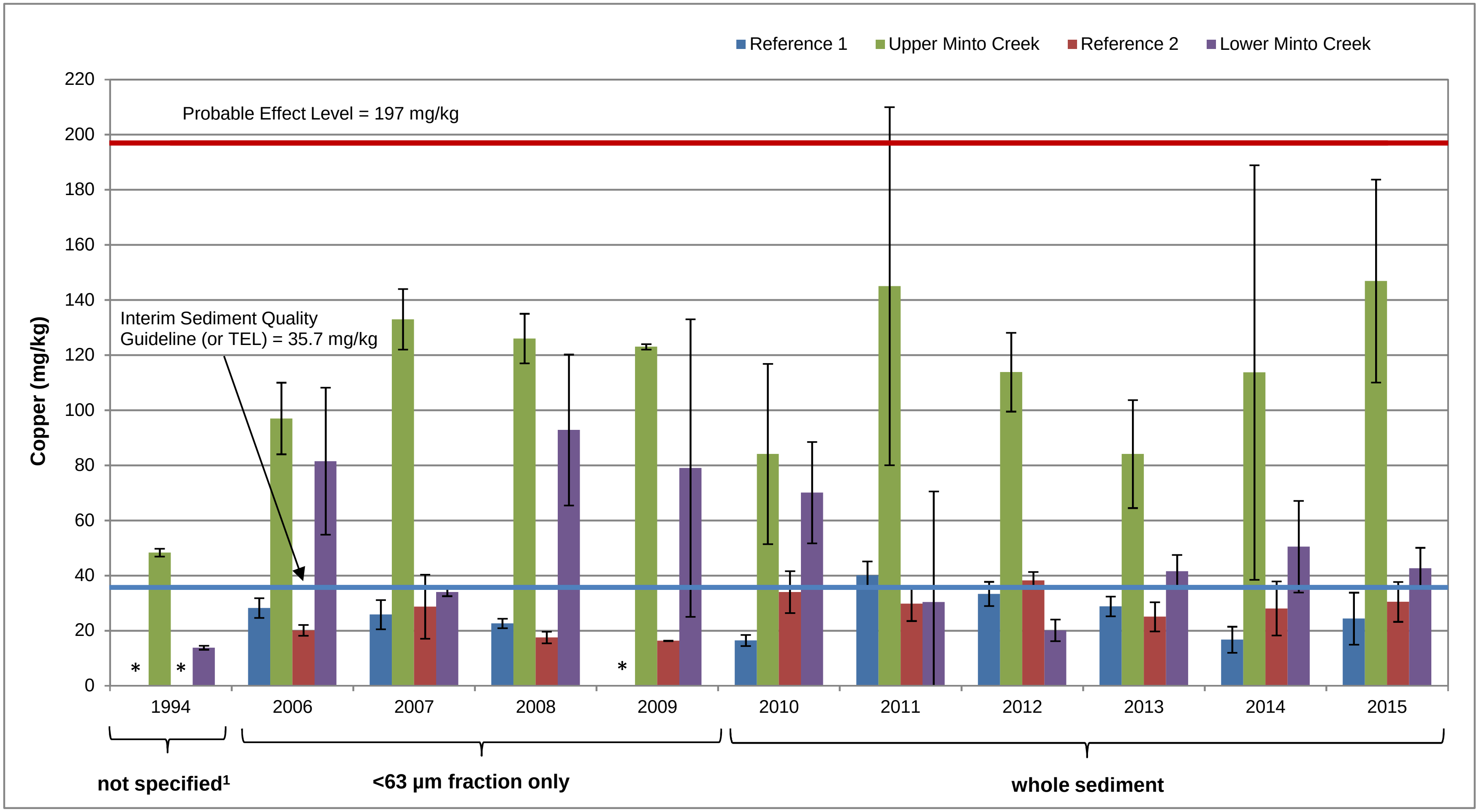

Figure 4.2: Copper (mean ± standard deviation) concentrations in sediment collected in Minto Creek and reference locations, 1994-2015[a].

[1] Methods were not specified, fine sediment was collected in triplicate in the mainstem of Minto Creek (HKP 1994)

[a] Reference 1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2015; Reference 2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2015

* = no data

than in the 1994 baseline (Figure 4.2; Table 4.1; Appendix Table C.1). This does not necessarily indicate a Minto Mine influence as concentrations are within the range of historical and the sampling methodology applied in 1994 was unspecified. The relationship between percent TOC and copper were evaluated and presented in Appendix Figure C.1 and indicate a positive relationship, as expected. Copper concentrations were normalized to percent TOC and lithium, and ratios of copper relative to TOC and lithium were consistent over the 2010-2015 period (Appendix Figure C.2, C.3). Data normalized to TOC and lithium were comparable over 2010–2015 further indicating that elevated copper are not likely mine influenced.

4.3 Sediment Toxicity

Sediment toxicity tests and associated water quality parameters were all within the range outlined in the test protocols so therefore the testing was judged to be acceptable (Appendix A). Survival and growth the midge *Chironomus dilutus* was evaluated in 10-day tests, and survival and growth of the amphipod *Hyalella azteca* was evaluated in 14-day tests. Lower Minto Creek sediment did not result in any effects to survival or growth of either test organism relative to the laboratory control or the field reference sediment (lower Wolverine Creek; Table 4.2). In fact, growth of *H. azteca* was greater in lower Minto Creek sediment than in reference sediment, and growth of *C. dilutus* was greater in lower Minto Creek sediment than in the laboratory control sediment (sand) and in reference sediment (Table 4.2). The only significant difference observed in the testing was a significantly lower growth of *H. azteca* in reference sediment relative to the laboratory control. These results are similar to those of 2011 (Minnow 2012) and continue to indicate no adverse effects associated with lower Minto Creek sediment.

4.4 Summary

Overall, concentrations of metals in Minto Creek sediments were similar to reference and lower than sediment quality guidelines with the exception of copper. Concentrations of copper in Minto Creek (both upper and lower) were greater than the sediment quality guideline and reference, but were similar to concentrations observed in several previous years. Minto Creek sediment quality has not shown any trend over time based on temporal comparisons of absolute and normalized (to total organic carbon and to lithium) concentrations. Sediment toxicity testing of *C. dilutus* and *H. azteca* indicated no adverse effects to survival or growth in lower Minto Creek sediment when compared to the laboratory control and the field reference (lower Wolverine Creek).

Table 4.2: Minto mine effluent sediment toxicity test results collected at lower Wolverine Creek (LWC) and lower Minto Creek (LMC), September 2015.

Site	*Hyalella azteca*		*Chironomus dilutus*	
	Survival (%)	**Dry Weight (mg)**	**Survival (%)**	**Dry Weight (mg)**
Control Sediment	98 ± 4.5	0.26 ± 0.050	100 ± 0.0	1.71 ± 0.17
LWC	100 ± 0.0	0.20 ± 0.050	96 ± 8.9	2.31 ± 0.13
LMC	100 ± 0.0	0.25 ± 0.080	96 ± 5.5	2.66 ± 0.26

Significantly different than control sediment (grey shading; applies to LWC *Hyalella azteca* dry weight)
Significantly different than reference sediment (bold box)

5.0 PERIPHYTON COMMUNITY

5.1 Primary Metrics and Community Composition

Periphyton community data quality was assessed prior to data analysis and interpretation, and was judged to be of good quality (Appendix A). Analysis of the periphyton community based on cells/cm^2 indicated that four of the five periphyton community metrics (density, taxon richness, Simpson's Diversity and Bray-Curtis index) differed between study areas (lower Minto Creek and the lower Wolverine Creek reference; Table 5.1). Only Simpson's Evenness did not differ significantly between areas. Density, taxon richness and Simpson's Diversity were all significantly lower at lower Minto Creek than at lower Wolverine Creek (Table 5.1). Bray-Curtis index was significantly higher at lower Minto Creek (0.99) than at lower Wolverine Creek (0.26). This suggests that lower Minto Creek had lower production, lower diversity and different community structure than the reference areas.

Analysis of the periphyton community based on biomass (µg/cm^2) indicated that all five metrics (density, taxon richness, Simpson's Diversity, Simpson's Evenness and Bray-Curtis index) were significantly different between areas (Table 5.2). Lower Minto Creek had significantly lower density and taxon richness, but significantly higher Simpson's Diversity, Simpson's Evenness and Bray-Curtis index compared to lower Wolverine Creek (Table 5.2). Greater Simpson's Diversity and Evenness are typically considered to be positive community attributes.

Dominant phyla in lower Minto and Wolverine creeks were Bacillariophycae (diatoms) and Cyanophyta (blue-green algae). Cyanophyta was the dominant phylum at lower Minto Creek (72% of the community) and Bacillariophycae was dominant at lower Wolverine Creek (85% of the community; Figure 5.1). Little information is available regarding specific periphyton taxon group sensitivities and tolerances to mining activities to assist in interpretation (Deniseger et al. 1986; De Jonge et al. 2008).

5.2 Temporal Comparisons

Differences in periphyton community composition were evident among samples taken in 1994 and 2011-2015, although temporal variability is substantial (Figure 5.1). For example, at lower Minto Creek, Bacillariophycae were dominant in 1994, 2013, 2014; Rhodophyta in 2012 and Cyanophyta in 2011, 2015 (Figure 5.1). This lack of temporal consistency was also observed at lower Wolverine Creek, with Cyanophyta dominant in 2011, 2013 and Bacillariophycae in 2012, 2014 and 2015 (Minnow 2013a; 2014, 2015b).

Table 5.1: Statistical contrasts of periphtyon density (cells/cm^2) for community metrics between lower Wolverine Creek (reference) and lower Minto Creek (exposure) areas, Minto Mine WUL, 2015.

Metric	Significant Difference Between Areas? ($p < 0.1$)	p-value	Mean Lower Wolverine Creek	Mean Lower Minto Creek	Mean Difference (LWC-LMC)	Power[1]	Magnitude of Difference (# of SDs)[2]	Minimum Detectable Effect Size[1] (# of SDs)[2]
Density (Log Transformation)	Yes	0.000	88,074	301	87,773	1.000	2.3	-
Number of Taxa	Yes	0.025	13	11	2.6	-	-	-
Simpson's Diversity	Yes	0.092	0.66	0.55	0.10	0.543	2.0	-
Simpson's Evenness	No	0.577	0.23	0.21	0.020	0.148	-	0.28
Bray-Curtis Index	Yes	0.000	0.26	0.99	-0.73	1.000	1.4	-

[1] Power and minimum detectable effect size were calculated using $p = 0.10$

[2] Relative to reference standard deviations

Table 5.2: Statistical contrasts of periphtyon biomass (µg/cm^2) for community metrics between lower Wolverine Creek (reference) and lower Minto Creek (exposure) areas, Minto Mine WUL, 2015.

Metric	Significant Difference Between Areas? ($p < 0.1$)	p-value	Mean Lower Wolverine Creek	Mean Lower Minto Creek	Mean Difference (LWC-LMC)	Power[1]	Magnitude of Difference (# of SDs)[2]	Minimum Detectable Effect Size[1] (# of SDs)[2]
Density (Square Root Transformation)	Yes	0.000	23	0.064	23	1.000	1.4	-
Number of Taxa	Yes	0.025	13	11	2.6	-	-	-
Simpson's Diversity	Yes	0.063	0.67	0.78	-0.10	0.629	1.6	-
Simpson's Evenness	Yes	0.001	0.24	0.44	-0.20	0.998	2.7	-
Bray-Curtis Index	Yes	0.009	0.51	0.97	-0.46	-	-	-

[1] Power and minimum detectable effect size were calculated using $p = 0.10$

[2] Relative to reference standard deviations

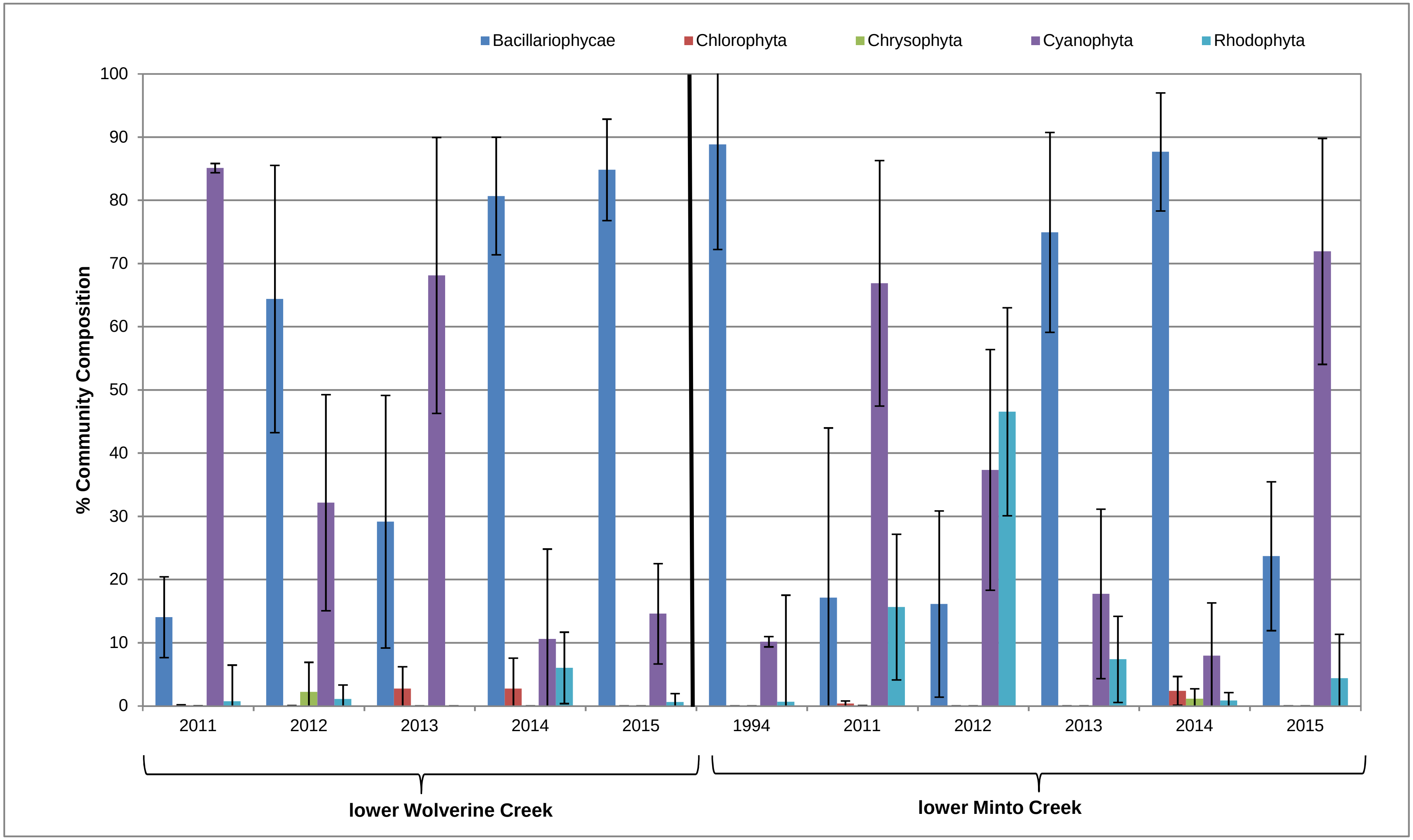

Figure 5.1: Periphyton community (cells/cm^2) composition in lower Minto Creek (1994, 2011-2015) and lower Wolverine Creek (2011-2015). Data presented as mean ± standard deviation.

5.3 Summary

Evaluation of periphyton community composition on the basis of density (cells/cm^2) and biomass (µg/cm^2) indicated significant differences in a number of metrics in lower Minto Creek relative to the lower Wolverine Creek reference. In general, lower Minto Creek had lower density/biomass, indicating lower production, and a different community composition than did lower Wolverine Creek. However, similar differences in periphyton community summary metrics and community composition were apparent among years at both lower Minto Creek and lower Wolverine Creek, indicating substantial temporal variability. Therefore, the differences observed in the periphyton communities of lower Minto Creek and lower Wolverine Creek in 2015 were within natural temporal variability and do not provide any resolution of potential mine influence.

6.0 BENTHIC INVERTEBRATE COMMUNITY

6.1 Primary Metrics and Community Composition

Benthic invertebrate community data quality was assessed prior to data analysis and interpretation, and was judged to be of good quality (Appendix A). The benthic invertebrate community of lower Minto Creek differed significantly from that of lower Wolverine Creek and lower Big Creek on the basis of four different metrics (Table 6.1). Benthic invertebrate density was significantly greater at lower Minto Creek (1,062 organisms/m^2) than at lower Wolverine Creek (142 organisms/m^2) and lower Big Creek (165 organisms/m^2; Table 6.1; Figure 6.1a). Taxon richness did not differ significantly among areas. Simpson's Diversity and Evenness were both significantly lower at lower Minto Creek than at both references areas (Table 6.1; Figure 6.1a). Lastly, the Bray-Curtis index (compared to combined reference areas) was significantly greater at lower Minto Creek (0.95) when compared to lower Wolverine Creek (0.45) and lower Big Creek (0.57; Table 6.1; Figure 6.1d). Greater density is considered to be a positive community attribute but lower Simpson's Diversity, Simpson's Evenness and higher Bray-Curtis index could suggest some influence of the mine.

Dominant taxonomic groups in lower Minto and lower Wolverine creeks included EPT taxa (Ephemeroptera [mayfly], Plecoptera [stonefly], Trichoptera [caddisfly] taxa) and chironomids (non-biting midges). Percent EPT taxa did not differ significantly among areas (Figure 6.2b; Table 6.1; Appendix Table E.1, E.2). The relative abundance of chironomids was significantly greater at lower Minto Creek than at lower Big Creek but did not differ from lower Wolverine Creek (Figure 6.2a; Table 6.1; Appendix Table E.1, E.2). Given the known sensitivity of EPT taxa to elevated concentrations of metals and nutrients and the known tolerance of most chironomid taxa (Chapman et al. 1982a,b; Rosenberg and Resh 1993; Taylor and Bailey 1997), the taxonomic dominance results (no significant difference in proportions of EPT taxa among areas and no significant difference in the proportion of chironomid taxa relative to one of two reference areas) suggests limited influence of the mine on the benthic invertebrate community of lower Minto Creek.

Correspondence Analysis (CA) explained 49.6 percent of the total community variance in the first two CA axes (Appendix Table E.6). The first CA axis explained 33.4 percent of the total inertia (variation) in the original benthic abundance data, and clearly and significantly separated lower Minto Creek from lower Wolverine Creek and lower Big Creek (Figures 6.3; Table 6.1). Lower Minto Creek had strong negative CA axis 1 scores, indicating high relative abundance of the chironomids Orthocladius but low relative abundance of the chironomids Diamesa (Appendix Table E.5). Even though percent abundance of EPT was not significantly

Table 6.1: Summary of benthic invertebrate community metrics and statistical comparisons, Minto Mine WUL, 2015.

Metric	Comparison		Area Means		Statistical Contrasts		
	Exposure Site	Reference Site			Significant Difference between areas?	Direction	p-value
Density (organisms/m^2)	lower Minto Creek	lower Wolverine Creek	1,062	142	YES	Minto > Wolverine	0.003
		lower Big Creek		165	YES	Minto > Big	0.006
Number of Taxa	lower Minto Creek	lower Wolverine Creek	17	17	NO	-	0.751
		lower Big Creek		17	NO	-	0.833
Simpson's Diversity[1]	lower Minto Creek	lower Wolverine Creek	0.71	0.89	YES	Minto < Wolverine	0.009
		lower Big Creek		0.87	YES	Minto < Big	0.016
Simpson's Evenness[1]	lower Minto Creek	lower Wolverine Creek	0.23	0.60	YES	Minto < Wolverine	0.002
		lower Big Creek		0.54	YES	Minto < Big	0.006
BC Index to Combined Reference Median	lower Minto Creek	lower Wolverine Creek	0.95	0.45	YES	Minto > Wolverine	0.000
		lower Big Creek		0.57	YES	Minto > Big	0.000
EPT (%)[2]	lower Minto Creek	lower Wolverine Creek	51	58	NO	-	1.000
		lower Big Creek		38	NO	-	0.367
Chironomids (%)	lower Minto Creek	lower Wolverine Creek	42	26	NO	-	0.295
		lower Big Creek		23	YES	Minto > Big	0.073
CA Axis-1 (33.4%)	lower Minto Creek	lower Wolverine Creek	-67	319	YES	Minto < Wolverine	0.000
		lower Big Creek		248	YES	Minto < Big	0.000
CA Axis-2 (16.2%)	lower Minto Creek	lower Wolverine Creek	-19	45	NO	-	0.331
		lower Big Creek		-46	NO	-	0.849

(Grey shading) Indicates a statistically significant difference between exposed and reference areas, p = 0.10

[1] Calculated as recommended by Environment Canada 2012

[2] Percent Ephemeroptera, Plecoptera, Trichoptera

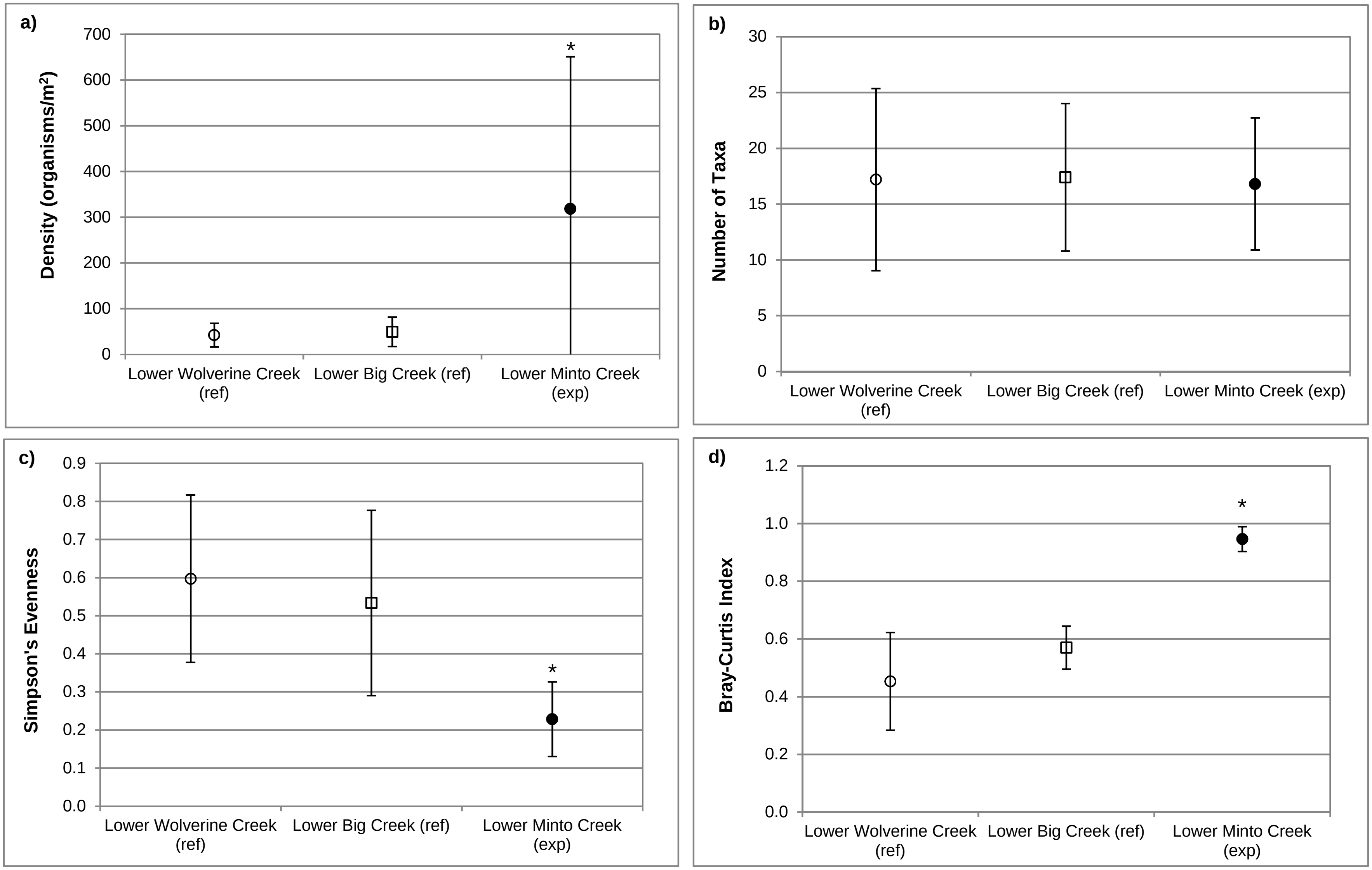

Figure 6.1: Comparison (mean ± 95% confidence intervals; n = 5 in all areas) of a) benthic invertebrate density, b) number of taxa, c) Simpson's Evenness and d) Bray-Curtis index, Minto Mine WUL, 2015. An asterisk (*) above lower Minto Creek indicates exposure area was significantly different ($p < 0.1$) from both reference areas.

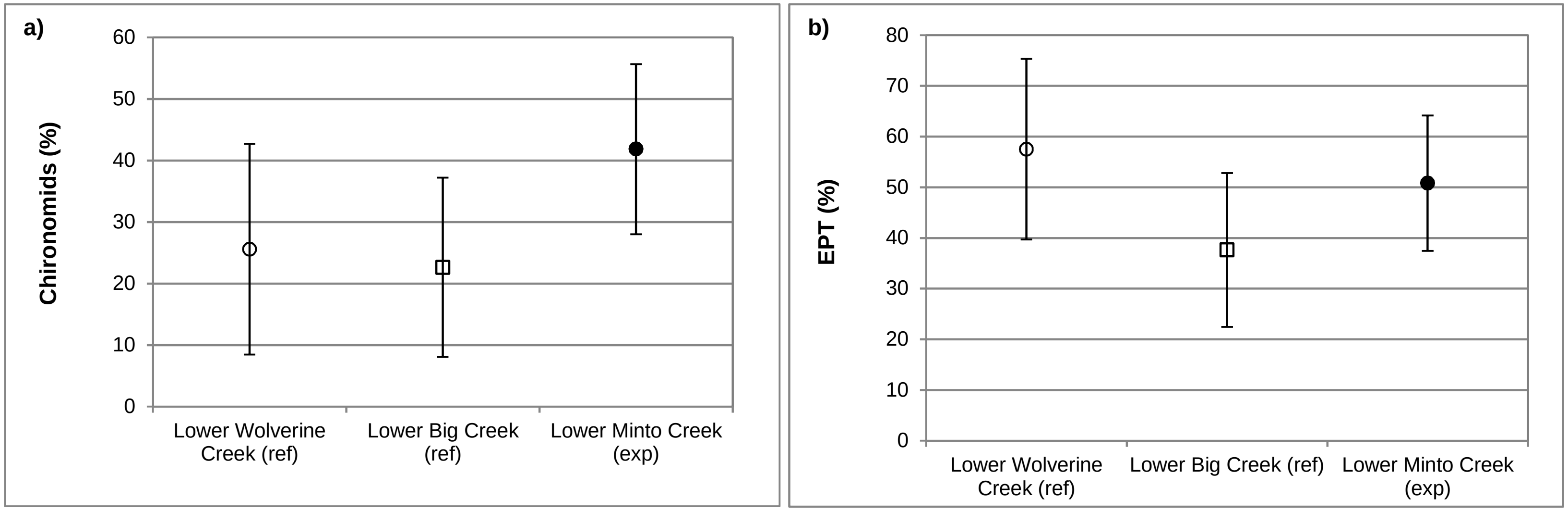

Figure 6.2: The relative abundance as percent of total organisms in an area for a) Chironomids and b) EPT, Minto Mine WUL, 2015. Data represents area means and 95% confidence intervals (n = 5 in all areas). An asterisk (*) above lower Minto Creek indicates exposure area was significantly different (p < 0.1) from both reference areas.

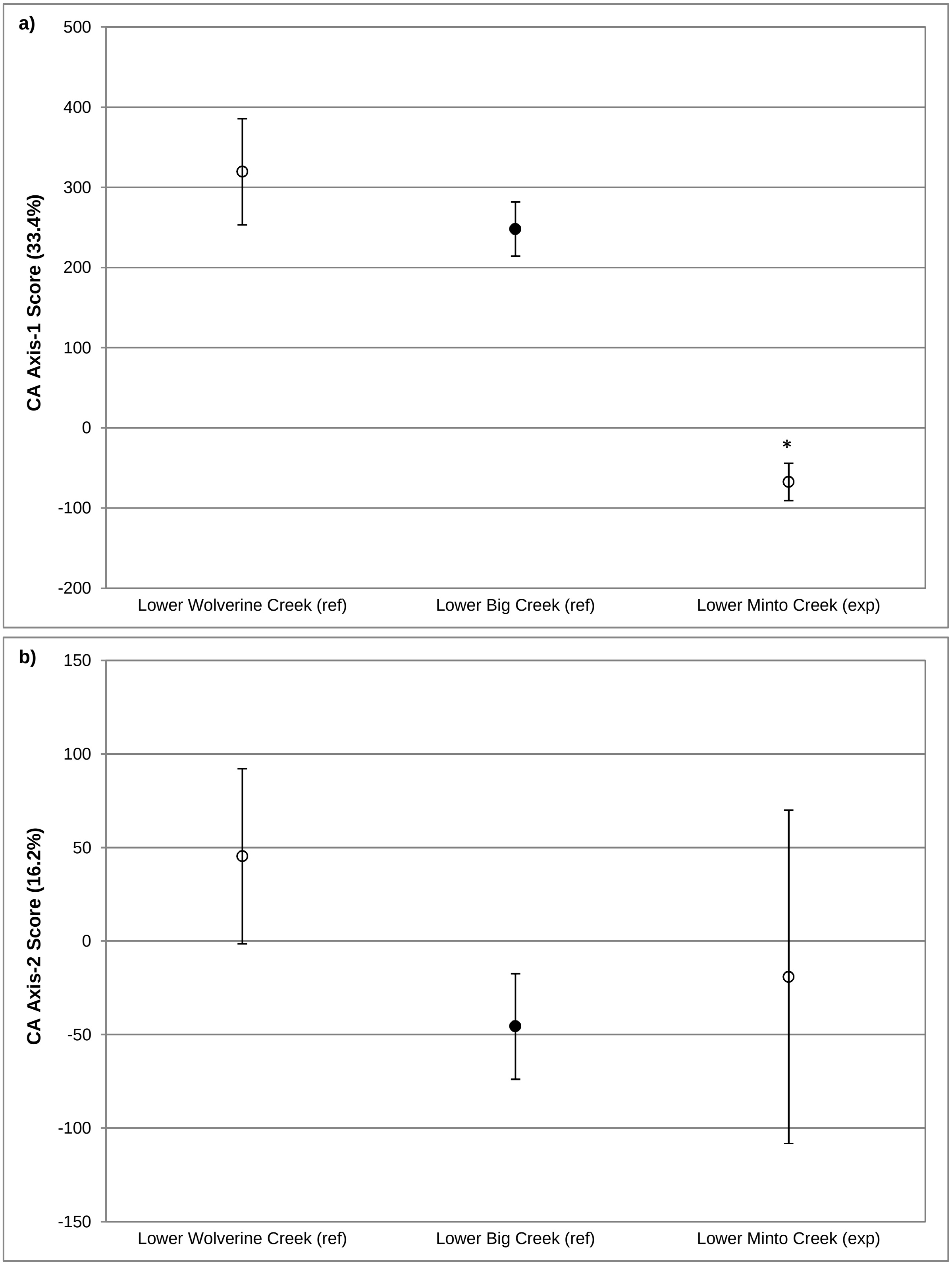

Figure 6.3: Comparison (mean ± 95 % confidence interval) of a) CA Axis-1 and b) CA Axis-2, Minto Mine, 2015. An asterisk (*) above lower Minto Creek indicates exposure area was significantly different ($p < 0.1$) from both reference areas.

different among areas, Plecoptera and Trichoptera were found at all areas but there were virtually no Ephemeroptera at lower Minto Creek (Appendix Table E.2). Lower Minto Creek had more Families Capniidae and Limnephilidae, whereas the reference areas had higher prevalence of Families Perlodidae, Chloroperlidae and Rhyacophilidae. Conversely, lower Wolverine and lower Big Creek had strong positive scores on CA axis 1, indicating the opposite taxon associations (Appendix Table E.5). Reduced abundance of Ephemeroptera in lower Minto Creek could be an indication an effect of effluent discharge as these organisms are sensitive to higher concentrations of metals and nutrients. The subsequent axes of the correspondence analysis summarized within-area variability and did not show further dimensions of significant difference among creeks (Table 6.1; Figures 6.3).

6.2 Correlation Analysis

Correlation analysis between 12 benthic indices and 11 supporting measurements resulted in 23 significant correlations at a p-level of 0.05, of which eight were significant at the Bonferroni-corrected p-level of 0.00038 (Table 6.2). It is important to consider that illustration of a significant or suggestive degree of correlation between two variables does not necessarily imply a cause-and-effect relationship, although it is cause to investigate further and to consider known biological responses to environmental change.

Of the eight correlations significant at the Bonferroni-corrected p-level, seven were with specific conductance (Table 6.2; Figure 6.4). Density, Bray-Curtis Index, and percent Plecoptera (stoneflies) were positively correlated with specific conductance, whereas Simpson's Diversity, Simpson's Evenness, percent Ephemeroptera (mayflies), and CA axis 1 scores were negatively correlated with specific conductance (Table 6.2; Figure 6.4). CA axis 1 scores were also negatively correlated with pH (Table 6.2; Figure 6.4). These relationships suggest an influence of the Minto Mine (high specific conductance due to mine activity) on the benthic invertebrate community of lower Minto Creek.

6.3 Temporal Comparisons

Temporal comparisons of the benthic invertebrate community condition of lower Minto Creek were made in order to augment data interpretation, but their power is tempered by temporal changes in sampling location, sampling methodology, level of replication and analytical processing techniques. For example, 1994 baseline data were collected near the mouth of Minto Creek as three single grab samples, 2006 data were collected at Station W2 in the same manner, 2008 and 2010 data were collected at Station W2 as three-grab composites whereas 2011-2014 data were collected as five replicate three-grab samples from a large area upstream of Station W2. Only in the later years (2011-2014) do data represent an area (i.e.,

Table 6.2: Correlations between benthic metrics and supporting environmental measurements at Minto Mine WUL, 2015.

		Median Intermediate Axis Length (cm)	Median Embeddedness (%)	Water Velocity (m/s)	Depth (m)	Temperature (°C)	Dissolved Oxygen (%)	Specific Conductivity (µS/cm)	pH	% Cobble	% Gravel	% Sand and finer
Density (organisms/m^2)	Pearson Correlation	0.034	-0.34	-0.42	0.37	-0.17	-0.54	0.84	0.49	0.25	0.090	-0.52
	Sig. (2-tailed)	0.905	0.211	0.121	0.169	0.557	0.036	0.000	0.092	0.370	0.749	0.046
	N	15	15	15	15	15	15	15	13	15	15	15
Number of Taxa	Pearson Correlation	0.32	-0.48	0.27	0.39	-0.19	-0.22	0.015	-0.34	0.40	-0.20	-0.40
	Sig. (2-tailed)	0.245	0.071	0.332	0.149	0.491	0.424	0.958	0.258	0.136	0.474	0.135
	N	15	15	15	15	15	15	15	13	15	15	15
Simpson's Diversity	Pearson Correlation	0.16	0.038	0.67	-0.029	0.066	0.29	-0.84	-0.81	0.16	-0.40	0.24
	Sig. (2-tailed)	0.573	0.894	0.006	0.919	0.815	0.299	0.000	0.001	0.572	0.142	0.381
	N	15	15	15	15	15	15	15	13	15	15	15
Simpson's Evenness	Pearson Correlation	0.047	0.23	0.55	-0.17	0.099	0.32	-0.81	-0.67	-0.043	-0.30	0.44
	Sig. (2-tailed)	0.867	0.406	0.035	0.533	0.727	0.243	0.000	0.013	0.879	0.284	0.097
	N	15	15	15	15	15	15	15	13	15	15	15
BC Index to Combined Reference Median	Pearson Correlation	-0.17	-0.25	-0.46	0.32	-0.0087	-0.45	0.94	0.72	0.11	0.29	-0.55
	Sig. (2-tailed)	0.539	0.365	0.082	0.245	0.976	0.093	0.000	0.005	0.696	0.286	0.033
	N	15	15	15	15	15	15	15	13	15	15	15
EPT (%)[1]	Pearson Correlation	0.059	0.25	-0.18	0.41	-0.63	-0.43	0.049	-0.43	0.21	0.022	-0.37
	Sig. (2-tailed)	0.835	0.366	0.531	0.126	0.012	0.108	0.862	0.141	0.449	0.939	0.171
	N	15	15	15	15	15	15	15	13	15	15	15
Chironomids (%)	Pearson Correlation	0.55	0.25	-0.034	0.24	-0.38	-0.35	0.046	0.052	-0.10	-0.036	0.21
	Sig. (2-tailed)	0.032	0.361	0.904	0.386	0.160	0.198	0.869	0.867	0.715	0.897	0.443
	N	15	15	15	15	15	15	15	13	15	15	15
Ephemeroptera (%)	Pearson Correlation	0.32	0.00	0.61	-0.19	-0.15	0.39	-0.88	-0.75	0.16	-0.35	0.17
	Sig. (2-tailed)	0.239	0.999	0.016	0.501	0.592	0.153	0.000	0.003	0.560	0.208	0.547
	N	15	15	15	15	15	15	15	13	15	15	15
Plecoptera (%)	Pearson Correlation	-0.083	-0.012	-0.45	0.39	-0.28	-0.65	0.89	0.60	-0.052	0.33	-0.33
	Sig. (2-tailed)	0.767	0.966	0.089	0.148	0.320	0.009	0.000	0.031	0.855	0.228	0.223
	N	15	15	15	15	15	15	15	13	15	15	15
Trichoptera (%)	Pearson Correlation	-0.31	0.42	-0.40	0.15	-0.13	0.012	-0.24	-0.50	0.15	-0.055	-0.18
	Sig. (2-tailed)	0.256	0.116	0.137	0.592	0.652	0.966	0.398	0.083	0.592	0.846	0.529
	N	15	15	15	15	15	15	15	13	15	15	15
CA Axis-1 (33.4%)	Pearson Correlation	0.043	0.26	0.43	-0.22	0.029	0.48	-0.95	-0.90	0.10	-0.34	0.27
	Sig. (2-tailed)	0.879	0.350	0.106	0.427	0.918	0.071	0.000	0.000	0.721	0.213	0.335
	N	15	15	15	15	15	15	15	13	15	15	15
CA Axis-2 (16.2%)	Pearson Correlation	0.22	0.13	-0.34	0.26	-0.61	-0.27	-0.25	-0.42	0.046	0.085	-0.18
	Sig. (2-tailed)	0.432	0.643	0.210	0.340	0.016	0.329	0.376	0.150	0.872	0.763	0.516
	N	15	15	15	15	15	15	15	13	15	15	15

Correlation scatterplot inspected: $p < 0.050$

Significant after Bonferroni correction; $p < 0.00038$ ($p = 0.05$ adjusted for 132 comparisons)

[1] Percent Ephemeroptera, Plecoptera, Trichoptera

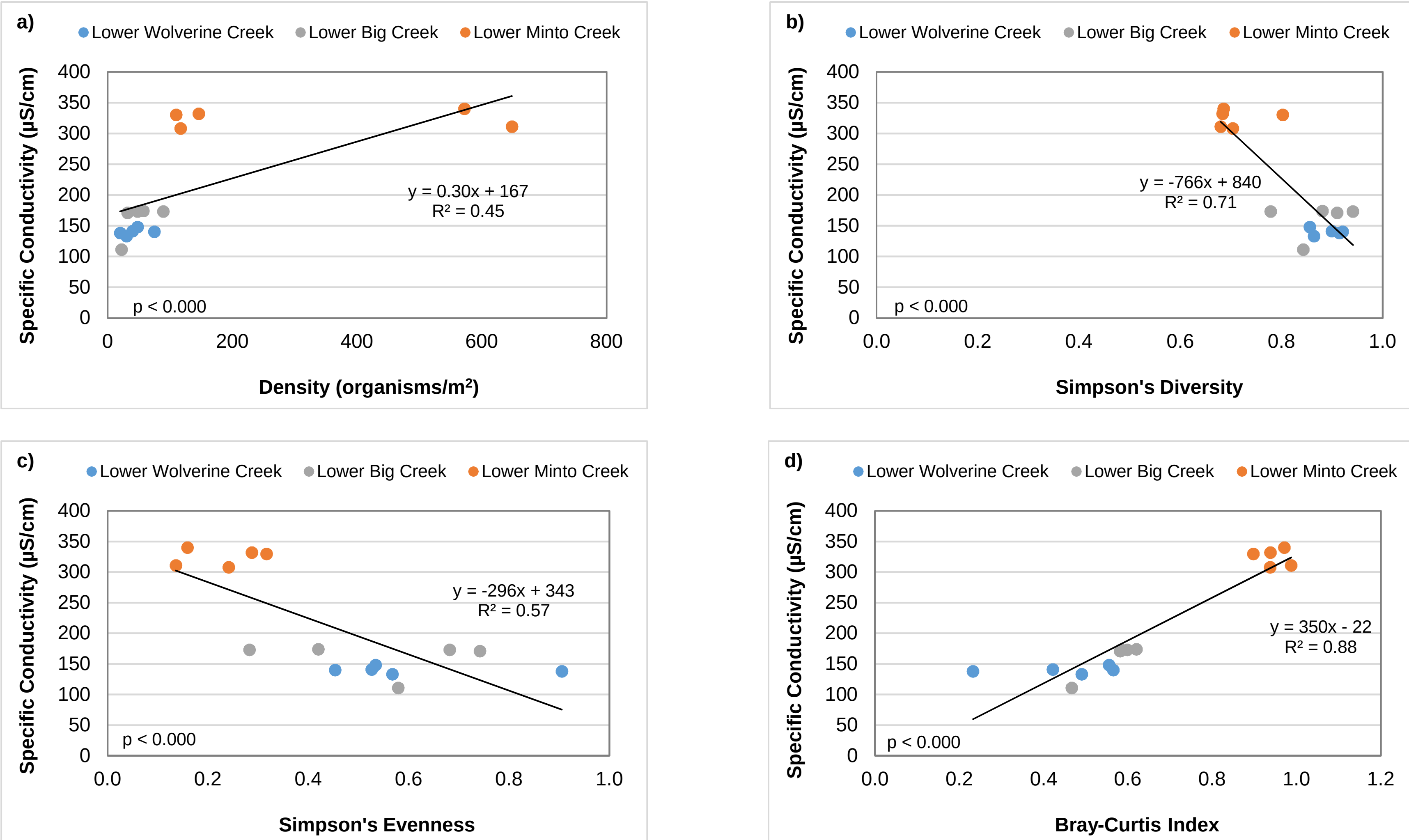

Figure 6.4: Scatterplots of significant relationships (Bonferroni corrected; $p < 0.00038$), between specific conducvitity and a) Density, b) Simpson's Diversity, c) Simpson's Evenness and d) Bray-Curtis Index, Minto Mine WUL, 2015.

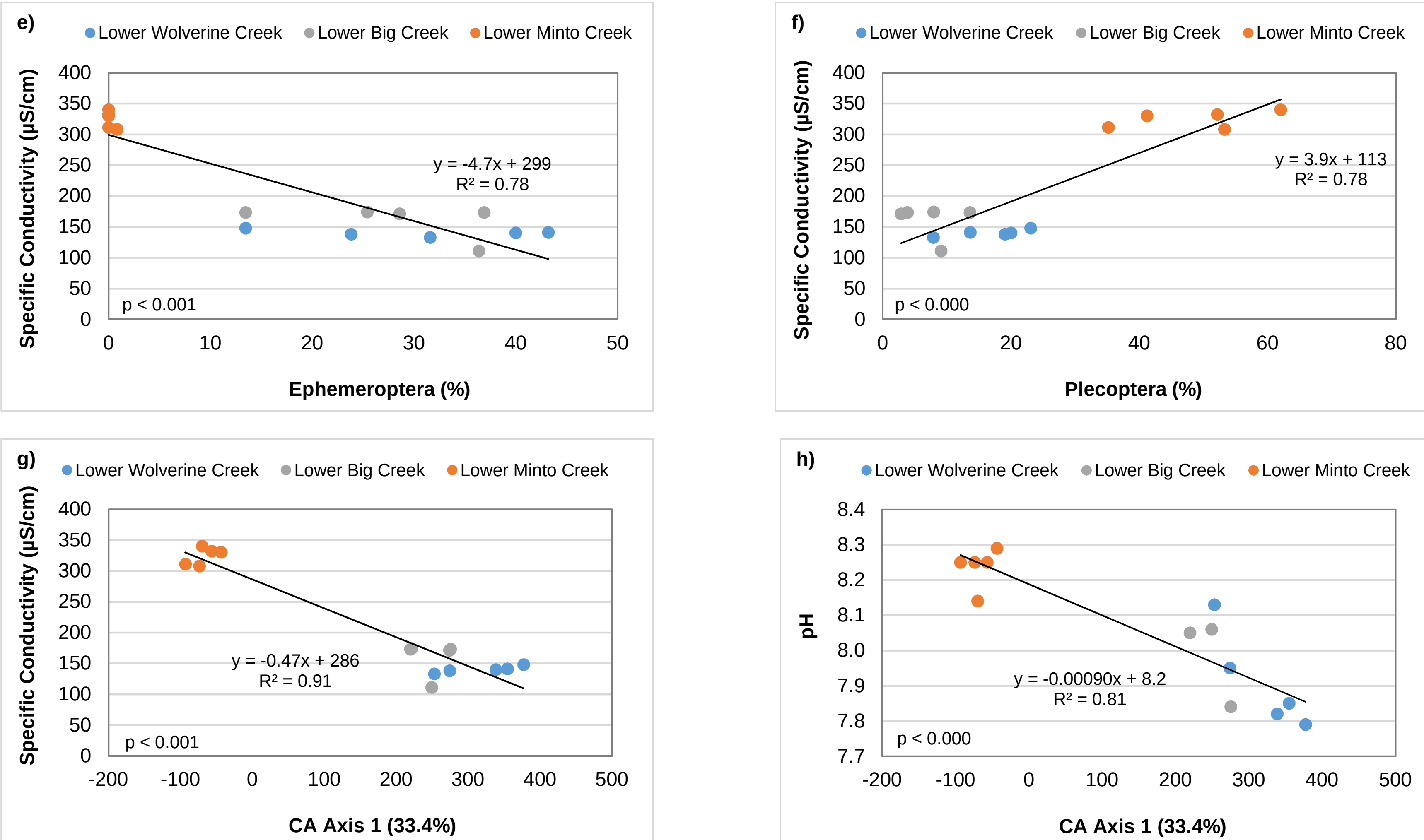

Figure 6.4: Scatterplots of significant relationships (Bonferroni corrected; p < 0.00038), between specific conductivity and e) Ephemeroptera, f) Plecoptera, c) CA Axis-1 and d) pH and CA Axis-1, Minto Mine WUL, 2015.

lower Minto Creek) rather than a station. In addition, data collected in 2013, 2014 and 2015 were sieved using 500 µm mesh, whereas all years prior to 2011 used smaller mesh (both 250 µm and 500 µm were used in 2012 to assist in transition). This is expected to result in lower densities in 2013 and later.

Benthic invertebrate density at lower Minto Creek in 2015 was lower than in 2014 but higher than in 2013 (Figure 6.5). Number of taxa at lower Minto Creek in 2015 was within the historical range from 2006 onwards, but moderately lower than in 1994 (Figure 6.5). Lastly, Simpson's Evenness was within the historical range documented after methodological change in 2011 (Figure 6.5). Over the 2012-2015 period benthic invertebrate community metrics parameters were stable, any differences between this time period and earlier sampling is likely due to a change in mesh size of the Hess sampler, with 2012 used as a bridge.

6.4 Summary

The erosional benthic invertebrate community of lower Minto Creek differed from that of lower Wolverine Creek and lower Big Creek on the basis of density (higher), Simpson's Diversity (lower), Simpson's Evenness (lower), Bray-Curtis index (greater), percent chironomids (higher than lower Wolverine Creek only), and CA Axis-1 (higher). Whereas taxon richness similar to reference is an indicator of a healthy erosional benthic invertebrate community, lower Simpson's Diversity and Evenness, higher Bray-Curtis index, greater dominance of chironomids, and a virtual absence of mayflies suggests a mine-related influence on lower Minto Creek. This is supported by significant correlations between a number of benthic invertebrate community metrics and specific conductance. A potential decrease in number of taxa from 2012-2014 identified last year (Minnow 2015b) was not supported by the 2015 data and appears to represent natural variability.

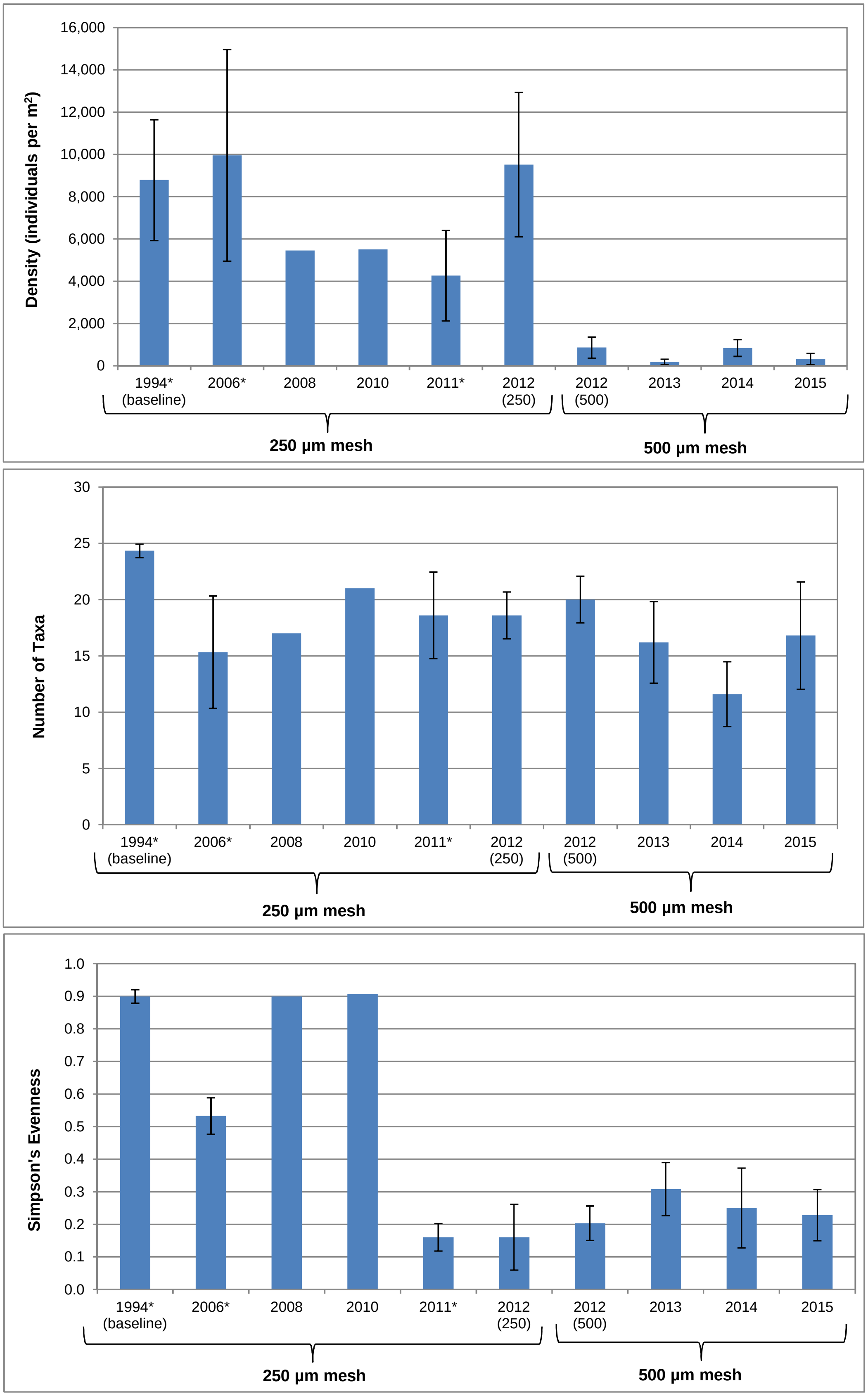

Figure 6.5: Primary benthic invertebrate community metrics at lower Minto Creek, 1994-2015. Data presented as mean ± standard deviation where replicated. Asterisk (*) indicates a year the mine was not discharging.

7.0 TISSUE CHEMISTRY

As indicated in Section 2.5, tissue chemistry data are provided here simply to report the ancillary data that were collected along with the selenium data reported under separate cover. Data interpretation is therefore limited to basic comparisons of metal concentrations in tissue collected at the exposure area (lower Minto Creek) to those collected at reference creeks (lower Wolverine Creek and lower Big Creek).

7.1 Periphyton Tissue

Periphyton tissue data quality was assessed prior to data analysis and interpretation and was judged to be of good quality (Appendix A). Selenium was the only analyte with a mean concentration at lower Minto Creek that differed significantly from both reference areas (Table 7.1; Appendix Table C.2). There were no significant differences between areas for selenium in 2013 (Minnow 2014), whereas in both 2014 and 2015, periphyton selenium concentrations were significantly greater at lower Minto Creek than at the reference areas (Minnow 2015b). Significantly higher concentrations of selenium at lower Minto Creek compared to reference areas over the last two years could indicate an influence of the mine on Minto Creek, but results have not been consistent over time and temporal differences could be an indication of natural variability.

7.2 Benthic Invertebrate Tissue

Benthic invertebrate tissue data quality was assessed prior to data analysis and interpretation and was judged to be of good quality (Appendix A). There were three analytes: antimony, cadmium and potassium at lower Minto Creek that were significantly different at both reference areas (Table 7.1; Appendix Table C.3), but none of these analytes have been identified as strongly mine-related (Sections 3.0 and 4.0). Analytes of concern, copper and selenium differed significantly in lower Minto Creek relative to lower Big Creek but not lower Wolverine Creek (lower and greater, respectively; Table 7.1; Appendix Table C.3). Variability in concentrations of copper and selenium in benthic invertebrate tissue has been high among years. In 2013, copper was significantly higher in benthic invertebrates from lower Minto Creek compared to lower Wolverine Creek, but in 2014 copper did not differ significantly among areas. This lack of consistency suggests that the observed differences likely represent natural variability.

Table 7.1: Periphyton and benthic invertebrate tissue chemistry results, Minto Mine WUL, September 2015.

Analyte	Units	Periphyton						Benthic Invertebrates					
		Lower Wolverine Creek (Reference)		Lower Big Creek (Reference)		Lower Minto Creek (Exposed)		Lower Wolverine Creek (Reference)		Lower Big Creek (Reference)		Lower Minto Creek (Exposed)	
		n = 5		n = 5		n = 5		n = 5		n = 5		n = 5	
		Mean[9]	Standard Deviation	Mean[9]	Standard Deviation	Mean[9]	Standard Deviation	Mean[9]	Standard Deviation	Mean[9]	Standard Deviation	Mean[9]	Standard Deviation
Aluminum (Al)	mg/kg dwt	6,954	2,339	14,634	5,169	9,278	1,003	2,204	784	2,140	517	2,756	673
Antimony (Sb)[1]	mg/kg dwt	0.029	0.018	0.023	0.0094	0.052	0.013	0.072	0.028	0.21	0.020	0.12	0.032
Arsenic (As)[2]	mg/kg dwt	3.4	1.3	10	6.3	7.4	1.9	2.2	1.2	7.0	0.90	3.2	0.82
Barium (Ba)	mg/kg dwt	195	82	316	118	386	138	92	42	76	7.4	111	28
Beryllium (Be)[3]	mg/kg dwt	0.66	0.28	0.86	0.56	0.34	0.040	0.18	0.064	0.17	0.021	0.14	0.039
Bismuth (Bi)[1]	mg/kg dwt	0.038	0.014	0.18	0.22	0.10	0.015	0.022	0.0041	0.25	0.062	0.040	0.012
Boron (B)[1,2,4]	mg/kg dwt	3.2	2.1	4.6	4.8	13	9.1	1.4	0.52	1.0	0	4.1	1.7
Cadmium (Cd)	mg/kg dwt	0.19	0.084	0.37	0.24	0.20	0.058	1.0	0.39	3.9	0.40	0.29	0.086
Calcium (Ca)[1,2]	mg/kg dwt	9,538	4,043	15,300	14,990	9,300	1,741	2,666	516	3,018	445	3,276	710
Cesium (Cs)[3]	mg/kg dwt	0.35	0.26	0.88	0.46	1.1	0.18	0.28	0.10	0.87	0.38	0.27	0.072
Chromium (Cr)[5]	mg/kg dwt	62	29	208	180	31	4.7	12	6.0	7.9	1.3	9.8	3.2
Cobalt (Co)	mg/kg dwt	35	8.8	27	16	13	3.6	3.8	1.1	5.2	1.6	2.8	0.9
Copper (Cu)	mg/kg dwt	27	5.8	37	16	38	7.4	27	4.4	59	11	40	11.6
Iron (Fe)	mg/kg dwt	45,300	10,057	42,100	22,982	18,380	2,340	6,004	2,853	5,680	1,531	6,590	2,012
Lead (Pb)	mg/kg dwt	3.1	0.38	4.0	1.7	4.9	0.74	1.2	0.39	3.1	0.70	1.7	0.37
Lithium (Li)[1]	mg/kg dwt	6.6	0.87	9.0	3.0	8.4	0.71	1.6	0.75	1.2	0.43	2.2	0.88
Magnesium (Mg)	mg/kg dwt	26,980	1,895	22,190	12,162	5,956	568	2,974	935	2,612	529	2,574	539
Manganese (Mn)[2]	mg/kg dwt	1,791	1,121	1,657	946	4,179	2,130	391	95	745	176	519	85
Mercury (Hg)[1]	mg/kg dwt	0.019	0.014	0.016	0.0066	0.029	0.011	0.028	0.0059	0.043	0.0044	0.031	0.0082
Molybdenum (Mo)[3,6]	mg/kg dwt	1.6	1.0	1.1	1.1	0.76	0.21	0.74	0.23	1.2	0.23	1.8	1.3
Nickel (Ni)[3]	mg/kg dwt	143	29	43	23	26	4.1	11	7.5	8.9	3.5	9.4	2.2
Phosphorus (P)[3]	mg/kg dwt	2,098	789	810	230	1,320	374	7,030	1,323	7,726	946	6,910	1,335
Potassium (K)[1]	mg/kg dwt	1,009	852	995	249	1,396	388	7,448	2,264	6,690	515	12,012	2,238
Rubidium (Rb)	mg/kg dwt	3.9	1.7	6.6	3.7	8.4	0.81	5.1	0.97	9.6	1.3	3.7	0.45
Selenium (Se)[2,5]	mg/kg dwt	0.18	0.11	0.15	0.066	0.77	0.35	1.6	0.78	1.1	0.10	2.0	0.34
Sodium (Na)	mg/kg dwt	1,691	1,574	777	516	373	41	2,518	491	2,838	324	5,354	2,264
Strontium (Sr)	mg/kg dwt	62	37	99	53	65	12	27	4.6	35	5.5	29	6.2
Tellurium (Te)[4,5,7]	mg/kg dwt	0.024	0.0089	0.029	0.022	0.021	0.00089	< 0.020	0	0.020	0	< 0.020	0
Thallium (Tl)	mg/kg dwt	0.030	0.013	0.11	0.062	0.091	0.0093	0.017	0.0035	0.055	0.0073	0.025	0.0067
Tin (Sn)[1,2]	mg/kg dwt	6.2	8.7	0.30	0.079	2.7	1.6	0.11	0.022	0.10	0.0045	0.13	0.046
Uranium (U)	mg/kg dwt	0.85	0.39	0.68	0.29	0.92	0.27	0.49	0.14	1.7	0.53	0.56	0.14
Vanadium (V)[1,8]	mg/kg dwt	66	44	88	42	48	10	17	6.2	14	4.1	20	7.7
Zinc (Zn)	mg/kg dwt	90	21	74	28	54	7.3	109	22	181	26	118	44
Zirconium (Zr)	mg/kg dwt	45	35	7.5	3.6	8.4	1.1	3.4	0.96	4.1	1.0	3.6	1.1

(grey shading) Indicates a mean concentration in lower Minto Creek that is significantly different than the mean concentration in lower Wolverine Creek (ANOVA; p = 0.050)

(box outline) Indicates a mean concentration in lower Minto Creek that is significantly different than the mean concentration in lower Big Creek (ANOVA; p = 0.050)

[1] For periphyton, data were normalized by log transformation (ANOVA, p = 0.050)

[2] For benthic calculations, data were not normal or equal variance not met, therefore a non-parametric Mann-Whitney U-test was conducted instead, p = 0.050

[3] For benthic, data were normalized by log transformation (ANOVA, p = 0.050)

[4] Statistical analysis between LBC and LMC was not possible as there was no variance at LBC

[5] For periphyton calculations, data were not normal or equal variance not met, therefore a non-parametric Mann-Whitney U-test was conducted instead, p = 0.050

[6] For periphyton, data were normalized by inverse transformation (ANOVA, p = 0.050)

[7] Statistical analysis between LWC and LMC was not possible as there was no variance at LWC

[8] Statistical analysis was not possible since there was no variance within each sites

[9] If value was < method detection limit, summary statistics were calculated using detection limit, i.e. if value was < 0.0048, summary statistics were calculated using the value 0.0048

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

The Minto Mine sediment, periphyton and benthic assessment undertaken from September 9th to 15th, 2015 served to quantitatively compare water quality (field measures and chemistry), sediment quality, periphyton community, benthic invertebrate community and benthic invertebrate tissue quality of Minto Creek to reference creeks and also drew on previous data for interpretation. Periphyton tissue quality data are also provided.

Supporting measures collected in September 2015 indicated good Minto Creek water quality. An influence of the Minto Mine was evident in higher specific conductance than in reference creeks, however, there were no water quality parameters with concentrations greater than WUL water quality objectives. Furthermore, parameters with concentrations in Minto Creek greater than guidelines were also elevated at reference areas, in apparent association with suspended solids/turbidity. Even though concentrations of chlorophyll *α* in periphyton were significantly higher at lower Minto Creek than lower Wolverine Creek, these concentrations were below the guideline of 100 mg/m^2 for the protection of aquatic life (BCMOE 1985) and both creeks were oligotrophic according to the classification system of Dodds et al. (1998).

Concentrations of metals in Minto Creek sediments were similar to reference and lower than sediment quality guidelines with the exception of copper. Concentrations of copper in Minto Creek (both upper and lower) were greater than the sediment quality guideline and reference, but were similar to concentrations observed in several previous years. Minto Creek sediment quality has not shown any trend over time based on temporal comparisons of absolute and normalized (to total organic carbon and to lithium) concentrations. Sediment toxicity testing of *Chironomus dilutus* and *Hyalella azteca* indicated no adverse effects to survival or growth in lower Minto Creek sediment when compared to the laboratory control and the field reference (lower Wolverine Creek) sediment.

Evaluation of periphyton community composition on the basis of density ($cells/cm^2$) and biomass ($\mu g/cm^2$) indicated significant differences in a number of metrics in lower Minto Creek relative to the lower Wolverine Creek reference. In general, lower Minto Creek had lower density/biomass, indicating lower production, and a different community composition than did lower Wolverine Creek. However, similar differences in periphyton community summary metrics and community composition were apparent among years at both lower Minto Creek and lower Wolverine Creek, indicating substantial temporal variability. Therefore, the differences observed in the periphyton communities of lower Minto Creek and lower Wolverine

Creek in 2015 were within natural temporal variability and do not provide any resolution of potential mine influence.

The erosional benthic invertebrate community of lower Minto Creek differed from that of lower Wolverine Creek and lower Big Creek on the basis of density (higher), Simpson's Diversity (lower), Simpson's Evenness (lower), Bray-Curtis index (greater), percent chironomids (higher than lower Wolverine Creek only), and CA Axis-1 (higher). Whereas taxon richness similar to reference is an indicator of a healthy erosional benthic invertebrate community, lower Simpson's Diversity and Evenness, higher Bray-Curtis index, greater dominance of chironomids, and a virtual absence of mayflies suggests a mine-related influence on lower Minto Creek. This is supported by significant correlations between a number of benthic invertebrate community metrics and specific conductance. A potential decrease in number of taxa from 2012-2014 identified last year (Minnow 2015b) was not supported by the 2015 data and appears to represent natural variability. High temporal variability has been observed at the exposure and reference areas (Minnow 2009b; 2011, 2012, 2013b, 2014, 2015b), presumably due to inter-annual variability in environmental conditions (e.g., flow, ice scour).

The chemical quality of biological tissues (periphyton and benthic invertebrates) collected at mine-exposed lower Minto Creek and reference areas indicated that only selenium in periphyton tissue from lower Minto Creek was significantly greater than in both reference areas (lower Wolverine Creek and lower Big Creek).

8.2 Recommendations

Based on the results and conclusions of the 2015 Minto Mine sediment, periphyton and benthic assessment, it is recommended that the program is repeated in 2016. It is recommended that the examination of TOC and lithium normalized sediment chemistry continue with key analytes of concern. It is recommended that both lower Wolverine Creek and lower Big Creek continue to be sampled as reference areas for the benthic invertebrate community assessment to provide better perspective on whether any of the observed differences are actually due to mine influence or simply due to natural differences between among creeks. It is recommended that sediment toxicity testing is not completed in 2016, but that it is completed at a three-year frequency (next monitoring in 2018) or in response to any increase in concentrations of copper (or other mine-related analyte). It is also recommended that periphyton community monitoring is removed from the WUL monitoring program as results are highly variable and are not effective in determining potential mine effects.

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APPENDIX A

DATA QUALITY ASSESSMENT

APPENDIX A: DATA QUALITY ASSESSMENT

LIST OF TABLES

After Page…

A1.0 INTRODUCTION

Data Quality Assessment (DQA) was conducted on data collected as part of the 2015 Minto Creek Sediment, Periphyton and Benthic Invertebrate Community Assessment Report. The objective of DQA is to define the overall quality of the data presented in the report, and, by extension, the confidence with which the data can be used to derive conclusions.

A1.1 Background

A variety of factors can influence the chemical and biological measurements made in an environmental study and thus affect the accuracy and/or precision of the data. Inconsistencies in sampling or laboratory methods, use of instruments that are inadequately calibrated or which cannot measure to the desired level of accuracy or precision, and contamination of samples in the field or laboratory are just some of the potential factors that can lead to the reporting of data that do not accurately reflect actual environmental conditions. Depending on the magnitude of the problem, inaccuracy or imprecision have the potential to affect the reliability of any conclusions made from the data. Therefore, it is important to ensure that monitoring 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, one must know the context in which the data will be interpreted in order to establish a relevant basis for judging whether or not the data set is adequate. DQA involves comparison of actual field and laboratory measurement performance to data quality objectives (DQOs) established for a particular study, such as evaluation of method detection limits, blank sample data, data precision (based on field and laboratory duplicate samples), and data accuracy (based on matrix spike recoveries and/or analysis of standards or certified reference materials). A trusted analytical laboratory certified by Canadian Association for Laboratory Accreditation (CALA) with a rigorous internal quality assurance program was selected to ensure the highest possible quality.

DQOs were established either at the outset of the field program or by the laboratory (ALS Environmental) and reflect reasonable and achievable performance expectations. The method detection limit (MDL) was set at the outset of the field program for water, sediment and tissue quality. Only samples that were below the laboratory detection limits were evaluated against target detection limits. Target detection limits should be at least as low as applicable guidelines, ideally ≤ 1/10th guideline values. Tissue samples are compared to the detection limit the laboratory quoted they could achieve. Programs involving a large amount of samples and analytes usually result in some results that exceed the DQOs. This is particularly so for multi-element scans (e.g., ICP scans for metals) since the analytical conditions are not necessarily optimal for every element included in the scan. Generally, scan results may be considered acceptable if no more than 20% of the parameters fail to meet the DQOs. Overall, the intent of comparing data to DQOs was not to reject any measurement that did not meet the DQO, but to ensure that any questionable data received more scrutiny to determine what effect, if any, this had on interpretation of results within the context of this project.

A1.2 Types of Quality Control Samples

Several types of quality control (QC) samples were assessed based on samples collected (or prepared) in the field and laboratory. These samples, and a description of each, include the following:

- **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 will reflect any contamination that occurred in the field (in the case of field or travel blanks) or 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.

- **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.

- **Laboratory Duplicates** are sub-sample pairs created in the laboratory from randomly selected field samples which are sub-sampled and then analyzed independently using identical analytical methods. The laboratory duplicate sample results reflect any variability introduced during laboratory sample handling and analysis and thus provide a measure of laboratory precision.

- **Spike Recovery Samples** are created in the laboratory by adding a known amount/concentration of a given analyte (or mixture of analytes) to a randomly selected test sample previously divided to create two sub-samples. The spiked and regular sub-samples are then analyzed in an identical manner. The spike recovery represents the difference between the measured spike amount (total amount in spiked sample minus amount in original sample) relative to the known spike amount (as a percentage). Two types of spike recovery samples are commonly analyzed. Spiked blanks (or blank spikes) are created using laboratory control materials whereas matrix spikes are created using field-collected samples. The analysis of spiked samples provides an indication of the accuracy of analytical results.
- **Certified Reference Materials** are samples containing known chemical concentrations that are processed and analyzed along with batches of environmental samples. The sample results are then compared to target results to provide a measure of analytical accuracy. The results are reported as the percent of the known amount that was recovered in the analysis.

The following QC was applied to benthic invertebrate community samples as follows:

- **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 WATER SAMPLES

A2.1 Method Detection Limits

Of the analytes that were below laboratory detection limits only total mercury was higher than targeted detection limits but was lower than guideline levels (Table A.1). Therefore, data for this project can be reliably interpreted relative to guidelines.

A2.2 Laboratory Blank Sample Analysis

All blank samples contained non-detectable analyte concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Appendix B).

A2.3 Data Precision

The relative percent difference (RPD) between field duplicate samples were greater than 40% in six analytes: total suspended solids (TSS), turbidity, total phosphorus, total cadmium, total lead and dissolved chromium (Table A.2). The RPD could presumably be due to higher concentrations of TSS and turbidity in one sample.

Agreement was achieved between all laboratory duplicate samples (Appendix B). This indicates that reported sample results were associated with good analytical precision.

A2.4 Data Accuracy

Analyte recoveries for spiked blanks all met the data quality objectives indicating excellent analytical accuracy for the water sample analyses (Appendix B).

The analyte recoveries for matrix spiked samples all met the data quality objectives indicating excellent analytical accuracy for the water sample analyses (Appendix B).

All the data quality objectives were met for analyte recoveries of certified reference materials indicating excellent analytical accuracy (Appendix B).

Table A.1: Laboratory method detection limits (MDLs) relative to targets and water quality guidelines, Minto Mine, 2015.

Analyte		Units	Method Detection Limit		Water Use Licence Objectives	CCME Water Quality Guidelines[1]	
			Target	Achieved		30 Day	Max
Anions and Nutrients	Chloride (Cl)	mg/L	12	0.50	-	120	640
	Nitrite (as N)	mg/L	0.0060	0.0010	0.060	0.060	-
Cyanides	Total Cyanide	mg/L	-	0.0050	-	-	
Total Metals	Total Antimony (Sb)	mg/L	-	0.00010	-	-	-
	Total Beryllium (Be)	mg/L	-	0.00010	-	-	-
	Total Bismuth (Bi)	mg/L	-	0.000050	-	-	-
	Total Boron (B)	mg/L	0.15	0.010	-	1.5	2.9
	Total Cadmium (Cd)	mg/L	0.000010	0.0000050	-	0.00010[a]	0.0012[a]
	Total Lead (Pb)	mg/L	0.00010	0.000050	-	0.0010[a]	-
	Total Mercury (Hg)	mg/L	0.0000026	0.0000050	-	0.000026	-
	Total Phosphorus (P)	mg/L	-	0.30	-	-	-
	Total Silver (Ag)	mg/L	0.000025	0.000010	-	0.00025	
	Total Thallium (Tl)	mg/L	0.000080	0.000010	-	0.00080	-
	Total Tin (Sn)	mg/L	-	0.00010	-	-	-
	Total Titanium (Ti)	mg/L	-	0.010	-	-	-
	Total Zinc (Zn)	mg/L	0.0030	0.0030	-	0.030	-
Dissolved Metals	Dissolved Antimony (Sb)	mg/L	-	0.00010	-	-	-
	Dissolved Beryllium (Be)	mg/L	-	0.00010	-	-	-
	Dissolved Bismuth (Bi)	mg/L	-	0.000050	-	-	-
	Dissolved Boron (B)	mg/L	-	0.010	-	-	-
	Dissolved Cadmium (Cd)	mg/L	0.015	0.0000050	0.15	-	-
	Dissolved Cobalt (Co)	mg/L	-	0.00010	-	-	-
	Dissolved Lead (Pb)	mg/L	0.00040	0.000050	0.0040	-	-
	Dissolved Mercury (Hg)	mg/L	-	0.0000050	-	-	-
	Dissolved Phosphorus (P)	mg/L	-	0.30	-	-	-
	Dissolved Silver (Ag)	mg/L	0.000010	0.000010	0.00010	-	-
	Dissolved Thallium (Tl)	mg/L	-	0.000010	-	-	-
	Dissolved Tin (Sn)	mg/L	-	0.00010	-	-	-
	Dissolved Titanium (Ti)	mg/L	-	0.010	-	-	-
	Dissolved Vanadium (V)	mg/L	-	0.00050	-	-	-
	Dissolved Zinc (Zn)	mg/L	0.0030	0.0010	0.030	-	-

value greater than DQO

[1] CCME 1999. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

[a] Based on lowest guideline using lowest hardness

Table A.2: Field duplicate results for analysis of water quality, Minto Mine, 2015[a]. Higlighted calues did not meet the data quality objective of 40% relative percent difference (RPD).

Analytes		Units	Lab Report L1669009		
			UMC	UMCX	RPD (%)
			7-Sep-2015	7-Sep-2015	
Physical Tests	Conductivity	µS/cm	512	516	0.78
	Hardness (as $CaCO_3$)	mg/L	262	260	0.77
	pH	pH Units	8.26	8.28	0.24
	Total Suspended Solids	mg/L	21	4.0	137
	Total Dissolved Solids	mg/L	332	335	0.90
	Turbidity	NTU	0.59	0.30	65
Anions and Nutrients	Total Alkalinity	mg/L	230	230	0
	Total Ammonia (as N)	mg/L	0.0064	0.0067	4.6
	Chloride (Cl)	mg/L	4.4	4.4	0.46
	Fluoride (F)	mg/L	0.56	0.56	0.72
	Nitrate (as N)	mg/L	0.20	0.20	0.51
	Nitrite (as N)	mg/L	< 0.0010	< 0.0010	0
	Total dissolved Phosphorus (P)	mg/L	0.0048	0.0059	21
	Total Phosphorus (P)	mg/L	0.010	0.0049	68
	Sulfate (SO_4)	mg/L	54	54	0
Other	Total Cyanide	mg/L	< 0.0050	< 0.0050	0
	Dissolved Organic Carbon	mg/L	5.6	5.5	2.2
	Total Inorganic Carbon	mg/L	49	47	3.3
	Total Organic Carbon	mg/L	5.6	5.7	2.5
Total Metals	Total Aluminum (Al)	mg/L	0.085	0.10	19
	Total Antimony (Sb)	mg/L	< 0.00010	< 0.00010	0
	Total Arsenic (As)	mg/L	0.00038	0.00038	0
	Total Barium (Ba)	mg/L	0.079	0.081	2.4
	Total Beryllium (Be)	mg/L	< 0.00010	< 0.00010	0
	Total Bismuth (Bi)	mg/L	< 0.000050	< 0.000050	0
	Total Boron (B)	mg/L	0.026	0.027	3.8
	Total Cadmium (Cd)	mg/L	< 0.0000050	0.000010	63
	Total Calcium (Ca)	mg/L	56	57	2.3
	Total Chromium (Cr)	mg/L	0.00026	0.00027	3.8
	Total Cobalt (Co)	mg/L	0.00010	0.00011	9.5
	Total Copper (Cu)	mg/L	0.0043	0.0047	10
	Total Iron (Fe)	mg/L	0.15	0.17	12
	Total Lead (Pb)	mg/L	0.000088	< 0.000050	55
	Total Lithium (Li)	mg/L	0.0043	0.0047	8.9
	Total Magnesium (Mg)	mg/L	27	28	3.2
	Total Manganese (Mn)	mg/L	0.051	0.055	5.9
	Total Mercury (Hg)	mg/L	< 0.0000050	< 0.0000050	0
	Total Molybdenum (Mo)	mg/L	0.0051	0.0053	4.6
	Total Nickel (Ni)	mg/L	0.0010	0.0011	3.8
	Total Phosphorus (P)	mg/L	< 0.30	< 0.30	0
	Total Potassium (K)	mg/L	2.3	2.3	0.88
	Total Selenium (Se)	mg/L	0.00034	0.00032	5.1
	Total Silicon (Si)	mg/L	6.4	6.5	1.4
	Total Silver (Ag)	mg/L	< 0.000010	< 0.000010	0
	Total Sodium (Na)	mg/L	18	19	3.8
	Total Strontium (Sr)	mg/L	0.72	0.74	2.3
	Total Thallium (Tl)	mg/L	< 0.000010	< 0.000010	0
	Total Tin (Sn)	mg/L	< 0.00010	< 0.00010	0
	Total Titanium (Ti)	mg/L	< 0.010	< 0.010	0
	Total Uranium (U)	mg/L	0.0026	0.0026	1.6
	Total Vanadium (V)	mg/L	0.0010	0.00091	10
	Total Zinc (Zn)	mg/L	< 0.0030	< 0.0030	0
Dissolved Metals	Dissolved Aluminum (Al)	mg/L	0.0028	0.0026	7.4
	Dissolved Antimony (Sb)	mg/L	< 0.00010	< 0.00010	0
	Dissolved Arsenic (As)	mg/L	0.00028	0.00026	7.4
	Dissolved Barium (Ba)	mg/L	0.077	0.077	0.26
	Dissolved Beryllium (Be)	mg/L	< 0.00010	< 0.00010	0
	Dissolved Bismuth (Bi)	mg/L	< 0.000050	< 0.000050	0
	Dissolved Boron (B)	mg/L	0.022	0.022	0
	Dissolved Cadmium (Cd)	mg/L	< 0.0000050	< 0.0000050	0
	Dissolved Calcium (Ca)	mg/L	58	57	1.4
	Dissolved Chromium (Cr)	mg/L	0.00013	0.00020	42
	Dissolved Cobalt (Co)	mg/L	< 0.00010	< 0.00010	0
	Dissolved Copper (Cu)	mg/L	0.0026	0.0026	2.3
	Dissolved Iron (Fe)	mg/L	0.020	0.021	4.9
	Dissolved Lead (Pb)	mg/L	< 0.000050	< 0.000050	0
	Dissolved Lithium (Li)	mg/L	0.0038	0.0040	5.1
	Dissolved Magnesium (Mg)	mg/L	29	29	0
	Dissolved Manganese (Mn)	mg/L	0.042	0.042	0.95
	Dissolved Mercury (Hg)	mg/L	< 0.0000050	< 0.0000050	0
	Dissolved Molybdenum (Mo)	mg/L	0.0050	0.0050	0
	Dissolved Nickel (Ni)	mg/L	0.00088	0.00092	4.4
	Dissolved Phosphorus (P)	mg/L	< 0.30	< 0.30	0
	Dissolved Potassium (K)	mg/L	2.3	2.2	0
	Dissolved Selenium (Se)	mg/L	0.00033	0.00034	3.6
	Dissolved Silicon (Si)	mg/L	6.4	6.3	0.95
	Dissolved Silver (Ag)	mg/L	< 0.000010	< 0.000010	0
	Dissolved Sodium (Na)	mg/L	18	18	0
	Dissolved Strontium (Sr)	mg/L	0.72	0.72	0
	Dissolved Thallium (Tl)	mg/L	< 0.000010	< 0.000010	0
	Dissolved Tin (Sn)	mg/L	< 0.00010	< 0.00010	0
	Dissolved Titanium (Ti)	mg/L	< 0.010	< 0.010	0
	Dissolved Uranium (U)	mg/L	0.0025	0.0025	0.80
	Dissolved Vanadium (V)	mg/L	< 0.00050	< 0.00050	0
	Dissolved Zinc (Zn)	mg/L	< 0.0010	< 0.0010	0

[shaded box] > 40% RPD

[a] Only analytes with reported values less than MDL were presented

A3.0 SEDIMENT SAMPLES

A3.1 Method Detection Limits

All analytes had reported MDLs that were lower than the target MDLs indicating that the data can be reliably interpreted (Appendix C).

A3.2 Laboratory Blank Sample Analysis

All blank samples contained non-detectable analyte concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Appendix C).

A3.3 Data Precision

Agreement was achieved between all laboratory duplicate samples (Appendix C). This indicates that reported sample results were associated with good analytical precision.

A3.4 Data Accuracy

Analyte recoveries for spiked blanks all met the data quality objectives indicating excellent analytical accuracy for the sediment sample analyses (Appendix C).

Recoveries of all analytes in certified reference materials met the data quality objective (Appendix C). These data indicated excellent analytical accuracy associated with the analysis of sediment samples.

A4.0 SEDIMENT TOXICITY TESTING

Both the 10 day *Chironomus dilutus* and the 14 day *Hyalella azteca* sediment toxicity tests were within the acceptability criteria outlined in the testing protocols. Water quality parameters throughout testing remained within the acceptability criteria as well. The sensitivity of the organisms was deemed to be appropriate when compared to historical results obtained by the laboratory (Appendix C – Nautilus Environmental Report).

A5.0 PERIPHYTON COMMUNITY

One sample was re-counted and the RPD was calculated. Close agreement was achieved between laboratory duplicate samples for both density (cells/cm^2; Table A.3) and biomass (µg/cm^2; Table A.4). Diatoms had the highest RPD for periphyton density (14%) and Cyanobacteria had the highest RPD for biomass (29%; just within the DQO of 30%). This indicates that the data can be reliably interpreted.

Table A.3: Laboratory duplicate results for analysis of periphyton group densities (cells/cm^2). Highlighted values did not meet the data quality objective of ≤ 30% relative percent difference (RPD).

Algal Density (cells/cm^2)	LMC-4	LMC-4R	RPD
Cyanobacteria	45,489	42,528	7%
Diatom	16,688	14,535	14%
Red Algae	4,037	5,114	0%
Total	66,214	62,177	6%

> 30% RPD

Table A.4: Laboratory duplicate results for analysis of periphyton group biomass (µg/cm^2). Highlighted values did not meet the data quality objective of ≤ 30% relative percent difference (RPD).

Algal Biomass (µg/cm^2)	LMC-4	LMC-4R	RPD
Cyanobacteria	17	12	29%
Diatom	5.3	6.6	21%
Red Algae	1.2	1.6	0%
Total	23	21	12%

> 30% RPD

A6.0 BENTHIC MACROINVERTEBRATE COMMUNITY

The objective for percent organism recovery was met for two re-sorted sample, with a percent recovery of 99% and 100% (Table A.5). This indicates that the data can be reliably interpreted. Records of percent sampled for each station were also maintained (Table A.6).

Table A.5: Percent sorting efficiency of benthic invertebrates, Minto Mine, 2015.

Station	Initial Sort	Re-sort	Percent sorting efficiency[1]
LBC-2	67	0	100%
LMC-2	161	2	99%

[1] Percent sorting efficiency = (1-(# in QA/AC re-sort / (# sorted originally + # in QA/QC re-sort)))* 100

(shaded box) Value less than 90%

Table A.6: Percent of benthic sample analyzed for each station.

Area	Station				
	1	2	3	4	5
LWC	100%	100%	100%	100%	100%
LBC	100%	100%	100%	100%	100%
LMC	100%	100%	50%	100%	50%

A7.0 TISSUE SAMPLES

There were issues with the benthic invertebrate analysis at the laboratory level. Concentrations of selenium were found to be higher than previous years and much higher than expected based on other parameters measured at the site. The issue was investigated and resolved; a new report and letter explaining the error and investigation was submitted (Appendix C).

A7.1 Method Detection Limits

For periphyton tissue samples only four analytes were below the laboratory detection limits, total antimony, mercury, selenium and tellurium (Table A.7). These analytes (except for mercury) were greater than the targeted detection limits in only one sample, LWC-5. Mercury was greater than the targeted detection limits at LMC-4, LWC-4 and LWC-5. Target concentrations are not guidelines but based off of detection limits the laboratory quoted it could achieve.

All of the benthic invertebrate analytes that were below the laboratory detection limits were less than or equal to the target MDL that the laboratory quoted they could achieve (Table A.8). Data for this project can be reliably interpreted.

Chlorophyll *α* was measured in periphyton and compared to the British Columbia Water Quality Guideline (BCWQG; BCMOE 1985). All chlorophyll *α* periphyton samples had reported MDLs that were lower than the target MDLs, except for LMC-4. Even though the sample was below the MDL it was less than the BCWQG for chlorophyll *α* indicating that the data can be reliably interpreted (Table A.9).

A7.2 Laboratory Blank Sample Analysis

Periphyton and benthic invertebrate tissue blank samples contained non-detectable analyte concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Appendix C).

A7.3 Data Precision

The laboratory duplicate periphyton tissue samples showed good agreement in most analyte concentrations, except for mercury due to heterogeneity within the samples (Appendix C). Periphyton samples were associated with good analytical precision.

Laboratory benthic invertebrate duplicate samples did not show close agreement in

Table A.7: Laboratory method detection limits (MDL) for periphyton tissue samples relative to targets, Minto Mine, 2015[a].

Analyte	Units	Method Detection Limits	
		Target	Achieved
Metals			
Total Antimony (Sb)	mg/kg dwt	0.010	0.010 - 0.020
Total Mercury (Hg)[1]	mg/kg dwt	0.0050	0.0050 - 0.035
Total Selenium (Se)	mg/kg dwt	0.10	0.10 - 0.20
Total Tellurium (Te)	mg/kg dwt	0.020	0.020 - 0.040

Target concentrations were exceeded

[a] Only analytes with reported values less than MDL were presented

Table A.8: Laboratory method detection limits (MDL) for benthic tissue samples relative to targets, Minto Mine, 2015[a].

Analyte	Units	Method Detection Limits	
		Target	Achieved
Metals			
Total Boron (B)	mg/kg dwt	1.0	1.0
Total Tellurium (Te)	mg/kg dwt	0.020	0.020
Total Tin (Sn)	mg/kg dwt	0.10	0.10

Target concentrations were exceeded

[a] Only analytes with reported values less than MDL were presented

Table A.9: Laboratory method detection limits (MDL) for chlorophyll *α* (mg/m^2) in periphyton relative to targets and to guidelines, Minto Mine, 2015.

Chlorophyll *α* (mg/m^2)	Method Detection Limit		British Columbia Water Quality Guideline[2]
Area	Target	Achieved[1]	
LWC-1	10	0.013	100
LWC-2	10	0.027	100
LWC-3	10	0.057	100
LWC-4	10	0.054	100
LWC-5	10	0.013	100
LMC-1	10	2.3	100
LMC-2	10	1.3	100
LMC-3	10	1.3	100
LMC-4	10	18	100
LMC-5	10	6.8	100

[1] Achieved method detection limits were converted from µg to mg/m^2 based on area of periphyton collected

[2] BCMOE 1985.

(shaded) Value greater than DQO

the following analytes: aluminum, beryllium, bismuth, cesium, chromium, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, rubidium, thallium, uranium, vanadium and zirconium (Appendix C). The RPD between duplicates for these analytes were not similar due to heterogeneity within the samples. Some tissue can be hard to homogenize and can cause higher variation between duplicate samples. All other samples were deemed to be acceptable.

A7.4 Data Accuracy

Recoveries of all analytes, for both periphyton and benthic invertebrate tissue samples, in certified reference materials met the data quality objective (Appendix C). Overall, these data indicated excellent analytical accuracy associated with the analysis of tissue samples.

A8.0 DATA QUALITY STATEMENT

Water, sediment, benthic community and periphyton tissue data were all of good quality compared to DQO indicating that they can be reliably interpreted. There was close agreement between all periphyton community laboratory duplicate samples; cyanobacteria was high at 29% but did fall just within the DQO. Benthic invertebrate tissue samples had tissue homogenization issues which resulted in high RPD and this should be considered when interpreting the data. The overall quality of data for this project was good to serve the project objectives.

APPENDIX B

SUPPORTING INFORMATION AND DATA

Table B.1: Habitat characteristics for benthic invertebrate areas, Minto Mine, September 2015.

Characteristics		Lower Wolverine Creek (Reference)	Lower Big Creek (Reference)	Lower Minto Creek (Exposure)
UTM		08V 382465 6954831	08V 396627 6942466	08V 392217 6948006
Approximate Length of Reach Assessed (m)		30	30	25
Gradient (%)		2.5	-	0.0
Velocity (m/s)	Mean (min-max)	0.22 - 0.37	0.29 - 0.41	0.20 - 0.34
Depth (m)	Mean	0.26	0.29	0.072
	Maximum	0.65	0.61	0.11
Width (m)	Wetted	15.0	49.0	1.3
	Bankfull	25.0	65.0	4.0
General Morphology	% pool	10	0	5
	% riffle	50	95	60
	% run	40	5	35
Bank Condition		Moderate	Moderate	Moderate
Substrate Coverage	% bedrock	0	0	0
	% boulder	5	5	0
	% cobble	80	85	70
	% gravel	10	5	10
	% sand and finer	5	5	20
Instream Cover (% total Surface)	undercut banks	5	30	20
	boulder	5	5	0
	woody debris	5	0	10
	deep pool	10	0	0
	macrophytes	0	0	0
	other	0	0	0
Overhead Canopy (% Surface)	Dense	0	0	85
	Partially Open	0	0	10
	Open	100	100	5
Aquatic Vegetation (% areal coverage)	Emergent	0	0	0
	Submergent	0	0	0
	Floating	0	0	0
	Attached Algae	0	0	0
Riparian vegetation		grasses, shrubs, balsam poplar, fir, spruce	willow, aspen, grasses	willow, grasses, aspen
Surrounding Land Use		forested	forested	mining
Evidence of Anthropogenic Disturbance		none	bridge over creek	mine and water storage pond upstream

Table B.2: Supporting information for erosional benthic invertebrate grab sample collections, Minto Mine, September 2015.

Characteristics		Lower Wolverine Creek (Reference)				
		LWC-1	LWC-2	LWC-3	LWC-4	LWC-5
Date/Time		4-Sep-15 11:56	2-Sep-15 14:48	2-Sep-15 10:39	3-Sep-15 13:56	3-Sep-15 9:05
UTM		08V 382441 6954537	08V 382423 6954732	08V 382465 6954831	08V 382550 6954995	08V 382537 6955033
Sampling Device		Hess	Hess	Hess	Hess	Hess
Sampler Size (m^2)		0.10	0.10	0.10	0.10	0.10
Mesh Size (µm)		500	500	500	500	500
Grabs in Composite		3	3	3	3	3
Water Velocity (m/s)		0.22	0.33	0.32	0.37	0.31
Depth (m)		0.21	0.12	0.11	0.12	0.14
Number of Jars		1	1	1	1	1
Average Depth (cm) (Sampler pushed into substrate)		5	5	5	5	5
Average Depth (cm) (Substrate is sampled/cleaned)		3	3	3	3	3
Average Sampling Time per Grab (min)		9	9	8	7	9
Macrophytes (in sample)		none	sparse (grasses)	none	none	none
Algae (in sample)		none	none	none	none	none
Sample Texture	% cobble	90	80	90	90	90
	% gravel	5	5	5	5	5
	% sand and finer	5	15	5	5	5
	% organic	0	0	0	0	0

Table B.2: Supporting information for erosional benthic invertebrate grab sample collections, Minto Mine, September 2015.

Characteristics		Lower Big Creek (Reference)				
		LBC-1	LBC-2	LBC-3	LBC-4	LBC-5
Date/Time		6-Sep-15 17:25	6-Sep-15 18:30	6-Sep-15 15:00	7-Sep-15 10:10	6-Sep-15 12:38
UTM		08V 396688 6942377	08V 396630 6942417	08V 396627 6942466	08V 396619 6942535	08V 396493 6942699
Sampling Device		Hess	Hess	Hess	Hess	Hess
Sampler Size (m^2)		0.10	0.10	0.10	0.10	0.10
Mesh Size (µm)		500	500	500	500	500
Grabs in Composite		3	3	3	3	3
Water Velocity (m/s)		0.34	0.32	0.33	0.29	0.41
Depth (m)		0.14	0.11	0.11	0.12	0.15
Number of Jars		1	1	1	1	1
Average Depth (cm) (Sampler pushed into substrate)		8	6	8	5	8
Average Depth (cm) (Substrate is sampled/cleaned)		4	4	5	3	5
Average Sampling Time per Grab (min)		7	6	7	8	8
Macrophytes (in sample)		none	none	none	none	sparse (grasses)
Algae (in sample)		none	none	none	none	none
Sample Texture	% cobble	85	80	95	85	90
	% gravel	5	10	2.5	5	5
	% sand and finer	10	10	2.5	10	5
	% organic	0	0	0	0	0

Table B.2: Supporting information for erosional benthic invertebrate grab sample collections, Minto Mine, September 2015.

Characteristics		Lower Minto Creek (Exposure)				
		LMC-1	**LMC-2**	**LMC-3**	**LMC-4**	**LMC-5**
Date/Time		5-Sep-15 14:00	5-Sep-15 11:39	5-Sep-15 16:35	1-Sep-15 15:42	1-Sep-15 12:35
UTM		08V 392103 6948048	08V 392127 6948034	08V 392217 6948006	08V 392236 6948027	08V 392267 6948075
Sampling Device		Hess	Hess	Hess	Hess	Hess
Sampler Size (m^2)		0.10	0.10	0.10	0.10	0.10
Mesh Size (µm)		500	500	500	500	500
Grabs in Composite		3	3	3	3	3
Water Velocity (m/s)		0.34	0.23	0.30	0.27	0.20
Depth (m)		0.077	0.087	0.097	0.10	0.16
Number of Jars		1	1	1	1	1
Average Depth (cm) (Sampler pushed into substrate)		6	5	6	7	8
Average Depth (cm) (Substrate is sampled/cleaned)		4	3	4	4	5
Average Sampling Time per Grab (min)		8	6	7	8	8
Macrophytes (in sample)		none	none	none	none	none
Algae (in sample)		none	none	none	sparse (brown film)	sparse (brown film)
Sample Texture	% cobble	90	90	90	75	90
	% gravel	5	5	5	20	5
	% sand and finer	5	5	5	5	5
	% organic	0	0	0	0	0

Table B.3: *In situ water quality* measures at sediment sampling stations, Minto Mine WUL, September 2015. Shading indicates value does not meet the water quality guideline.

Area	Variable	Temperature	Specific Conductance	Dissolved Oxygen	Dissolved Oxygen	pH
	Unit	**°C**	**µS/cm**	**mg/L**	**%**	**pH units**
	CCME Water Quality Guidelines	**-**	**-**	**6.5 - 9.5**	**54**	**6.5-9.0[a]**
Upper McGinty Creek (Reference)	URC-1	2.94	110	12.90	95.7	7.45
	URC-2	2.94	111	12.94	96.6	7.56
	URC-3	2.95	119	12.78	95.1	7.62
	URC-4	2.93	120	12.81	95.4	7.68
	URC-5	2.86	119	12.61	93.4	7.79
	Mean	2.92	116	12.81	95.2	7.62
	Standard Deviation	0.04	5	0.13	1.2	0.13
Upper Minto Creek (Exposure)	UMC-1	2.10	520	12.04	87.6	7.91
	UMC-2	2.06	519	12.37	89.8	7.99
	UMC-3	2.03	520	12.49	90.6	8.00
	UMC-4	2.02	516	11.98	86.9	-
	UMC-5	2.14	547	11.29	82.6	-
	Mean	2.07	524	12.03	87.5	7.97
	Standard Deviation	0.05	13	0.47	3.1	0.05
Lower Wolverine Creek (Reference)	LWC-1	5.48	150	7.19	64.5	7.57
	LWC-2	5.33	149	7.07	53.9	7.38
	LWC-3	4.19	152	10.56	80.3	8.23
	LWC-4	5.63	152	5.92	45.9	7.47
	LWC-5	3.81	144	12.36	91.1	7.82
	Mean	4.89	149	8.62	67.1	7.69
	Standard Deviation	0.83	3	2.72	18.6	0.34
Lower Minto Creek (Exposure)	LMC-1	3.27	337	12.81	95.4	8.13
	LMC-2	3.25	337	12.83	96.2	8.10
	LMC-3	3.33	338	12.77	96.0	8.06
	LMC-4	5.74	344	13.32	98.2	8.15
	LMC-5	5.66	337	12.26	97.6	8.14
	Mean	4.25	339	12.80	96.7	8.12
	Standard Deviation	1.32	3	0.38	1.2	0.04

[a] Range for the Water Use Licence is 6.0 - 9.0

Table B.4: *In situ* water quality measures at benthic invertebrate sampling stations, Minto Mine WUL, September 2015. Shading indicates value does not meet the water quality guideline.

Area	Variable	Temperature	Specific Conductance	Dissolved Oxygen	Dissolved Oxygen	pH	Mean Depth	Mean Velocity
	Unit	**°C**	**µS/cm**	**mg/L**	**%**	**pH units**	**m**	**m/s**
	CCME Water Quality Guidelines	**-**	**-**	**6.5 - 9.5**	**54**	**6.5-9.0[a]**	**-**	**-**
Lower Wolverine Creek (Reference)	LWC-1	4.31	148	13.15	101.1	7.79	0.21	0.220
	LWC-2	4.53	138	12.86	99.4	7.95	0.12	0.328
	LWC-3	3.87	133	12.86	98.1	8.13	0.11	0.323
	LWC-4	3.66	141	13.50	102.1	7.85	0.12	0.371
	LWC-5	2.87	140	13.57	99.3	7.82	0.14	0.311
	Mean	3.85	140	13.19	100.0	7.91	0.14	0.311
	Standard Deviation	0.65	5	0.34	1.6	0.14	0.04	0.055
Lower Big Creek (Reference)	LBC-1	6.79	171	12.64	103.6	-	0.14	0.343
	LBC-2	6.85	173	13.11	107.6	8.05	0.11	0.320
	LBC-3	6.12	174	12.54	101.0	-	0.11	0.328
	LBC-4	3.54	111	14.16	106.4	8.06	0.12	0.293
	LBC-5	4.87	173	12.92	100.9	7.84	0.15	0.414
	Mean	5.63	160	13.07	103.9	7.98	0.12	0.340
	Standard Deviation	1.42	28	0.65	3.1	0.12	0.02	0.045
Lower Minto Creek (Exposure)	LMC-1	5.07	330	12.58	98.7	8.29	0.077	0.343
	LMC-2	4.79	332	12.68	98.8	8.25	0.087	0.233
	LMC-3	4.68	340	12.57	97.7	8.14	0.097	0.302
	LMC-4	3.94	308	12.96	98.9	8.25	0.10	0.271
	LMC-5	3.39	311	13.05	98.1	8.25	0.163	0.196
	Mean	4.37	324	12.77	98.4	8.24	0.10	0.269
	Standard Deviation	0.69	14	0.22	0.5	0.06	0.03	0.057

[a] Range for the Water Use Licence is 6.0 - 9.0

Table B.5: Water quality results at reference and exposure areas, Minto Mine WUL, September 2015.

Analyte		Units	URC (reference)	UMC (exposure)	LWC (reference)	LBC (reference)	LMC (exposure)
Sampling Dates:			4-Sep-15	7-Sep-15	4-Sep-15	7-Sep-15	7-Sep-15
Physical Tests	Conductivity	µS/cm	109	512	140	161	328
	Hardness (as $CaCO_3$)	mg/L	58	262	73	82	170
	pH	pH Units	7.87	8.26	7.94	8.06	8.27
	Total Suspended Solids	mg/L	5.3	21	6.0	13	8.7
	Total Dissolved Solids	mg/L	124	332	143	135	233
	Turbidity	NTU	1.6	0.59	3.5	4.1	0.81
Anions and Nutrients	Total Alkalinity	mg/L	55	230	77	87	164
	Total Ammonia (as N)	mg/L	0.0085	0.0064	0.010	0.0052	0.0054
	Chloride (Cl)	mg/L	< 0.50	4.4	< 0.50	< 0.50	1.4
	Fluoride (F)	mg/L	0.20	0.56	0.11	0.11	0.38
	Nitrate (as N)	mg/L	0.022	0.20	0.041	0.097	0.038
	Nitrite (as N)	mg/L	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
	Phosphorus (P)-Total dissolved	mg/L	0.015	0.0048	0.0098	0.0055	0.0088
	Phosphorus (P)-Total	mg/L	0.011	0.010	0.012	0.0069	0.0072
	Sulfate (SO_4)	mg/L	6.4	54	9.1	11	18
Cyanides	Total Cyanide	mg/L	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Organic/inorganic carbon	Dissolved Organic Carbon	mg/L	22	5.6	21	11	12
	Total Inorganic Carbon	mg/L	9.3	49	12	15	33
	Total Organic Carbon	mg/L	22	5.6	22	11	12
Total Metals	Total Aluminum (Al)	mg/L	0.074	0.085	0.28	0.31	0.077
	Total Antimony (Sb)	mg/L	0.00010	< 0.00010	< 0.00010	0.00020	< 0.00010
	Total Arsenic (As)	mg/L	0.00065	0.00038	0.00062	0.0017	0.00066
	Total Barium (Ba)	mg/L	0.034	0.079	0.035	0.058	0.065
	Total Beryllium (Be)	mg/L	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Total Bismuth (Bi)	mg/L	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
	Total Boron (B)	mg/L	< 0.010	0.026	< 0.010	< 0.010	< 0.010
	Total Cadmium (Cd)	mg/L	< 0.0000050	< 0.0000050	0.000008	0.000016	< 0.0000050
	Total Calcium (Ca)	mg/L	16	56	15	20	45
	Total Chromium (Cr)	mg/L	0.00069	0.00026	0.0012	0.00076	0.00044
	Total Cobalt (Co)	mg/L	0.00015	0.00010	0.00025	0.00023	0.00011
	Total Copper (Cu)	mg/L	0.0022	0.0043	0.0032	0.0040	0.0022
	Total Iron (Fe)	mg/L	0.50	0.15	0.50	0.44	0.24
	Total Lead (Pb)	mg/L	< 0.000050	0.000088	0.00011	0.00029	< 0.000050
	Total Lithium (Li)	mg/L	0.0013	0.0043	0.0023	0.0024	0.0024
	Total Magnesium (Mg)	mg/L	4.5	27	7.8	7.8	15
	Total Manganese (Mn)	mg/L	0.027	0.051	0.019	0.021	0.010
	Total Mercury (Hg)	mg/L	0.0000084	< 0.0000050	0.000011	0.0000080	< 0.0000050
	Total Molybdenum (Mo)	mg/L	0.00060	0.0051	0.00040	0.0012	0.0015
	Total Nickel (Ni)	mg/L	0.0014	0.0010	0.0024	0.0015	0.0013
	Total Phosphorus (P)	mg/L	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30
	Total Potassium (K)	mg/L	0.39	2.3	0.52	0.75	1.4
	Total Selenium (Se)	mg/L	0.00026	0.00034	0.00011	0.000069	0.000117
	Total Silicon (Si)	mg/L	6.7	6.4	5.9	7.3	6.9
	Total Silver (Ag)	mg/L	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
	Total Sodium (Na)	mg/L	3.5	18	5.1	5.7	9.4
	Total Strontium (Sr)	mg/L	0.10	0.72	0.14	0.21	0.43
	Total Thallium (Tl)	mg/L	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
	Total Tin (Sn)	mg/L	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Total Titanium (Ti)	mg/L	< 0.010	< 0.010	0.012	0.012	< 0.010
	Total Uranium (U)	mg/L	0.00020	0.0026	0.00040	0.0016	0.0014
	Total Vanadium (V)	mg/L	0.0012	0.0010	0.0022	0.0020	0.0013
	Total Zinc (Zn)	mg/L	< 0.0030	< 0.0030	< 0.0030	< 0.0030	< 0.0030
Dissolved Metals	Dissolved Aluminum (Al)	mg/L	0.054	0.0028	0.047	0.035	0.010
	Dissolved Antimony (Sb)	mg/L	< 0.00010	< 0.00010	< 0.00010	0.00015	< 0.00010
	Dissolved Arsenic (As)	mg/L	0.00053	0.00028	0.00045	0.00081	0.00055
	Dissolved Barium (Ba)	mg/L	0.034	0.077	0.032	0.053	0.061
	Dissolved Beryllium (Be)	mg/L	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Dissolved Bismuth (Bi)	mg/L	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
	Dissolved Boron (B)	mg/L	< 0.010	0.022	< 0.010	< 0.010	< 0.010
	Dissolved Cadmium (Cd)	mg/L	< 0.0000050	< 0.0000050	< 0.0000050	0.0000069	< 0.0000050
	Dissolved Calcium (Ca)	mg/L	16	58	16	20	44
	Dissolved Chromium (Cr)	mg/L	0.00056	0.00013	0.00063	0.00032	0.00025
	Dissolved Cobalt (Co)	mg/L	0.00012	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Dissolved Copper (Cu)	mg/L	0.0021	0.0026	0.0026	0.0024	0.0019
	Dissolved Iron (Fe)	mg/L	0.39	0.020	0.17	0.071	0.12
	Dissolved Lead (Pb)	mg/L	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
	Dissolved Lithium (Li)	mg/L	< 0.0010	0.0038	0.0016	0.0017	0.0020
	Dissolved Magnesium (Mg)	mg/L	4.5	29	8.0	7.8	15
	Dissolved Manganese (Mn)	mg/L	0.024	0.042	0.0071	0.0091	0.0027
	Dissolved Mercury (Hg)	mg/L	< 0.0000050	< 0.0000050	0.000010	< 0.0000050	< 0.0000050
	Dissolved Molybdenum (Mo)	mg/L	0.00054	0.0050	0.00041	0.0011	0.0015
	Dissolved Nickel (Ni)	mg/L	0.0013	0.00088	0.0019	0.0011	0.0011
	Dissolved Phosphorus (P)	mg/L	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30
	Dissolved Potassium (K)	mg/L	0.37	2.3	0.53	0.69	1.4
	Dissolved Selenium (Se)	mg/L	0.00022	0.00033	0.00012	0.000058	0.00012
	Dissolved Silicon (Si)	mg/L	6.6	6.4	5.5	6.8	6.5
	Dissolved Silver (Ag)	mg/L	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
	Dissolved Sodium (Na)	mg/L	3.3	17.9	5.3	5.6	9.1
	Dissolved Strontium (Sr)	mg/L	0.099	0.72	0.14	0.21	0.42
	Dissolved Thallium (Tl)	mg/L	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
	Dissolved Tin (Sn)	mg/L	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Dissolved Titanium (Ti)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
	Dissolved Uranium (U)	mg/L	0.00020	0.0025	0.00036	0.0016	0.0013
	Dissolved Vanadium (V)	mg/L	0.00069	< 0.00050	0.0012	0.00093	0.00073
	Dissolved Zinc (Zn)	mg/L	0.0017	< 0.0010	< 0.0010	< 0.0010	< 0.0010

Table B.6: Explanatory notes for selected water quality guidelines, Minto Mine WUL, 2015.

Analyte		Water Quality Guidelines	Unit	CCME[1]
Physical, anion and nutrient analytes	Ammonia (Total)	**1.5**	mg/L	Ammonia guideline is based on highest field pH of 8.19 and highest temperature of 3.7°C
	Fluoride	**0.12**	mg/L	Guideline is an interim level
	Total Suspended Solids	**12 / 32[a]**	mg/L	Guideline is based on the median of background of 7.4 mg/L plus 5.0 mg/L for 30 day and plus 25 mg/L for max
	Turbidity	**3.2 / 9.2[a]**	NTU	Guideline is based on the median of background of 1.2 NTU plus 2.0 NTU for 30 day and plus 8 NTU for max
Total Metals	Aluminum	**0.10**	mg/L	Guideline is based on pH of > 6.5
	Cadmium	**0.00010 / 0.0012[a]**	mg/L	Guideline is based on lowest hardness of 58 mg/L
	Chromium	**0.0010**	mg/L	Guideline is based hexavalent chromium (Cr VI)
	Copper	**0.0020**	mg/L	Guideline is based on lowest hardness of 58 mg/L
	Lead	**0.0010**	mg/L	Guideline is based on lowest hardness of 58 mg/L
	Nickel	**0.025**	mg/L	Guideline is based on lowest hardness of 58 mg/L

[1] CCME 1999

[a] 30 day guideline / Max guideline

Table B.7: Comparison of water quality results at reference and exposure areas in 2014 and 2015, Minto Mine WUL.

Analyte		Units	CCME Water Quality Guidelines[1]		WUL Objectives at W2	2014					2015				
			30 Day	Max		Upper McGinty Creek (reference)	Upper Minto Creek (exposure)	Lower Wolverine Creek (reference)	Little Big Creek (reference)	Lower Minto Creek (exposure)	Upper McGinty Creek (reference)	Upper Minto Creek (exposure)	Lower Wolverine Creek (reference)	Little Big Creek (reference)	Lower Minto Creek (exposure)
Physical Tests	Total Suspended Solids	mg/L	12[a]	32[a]	-	< 3.0	< 3.0	3.3	10	3.3	5.3	21	6.0	13	8.7
Total Metals	Total Aluminum (Al)	mg/L	0.10[b]	-	0.62	0.031	0.020	0.12	0.55	0.036	0.074	0.085	0.28	0.31	0.077
	Total Antimony (Sb)	mg/L	-	-	-	0.00013	< 0.00010	< 0.00010	0.00044	< 0.00010	0.00010	< 0.00010	< 0.00010	0.00020	< 0.00010
	Total Arsenic (As)	mg/L	0.0050	-	0.0050	0.00069	0.00027	0.00050	0.0034	0.00057	0.00065	0.00038	0.00062	0.0017	0.00066
	Total Barium (Ba)	mg/L	-	-	-	0.035	0.081	0.038	0.063	0.059	0.034	0.079	0.035	0.058	0.065
	Total Beryllium (Be)	mg/L	-	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Total Bismuth (Bi)	mg/L	-	-	-	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
	Total Boron (B)	mg/L	1.5	29	-	< 0.010	0.023	0.014	< 0.010	< 0.010	< 0.010	0.026	< 0.010	< 0.010	< 0.010
	Total Cadmium (Cd)	mg/L	0.00010[c]	0.0012[c]	0.000040	< 0.000010	< 0.000010	< 0.000010	0.000022	< 0.000010	< 0.0000050	< 0.0000050	0.0000080	0.000016	< 0.0000050
	Total Calcium (Ca)	mg/L	-	-	-	21	57	20	22	43	16	56	15	20	45
	Total Chromium (Cr)	mg/L	0.0010 Cr(VI)	-	0.0020	0.00050	0.00018	0.00084	0.00087	0.00029	0.00069	0.00026	0.0012	0.00076	0.00044
	Total Cobalt (Co)	mg/L	-	-	-	0.00014	< 0.00010	0.00013	0.00036	< 0.00010	0.00015	0.00010	0.00025	0.00023	0.00011
	Total Copper (Cu)	mg/L	0.0020[c]	-	0.013	0.0015	0.0028	0.0026	0.0042	0.0016	0.0022	0.0043	0.0032	0.0040	0.0022
	Total Iron (Fe)	mg/L	0.30	-	1.1	0.61	0.033	0.29	0.79	0.24	0.50	0.15	0.50	0.44	0.24
	Total Lead (Pb)	mg/L	0.0010[c]	-	0.0040	< 0.000050	< 0.000050	< 0.000050	0.00089	< 0.000050	< 0.000050	0.000088	0.00011	0.00029	< 0.000050
	Total Lithium (Li)	mg/L	-	-	-	< 0.00050	0.0029	0.0014	0.0017	0.0011	0.0013	0.0043	0.0023	0.0024	0.0024
	Total Magnesium (Mg)	mg/L	-	-	-	5.7	27	11	8.7	15	4.5	27	7.8	7.8	15
	Total Manganese (Mn)	mg/L	-	-	-	0.040	0.051	0.012	0.028	0.0063	0.027	0.051	0.019	0.021	0.010
	Total Mercury (Hg)	mg/L	0.000026	-	-	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	0.0000084	< 0.0000050	0.000011	0.0000080	< 0.0000050
	Total Molybdenum (Mo)	mg/L	0.073	-	0.073	0.00085	0.0047	0.00048	0.0012	0.0014	0.00060	0.0051	0.00040	0.0012	0.0015
	Total Nickel (Ni)	mg/L	0.025[c]	-	0.11	0.0012	0.00087	0.0019	0.0015	0.0010	0.0014	0.0010	0.0024	0.0015	0.0013
	Total Phosphorus (P)	mg/L	-	-	-	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30
	Total Potassium (K)	mg/L	-	-	-	0.56	2.4	0.62	0.83	1.3	0.39	2.3	0.52	0.75	1.4
	Total Selenium (Se)	mg/L	0.0010	-	0.0010	0.00028	0.00034	0.00011	< 0.00010	< 0.00010	0.00026	0.00034	0.00011	0.000069	0.00012
	Total Silicon (Si)	mg/L	-	-	-	6.5	5.8	5.4	7.5	6.2	6.7	6.4	5.9	7.3	6.9
	Total Silver (Ag)	mg/L	0.00025	-	-	0.000023	< 0.000010	< 0.000010	0.000031	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
	Total Sodium (Na)	mg/L	-	-	-	4.0	17	6.4	6.0	8.4	3.5	18	5.1	5.7	9.4
	Total Strontium (Sr)	mg/L	-	-	-	0.14	0.75	0.18	0.24	0.39	0.10	0.72	0.14	0.21	0.43
	Total Thallium (Tl)	mg/L	0.00080	-	-	< 0.000010	< 0.000010	< 0.000010	0.000019	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
	Total Tin (Sn)	mg/L	-	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Total Titanium (Ti)	mg/L	-	-	-	< 0.010	< 0.010	< 0.010	0.027	< 0.010	< 0.010	< 0.010	0.012	0.012	< 0.010
	Total Uranium (U)	mg/L	0.015	0.033	-	0.00034	0.0026	0.00061	0.0020	0.0015	0.00020	0.0026	0.00040	0.0016	0.0014
	Total Vanadium (V)	mg/L	-	-	-	< 0.0010	< 0.0010	0.0015	0.0022	< 0.0010	0.0012	0.0010	0.0022	0.0020	0.0013
	Total Zinc (Zn)	mg/L	0.030	-	0.030	< 0.0030	< 0.0030	< 0.0030	0.0036	< 0.0030	< 0.0030	< 0.0030	< 0.0030	< 0.0030	< 0.0030

Water use licence standard not met (outlined box)

Water quality guideline not met (grey shading)

[1] CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

[a] Based on the median of background levels plus 5 mg/L for 30 day and 25 mg/L for max guidelines

[b] Based on lowest guideline using highest pH

[c] Based on lowest guideline using lowest hardness

[d] Dissolved copper water quality objective depends on concentration of dissolved organic carbon (DOC). If DOC is > 10 mg/L/ DOC is ≤ 10 mg/L

Table B.7: Comparison of water quality results at reference and exposure areas in 2014 and 2015, Minto Mine WUL.

Analyte		Units	CCME Water Quality Guidelines[1]		WUL Objectives at W2	2014					2015				
			30 Day	Max		Upper McGinty Creek (reference)	Upper Minto Creek (exposure)	Lower Wolverine Creek (reference)	Little Big Creek (reference)	Lower Minto Creek (exposure)	Upper McGinty Creek (reference)	Upper Minto Creek (exposure)	Lower Wolverine Creek (reference)	Little Big Creek (reference)	Lower Minto Creek (exposure)
Dissolved Metals	Dissolved Aluminum (Al)	mg/L	-	-	0.10	0.025	0.012	0.030	0.021	0.0086	0.054	0.0028	0.047	0.035	0.010
	Dissolved Antimony (Sb)	mg/L	-	-	-	< 0.00010	< 0.00010	< 0.00010	0.00014	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.00015	< 0.00010
	Dissolved Arsenic (As)	mg/L	-	-	0.0050	0.00059	0.00024	0.00046	0.00072	0.00053	0.00053	0.00028	0.00045	0.00081	0.00055
	Dissolved Barium (Ba)	mg/L	-	-	-	0.034	0.084	0.035	0.052	0.062	0.034	0.077	0.032	0.053	0.061
	Dissolved Beryllium (Be)	mg/L	-	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Dissolved Bismuth (Bi)	mg/L	-	-	-	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
	Dissolved Boron (B)	mg/L	-	-	-	< 0.010	0.011	< 0.010	< 0.010	< 0.010	< 0.010	0.022	< 0.010	< 0.010	< 0.010
	Dissolved Cadmium (Cd)	mg/L	-	-	0.15	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.0000050	< 0.0000050	< 0.0000050	0.0000069	< 0.0000050
	Dissolved Calcium (Ca)	mg/L	-	-	-	21	62	20	21	46	16	58	16	20	44
	Dissolved Chromium (Cr)	mg/L	-	-	0.0010	0.00041	< 0.00010	0.00050	0.00024	0.00022	0.00056	0.00013	0.00063	0.00032	0.00025
	Dissolved Cobalt (Co)	mg/L	-	-	-	0.00013	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.00012	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Dissolved Copper (Cu)	mg/L	-	-	0.020/0.013[d]	0.0013	0.0023	0.0022	0.0022	0.0015	0.0021	0.0026	0.0026	0.0024	0.0019
	Dissolved Iron (Fe)	mg/L	-	-	1.1	0.49	0.016	0.15	0.040	0.17	0.39	0.020	0.17	0.071	0.12
	Dissolved Lead (Pb)	mg/L	-	-	0.0040	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
	Dissolved Lithium (Li)	mg/L	-	-	-	< 0.00050	0.0029	0.0018	0.0012	0.0012	< 0.0010	0.0038	0.0016	0.0017	0.0020
	Dissolved Magnesium (Mg)	mg/L	-	-	-	5.7	29	10	8.4	16	4.5	29	8.0	7.8	15
	Dissolved Manganese (Mn)	mg/L	-	-	-	0.038	0.036	0.0085	0.0086	0.0034	0.024	0.042	0.0071	0.0091	0.0027
	Dissolved Mercury (Hg)	mg/L	-	-	-	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.0000050	< 0.0000050	0.000010	< 0.0000050	< 0.0000050
	Dissolved Molybdenum (Mo)	mg/L	-	-	0.073	0.00071	0.0047	0.00045	0.0010	0.0014	0.00054	0.0050	0.00041	0.0011	0.0015
	Dissolved Nickel (Ni)	mg/L	-	-	0.11	0.0011	0.00086	0.0017	0.0010	0.0011	0.0013	0.00088	0.0019	0.0011	0.0011
	Dissolved Phosphorus (P)	mg/L	-	-	-	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30
	Dissolved Potassium (K)	mg/L	-	-	-	0.54	2.5	0.65	0.72	1.3	0.37	2.3	0.53	0.69	1.4
	Dissolved Selenium (Se)	mg/L	-	-	0.0020	0.00028	0.00033	< 0.00010	< 0.00010	0.00010	0.00022	0.00033	0.00012	0.000058	0.00012
	Dissolved Silicon (Si)	mg/L	-	-	-	6.5	6.1	5.2	6.3	6.4	6.6	6.4	5.5	6.8	6.5
	Dissolved Silver (Ag)	mg/L	-	-	0.00010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
	Dissolved Sodium (Na)	mg/L	-	-	-	3.9	17	6.5	6.0	8.7	3.3	18	5.3	5.6	9.1
	Dissolved Strontium (Sr)	mg/L	-	-	-	0.13	0.77	0.17	0.22	0.39	0.099	0.72	0.14	0.21	0.42
	Dissolved Thallium (Tl)	mg/L	-	-	-	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010
	Dissolved Tin (Sn)	mg/L	-	-	-	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
	Dissolved Titanium (Ti)	mg/L	-	-	-	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
	Dissolved Uranium (U)	mg/L	-	-	-	0.00033	0.0025	0.00055	0.0018	0.0015	0.00020	0.0025	0.00036	0.0016	0.0013
	Dissolved Vanadium (V)	mg/L	-	-	-	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	0.00069	< 0.00050	0.0012	0.00093	0.00073
	Dissolved Zinc (Zn)	mg/L	-	-	0.030	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	0.0017	< 0.0010	< 0.0010	< 0.0010	< 0.0010

Water use licence standard not met

Water quality guideline not met

[1] CCME 1999. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

[a] Based on the median of background levels plus 5 mg/L for 30 day and 25 mg/L for max guidelines

[b] Based on lowest guideline using highest pH

[c] Based on lowest guideline using lowest hardness

[d] Dissolved copper water quality objective depends on concentration of dissolved organic carbon (DOC). If DOC is > 10 mg/L/ DOC is ≤ 10 mg/L

Table B.8: Concentration of chlorophyll *α* measured at five benthic stations in lower Wolverine and lower Minto Creeks, Minto Mine WUL, 2015.

Lower Wolverine Creek (reference)		Lower Minto Creek (exposure)	
Station	mg/m^2	Station	mg/m^2
LWC-1	0.013	LMC-1	2.3
LWC-2	0.027	LMC-2	1.3
LWC-3	0.057	LMC-3	1.3
LWC-4	0.054	LMC-4	18
LWC-5	0.013	LMC-5	6.8
Mean	0.033	Mean	5.9
Standard Deviation	0.021	Standard Deviation	7.0

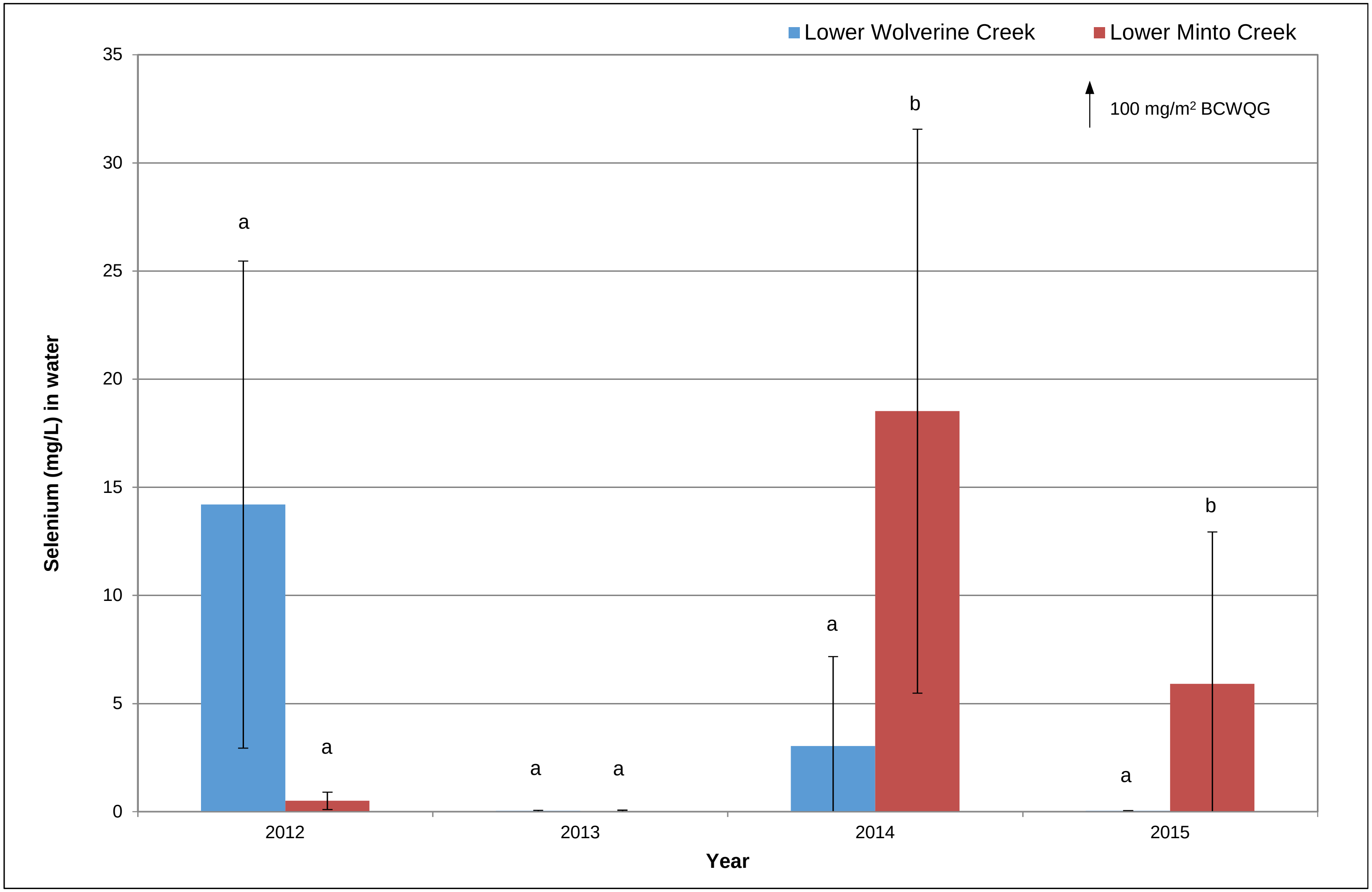

Figure B.1: Concentrations of chlorophyll *α* in periphyton measured in lower Wolverine and lower Minto Creeks, Minto Mine WUL, 2012 - 2015. Data presented as mean ± standard deviation. Different letters represent significant differences between sites within years.

MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 08-SEP-15
Report Date: 18-SEP-15 16:40 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L1669009

Project P.O. #: PO#0073
Job Reference: MEI125-MIN200
C of C Numbers: 1
Legal Site Desc:

Can Dang
Senior Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1669009-1 Water 07-SEP-15 LMC	L1669009-2 Water 07-SEP-15 UMC	L1669009-3 Water 07-SEP-15 LBC	L1669009-4 Water 07-SEP-15 UMCX	
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	328	512	161	516	
	Hardness (as CaCO3) (mg/L)	170	262	82.1	260	
	pH (pH)	8.27	8.26	8.06	8.28	
	Total Suspended Solids (mg/L)	8.7	21.3	12.7	4.0	
	Total Dissolved Solids (mg/L)	233	332	135	335	
	Turbidity (NTU)	0.81	0.59	4.05	0.30	
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	164	230	87.2	230	
	Ammonia, Total (as N) (mg/L)	0.0054	0.0064	0.0052	0.0067	
	Chloride (Cl) (mg/L)	1.41	4.40	<0.50	4.38	
	Fluoride (F) (mg/L)	0.377	0.557	0.113	0.561	
	Nitrate (as N) (mg/L)	0.0383	0.198	0.0972	0.197	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Phosphorus (P)-Total Dissolved (mg/L)	0.0088	0.0048	0.0055	0.0059	
	Phosphorus (P)-Total (mg/L)	0.0072	0.0099	0.0069	0.0049	
	Sulfate (SO4) (mg/L)	18.3	54.2	10.5	54.2	
Cyanides	Cyanide, Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	12.2	5.63	11.1	5.51	
	Total Inorganic Carbon (mg/L)	33.0	49.0	15.3	47.4	
	Total Organic Carbon (mg/L)	12.0	5.60	11.2	5.74	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0772	0.0845	0.306	0.102	
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00020	<0.00010	
	Arsenic (As)-Total (mg/L)	0.00066	0.00038	0.00173	0.00038	
	Barium (Ba)-Total (mg/L)	0.0647	0.0791	0.0577	0.0810	
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	<0.010	0.026	<0.010	0.027	
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	0.0000161	0.0000096	
	Calcium (Ca)-Total (mg/L)	44.7	55.9	19.7	57.2	
	Chromium (Cr)-Total (mg/L)	0.00044	0.00026	0.00076	0.00027	
	Cobalt (Co)-Total (mg/L)	0.00011	0.00010	0.00023	0.00011	
	Copper (Cu)-Total (mg/L)	0.00221	0.00429	0.00397	0.00474	
	Iron (Fe)-Total (mg/L)	0.243	0.148	0.435	0.167	
	Lead (Pb)-Total (mg/L)	<0.000050	0.000088	0.000292	<0.000050	
	Lithium (Li)-Total (mg/L)	0.0024	0.0043	0.0024	0.0047	
	Magnesium (Mg)-Total (mg/L)	15.0	27.3	7.77	28.2	
	Manganese (Mn)-Total (mg/L)	0.0101	0.0514	0.0214	0.0545	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1669009-1	L1669009-2	L1669009-3	L1669009-4	
	Description	Water	Water	Water	Water	
	Sampled Date	07-SEP-15	07-SEP-15	07-SEP-15	07-SEP-15	
	Sampled Time					
	Client ID	LMC	UMC	LBC	UMCX	
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	0.0000080	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00154	0.00506	0.00118	0.00530	
	Nickel (Ni)-Total (mg/L)	0.00126	0.00102	0.00154	0.00106	
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	
	Potassium (K)-Total (mg/L)	1.37	2.27	0.746	2.29	
	Selenium (Se)-Total (mg/L)	0.000117	0.000340	0.000069	0.000323	
	Silicon (Si)-Total (mg/L)	6.90	6.42	7.29	6.51	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	9.35	18.0	5.70	18.7	
	Strontium (Sr)-Total (mg/L)	0.427	0.724	0.210	0.741	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	0.012	<0.010	
	Uranium (U)-Total (mg/L)	0.00137	0.00256	0.00158	0.00260	
	Vanadium (V)-Total (mg/L)	0.00133	0.00101	0.00196	0.00091	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0100	0.0028	0.0351	0.0026	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00015	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00055	0.00028	0.00081	0.00026	
	Barium (Ba)-Dissolved (mg/L)	0.0607	0.0772	0.0534	0.0770	
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	<0.010	0.022	<0.010	0.022	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000069	<0.0000050	
	Calcium (Ca)-Dissolved (mg/L)	44.1	58.1	20.1	57.3	
	Chromium (Cr)-Dissolved (mg/L)	0.00025	0.00013	0.00032	0.00020	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00188	0.00263	0.00244	0.00257	
	Iron (Fe)-Dissolved (mg/L)	0.115	0.020	0.071	0.021	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0020	0.0038	0.0017	0.0040	
	Magnesium (Mg)-Dissolved (mg/L)	14.5	28.5	7.77	28.5	
	Manganese (Mn)-Dissolved (mg/L)	0.00273	0.0417	0.00910	0.0421	
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00147	0.00498	0.00109	0.00500	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1669009-1	L1669009-2	L1669009-3	L1669009-4
	Description	Water	Water	Water	Water
	Sampled Date	07-SEP-15	07-SEP-15	07-SEP-15	07-SEP-15
	Sampled Time				
	Client ID	LMC	UMC	LBC	UMCX
Grouping	**Analyte**				
WATER					
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	0.00111	0.00088	0.00114	0.00092
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	1.35	2.25	0.691	2.24
	Selenium (Se)-Dissolved (mg/L)	0.000124	0.000331	0.000058	0.000343
	Silicon (Si)-Dissolved (mg/L)	6.49	6.36	6.78	6.30
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	9.05	17.9	5.59	17.9
	Strontium (Sr)-Dissolved (mg/L)	0.415	0.717	0.211	0.717
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00129	0.00248	0.00155	0.00250
	Vanadium (V)-Dissolved (mg/L)	0.00073	<0.00050	0.00093	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Antimony (Sb)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Arsenic (As)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Beryllium (Be)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Cadmium (Cd)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Chromium (Cr)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Cobalt (Co)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Copper (Cu)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Lead (Pb)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Nickel (Ni)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Selenium (Se)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Silver (Ag)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Thallium (Tl)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Tin (Sn)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Vanadium (V)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Zinc (Zn)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Aluminum (Al)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Antimony (Sb)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Beryllium (Be)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Boron (B)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Chromium (Cr)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Cobalt (Co)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Copper (Cu)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Lead (Pb)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Nickel (Ni)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Silver (Ag)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Thallium (Tl)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Tin (Sn)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Vanadium (V)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Zinc (Zn)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Beryllium (Be)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Chromium (Cr)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Cobalt (Co)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Iron (Fe)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Nickel (Ni)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Silver (Ag)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Beryllium (Be)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Cadmium (Cd)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Chromium (Cr)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Copper (Cu)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Iron (Fe)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Nickel (Ni)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Silver (Ag)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Tin (Sn)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Zinc (Zn)-Dissolved	DLA	L1669009-1, -2, -3, -4
Duplicate	Cadmium (Cd)-Dissolved	DLM	L1669009-1, -2, -3, -4
Matrix Spike	Mercury (Hg)-Total	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1669009-1, -2, -3, -4

Reference Information

	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Total Inorganic Carbon	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Total Inorganic Carbon	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Total	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Total Organic Carbon	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Total Organic Carbon	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Dissolved Organic Carbon	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Dissolved Organic Carbon	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1669009-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1669009-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**

Reference Information

ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TIC-VA	Water	Total inorganic carbon by CO2 purge	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CN-T-CFA-VA	Water	Total Cyanide in water by CFA	ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-IC-N-WR	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et

Reference Information

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NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-MAN-WR	Water	Total Suspended Solids by Gravimetric	APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L1669009-COFC

COC Number: 14 -

Page 1 of 1

Report To	
Company:	Minnow Environmental Inc.
Contact:	Lisa Bowron
Address:	101-1025 Hillside Ave. Victoria, BC
Phone:	(250) 595-1627

Report Format / Distribution

Select Report Format: ☐ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ✓ Yes ☐ No
☐ Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: lbowron@minnow.ca
Email 2: pstecko@minnow.ca

Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)

- R ☑ Regular (Standard TAT if received by 3 pm - business days)
- P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
- E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
- E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge

Specify Date Required for E2,E or P:

Invoice To	
Same as Report To	☐ Yes ☑ No
Copy of Invoice with Report	☑ Yes ☐ No
Company:	Minto Explorations Ltd.
Contact:	~~Elvina Wong~~ Cindy Keehn

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☑ FAX
Email 1 or Fax: 604-688-2180
Email 2:

Project Information

ALS Quote #:	Q51327
Job #:	
PO / AFE:	PO#0073
LSD:	

Oil and Gas Required Fields (client use)

Approver ID:		Cost Center:	
GL Account:		Routing Code:	
Activity Code:			
Location:			

ALS Lab Work Order # (lab use only)

ALS Contact: Sampler:

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	ALK-TITR-TOT-ONLY-VA, TDS-VA	EC-PCT-VA, PH-PCT-VA, TURBIDITY-VA	ANIONS-ALL-IC-WR, TSS-MAN-WR	CARBONS-TOC-VA, NH3-F-VA	CARBONS-DOC-VA	CARBONS-TIC-VA	CN-T-CFA-VA	P-T-PRES-COL-VA	P-TD-COL-VA	MET-T-NDR-VA, HG-T-CVAA-VA	MET-D-NDR-VA, HG-D-CVAA-VA	HARDNESS-CALC-VA		Number of Containers
	LMC	07-Sep-15		Water	X	X	X	X	X	X	X	X	X	X	X	X		9
	UMC	07-Sep-15		Water	X	X	X	X	X	X	X	X	X	X	X	X		9
	LBC	07-Sep-15		Water	X	X	X	X	X	X	X	X	X	X	X	X		9
	UMCX	07-Sep-15		Water	X	X	X	X	X	X	X	X	X	X	X	X		9
				Water														
				Water														
				Water														
				Water														
				Water														
				Water														
				Water														
				Water														

Short Holding Time

Rush Processing

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ Yes ☐ No

Are samples for human drinking water use? ☐ Yes ☐ No

Special Instructions / Specify Criteria to add on report (client Use)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice packs Yes ☒ No ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C: 2.1
FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by: [signature]	Date: 8-Sep-15	Time: 8:45	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY

NA-FM-0326e v09 Front/04 January 2014

Twila 9 Sept 9.8° 14:20

MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 08-SEP-15
Report Date: 18-SEP-15 16:35 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L1668986

Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT 0073
C of C Numbers: 1
Legal Site Desc:

Can Dang
Senior Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1668986-1	L1668986-2			
	Description	Water	Water			
	Sampled Date	04-SEP-15	04-SEP-15			
	Sampled Time					
	Client ID	LWC	URC			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	140	109			
	Hardness (as CaCO3) (mg/L)	73.2	58.0			
	pH (pH)	7.94	7.87			
	Total Suspended Solids (mg/L)	6.0	5.3			
	Total Dissolved Solids (mg/L)	143	124			
	Turbidity (NTU)	3.45	1.55			
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	77.2	55.3			
	Ammonia, Total (as N) (mg/L)	0.0102	0.0085			
	Chloride (Cl) (mg/L)	<0.50	<0.50			
	Fluoride (F) (mg/L)	0.111	0.197			
	Nitrate (as N) (mg/L)	0.0409	0.0222			
	Nitrite (as N) (mg/L)	<0.0010	<0.0010			
	Phosphorus (P)-Total Dissolved (mg/L)	0.0098	0.0147			
	Phosphorus (P)-Total (mg/L)	0.0124	0.0113			
	Sulfate (SO4) (mg/L)	9.06	6.35			
Cyanides	Cyanide, Total (mg/L)	<0.0050	<0.0050			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	20.5	21.7			
	Total Inorganic Carbon (mg/L)	12.2	9.30			
	Total Organic Carbon (mg/L)	22.0	22.2			
Total Metals	Aluminum (Al)-Total (mg/L)	0.279	0.0742			
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00010			
	Arsenic (As)-Total (mg/L)	0.00062	0.00065			
	Barium (Ba)-Total (mg/L)	0.0345	0.0336			
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010			
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050			
	Boron (B)-Total (mg/L)	<0.010	<0.010			
	Cadmium (Cd)-Total (mg/L)	0.0000080	<0.0000050			
	Calcium (Ca)-Total (mg/L)	15.4	15.7			
	Chromium (Cr)-Total (mg/L)	0.00117	0.00069			
	Cobalt (Co)-Total (mg/L)	0.00025	0.00015			
	Copper (Cu)-Total (mg/L)	0.00323	0.00222			
	Iron (Fe)-Total (mg/L)	0.502	0.500			
	Lead (Pb)-Total (mg/L)	0.000105	<0.000050			
	Lithium (Li)-Total (mg/L)	0.0023	0.0013			
	Magnesium (Mg)-Total (mg/L)	7.81	4.49			
	Manganese (Mn)-Total (mg/L)	0.0191	0.0270			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1668986-1	L1668986-2			
	Description	Water	Water			
	Sampled Date	04-SEP-15	04-SEP-15			
	Sampled Time					
	Client ID	LWC	URC			
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	0.0000105	0.0000084			
	Molybdenum (Mo)-Total (mg/L)	0.000399	0.000599			
	Nickel (Ni)-Total (mg/L)	0.00238	0.00136			
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30			
	Potassium (K)-Total (mg/L)	0.518	0.387			
	Selenium (Se)-Total (mg/L)	0.000110	0.000261			
	Silicon (Si)-Total (mg/L)	5.88	6.65			
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Total (mg/L)	5.14	3.49			
	Strontium (Sr)-Total (mg/L)	0.140	0.102			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.012	<0.010			
	Uranium (U)-Total (mg/L)	0.000398	0.000200			
	Vanadium (V)-Total (mg/L)	0.00223	0.00123			
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0465	0.0540			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00045	0.00053			
	Barium (Ba)-Dissolved (mg/L)	0.0318	0.0338			
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Calcium (Ca)-Dissolved (mg/L)	16.1	15.8			
	Chromium (Cr)-Dissolved (mg/L)	0.00063	0.00056			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00012			
	Copper (Cu)-Dissolved (mg/L)	0.00256	0.00206			
	Iron (Fe)-Dissolved (mg/L)	0.166	0.390			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.0016	<0.0010			
	Magnesium (Mg)-Dissolved (mg/L)	8.01	4.48			
	Manganese (Mn)-Dissolved (mg/L)	0.00707	0.0240			
	Mercury (Hg)-Dissolved (mg/L)	0.0000102	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.000408	0.000544			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1668986-1	L1668986-2			
	Description	Water	Water			
	Sampled Date	04-SEP-15	04-SEP-15			
	Sampled Time					
	Client ID	LWC	URC			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	0.00189	0.00131			
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30			
	Potassium (K)-Dissolved (mg/L)	0.525	0.367			
	Selenium (Se)-Dissolved (mg/L)	0.000117	0.000215			
	Silicon (Si)-Dissolved (mg/L)	5.53	6.58			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	5.27	3.27			
	Strontium (Sr)-Dissolved (mg/L)	0.141	0.0994			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010			
	Uranium (U)-Dissolved (mg/L)	0.000363	0.000198			
	Vanadium (V)-Dissolved (mg/L)	0.00116	0.00069			
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0017			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Antimony (Sb)-Dissolved	DLA	L1668986-1, -2
Duplicate	Arsenic (As)-Dissolved	DLA	L1668986-1, -2
Duplicate	Beryllium (Be)-Dissolved	DLA	L1668986-1, -2
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1668986-1, -2
Duplicate	Cadmium (Cd)-Dissolved	DLA	L1668986-1, -2
Duplicate	Chromium (Cr)-Dissolved	DLA	L1668986-1, -2
Duplicate	Cobalt (Co)-Dissolved	DLA	L1668986-1, -2
Duplicate	Copper (Cu)-Dissolved	DLA	L1668986-1, -2
Duplicate	Lead (Pb)-Dissolved	DLA	L1668986-1, -2
Duplicate	Nickel (Ni)-Dissolved	DLA	L1668986-1, -2
Duplicate	Selenium (Se)-Dissolved	DLA	L1668986-1, -2
Duplicate	Silver (Ag)-Dissolved	DLA	L1668986-1, -2
Duplicate	Thallium (Tl)-Dissolved	DLA	L1668986-1, -2
Duplicate	Tin (Sn)-Dissolved	DLA	L1668986-1, -2
Duplicate	Vanadium (V)-Dissolved	DLA	L1668986-1, -2
Duplicate	Zinc (Zn)-Dissolved	DLA	L1668986-1, -2
Duplicate	Aluminum (Al)-Dissolved	DLA	L1668986-1, -2
Duplicate	Antimony (Sb)-Dissolved	DLA	L1668986-1, -2
Duplicate	Beryllium (Be)-Dissolved	DLA	L1668986-1, -2
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1668986-1, -2
Duplicate	Boron (B)-Dissolved	DLA	L1668986-1, -2
Duplicate	Chromium (Cr)-Dissolved	DLA	L1668986-1, -2
Duplicate	Cobalt (Co)-Dissolved	DLA	L1668986-1, -2
Duplicate	Copper (Cu)-Dissolved	DLA	L1668986-1, -2
Duplicate	Lead (Pb)-Dissolved	DLA	L1668986-1, -2
Duplicate	Nickel (Ni)-Dissolved	DLA	L1668986-1, -2
Duplicate	Silver (Ag)-Dissolved	DLA	L1668986-1, -2
Duplicate	Thallium (Tl)-Dissolved	DLA	L1668986-1, -2
Duplicate	Tin (Sn)-Dissolved	DLA	L1668986-1, -2
Duplicate	Vanadium (V)-Dissolved	DLA	L1668986-1, -2
Duplicate	Zinc (Zn)-Dissolved	DLA	L1668986-1, -2
Duplicate	Beryllium (Be)-Dissolved	DLA	L1668986-1, -2
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1668986-1, -2
Duplicate	Chromium (Cr)-Dissolved	DLA	L1668986-1, -2
Duplicate	Cobalt (Co)-Dissolved	DLA	L1668986-1, -2
Duplicate	Iron (Fe)-Dissolved	DLA	L1668986-1, -2
Duplicate	Nickel (Ni)-Dissolved	DLA	L1668986-1, -2
Duplicate	Silver (Ag)-Dissolved	DLA	L1668986-1, -2
Duplicate	Beryllium (Be)-Dissolved	DLA	L1668986-1, -2
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1668986-1, -2
Duplicate	Cadmium (Cd)-Dissolved	DLA	L1668986-1, -2
Duplicate	Chromium (Cr)-Dissolved	DLA	L1668986-1, -2
Duplicate	Copper (Cu)-Dissolved	DLA	L1668986-1, -2
Duplicate	Iron (Fe)-Dissolved	DLA	L1668986-1, -2
Duplicate	Nickel (Ni)-Dissolved	DLA	L1668986-1, -2
Duplicate	Silver (Ag)-Dissolved	DLA	L1668986-1, -2
Duplicate	Tin (Sn)-Dissolved	DLA	L1668986-1, -2
Duplicate	Zinc (Zn)-Dissolved	DLA	L1668986-1, -2
Duplicate	Cadmium (Cd)-Dissolved	DLM	L1668986-1, -2
Matrix Spike	Mercury (Hg)-Total	MS-B	L1668986-1, -2
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1668986-1, -2

Reference Information

	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Total Inorganic Carbon	MS-B	L1668986-1, -2
Matrix Spike	Total Inorganic Carbon	MS-B	L1668986-1, -2
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Total Organic Carbon	MS-B	L1668986-1, -2
Matrix Spike	Total Organic Carbon	MS-B	L1668986-1, -2
Matrix Spike	Dissolved Organic Carbon	MS-B	L1668986-1, -2
Matrix Spike	Dissolved Organic Carbon	MS-B	L1668986-1, -2
Matrix Spike	Aluminum (Al)-Total	MS-B	L1668986-1, -2
Matrix Spike	Barium (Ba)-Total	MS-B	L1668986-1, -2
Matrix Spike	Manganese (Mn)-Total	MS-B	L1668986-1, -2
Matrix Spike	Sodium (Na)-Total	MS-B	L1668986-1, -2
Matrix Spike	Strontium (Sr)-Total	MS-B	L1668986-1, -2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1668986-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1668986-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TIC-VA	Water	Total inorganic carbon by CO2 purge	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CN-T-CFA-VA	Water	Total Cyanide in water by CFA	ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-IC-N-WR	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et

Reference Information

al.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-MAN-WR	Water	Total Suspended Solids by Gravimetric	APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids are determined by filtering a sample through a glass fibre filter and drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody / Analytical Request F[orm]
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

L1668986-COFC

Report To		Report Format / Distribution		Service Requested (Rush for routine analysis subject to availability)
Company:	Minnow Environmental Inc.	☑ Standard ☐ Other		◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Lisa Bowron	☑ PDF ☑ Excel ☐ Digital ☐ Fax		○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	101 - 1025 Hillside Ave.	Email 1:	lbowron@minnow.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Victoria, BC	Email 2:	pstecko@minnow.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	(250)595-1627 x21 Fax: (250) 595-1625	Email 3:		

Invoice To		Client / Project Information	
Same as Report ?	☐ Yes ☑ No	Job #:	Minnow Project 0073
Hardcopy of Invoice with Report?	☑ Yes ☐ No	PO / AFE:	
Company:	Minto Explorations Ltd	LSD:	
Contact:	Cindy Keehn		
Address:	Suite 2100 - 510 West Georgia St., Vancouver, BC		
Phone:	604-684-8894 Fax: 604-688-2180	Quote #:	Q51327
Lab Work Order # (lab use only)		ALS Contact: Can Dang	Sampler: Lisa Bowron

Analysis Request — Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals by CCMS & ICPOES	Mercury by CVAFS (Low)	Alkalinity by Auto Titration	Phosphorus in water by colour	Organic/Inorganic Carbon	Cyanide	Conductivity, Hardness and pH	TDS & TSS by Gravimetric	Turbidity by Meter	Anions by Ion Chromatography	Ammonia by Fluorescence	**See Complete Quote #Q51327	Number of Containers
	LWC	04-Sep-15		Water	X	X	X	X	X	X	X	X	X	X	X	X	9
	URC	04-Sep-15		Water	X	X	X	X	X	X	X	X	X	X	X	X	9

Short Holding Time

● *Rush Processing*

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Lisa Bowron	05-Sep-15	7:56am	[signature]	8 Sep 15	8:46	6.5 °C				
			Twila	Sep 19	14:20	9.8°				

APPENDIX C

SEDIMENT, PERIPHYTON AND BENTHIC INVERTEBRATE QUALITY DATA

Table C.1: Sediment chemistry data collected at reference and exposed areas, Minto Mine WUL, 2014.

Analyte		Units	CSQG[1]		Upper McGinty Creek (Reference)					Upper Minto Creek (Exposure)				
					URC-1	URC-2	URC-3	URC-4	URC-5	UMC-1	UMC-2	UMC-3	UMC-4	UMC-5
			ISQG	PEL	4-Sep-15	4-Sep-15	4-Sep-15	4-Sep-15	4-Sep-15	1-Sep-15	1-Sep-15	1-Sep-15	1-Sep-15	1-Sep-15
Particle size, TKN, carbon analytes and pH	Loss on Ignition @ 550 °C	%	-	-	22	11	12	11	4.0	3.0	3.0	6.0	6.0	5.0
	pH (1:2 soil:water)	pH units	-	-	6.33	6.58	6.49	6.76	7.26	7.63	7.76	7.67	7.40	7.66
	% Gravel (>2mm)	%	-	-	-	-	-	-	-	-	-	-	-	-
	% Sand (2.0mm - 0.063mm)	%	-	-	-	-	-	-	-	-	-	-	-	-
	% Silt (0.063mm - 4um)	%	-	-	-	-	-	-	-	-	-	-	-	-
	% Clay (<4um)	%	-	-	-	-	-	-	-	-	-	-	-	-
	Total Kjeldahl Nitrogen (TKN)	%	-	-	0.52	0.25	0.27	0.28	0.067	0.082	0.086	0.13	0.15	0.12
	Inorganic Carbon	%	-	-	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
	Inorganic Carbon (as $CaCO_3$ Equivalent)	%	-	-	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80
	Total Carbon by Combustion	%	-	-	11	5.2	6.7	4.9	1.4	1.5	1.3	3.0	2.7	3.0
	Total Organic Carbon	%	-	-	11	5.2	6.7	5.0	1.4	1.5	1.3	3.0	2.7	3.0
Total Metals	Aluminum (Al)	mg/kg	-	-	16,400	12,500	12,600	12,200	6,630	9,280	9,220	8,950	13,400	10,800
	Antimony (Sb)	mg/kg	-	-	0.64	0.46	0.45	0.45	0.25	0.35	0.34	0.32	0.48	0.41
	Arsenic (As)	mg/kg	5.9	17	8.4	8.5	11	13	5.3	4.9	4.6	5.2	6.3	5.7
	Barium (Ba)	mg/kg	-	-	319	213	268	267	127	178	186	197	238	163
	Beryllium (Be)	mg/kg	-	-	0.51	0.37	0.40	0.38	0.19	0.40	0.38	0.32	0.48	0.39
	Bismuth (Bi)	mg/kg	-	-	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
	Boron (B)	mg/kg	-	-	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
	Cadmium (Cd)	mg/kg	0.60	3.5	0.27	0.16	0.20	0.19	0.076	0.16	0.18	0.21	0.23	0.16
	Calcium (Ca)	mg/kg	-	-	11,700	8,530	9,050	8,670	4,630	6,670	6,680	5,530	8,890	7,420
	Chromium (Cr)	mg/kg	37	90	35	27	27	27	15	20	22	18	31	26
	Cobalt (Co)	mg/kg	-	-	13	10	11	11	6.7	9.0	9.0	9.2	11	10
	Copper (Cu)	mg/kg	36	197	37	24	26	25	10	152	134	165	191	93
	Iron (Fe)	mg/kg	-	-	28,300	25,800	31,000	32,700	16,600	22,000	21,800	20,700	25,700	22,600
	Lead (Pb)	mg/kg	35	91	6.5	5.2	5.1	4.9	2.8	5.1	5.9	4.6	6.4	5.5
	Lithium (Li)	mg/kg	-	-	8.8	7.0	7.2	6.7	3.8	7.4	7.2	5.7	8.4	6.9
	Magnesium (Mg)	mg/kg	-	-	5,240	5,080	4,820	4,940	3,110	5,740	5,620	5,270	7,360	6,270
	Manganese (Mn)	mg/kg	-	-	720	460	792	637	603	1,500	1,890	2,170	1,740	1,120
	Mercury (Hg)	mg/kg	0.17	0.49	0.076	0.047	0.056	0.047	0.016	0.018	0.019	0.021	0.028	0.024
	Molybdenum (Mo)	mg/kg	-	-	0.57	0.44	0.70	0.57	0.51	1.4	1.4	1.7	2.0	1.1
	Nickel (Ni)	mg/kg	-	-	24	20	20	20	11	21	23	22	30	27
	Phosphorus (P)	mg/kg	-	-	972	934	1,110	1,220	687	816	934	793	1,010	912
	Potassium (K)	mg/kg	-	-	880	870	870	850	550	1,350	1,220	1,250	1,690	1,180
	Selenium (Se)	mg/kg	-	-	0.62	0.48	0.69	0.69	0.29	0.32	0.30	0.42	0.54	0.33
	Silver (Ag)	mg/kg	-	-	0.13	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.11	< 0.10
	Sodium (Na)	mg/kg	-	-	399	339	363	380	181	348	300	270	422	376
	Strontium (Sr)	mg/kg	-	-	82	65	76	82	42	73	70	70	104	81
	Thallium (Tl)	mg/kg	-	-	0.099	0.081	0.083	0.076	< 0.050	0.081	0.074	0.063	0.11	0.082
	Tin (Sn)	mg/kg	-	-	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
	Titanium (Ti)	mg/kg	-	-	813	767	757	717	509	560	577	523	781	654
	Uranium (U)	mg/kg	-	-	1.6	1.3	1.4	1.2	0.60	0.59	0.63	0.64	1.1	0.79
	Vanadium (V)	mg/kg	-	-	66	54	56	56	37	47	47	43	60	51
	Zinc (Zn)	mg/kg	123	315	59	51	51	50	31	56	55	57	71	55

Indicates sediment concentration exceeding CSQG ISQG

Indicates sediment concentration exceeding CSQG PEL

[1] Canadian Sediment Quality Guidelines:
ISQG = interim sediment quality guideline; PEL = probable effect level (CCME 1999)

Table C.1: Sediment chemistry data collected at reference and exposed areas, Minto Mine WUL, 2014.

Analyte		Units	CSQG[1]		Lower Wolverine Creek (Reference)					Lower Minto Creek (Exposure)				
					LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
			ISQG	PEL	4-Sep-15	4-Sep-15	4-Sep-15	3-Sep-15	3-Sep-15	6-Sep-15	6-Sep-15	6-Sep-15	5-Sep-15	5-Sep-15
Particle size, TKN, carbon analytes and pH	Loss on Ignition @ 550 °C	%	-	-	12	14	22	13	6	12	8.0	8.0	4.0	4.0
	pH (1:2 soil:water)	pH units	-	-	7.10	7.04	7.04	6.56	6.85	7.83	7.82	7.82	7.94	7.91
	% Gravel (>2mm)	%	-	-	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.31	0.28	1.3
	% Sand (2.0mm - 0.063mm)	%	-	-	35	44	7.4	21	69	13	30	20	24	28
	% Silt (0.063mm - 4um)	%	-	-	60	52	87	74	29	80	64	72	69	65
	% Clay (<4um)	%	-	-	4.6	4.1	5.8	5.2	2.8	6.8	6.2	8.4	7.1	6.3
	Total Kjeldahl Nitrogen (TKN)	%	-	-	0.30	0.25	0.51	0.27	0.14	0.32	0.24	0.24	0.11	0.11
	Inorganic Carbon	%	-	-	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
	Inorganic Carbon (as $CaCO_3$ Equivalent)	%	-	-	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80
	Total Carbon by Combustion	%	-	-	7.0	7.5	11	6.4	4.1	6.2	5.0	4.1	2.0	2.2
	Total Organic Carbon	%	-	-	7.0	7.5	11	6.4	4.1	6.2	5.0	4.1	2.0	2.2
Total Metals	Aluminum (Al)	mg/kg	-	-	15,800	13,100	14,600	15,300	10,400	14,300	11,400	14,100	12,000	13,100
	Antimony (Sb)	mg/kg	-	-	0.53	0.54	0.56	0.45	0.35	0.48	0.50	0.49	0.39	0.42
	Arsenic (As)	mg/kg	5.9	17	7.0	7.3	7.2	5.9	5.3	6.1	6.8	7.5	5.4	5.6
	Barium (Ba)	mg/kg	-	-	241	247	247	213	147	208	239	243	176	196
	Beryllium (Be)	mg/kg	-	-	0.88	0.85	0.87	0.79	0.60	0.47	0.38	0.45	0.34	0.37
	Bismuth (Bi)	mg/kg	-	-	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
	Boron (B)	mg/kg	-	-	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
	Cadmium (Cd)	mg/kg	0.60	3.5	0.33	0.38	0.34	0.25	0.15	0.16	0.20	0.19	0.12	0.14
	Calcium (Ca)	mg/kg	-	-	13,400	13,600	13,400	10,700	7,340	10,900	12,300	11,400	7,430	8,780
	Chromium (Cr)	mg/kg	37	90	52	45	51	49	34	32	26	34	28	30
	Cobalt (Co)	mg/kg	-	-	15	14	15	14	12	10	10	12	9.4	10
	Copper (Cu)	mg/kg	36	197	34	35	35	29	18	45	45	53	33	39
	Iron (Fe)	mg/kg	-	-	28,900	26,500	28,000	28,400	24,600	24,700	21,700	25,900	22,100	23,100
	Lead (Pb)	mg/kg	35	91	7.1	6.7	6.7	7.0	5.0	6.1	5.4	5.9	4.8	5.3
	Lithium (Li)	mg/kg	-	-	10	8.1	9.1	12	8.3	10	7.4	9.1	7.7	9.0
	Magnesium (Mg)	mg/kg	-	-	9,450	8,750	9,360	9,190	7,190	6,980	5,890	7,430	6,200	6,740
	Manganese (Mn)	mg/kg	-	-	758	799	789	592	488	712	946	927	629	672
	Mercury (Hg)	mg/kg	0.17	0.49	0.058	0.061	0.060	0.052	0.025	0.033	0.036	0.037	0.025	0.025
	Molybdenum (Mo)	mg/kg	-	-	0.66	0.63	0.64	0.55	0.54	0.63	0.68	0.66	0.48	0.52
	Nickel (Ni)	mg/kg	-	-	42	40	41	38	30	28	24	30	24	27
	Phosphorus (P)	mg/kg	-	-	1,030	1,000	1,090	984	909	775	780	848	820	807
	Potassium (K)	mg/kg	-	-	1,030	900	1,050	1,070	870	1,150	1,040	1,330	1,000	1,050
	Selenium (Se)	mg/kg	-	-	0.51	0.59	0.56	0.38	< 0.20	0.44	0.46	0.49	0.25	0.29
	Silver (Ag)	mg/kg	-	-	0.13	0.13	0.13	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
	Sodium (Na)	mg/kg	-	-	531	482	514	492	387	363	332	411	345	349
	Strontium (Sr)	mg/kg	-	-	125	125	125	104	82	105	100	101	65	73
	Thallium (Tl)	mg/kg	-	-	0.094	0.083	0.090	0.098	0.057	0.11	0.088	0.10	0.083	0.088
	Tin (Sn)	mg/kg	-	-	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
	Titanium (Ti)	mg/kg	-	-	774	687	831	872	785	770	679	854	697	710
	Uranium (U)	mg/kg	-	-	3.7	4.5	4.1	2.9	1.7	0.96	1.1	1.1	0.64	0.72
	Vanadium (V)	mg/kg	-	-	75	72	76	68	60	51	47	59	48	49
	Zinc (Zn)	mg/kg	123	315	65	57	62	63	48	57	50	62	53	57

Indicates sediment concentration exceeding CSQG ISQG

Indicates sediment concentration exceeding CSQG PEL

[1] Canadian Sediment Quality Guidelines:

ISQG = interim sediment quality guideline; PEL = probable effect level (CCME 1999)

Table C.2: Periphyton tissue quality results[1] at reference and exposure areas, Minto Mine WUL, 2015.

Analyte		Units	Lower Wolverine Creek (Reference)							Lower Big Creek (Reference)							Lower Minto Creek (Exposure)						
			LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	Mean	Standard Deviation	LBC-1	LBC-2	LBC-3	LBC-4	LBC-5	Mean	Standard Deviation	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5	Mean	Standard Deviation
Physical Tests	Moisture	%	32	3.5	15	98	99	49	46	2.6	6.3	5.4	22	4.4	8.0	7.6	85	79	81	90	78	83	4.8
Total Metals	Total Aluminum (Al)	mg/kg dw	4,290	6,010	7,800	6,170	10,500	6,954	2,339	14,900	22,600	13,700	8,170	13,800	14,634	5,169	9,030	7,870	10,300	10,200	8,990	9,278	1,003
	Total Antimony (Sb)	mg/kg dw	0.018	0.017	0.028	0.021	0.059	0.029	0.018	< 0.010	0.021	0.023	0.036	0.027	0.023	0.0094	0.052	0.043	0.057	0.072	0.038	0.052	0.013
	Total Arsenic (As)	mg/kg dw	2.2	2.2	3.9	3.5	5.3	3.4	1.3	2.5	5.1	17	15	10	10	6.3	7.1	7.0	10	8.7	4.8	7.4	1.9
	Total Barium (Ba)	mg/kg dw	136	124	238	157	319	195	82	279	296	513	193	297	316	118	422	314	510	501	182	386	138
	Total Beryllium (Be)	mg/kg dw	0.43	0.37	0.66	0.76	1.1	0.66	0.28	0.57	1.1	1.7	0.39	0.51	0.86	0.56	0.33	0.29	0.39	0.38	0.34	0.34	0.040
	Total Bismuth (Bi)	mg/kg dw	0.027	0.031	0.062	0.036	0.036	0.038	0.014	0.013	0.027	0.027	0.42	0.42	0.18	0.22	0.10	0.086	0.12	0.12	0.094	0.10	0.015
	Total Boron (B)	mg/kg dw	1.2	2.2	2.3	4.0	6.5	3.2	2.1	2.1	4.1	13	1.1	2.8	4.6	4.8	5.6	7.7	22	24	6.8	**13**	9.1
	Total Cadmium (Cd)	mg/kg dw	0.13	0.090	0.25	0.18	0.29	0.19	0.084	0.28	0.36	0.79	0.17	0.26	0.37	0.24	0.21	0.15	0.26	0.26	0.14	0.20	0.058
	Total Calcium (Ca)	mg/kg dw	5,960	6,720	8,110	11,000	15,900	9,538	4,043	5,580	15,900	41,000	5,270	8,750	15,300	14,990	9,700	8,000	8,910	12,100	7,790	9,300	1,741
	Total Cesium (Cs)	mg/kg dw	0.51	0.27	0.73	0.11	0.16	0.35	0.26	0.29	0.84	1.0	1.6	0.75	0.88	0.46	0.95	0.89	1.4	1.0	1.1	1.1	0.18
	Total Chromium (Cr)	mg/kg dw	50	51	52	44	114	62	29	150	452	337	26	76	208	180	29	25	35	36	28	31	4.7
	Total Cobalt (Co)	mg/kg dw	29	36	27	35	50	35	8.8	21	38	49	8.2	19	27	16	14	11	17	16	8.2	13	3.6
	Total Copper (Cu)	mg/kg dw	21	21	28	32	33	27	5.8	43	41	59	18	23	37	16	35	31	44	47	32	38	7.4
	Total Iron (Fe)	mg/kg dw	37,600	46,300	37,900	42,600	62,100	45,300	10,057	33,100	57,100	73,800	16,500	30,000	42,100	22,982	17,700	15,600	21,400	20,100	17,100	18,380	2,340
	Total Lead (Pb)	mg/kg dw	2.7	3.4	3.0	2.7	3.6	3.1	0.38	2.2	3.9	2.5	5.7	5.8	4.0	1.7	4.9	4.4	4.9	6.1	4.2	4.9	0.74
	Total Lithium (Li)	mg/kg dw	5.5	6.7	7.8	6.2	6.7	6.6	0.87	7.2	14	8.5	8.4	6.8	9.0	3.0	8.1	7.4	9.1	9.0	8.6	8.4	0.71
	Total Magnesium (Mg)	mg/kg dw	25,400	26,600	25,000	28,800	29,100	26,980	1,895	25,800	31,400	34,700	6,650	12,400	22,190	12,162	5,730	5,240	6,460	6,610	5,740	5,956	568
	Total Manganese (Mn)	mg/kg dw	1,180	873	2,360	1,040	3,500	1,791	1,121	1,590	1,730	3,050	386	1,530	1,657	946	5,270	3,360	5,790	5,680	797	**4,179**	2,130
	Total Mercury (Hg)	mg/kg dw	0.010	0.0072	0.033	< 0.010	< 0.035	0.019	0.014	0.0057	0.018	0.017	0.024	0.015	0.016	0.0066	0.025	0.018	0.046	0.032	0.023	0.029	0.011
	Total Molybdenum (Mo)	mg/kg dw	0.94	1.3	1.0	1.2	3.3	1.6	1.0	0.33	0.58	3.1	0.70	0.78	1.1	1.1	0.82	0.62	0.87	1.0	0.50	0.76	0.21
	Total Nickel (Ni)	mg/kg dw	122	167	104	173	147	143	29	34	67	66	23	22	43	23	25	22	30	29	22	26	4.1
	Total Phosphorus (P)	mg/kg dw	1,690	1,370	1,630	2,520	3,280	2,098	789	692	1,110	501	831	918	810	230	1,060	928	1,590	1,820	1,200	1,320	374
	Total Potassium (K)	mg/kg dw	489	845	703	500	2,510	1,009	852	623	1,070	1,090	901	1,290	995	249	1,180	1,090	1,740	1,890	1,080	1,396	388
	Total Rubidium (Rb)	mg/kg dw	3.6	3.7	6.1	1.4	4.8	3.9	1.7	2.5	4.8	11	9.4	5.0	6.6	3.7	8.3	7.5	9.3	9.1	7.7	8.4	0.81
	Total Selenium (Se)	mg/kg dw	0.10	< 0.10	0.29	< 0.10	0.32	0.18	0.11	< 0.10	< 0.10	0.26	0.13	0.16	0.15	0.066	0.69	0.45	1.2	1.1	0.43	**0.77**	0.35
	Total Sodium (Na)	mg/kg dw	405	1,440	811	1,400	4,400	1,691	1,574	727	773	524	239	1,620	777	516	354	348	385	439	340	373	41
	Total Strontium (Sr)	mg/kg dw	34	38	62	50	125	62	37	59	178	111	41	105	99	53	71	54	76	74	51	65	12
	Total Tellurium (Te)	mg/kg dw	< 0.020	< 0.020	< 0.020	< 0.020	< 0.040	< 0.024	< 0.0089	< 0.020	< 0.020	< 0.020	0.022	0.064	0.029	0.022	0.021	< 0.020	0.022	0.020	< 0.020	0.021	0.00089
	Total Thallium (Tl)	mg/kg dw	0.031	0.027	0.051	0.017	0.025	0.030	0.013	0.055	0.055	0.21	0.11	0.12	0.11	0.062	0.095	0.084	0.10	0.097	0.079	0.091	0.0093
	Total Tin (Sn)	mg/kg dw	0.47	0.78	0.60	8.4	21	6.2	8.7	0.22	0.30	0.31	0.26	0.43	0.30	0.079	4.5	2.7	0.36	4.0	2.0	2.7	1.6
	Total Uranium (U)	mg/kg dw	0.56	0.46	1.0	0.80	1.4	0.85	0.39	0.29	0.49	0.87	1.0	0.74	0.68	0.29	0.97	0.84	0.73	1.4	0.69	0.92	0.27
	Total Vanadium (V)	mg/kg dw	39	56	50	39	144	66	44	77	151	99	36	75	88	42	51	39	47	64	40	48	10
	Total Zinc (Zn)	mg/kg dw	85	91	66	83	123	90	21	50	113	75	47	88	74	28	51	46	64	58	50	54	7.3
	Total Zirconium (Zr)	mg/kg dw	22	22	17	78	88	45	35	4.0	6.5	13	5.8	7.6	7.5	3.6	8.1	6.9	9.2	9.8	7.9	8.4	1.1

bold Indicates periphyton tissue concentration exceeding the higher reference mean by more than 2 times

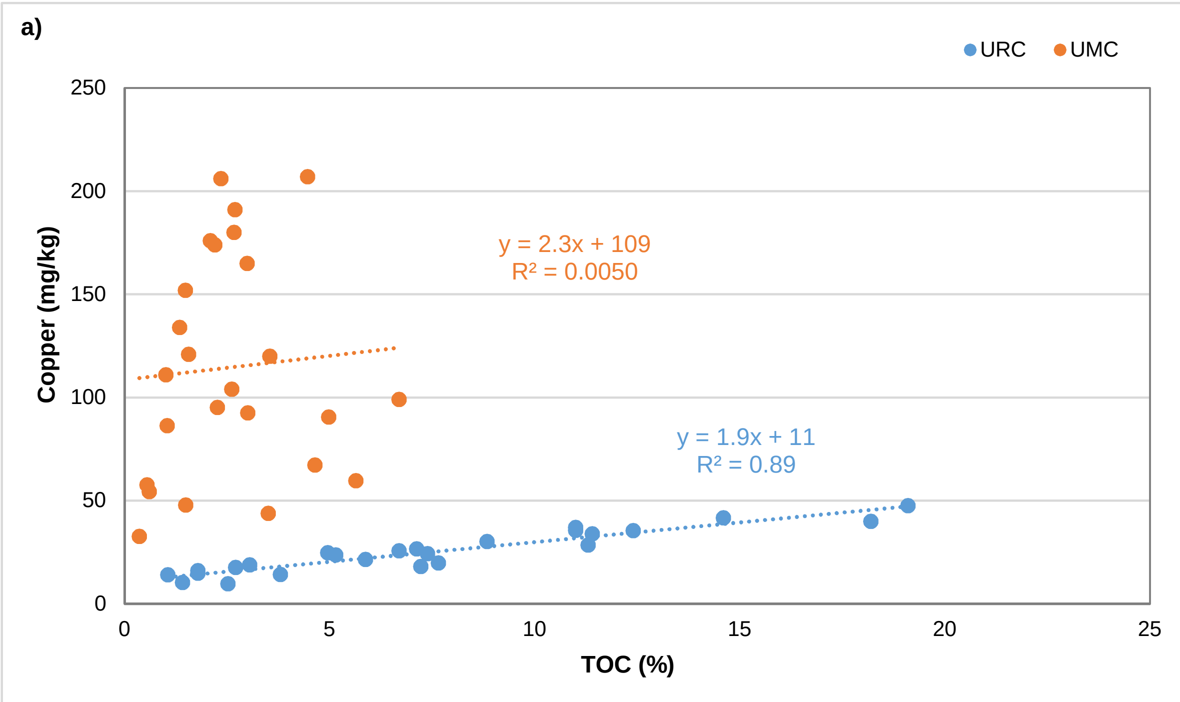
[1] If value was < method detection limit, summary statistics were calculated using detection limit, i.e. if value was < 0.0048, summary statistics were calculated using the value 0.0048

Table C.3: Benthic tissue quality results[1] at reference and exposure areas, Minto Mine WUL, 2015.

Analyte		Units	Lower Wolverine Creek (Reference)							Lower Big Creek (Reference)							Lower Minto Creek (Exposure)						
			LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	Mean	Standard Deviation	LBC-1	LBC-2	LBC-3	LBC-4	LBC-5	Mean	Standard Deviation	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5	Mean	Standard Deviation
Physical Tests	Moisture	%	80	83	79	70	70	76	6.3	79	82	80	81	77	80	1.9	87	78	80	79	83	81	3.8
Total Metals	Total Aluminum (Al)	mg/kg dw	1,510	2,280	1,330	3,170	2,730	2,204	784	2,070	2,230	1,440	2,890	2,070	2,140	517	2,250	3,280	2,120	2,480	3,650	2,756	673
	Total Antimony (Sb)	mg/kg dw	0.043	0.047	0.070	0.11	0.088	0.072	0.028	0.24	0.23	0.19	0.22	0.20	0.21	0.020	0.13	0.17	0.11	0.085	0.11	0.12	0.032
	Total Arsenic (As)	mg/kg dw	1.3	1.9	1.6	4.3	1.9	2.2	1.2	7.4	7.4	5.4	7.6	7.1	7.0	0.90	3.5	3.8	2.3	2.4	4.1	3.2	0.82
	Total Barium (Ba)	mg/kg dw	72	162	58	68	99	92	42	79	84	64	79	76	76	7.4	123	138	64	111	118	111	28
	Total Beryllium (Be)	mg/kg dw	0.12	0.18	0.11	0.26	0.21	0.18	0.064	0.17	0.20	0.14	0.17	0.16	0.17	0.021	0.12	0.14	0.11	0.12	0.20	0.14	0.039
	Total Bismuth (Bi)	mg/kg dw	0.020	0.028	0.021	0.023	0.017	0.022	0.0041	0.32	0.24	0.16	0.30	0.23	0.25	0.062	0.032	0.051	0.030	0.031	0.055	0.040	0.012
	Total Boron (B)	mg/kg dw	< 1.0	2.0	< 1.0	< 1.0	1.9	1.4	0.52	1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.0	0	6.2	4.1	2.1	2.6	5.3	**4.1**	1.7
	Total Cadmium (Cd)	mg/kg dw	1.3	1.0	1.6	0.73	0.65	1.0	0.39	3.9	4.3	3.3	4.1	4.0	3.9	0.40	0.41	0.32	0.27	0.17	0.28	0.29	0.086
	Total Calcium (Ca)	mg/kg dw	2,260	2,530	3,420	2,940	2,180	2,666	516	3,780	2,770	2,740	3,050	2,750	3,018	445	3,020	3,800	2,950	2,420	4,190	3,276	710
	Total Cesium (Cs)	mg/kg dw	0.17	0.35	0.21	0.43	0.26	0.28	0.10	0.71	1.5	0.62	0.83	0.65	0.87	0.38	0.25	0.35	0.20	0.21	0.35	0.27	0.072
	Total Chromium (Cr)	mg/kg dw	5.5	21	8.5	13	11	12	6.0	6.7	7.0	9.6	8.9	7.2	7.9	1.3	7.3	12	7.2	8.0	14	9.8	3.2
	Total Cobalt (Co)	mg/kg dw	2.4	3.6	3.2	4.8	5.0	3.8	1.1	5.0	7.3	3.2	6.0	4.3	5.2	1.6	2.9	3.7	1.7	2.0	3.8	2.8	0.95
	Total Copper (Cu)	mg/kg dw	29	33	29	22	23	27	4.4	66	57	41	66	67	59	11	37	39	29	37	60	40	12
	Total Iron (Fe)	mg/kg dw	3,520	5,910	3,190	10,100	7,300	6,004	2,853	4,900	7,400	3,450	6,310	6,340	5,680	1,531	5,220	7,410	4,990	5,570	9,760	6,590	2,012
	Total Lead (Pb)	mg/kg dw	0.71	1.3	0.94	1.7	1.4	1.2	0.39	3.6	4.0	2.3	2.9	2.6	3.1	0.70	1.4	2.0	1.3	1.5	2.1	1.7	0.37
	Total Lithium (Li)	mg/kg dw	0.91	1.4	1.0	2.7	2.0	1.6	0.75	1.1	1.6	0.62	1.7	1.2	1.2	0.43	2.0	3.1	1.3	1.6	3.3	2.2	0.88
	Total Magnesium (Mg)	mg/kg dw	2,000	2,960	2,130	3,610	4,170	2,974	935	2,750	2,460	1,930	3,390	2,530	2,612	529	2,640	2,660	2,000	2,180	3,390	2,574	539
	Total Manganese (Mn)	mg/kg dw	533	428	335	287	370	391	95	802	893	440	795	796	745	176	635	502	400	505	551	519	85
	Total Mercury (Hg)	mg/kg dw	0.030	0.027	0.037	0.023	0.022	0.028	0.0059	0.043	0.042	0.040	0.051	0.040	0.043	0.0044	0.023	0.032	0.028	0.028	0.045	0.031	0.0082
	Total Molybdenum (Mo)	mg/kg dw	0.77	0.69	1.1	0.70	0.45	0.74	0.23	1.2	1.6	0.94	1.1	1.2	1.2	0.23	0.84	1.4	1.5	1.2	4.2	1.8	1.3
	Total Nickel (Ni)	mg/kg dw	5.9	9.4	5.9	10	24	11	7.5	6.6	15	6.3	10	7.1	8.9	3.5	9.4	11	7.1	7.4	12	9.4	2.2
	Total Phosphorus (P)	mg/kg dw	7,900	7,610	8,410	5,590	5,640	7,030	1,323	7,010	7,750	6,620	8,960	8,290	7,726	946	9,230	6,220	6,790	6,400	5,910	6,910	1,335
	Total Potassium (K)	mg/kg dw	6,890	11,200	6,420	5,200	7,530	7,448	2,264	5,970	7,180	6,510	7,200	6,590	6,690	515	14,600	8,960	10,700	12,300	13,500	12,012	2,238
	Total Rubidium (Rb)	mg/kg dw	4.2	6.8	4.9	4.8	4.7	5.1	1.0	8.3	11	8.2	10	11	10	1.3	3.9	3.8	3.0	4.2	3.5	3.7	0.45
	Total Selenium (Se)	mg/kg dw	1.6	1.4	2.9	1.2	0.87	1.6	0.78	1.1	1.2	1.0	1.1	1.1	1.1	0.10	2.2	2.2	2.2	1.4	2.2	2.0	0.34
	Total Sodium (Na)	mg/kg dw	2,620	3,270	2,170	2,530	2,000	2,518	491	2,770	3,350	2,460	2,870	2,740	2,838	324	3,620	2,500	6,470	6,070	8,110	5,354	2,264
	Total Strontium (Sr)	mg/kg dw	29	28	23	34	22	27	4.6	37	29	43	31	38	35	5.5	37	26	27	22	35	29	6.2
	Total Tellurium (Te)	mg/kg dw	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0	< 0.020	< 0.020	< 0.020	0.020	< 0.020	0.020	0	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0
	Total Thallium (Tl)	mg/kg dw	0.014	0.018	0.021	0.019	0.013	0.017	0.0035	0.051	0.063	0.048	0.053	0.064	0.055	0.0073	0.020	0.033	0.019	0.022	0.031	0.025	0.0067
	Total Tin (Sn)	mg/kg dw	< 0.10	0.15	< 0.10	< 0.10	< 0.10	0.11	0.022	0.11	< 0.10	< 0.10	< 0.10	< 0.10	0.10	0.0045	< 0.10	0.16	< 0.10	< 0.10	0.20	0.13	0.046
	Total Uranium (U)	mg/kg dw	0.32	0.58	0.68	0.46	0.41	0.49	0.14	1.9	1.2	2.4	1.1	2.0	1.7	0.53	0.35	0.53	0.57	0.67	0.71	0.56	0.14
	Total Vanadium (V)	mg/kg dw	12	18	9.4	25	20	17	6.2	14	16	8.1	19	13	14	4.1	15	18	16	17	34	20	7.7
	Total Zinc (Zn)	mg/kg dw	99	141	109	81	113	109	22	173	152	179	175	224	181	26	190	117	81	85	118	118	44
	Total Zirconium (Zr)	mg/kg dw	2.8	4.1	2.8	4.8	2.7	3.4	1.0	5.0	3.9	3.3	5.4	3.0	4.1	1.0	3.3	4.3	2.6	2.7	5.1	3.6	1.1

bold Indicates periphyton tissue concentration exceeding the higher reference mean by more than 2 times

[1] If value was < method detection limit, summary statistics were calculated using detection limit, i.e. if value was < 0.0048, summary statistics were calculated using the value 0.0048



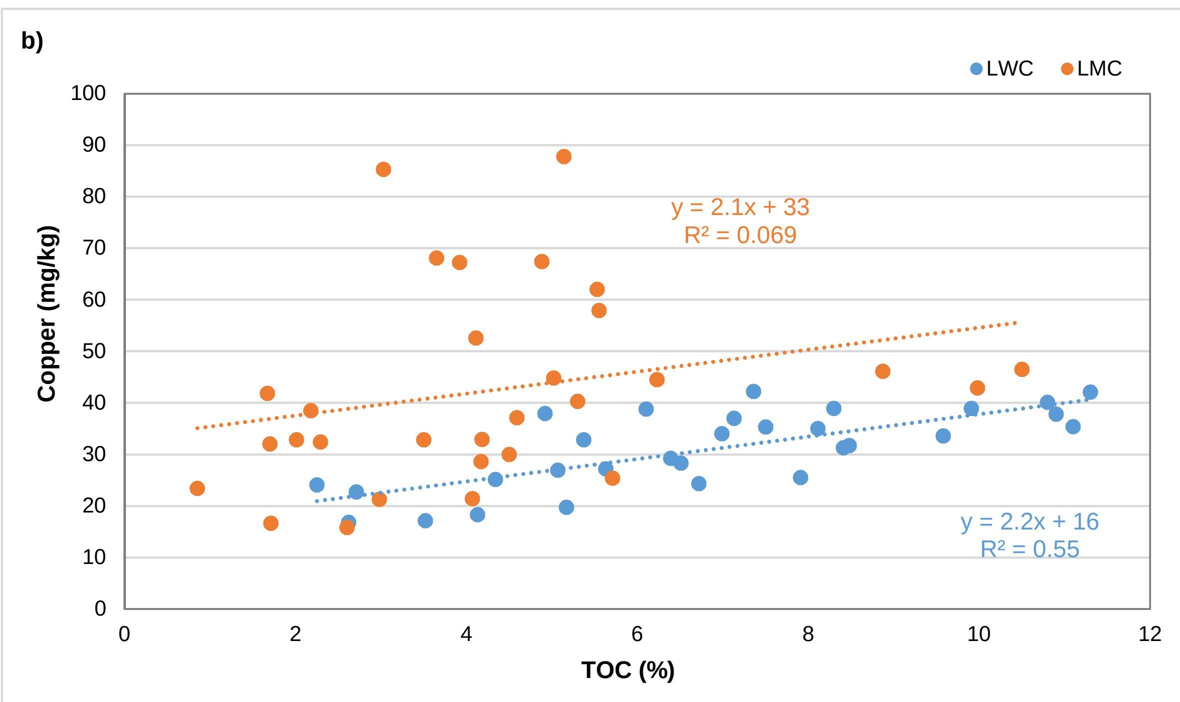
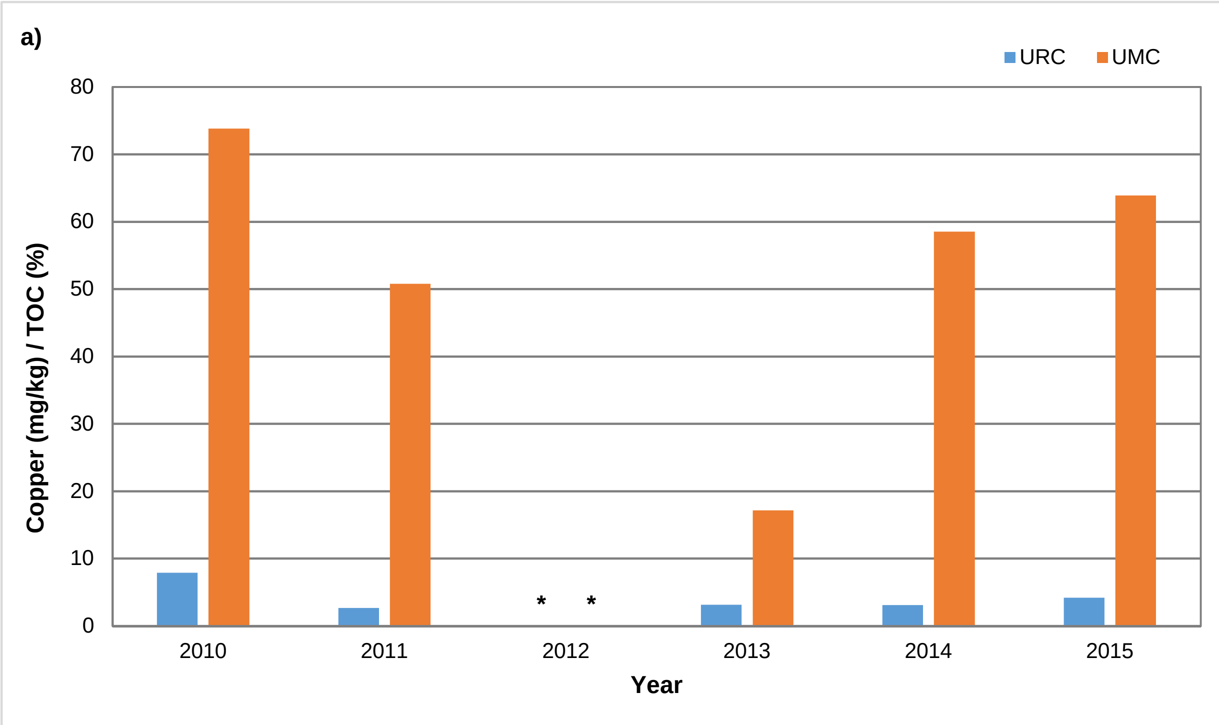


Figure C.1: Relationship between copper and percent TOC, a) upper McGinty (URC) and upper Minto creeks (UMC) and b) lower Wolverine (LWC) and lower Minto creeks (LMC), 2010-2015 (TOC was not collected in 2012).



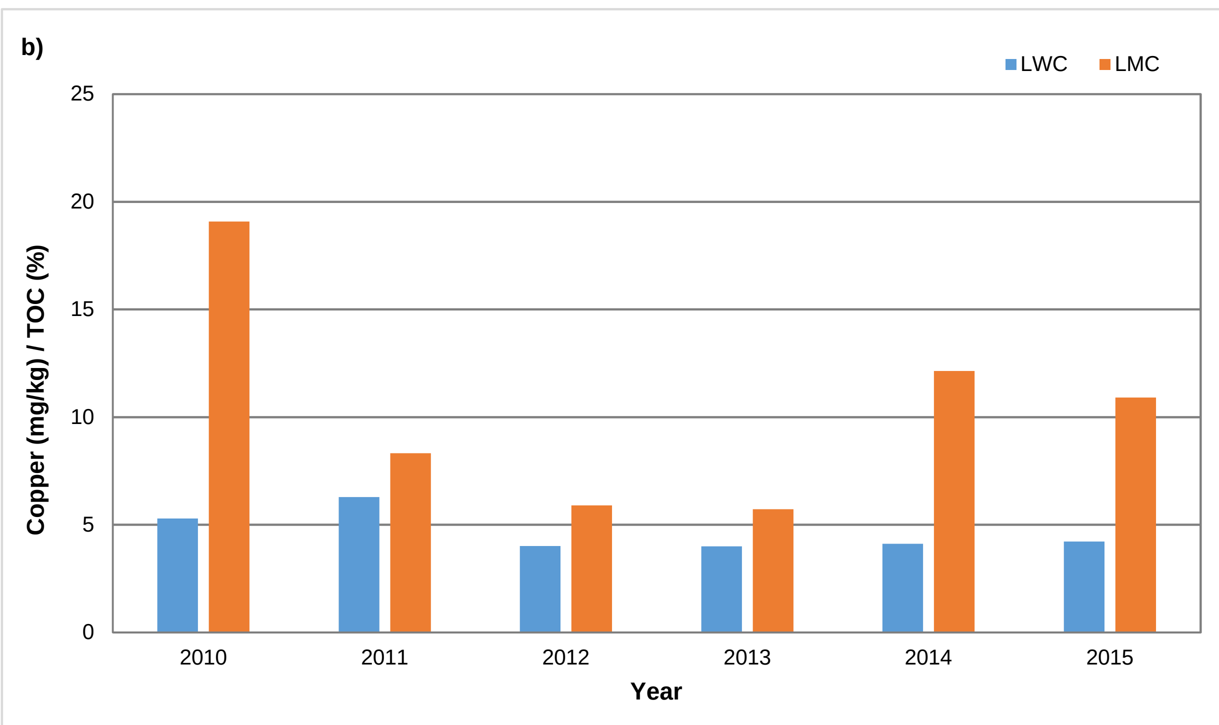


Figure C.2: Copper normalized to percent TOC at a) upper McGinty (URC) and upper Minto creeks (UMC) and b) lower Wolverine (LWC) and lower Minto creeks (LMC), 2010-2015.

* TOC was not collected

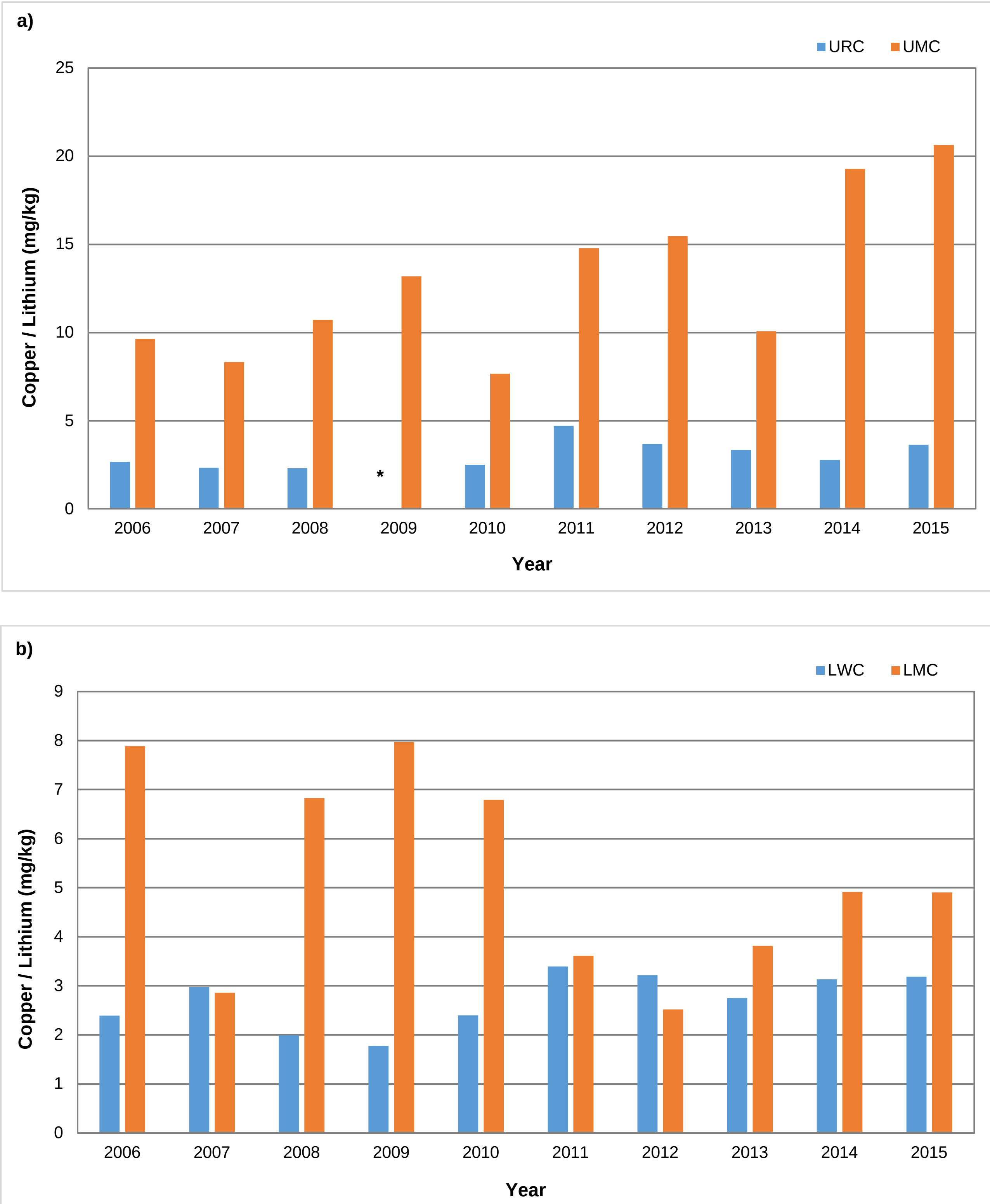


Figure C.3: Copper normalized to lithium at a) upper McGinty (URC) and upper Minto creeks (UMC) and b) lower Wolverine (LWC) and lower Minto creeks (LMC), 2006-2015.

* no data available

MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 08-SEP-15
Report Date: 17-SEP-15 18:19 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L1669082

Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT 0073
C of C Numbers: 1, 2
Legal Site Desc:

Can Dang
Senior Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1669082-1 Sediment 03-SEP-15 LWC-4	L1669082-2 Sediment 03-SEP-15 LWC-5	L1669082-3 Sediment 01-SEP-15 UMC-1	L1669082-4 Sediment 01-SEP-15 UMC-2	L1669082-5 Sediment 01-SEP-15 UMC-3
Grouping	**Analyte**					
SOIL						
Physical Tests	Loss On Ignition @ 420 C (%)	13	6	3	3	6
	pH (1:2 soil:water) (pH)	6.56	6.85	7.63	7.76	7.67
Particle Size	% Gravel (>2mm) (%)	<0.10	<0.10			
	% Sand (2.0mm - 0.063mm) (%)	21.0	68.5			
	% Silt (0.063mm - 4um) (%)	73.8	28.7			
	% Clay (<4um) (%)	5.24	2.78			
	Texture	Silt loam	Sandy loam			
Leachable Anions & Nutrients	Total Kjeldahl Nitrogen (%)	DLA 0.274	DLA 0.144	0.082	0.086	0.125
Organic / Inorganic Carbon	CaCO3 Equivalent (%)	<0.80	<0.80	<0.80	<0.80	<0.80
	Inorganic Carbon (%)	<0.10	<0.10	<0.10	<0.10	<0.10
	Inorganic Carbon (as CaCO3 Equivalent) (%)	<0.80	<0.80	<0.80	<0.80	<0.80
	Total Carbon by Combustion (%)	6.4	4.1	1.5	1.3	3.0
	Total Organic Carbon (%)	6.39	4.13	1.48	1.34	2.99
Metals	Aluminum (Al) (mg/kg)	15300	10400	9280	9220	8950
	Antimony (Sb) (mg/kg)	0.45	0.35	0.35	0.34	0.32
	Arsenic (As) (mg/kg)	5.86	5.34	4.94	4.62	5.20
	Barium (Ba) (mg/kg)	213	147	178	186	197
	Beryllium (Be) (mg/kg)	0.79	0.60	0.40	0.38	0.32
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.251	0.145	0.158	0.176	0.210
	Calcium (Ca) (mg/kg)	10700	7340	6670	6680	5530
	Chromium (Cr) (mg/kg)	48.8	33.5	19.9	21.8	18.0
	Cobalt (Co) (mg/kg)	13.9	11.7	8.95	9.02	9.24
	Copper (Cu) (mg/kg)	29.2	18.3	152	134	165
	Iron (Fe) (mg/kg)	28400	24600	22000	21800	20700
	Lead (Pb) (mg/kg)	6.96	4.96	5.07	5.93	4.57
	Lithium (Li) (mg/kg)	11.9	8.3	7.4	7.2	5.7
	Magnesium (Mg) (mg/kg)	9190	7190	5740	5620	5270
	Manganese (Mn) (mg/kg)	592	488	1500	1890	2170
	Mercury (Hg) (mg/kg)	0.0515	0.0249	0.0182	0.0191	0.0211
	Molybdenum (Mo) (mg/kg)	0.55	0.54	1.40	1.43	1.66
	Nickel (Ni) (mg/kg)	38.4	30.0	20.7	22.8	21.7
	Phosphorus (P) (mg/kg)	984	909	816	934	793
	Potassium (K) (mg/kg)	1070	870	1350	1220	1250
	Selenium (Se) (mg/kg)	0.38	<0.20	0.32	0.30	0.42

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1669082-6	L1669082-7	L1669082-8	L1669082-9	L1669082-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	01-SEP-15	01-SEP-15	01-SEP-15	04-SEP-15	04-SEP-15
	Sampled Time					
	Client ID	UMC-4	UMC-5	UMC	LWC-1	LWC-2
SOIL						
Physical Tests	Loss On Ignition @ 420 C (%)	6	5		12	14
	pH (1:2 soil:water) (pH)	7.40	7.66		7.10	7.04
Particle Size	% Gravel (>2mm) (%)			1.59	<0.10	<0.10
	% Sand (2.0mm - 0.063mm) (%)			62.8	35.2	43.8
	% Silt (0.063mm - 4um) (%)			29.8	60.3	52.0
	% Clay (<4um) (%)			5.81	4.60	4.13
	Texture			Sandy loam	Silt loam	Silt loam
Leachable Anions & Nutrients	Total Kjeldahl Nitrogen (%)	0.149	0.118		DLA 0.300	DLA 0.253
Organic / Inorganic Carbon	CaCO3 Equivalent (%)	<0.80	<0.80		<0.80	<0.80
	Inorganic Carbon (%)	<0.10	<0.10		<0.10	<0.10
	Inorganic Carbon (as CaCO3 Equivalent) (%)	<0.80	<0.80		<0.80	<0.80
	Total Carbon by Combustion (%)	2.7	3.0		7.0	7.5
	Total Organic Carbon (%)	2.69	3.00		6.99	7.50
Metals	Aluminum (Al) (mg/kg)	13400	10800		15800	13100
	Antimony (Sb) (mg/kg)	0.48	0.41		0.53	0.54
	Arsenic (As) (mg/kg)	6.27	5.71		7.04	7.29
	Barium (Ba) (mg/kg)	238	163		241	247
	Beryllium (Be) (mg/kg)	0.48	0.39		0.88	0.85
	Bismuth (Bi) (mg/kg)	<0.20	<0.20		<0.20	<0.20
	Boron (B) (mg/kg)	<5.0	<5.0		<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.233	0.158		0.326	0.378
	Calcium (Ca) (mg/kg)	8890	7420		13400	13600
	Chromium (Cr) (mg/kg)	30.8	25.9		51.7	45.1
	Cobalt (Co) (mg/kg)	11.4	9.97		15.0	14.2
	Copper (Cu) (mg/kg)	191	92.5		34.0	35.3
	Iron (Fe) (mg/kg)	25700	22600		28900	26500
	Lead (Pb) (mg/kg)	6.41	5.54		7.07	6.65
	Lithium (Li) (mg/kg)	8.4	6.9		10.4	8.1
	Magnesium (Mg) (mg/kg)	7360	6270		9450	8750
	Manganese (Mn) (mg/kg)	1740	1120		758	799
	Mercury (Hg) (mg/kg)	0.0282	0.0237		0.0579	0.0607
	Molybdenum (Mo) (mg/kg)	1.98	1.07		0.66	0.63
	Nickel (Ni) (mg/kg)	30.4	26.6		41.7	39.8
	Phosphorus (P) (mg/kg)	1010	912		1030	1000
	Potassium (K) (mg/kg)	1690	1180		1030	900
	Selenium (Se) (mg/kg)	0.54	0.33		0.51	0.59

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1669082-11	L1669082-12	L1669082-13	L1669082-14	L1669082-15
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	04-SEP-15	04-SEP-15	04-SEP-15	04-SEP-15	04-SEP-15
	Sampled Time					
	Client ID	LWC-3	URC-1	URC-2	URC-3	URC-4
Grouping	**Analyte**					
SOIL						
Physical Tests	Loss On Ignition @ 420 C (%)	22	22	11	12	11
	pH (1:2 soil:water) (pH)	7.04	6.33	6.58	6.49	6.76
Particle Size	% Gravel (>2mm) (%)	<0.10				
	% Sand (2.0mm - 0.063mm) (%)	7.35				
	% Silt (0.063mm - 4um) (%)	86.8				
	% Clay (<4um) (%)	5.83				
	Texture	Silt				
Leachable Anions & Nutrients	Total Kjeldahl Nitrogen (%)	0.507 DLA	0.524 DLA	0.249	0.273	0.281 DLA
Organic / Inorganic Carbon	CaCO3 Equivalent (%)	<0.80	<0.80	<0.80	<0.80	<0.80
	Inorganic Carbon (%)	<0.10	<0.10	<0.10	<0.10	<0.10
	Inorganic Carbon (as CaCO3 Equivalent) (%)	<0.80	<0.80	<0.80	<0.80	<0.80
	Total Carbon by Combustion (%)	11.1	11.0	5.2	6.7	4.9
	Total Organic Carbon (%)	11.1	11.0	5.15	6.69	4.95
Metals	Aluminum (Al) (mg/kg)	14600	16400	12500	12600	12200
	Antimony (Sb) (mg/kg)	0.56	0.64	0.46	0.45	0.45
	Arsenic (As) (mg/kg)	7.17	8.39	8.48	10.6	13.1
	Barium (Ba) (mg/kg)	247	319	213	268	267
	Beryllium (Be) (mg/kg)	0.87	0.51	0.37	0.40	0.38
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.344	0.267	0.157	0.199	0.192
	Calcium (Ca) (mg/kg)	13400	11700	8530	9050	8670
	Chromium (Cr) (mg/kg)	50.5	35.4	27.2	27.1	27.1
	Cobalt (Co) (mg/kg)	14.8	12.5	10.4	10.7	11.2
	Copper (Cu) (mg/kg)	35.4	37.0	23.8	25.7	24.8
	Iron (Fe) (mg/kg)	28000	28300	25800	31000	32700
	Lead (Pb) (mg/kg)	6.74	6.51	5.19	5.09	4.93
	Lithium (Li) (mg/kg)	9.1	8.8	7.0	7.2	6.7
	Magnesium (Mg) (mg/kg)	9360	5240	5080	4820	4940
	Manganese (Mn) (mg/kg)	789	720	460	792	637
	Mercury (Hg) (mg/kg)	0.0604	0.0756	0.0468	0.0556	0.0472
	Molybdenum (Mo) (mg/kg)	0.64	0.57	0.44	0.70	0.57
	Nickel (Ni) (mg/kg)	40.9	24.4	20.4	19.9	19.7
	Phosphorus (P) (mg/kg)	1090	972	934	1110	1220
	Potassium (K) (mg/kg)	1050	880	870	870	850
	Selenium (Se) (mg/kg)	0.56	0.62	0.48	0.69	0.69

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1669082-16	L1669082-17	L1669082-18	L1669082-19	L1669082-20
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	04-SEP-15	04-SEP-15	05-SEP-15	05-SEP-15	06-SEP-15
	Sampled Time					
	Client ID	URC-5	URC	LMC-4	LMC-5	LMC-1
SOIL						
Physical Tests	Loss On Ignition @ 420 C (%)	4		4	4	12
	pH (1:2 soil:water) (pH)	7.26		7.94	7.91	7.83
Particle Size	% Gravel (>2mm) (%)		<0.10	0.28	1.27	<0.10
	% Sand (2.0mm - 0.063mm) (%)		29.4	24.2	28.0	13.3
	% Silt (0.063mm - 4um) (%)		65.0	68.5	64.5	79.9
	% Clay (<4um) (%)		5.60	7.06	6.27	6.83
	Texture		Silt loam	Silt loam	Silt loam	Silt
Leachable Anions & Nutrients	Total Kjeldahl Nitrogen (%)	0.067		0.114	0.109	DLA 0.322
Organic / Inorganic Carbon	CaCO3 Equivalent (%)	<0.80		<0.80	<0.80	<0.80
	Inorganic Carbon (%)	<0.10		<0.10	<0.10	<0.10
	Inorganic Carbon (as CaCO3 Equivalent) (%)	<0.80		<0.80	<0.80	<0.80
	Total Carbon by Combustion (%)	1.4		2.0	2.2	6.2
	Total Organic Carbon (%)	1.41		2.01	2.18	6.23
Metals	Aluminum (Al) (mg/kg)	6630		12000	13100	14300
	Antimony (Sb) (mg/kg)	0.25		0.39	0.42	0.48
	Arsenic (As) (mg/kg)	5.34		5.39	5.58	6.08
	Barium (Ba) (mg/kg)	127		176	196	208
	Beryllium (Be) (mg/kg)	0.19		0.34	0.37	0.47
	Bismuth (Bi) (mg/kg)	<0.20		<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<5.0		<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.076		0.118	0.139	0.162
	Calcium (Ca) (mg/kg)	4630		7430	8780	10900
	Chromium (Cr) (mg/kg)	14.5		27.9	29.9	31.8
	Cobalt (Co) (mg/kg)	6.73		9.38	10.1	10.3
	Copper (Cu) (mg/kg)	10.4		32.8	38.5	44.5
	Iron (Fe) (mg/kg)	16600		22100	23100	24700
	Lead (Pb) (mg/kg)	2.77		4.84	5.25	6.06
	Lithium (Li) (mg/kg)	3.8		7.7	9.0	10.3
	Magnesium (Mg) (mg/kg)	3110		6200	6740	6980
	Manganese (Mn) (mg/kg)	603		629	672	712
	Mercury (Hg) (mg/kg)	0.0157		0.0247	0.0253	0.0332
	Molybdenum (Mo) (mg/kg)	0.51		0.48	0.52	0.63
	Nickel (Ni) (mg/kg)	11.3		24.4	26.6	28.0
	Phosphorus (P) (mg/kg)	687		820	807	775
	Potassium (K) (mg/kg)	550		1000	1050	1150
	Selenium (Se) (mg/kg)	0.29		0.25	0.29	0.44

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1669082-21	L1669082-22			
	Description	Sediment	Sediment			
	Sampled Date	06-SEP-15	06-SEP-15			
	Sampled Time					
	Client ID	LMC-2	LMC-3			
Grouping	**Analyte**					
SOIL						
Physical Tests	Loss On Ignition @ 420 C (%)	8	8			
	pH (1:2 soil:water) (pH)	7.82	7.82			
Particle Size	% Gravel (>2mm) (%)	<0.10	0.31			
	% Sand (2.0mm - 0.063mm) (%)	29.5	19.5			
	% Silt (0.063mm - 4um) (%)	64.3	71.9			
	% Clay (<4um) (%)	6.16	8.37			
	Texture	Silt loam	Silt loam			
Leachable Anions & Nutrients	Total Kjeldahl Nitrogen (%)	0.236	0.243 DLA			
Organic / Inorganic Carbon	CaCO3 Equivalent (%)	<0.80	<0.80			
	Inorganic Carbon (%)	<0.10	<0.10			
	Inorganic Carbon (as CaCO3 Equivalent) (%)	<0.80	<0.80			
	Total Carbon by Combustion (%)	5.0	4.1			
	Total Organic Carbon (%)	5.02	4.11			
Metals	Aluminum (Al) (mg/kg)	11400	14100			
	Antimony (Sb) (mg/kg)	0.50	0.49			
	Arsenic (As) (mg/kg)	6.79	7.47			
	Barium (Ba) (mg/kg)	239	243			
	Beryllium (Be) (mg/kg)	0.38	0.45			
	Bismuth (Bi) (mg/kg)	<0.20	<0.20			
	Boron (B) (mg/kg)	<5.0	<5.0			
	Cadmium (Cd) (mg/kg)	0.199	0.194			
	Calcium (Ca) (mg/kg)	12300	11400			
	Chromium (Cr) (mg/kg)	25.7	34.0			
	Cobalt (Co) (mg/kg)	9.61	11.6			
	Copper (Cu) (mg/kg)	44.8	52.6			
	Iron (Fe) (mg/kg)	21700	25900			
	Lead (Pb) (mg/kg)	5.39	5.87			
	Lithium (Li) (mg/kg)	7.4	9.1			
	Magnesium (Mg) (mg/kg)	5890	7430			
	Manganese (Mn) (mg/kg)	946	927			
	Mercury (Hg) (mg/kg)	0.0355	0.0373			
	Molybdenum (Mo) (mg/kg)	0.68	0.66			
	Nickel (Ni) (mg/kg)	24.1	30.2			
	Phosphorus (P) (mg/kg)	780	848			
	Potassium (K) (mg/kg)	1040	1330			
	Selenium (Se) (mg/kg)	0.46	0.49			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1669082-1 Sediment 03-SEP-15 LWC-4	L1669082-2 Sediment 03-SEP-15 LWC-5	L1669082-3 Sediment 01-SEP-15 UMC-1	L1669082-4 Sediment 01-SEP-15 UMC-2	L1669082-5 Sediment 01-SEP-15 UMC-3
Grouping	**Analyte**					
SOIL						
Metals	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	492	387	348	300	270
	Strontium (Sr) (mg/kg)	104	81.5	73.0	70.2	70.2
	Thallium (Tl) (mg/kg)	0.098	0.057	0.081	0.074	0.063
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	872	785	560	577	523
	Uranium (U) (mg/kg)	2.86	1.67	0.592	0.628	0.640
	Vanadium (V) (mg/kg)	68.2	60.1	47.1	47.1	43.4
	Zinc (Zn) (mg/kg)	63.4	48.1	56.0	55.2	56.7

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1669082-6	L1669082-7	L1669082-8	L1669082-9	L1669082-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	01-SEP-15	01-SEP-15	01-SEP-15	04-SEP-15	04-SEP-15
	Sampled Time					
	Client ID	UMC-4	UMC-5	UMC	LWC-1	LWC-2
Grouping	**Analyte**					
SOIL						
Metals	Silver (Ag) (mg/kg)	0.11	<0.10		0.13	0.13
	Sodium (Na) (mg/kg)	422	376		531	482
	Strontium (Sr) (mg/kg)	104	80.8		125	125
	Thallium (Tl) (mg/kg)	0.109	0.082		0.094	0.083
	Tin (Sn) (mg/kg)	<2.0	<2.0		<2.0	<2.0
	Titanium (Ti) (mg/kg)	781	654		774	687
	Uranium (U) (mg/kg)	1.06	0.786		3.71	4.48
	Vanadium (V) (mg/kg)	59.9	50.7		74.8	71.8
	Zinc (Zn) (mg/kg)	70.5	54.6		64.9	57.2

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1669082-11 Sediment 04-SEP-15 LWC-3	L1669082-12 Sediment 04-SEP-15 URC-1	L1669082-13 Sediment 04-SEP-15 URC-2	L1669082-14 Sediment 04-SEP-15 URC-3	L1669082-15 Sediment 04-SEP-15 URC-4
Grouping	**Analyte**					
SOIL						
Metals	Silver (Ag) (mg/kg)	0.13	0.13	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	514	399	339	363	380
	Strontium (Sr) (mg/kg)	125	81.9	65.2	75.7	81.9
	Thallium (Tl) (mg/kg)	0.090	0.099	0.081	0.083	0.076
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	831	813	767	757	717
	Uranium (U) (mg/kg)	4.13	1.64	1.25	1.42	1.15
	Vanadium (V) (mg/kg)	75.6	65.6	53.7	56.0	56.3
	Zinc (Zn) (mg/kg)	61.6	58.8	50.8	50.6	50.4

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1669082-16	L1669082-17	L1669082-18	L1669082-19	L1669082-20
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	04-SEP-15	04-SEP-15	05-SEP-15	05-SEP-15	06-SEP-15
	Sampled Time					
	Client ID	URC-5	URC	LMC-4	LMC-5	LMC-1
Grouping	**Analyte**					
SOIL						
Metals	Silver (Ag) (mg/kg)	<0.10		<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	181		345	349	363
	Strontium (Sr) (mg/kg)	42.1		64.8	73.1	105
	Thallium (Tl) (mg/kg)	<0.050		0.083	0.088	0.106
	Tin (Sn) (mg/kg)	<2.0		<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	509		697	710	770
	Uranium (U) (mg/kg)	0.603		0.638	0.717	0.960
	Vanadium (V) (mg/kg)	36.5		47.5	48.5	51.4
	Zinc (Zn) (mg/kg)	31.1		53.0	56.6	57.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1669082-21	L1669082-22			
	Description	Sediment	Sediment			
	Sampled Date	06-SEP-15	06-SEP-15			
	Sampled Time					
	Client ID	LMC-2	LMC-3			
Grouping	**Analyte**					
SOIL						
Metals	Silver (Ag) (mg/kg)	<0.10	<0.10			
	Sodium (Na) (mg/kg)	332	411			
	Strontium (Sr) (mg/kg)	100	101			
	Thallium (Tl) (mg/kg)	0.088	0.101			
	Tin (Sn) (mg/kg)	<2.0	<2.0			
	Titanium (Ti) (mg/kg)	679	854			
	Uranium (U) (mg/kg)	1.05	1.06			
	Vanadium (V) (mg/kg)	47.3	58.6			
	Zinc (Zn) (mg/kg)	50.2	61.9			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-INORG-ORG-SK	Soil	Inorganic and Organic Carbon	SSSA (1996) P455-456

When carbonates are decomposed with acid in an open system, carbon dioxide is released to the atmosphere. The decrease in sample weight resulting from CO2 loss is proportional to the carbonate content of the soil.

Reference:
Loeppert, R.H. and Suarez, D.L. 1996. Gravimetric Method for Loss of Carbon Dioxide. P. 455-456 In: J.M. Bartels et al. (ed.) Methods of soil analysis: Part 3 Chemical methods. (3rd ed.) ASA and SSSA, Madison, WI. Book series no. 5

ALS Test Code	Matrix	Test Description	Method Reference**
C-INORG-SK	Soil	Inorganic Carbon / Calcium Carbonate	SSSA (1996) P455-456

When carbonates are decomposed with acid in an open system, carbon dioxide is released to the atmosphere. The decrease in sample weight resulting from CO2 loss is proportional to the carbonate content of the soil.

Reference:
Loeppert, R.H. and Suarez, D.L. 1996. Gravimetric Method for Loss of Carbon Dioxide. P. 455-456 In: J.M. Bartels et al. (ed.) Methods of soil analysis: Part 3 Chemical methods. (3rd ed.) ASA and SSSA, Madison, WI. Book series no. 5

ALS Test Code	Matrix	Test Description	Method Reference**
C-TOT-LECO-SK	Soil	Total Carbon by combustion method	SSSA (1996) P. 973-974

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

ALS Test Code	Matrix	Test Description	Method Reference**
HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS.

ALS Test Code	Matrix	Test Description	Method Reference**
IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
LOI-420-SK	Soil	Loss on Ignition @ 420 C	CSSS (1978) METHOD 3.81

The dry-ash method involves the removal of organic matter by combustion at 420OC for 2 hours. Samples are dried prior to combustion.

Reference: McKeague, J.A. Soil Sampling and Methods of Analysis. Can. Soc. Soil Sci.(1978) method 3.81

ALS Test Code	Matrix	Test Description	Method Reference**
MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CRC ICPMS.

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. This method does not dissolve all silicate materials and may result in a partial extraction. depending on the sample matrix, for some metals, including, but not limited to Al, Ba, Be, Cr, Sr, Ti, Tl, and V.

ALS Test Code	Matrix	Test Description	Method Reference**
N-TOTKJ-COL-SK	Soil	Total Kjeldahl Nitrogen	CSSS (1993) 22.2.3

The soil is digested with sulfuric acid in the presence of CuSO4 and K2SO4 catalysts. Ammonia in the soil extract is determined colrimetrically at 660 nm.

ALS Test Code	Matrix	Test Description	Method Reference**
PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

ALS Test Code	Matrix	Test Description	Method Reference**
PSA-PIPET+GRAVEL-SK	Soil	Particle size - Sieve and Pipette	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference:

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Reference Information

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Chain of Custody Numbers:

1	2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

L1669082-COFC

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC #

Report To	
Company:	Minnow Environmental Inc.
Contact:	Lisa Bowron
Address:	101 - 1025 Hillside Ave. Victoria, BC
Phone:	(250)595-1627 x21 Fax: (250) 595-1625
Invoice To	Same as Report ? ☐ Yes ☑ No
Hardcopy of Invoice with Report?	☑ Yes ☐ No
Company:	Minto Explorations Ltd
Contact:	Cindy Keehn
Address:	Suite 2100-510 West Georgia Street, Vancouver, BC
Phone:	604-684-8894 Fax: 604-688-2180
Lab Work Order # (lab use only)	

Report Format / Distribution	
☑ Standard	☐ Other
☑ PDF ☑ Excel	☐ Digital ☐ Fax
Email 1:	lbowron@minnow.ca
Email 2:	pstecko@minnow.ca
Email 3:	
Client / Project Information	
Job #:	Minnow Project 0073
PO / AFE:	
LSD:	
Quote #:	Q51327
ALS Contact:	Can Dang
Sampler:	Lisa Bowron

Service Requested (Rush for routine analysis subject to availability)

- ◉ Regular (Standard Turnaround Times - Business Days)
- ○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
- ○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
- ○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Rescan Low Level Sediments	Inorganic Carbon	Total Carbon by combustion	Mercury by CVAFS	Loss on Ignition	pH in soil	Particle Size	Total Organic Carbon	Total Kjeldahl Nitrogen	**See Complete Quote #Q51327			Number of Containers
	LWC-4	03-Sep-15		Sediment	X	X	X	X	X	X	X	X	X	X			2
	LWC-5	03-Sep-15		Sediment	X	X	X	X	X	X	X	X	X	X			2
	UMC-1	01-Sep-15		Sediment	X	X	X	X	X	X		X	X	X			1
	UMC-2	01-Sep-15		Sediment	X	X	X	X	X	X		X	X	X			1
	UMC-3	01-Sep-15		Sediment	X	X	X	X	X	X		X	X	X			1
	UMC-4	01-Sep-15		Sediment	X	X	X	X	X	X		X	X	X			1
	UMC-5	01-Sep-15		Sediment	X	X	X	X	X	X		X	X	X			1
	UMC	01-Sep-15		Sediment							X						1
	LWC-1	04-Sep-15		Sediment	X	X	X	X	X	X	X	X	X	X			2
	LWC-2	04-Sep-15		Sediment	X	X	X	X	X	X	X	X	X	X			2
	LWC-3	04-Sep-15		Sediment	X	X	X	X	X	X	X	X	X	X			2
	URC-1	04-Sep-15		Sediment	X	X	X	X	X	X		X	X	X			1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Lisa Bowron	Date (dd-mmm-yy) 07-Sep-15	Time (hh-mm) 15:30	~~Received~~ by: [signature]	Date: 8-Sep-15	Time: 8:45	Temperature: 1.1 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

Tuila Sept 9 14:20 9.8°

L1669082-COFC

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC #

Report To	
Company:	Minnow Environmental Inc.
Contact:	Lisa Bowron
Address:	101 - 1025 Hillside Ave. Victoria, BC
Phone:	(250)595-1627 x21 Fax: (250) 595-1625
Invoice To	Same as Report ? ☐ Yes ☑ No
Hardcopy of Invoice with Report?	☑ Yes ☐ No
Company:	Minto Explorations Ltd
Contact:	Cindy Keehn
Address:	Suite 2100-510 West Georgia Street, Vancouver, BC
Phone:	604-684-8894 Fax: 604-688-2180
Lab Work Order # (lab use only)	

Report Format / Distribution	
☑ Standard ☐ Other	
☑ PDF ☑ Excel ☐ Digital ☐ Fax	
Email 1:	lbowron@minnow.ca
Email 2:	pstecko@minnow.ca
Email 3:	
Client / Project Information	
Job #:	Minnow Project 0073
PO / AFE:	
LSD:	
Quote #:	Q51327
ALS Contact:	Can Dang
Sampler:	Lisa Bowron

Service Requested (Rush for routine analysis subject to availability)

- ● Regular (Standard Turnaround Times - Business Days)
- ○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
- ○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
- ○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Rescan Low Level Sediments	Inorganic Carbon	Total Carbon by combustion	Mercury by CVAFS	Loss on Ignition	pH in soil	Particle Size	Total Organic Carbon	Total Kjeldahl Nitrogen	**See Complete Quote #Q51327			Number of Containers
	URC-2	04-Sep-15		Sediment	X	X	X	X	X	X		X	X	X			1
	URC-3	04-Sep-15		Sediment	X	X	X	X	X	X		X	X	X			1
	URC-4	04-Sep-15		Sediment	X	X	X	X	X	X		X	X	X			1
	URC-5	04-Sep-15		Sediment	X	X	X	X	X	X		X	X	X			1
	URC	04-Sep-15		Sediment	[illegible]						X						1
	LMC-4	05-Sep-15		Sediment	X	X	X	X	X	X	X	X	X	X			2
	LMC-5	05-Sep-15		Sediment	X	X	X	X	X	X	X	X	X	X			2
	LMC-1	06-Sep-15		Sediment	X	X	X	X	X	X	X	X	X	X			2
	LMC-2	06-Sep-15		Sediment	X	X	X	X	X	X	X	X	X	X			2
	LMC-3	06-Sep-15		Sediment	X	X	X	X	X	X	X	X	X	X			2

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Lisa Bowron	07-Sep-15	15:30				°C				

MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 08-SEP-15
Report Date: 02-NOV-15 14:48 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L1669058

Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT 0073
C of C Numbers: 1, 2
Legal Site Desc:

Comments: Please note the dried sample was analyzed.

Can Dang
Senior Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1669058-1	L1669058-2	L1669058-3	L1669058-4	L1669058-5
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	01-SEP-15	01-SEP-15	02-SEP-15	02-SEP-15	03-SEP-15
	Sampled Time					
	Client ID	LMC-4	LMC-5	LWC-2	LWC-3	LWC-4
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	89.8	78.2	3.46	15.0	97.6
Metals	Aluminum (Al)-Total (mg/kg)	10200	8990	6010	7800	6170
	Antimony (Sb)-Total (mg/kg)	0.072	0.038	0.017	0.028	0.021
	Arsenic (As)-Total (mg/kg)	8.66	4.83	2.20	3.85	3.45
	Barium (Ba)-Total (mg/kg)	501	182	124	238	157
	Beryllium (Be)-Total (mg/kg)	0.376	0.338	0.372	0.662	0.759
	Bismuth (Bi)-Total (mg/kg)	0.120	0.094	0.031	0.062	0.036
	Boron (B)-Total (mg/kg)	24.0	6.8	2.2	2.3	4.0
	Cadmium (Cd)-Total (mg/kg)	0.259	0.136	0.090	0.248	0.180
	Calcium (Ca)-Total (mg/kg)	12100	7790	6720	8110	11000
	Cesium (Cs)-Total (mg/kg)	1.04	1.06	0.268	0.728	0.105
	Chromium (Cr)-Total (mg/kg)	36.0	28.2	51.3	51.6	44.0
	Cobalt (Co)-Total (mg/kg)	15.7	8.19	35.8	27.3	34.8
	Copper (Cu)-Total (mg/kg)	47.2	32.0	20.6	27.9	31.8
	Iron (Fe)-Total (mg/kg)	20100	17100	46300	37900	42600
	Lead (Pb)-Total (mg/kg)	6.11	4.23	3.35	2.99	2.72
	Lithium (Li)-Total (mg/kg)	8.96	8.56	6.70	7.83	6.19
	Magnesium (Mg)-Total (mg/kg)	6610	5740	26600	25000	28800
	Manganese (Mn)-Total (mg/kg)	5680	797	873	2360	1040
	Mercury (Hg)-Total (mg/kg)	0.032	0.0229	0.0072	0.0332	<0.010
	Molybdenum (Mo)-Total (mg/kg)	1.02	0.503	1.29	1.04	1.18
	Nickel (Ni)-Total (mg/kg)	29.0	21.5	167	104	173
	Phosphorus (P)-Total (mg/kg)	1820	1200	1370	1630	2520
	Potassium (K)-Total (mg/kg)	1890	1080	845	703	500
	Rubidium (Rb)-Total (mg/kg)	9.13	7.69	3.74	6.06	1.43
	Selenium (Se)-Total (mg/kg)	1.08	0.43	<0.10	0.29	<0.10
	Sodium (Na)-Total (mg/kg)	439	340	1440	811	1400
	Strontium (Sr)-Total (mg/kg)	73.8	51.2	37.9	62.0	49.6
	Tellurium (Te)-Total (mg/kg)	0.020	<0.020	<0.020	<0.020	<0.020
	Thallium (Tl)-Total (mg/kg)	0.0967	0.0791	0.0265	0.0509	0.0166
	Tin (Sn)-Total (mg/kg)	4.02	2.00	0.78	0.60	8.41
	Uranium (U)-Total (mg/kg)	1.36	0.686	0.458	1.01	0.797
	Vanadium (V)-Total (mg/kg)	63.8	39.9	55.8	50.0	39.3
	Zinc (Zn)-Total (mg/kg)	58.3	49.7	90.5	65.9	83.1
	Zirconium (Zr)-Total (mg/kg)	9.81	7.87	22.4	16.6	77.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1669058-6 Tissue 03-SEP-15 LWC-5	L1669058-7 Tissue 04-SEP-15 LWC-1	L1669058-8 Tissue 05-SEP-15 LMC-1	L1669058-9 Tissue 05-SEP-15 LMC-2	L1669058-10 Tissue 05-SEP-15 LMC-3
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	99.1	31.9	84.9	78.6	81.4
Metals	Aluminum (Al)-Total (mg/kg)	10500	4290	9030	7870	10300
	Antimony (Sb)-Total (mg/kg)	0.059	0.018	0.052	0.043	0.057
	Arsenic (As)-Total (mg/kg)	5.29	2.24	7.06	7.00	9.69
	Barium (Ba)-Total (mg/kg)	319	136	422	314	510
	Beryllium (Be)-Total (mg/kg)	1.08	0.428	0.328	0.290	0.390
	Bismuth (Bi)-Total (mg/kg)	0.036	0.027	0.098	0.086	0.119
	Boron (B)-Total (mg/kg)	6.5	1.2	5.6	7.7	22.3
	Cadmium (Cd)-Total (mg/kg)	0.294	0.126	0.207	0.150	0.258
	Calcium (Ca)-Total (mg/kg)	15900	5960	9700	8000	8910
	Cesium (Cs)-Total (mg/kg)	0.161	0.511	0.946	0.891	1.36
	Chromium (Cr)-Total (mg/kg)	114	49.5	29.0	25.3	35.3
	Cobalt (Co)-Total (mg/kg)	49.7	29.4	14.3	11.3	17.0
	Copper (Cu)-Total (mg/kg)	32.7	20.9	34.8	30.5	43.7
	Iron (Fe)-Total (mg/kg)	62100	37600	17700	15600	21400
	Lead (Pb)-Total (mg/kg)	3.55	2.68	4.93	4.36	4.94
	Lithium (Li)-Total (mg/kg)	6.7	5.45	8.05	7.35	9.06
	Magnesium (Mg)-Total (mg/kg)	29100	25400	5730	5240	6460
	Manganese (Mn)-Total (mg/kg)	3500	1180	5270	3360	5790
	Mercury (Hg)-Total (mg/kg)	<0.035	0.0100	0.0249	0.0177	0.0456
	Molybdenum (Mo)-Total (mg/kg)	3.33	0.939	0.816	0.615	0.866
	Nickel (Ni)-Total (mg/kg)	147	122	25.4	21.5	30.3
	Phosphorus (P)-Total (mg/kg)	3280	1690	1060	928	1590
	Potassium (K)-Total (mg/kg)	2510	489	1180	1090	1740
	Rubidium (Rb)-Total (mg/kg)	4.84	3.58	8.25	7.51	9.28
	Selenium (Se)-Total (mg/kg)	0.32	0.10	0.69	0.45	1.18
	Sodium (Na)-Total (mg/kg)	4400	405	354	348	385
	Strontium (Sr)-Total (mg/kg)	125	34.3	71.1	53.8	75.6
	Tellurium (Te)-Total (mg/kg)	<0.040	<0.020	0.021	<0.020	0.022
	Thallium (Tl)-Total (mg/kg)	0.0246	0.0314	0.0951	0.0836	0.101
	Tin (Sn)-Total (mg/kg)	20.6	0.47	4.47	2.68	0.36
	Uranium (U)-Total (mg/kg)	1.44	0.561	0.968	0.842	0.727
	Vanadium (V)-Total (mg/kg)	144	38.7	50.8	38.8	46.8
	Zinc (Zn)-Total (mg/kg)	123	85.1	51.1	46.1	64.3
	Zirconium (Zr)-Total (mg/kg)	88.1	22.2	8.14	6.92	9.21

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1669058-11	L1669058-12	L1669058-13	L1669058-14	L1669058-15
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	06-SEP-15	06-SEP-15	06-SEP-15	06-SEP-15	07-SEP-15
	Sampled Time					
	Client ID	LBC-1	LBC-2	LBC-3	LBC-5	LBC-4
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	2.62	6.26	5.37	4.42	21.5
Metals	Aluminum (Al)-Total (mg/kg)	14900	22600	13700	13800	8170
	Antimony (Sb)-Total (mg/kg)	<0.010	0.021	0.023	0.027	0.036
	Arsenic (As)-Total (mg/kg)	2.46	5.08	17.3	9.67	15.1
	Barium (Ba)-Total (mg/kg)	279	296	513	297	193
	Beryllium (Be)-Total (mg/kg)	0.574	1.09	1.74	0.506	0.393
	Bismuth (Bi)-Total (mg/kg)	0.013	0.027	0.027	0.420	0.415
	Boron (B)-Total (mg/kg)	2.1	4.1	12.9	2.8	1.1
	Cadmium (Cd)-Total (mg/kg)	0.281	0.364	0.789	0.264	0.171
	Calcium (Ca)-Total (mg/kg)	5580	15900	41000	8750	5270
	Cesium (Cs)-Total (mg/kg)	0.287	0.842	0.958	0.745	1.57
	Chromium (Cr)-Total (mg/kg)	150	452	337	75.9	25.6
	Cobalt (Co)-Total (mg/kg)	20.9	37.9	49.0	18.8	8.24
	Copper (Cu)-Total (mg/kg)	43.2	40.6	59.0	22.9	18.4
	Iron (Fe)-Total (mg/kg)	33100	57100	73800	30000	16500
	Lead (Pb)-Total (mg/kg)	2.19	3.91	2.47	5.77	5.68
	Lithium (Li)-Total (mg/kg)	7.16	14.3	8.48	6.83	8.36
	Magnesium (Mg)-Total (mg/kg)	25800	31400	34700	12400	6650
	Manganese (Mn)-Total (mg/kg)	1590	1730	3050	1530	386
	Mercury (Hg)-Total (mg/kg)	0.0057	0.0184	0.0166	0.0149	0.0238
	Molybdenum (Mo)-Total (mg/kg)	0.325	0.576	3.13	0.780	0.695
	Nickel (Ni)-Total (mg/kg)	34.4	67.0	66.4	21.8	23.2
	Phosphorus (P)-Total (mg/kg)	692	1110	501	918	831
	Potassium (K)-Total (mg/kg)	623	1070	1090	1290	901
	Rubidium (Rb)-Total (mg/kg)	2.47	4.84	11.4	4.95	9.41
	Selenium (Se)-Total (mg/kg)	<0.10	<0.10	0.26	0.16	0.13
	Sodium (Na)-Total (mg/kg)	727	773	524	1620	239
	Strontium (Sr)-Total (mg/kg)	59.4	178	111	105	41.0
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	0.064	0.022
	Thallium (Tl)-Total (mg/kg)	0.0547	0.0546	0.206	0.117	0.113
	Tin (Sn)-Total (mg/kg)	0.22	0.30	0.31	0.43	0.26
	Uranium (U)-Total (mg/kg)	0.294	0.493	0.870	0.744	1.01
	Vanadium (V)-Total (mg/kg)	76.5	151	99.4	75.1	35.6
	Zinc (Zn)-Total (mg/kg)	49.6	113	74.9	87.7	46.8
	Zirconium (Zr)-Total (mg/kg)	4.00	6.54	13.4	7.61	5.77

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Mercury (Hg)-Total	DUP-H	L1669058-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-DRY-MICR-CVAF-VA	Tissue	Mercury in Tissue by CVAFS Micro (DRY)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

ALS Test Code	Matrix	Test Description	Method Reference**
MET-DRY-MICR-HRMS-VA	Tissue	Metals in Tissue by HR-ICPMS Micro (DRY)	EPA 200.3/200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on dry weight basis.

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

ALS Test Code	Matrix	Test Description	Method Reference**
MOISTURE-TISS-VA	Tissue	% Moisture in Tissues	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Chain of Custody Numbers:

1 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

L1669058-COFC

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # ____________

Periphyton

Report To		Report Format / Distribution		Service Requested (Rush for routine analysis subject to availability)
Company:	Minnow Environmental Inc.	☑ Standard ☐ Other		◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Lisa Bowron	☑ PDF ☑ Excel ☐ Digital ☐ Fax		○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	101 - 1025 Hillside Ave.	Email 1:	lbowron@minnow.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Victoria, BC	Email 2:	pstecko@minnow.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	(250)595-1627 x21 Fax: (250) 595-1625	Email 3:		
Invoice To	Same as Report ? ☐ Yes ☑ No	**Client / Project Information**		
Hardcopy of Invoice with Report?	☑ Yes ☐ No	Job #:	Minnow Project 0073	
Company:	Minto Exploration Ltd	PO / AFE:		
Contact:	Cindy Keehn	LSD:		
Address:	Suite 2100 - 510 West Georgia St., Vancouver, BC			
Phone:	604-684-8894 Fax: 604-688-2180	Quote #:	Q51327	
Lab Work Order # (lab use only)		ALS Contact:	Can Dang	Sampler: Lisa Bowron

Analysis Request — Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Moisture (%)	High Resolution ICP-MS scan	Mercury in Tissue by CVAFS		**See Complete Quote #Q51327								Number of Containers
	LMC-4	01-Sep-15		Tissue	X	X	X		X								1
	LMC-5	01-Sep-15		Tissue	X	X	X		X								1
	LWC-2	02-Sep-15		Tissue	X	X	X		X								1
	LWC-3	02-Sep-15		Tissue	X	X	X		X								1
	LWC-4	03-Sep-15		Tissue	X	X	X		X								1
	LWC-5	03-Sep-15		Tissue	X	X	X		X								1
	LWC-1	04-Sep-15		Tissue	X	X	X		X								1
	LMC-1	05-Sep-15		Tissue	X	X	X		X								1
	LMC-2	05-Sep-15		Tissue	X	X	X		X								1
	LMC-3	05-Sep-15		Tissue	X	X	X		X								1
	LBC-1	06-Sep-15		″	X	X	X		X								1
	LBC-2	″		″	X	X	X		X								1

Short Holding Time • *Rush Processing*

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs. Benthic samples

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Lisa Bowron	Date (dd-mmm-yy) 7-Sep-15	Time (hh-mm) 15:30	Received by: [signature]	Date: 8-Sep-15	Time: 8:45	Temperature: 1.1 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

Twila Sep 9 14:20 9.8°

L1669058-COFC

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC #

Penplayton

Report To		Report Format / Distribution		Service Requested (Rush for routine analysis subject to availability)
Company:	Minnow Environmental Inc.	[x] Standard [ ] Other		(●) Regular (Standard Turnaround Times - Business Days)
Contact:	Lisa Bowron	[x] PDF [x] Excel [ ] Digital [ ] Fax		( ) Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	101 - 1025 Hillside Ave.	Email 1:	lbowron@minnow.ca	( ) Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Victoria, BC	Email 2:	pstecko@minnow.ca	( ) Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	(250)595-1627 x21 Fax: (250) 595-1625	Email 3:		
Invoice To	Same as Report ? [ ] Yes [x] No	Client / Project Information		
Hardcopy of Invoice with Report?	[x] Yes [ ] No	Job #:	Minnow Project 0073	
Company:	Minto Exploration Ltd	PO / AFE:		
Contact:	Cindy Keehn	LSD:		
Address:	Suite 2100 - 510 West Georgia St., Vancouver, BC			
Phone:	604-684-8894 Fax: 604-688-2180	Quote #:	Q51327	
Lab Work Order # (lab use only)		ALS Contact:	Can Dang	Sampler: Lisa Bowron

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Moisture (%)	High Resolution ICP-MS scan	Mercury in Tissue by CVAFS		**See Complete Quote #Q51327									Number of Containers
	LBC-3	06-Sep-15		Tissue	X	✓	✓		✓									1
	LBC-5	〃		〃	✓	✓	✓		✓									1
	LBC-4	07-Sep-15		〃	✓	✓	✓		✓									1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs. Benthic samples.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Lisa Bowron	Date (dd-mmm-yy) 07-Sep-15	Time (hh-mm) 15:30	Received by:	Date:	Time:	Temperature: °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 08-SEP-15
Report Date: 18-JAN-16 14:17 (MT)
Version: FINAL REV. 4

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L1669031

Project P.O. #: NOT SUBMITTED
Job Reference: MINNOW PROJECT 0073
C of C Numbers: 1, 2
Legal Site Desc:

Comments: ADDITIONAL 11-DEC-15 16:01
ADDITIONAL 10-DEC-15 11:28
ADDITIONAL 03-DEC-15 15:08

8-DEC-2015 Revision 2: Some of the samples were rechecked(re-digested and re-analyzed) for metals analyses. This revision includes the additional rechecked data.
23-DEC-2015 .
23-DEC-2015 Revision 3: Additional data are included in this revision.

18-JAN-2016 Revision 4: This revision replaces and supersedes all previous revision of this report. This revision includes corrected data for all samples.

Can Dang
Senior Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1669031-1	L1669031-3	L1669031-4	L1669031-5	L1669031-6
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	01-SEP-15	02-SEP-15	02-SEP-15	03-SEP-15	03-SEP-15
	Sampled Time					
	Client ID	LMC-4	LWC-2	LWC-3	LWC-4	LWC-5
TISSUE						
Physical Tests	% Moisture (%)	79.4	83.2	79.3	69.5	69.9
Metals	Aluminum (Al)-Total (mg/kg)	2480	2280	1330	3170	2730
	Antimony (Sb)-Total (mg/kg)	0.085	0.047	0.070	0.110	0.088
	Arsenic (As)-Total (mg/kg)	2.41	1.93	1.57	4.28	1.94
	Barium (Ba)-Total (mg/kg)	111	162	57.6	67.9	99.2
	Beryllium (Be)-Total (mg/kg)	0.116	0.179	0.109	0.264	0.209
	Bismuth (Bi)-Total (mg/kg)	0.031	0.028	0.021	0.023	0.017
	Boron (B)-Total (mg/kg)	2.6	2.0	<1.0	<1.0	1.9
	Cadmium (Cd)-Total (mg/kg)	0.173	0.988	1.61	0.731	0.653
	Calcium (Ca)-Total (mg/kg)	2420	2530	3420	2940	2180
	Cesium (Cs)-Total (mg/kg)	0.211	0.348	0.207	0.425	0.257
	Chromium (Cr)-Total (mg/kg)	7.96	21.2	8.51	13.4	11.1
	Cobalt (Co)-Total (mg/kg)	2.02	3.64	3.17	4.77	5.04
	Copper (Cu)-Total (mg/kg)	36.5	33.0	28.9	22.3	23.3
	Iron (Fe)-Total (mg/kg)	5570	5910	3190	10100	7300
	Lead (Pb)-Total (mg/kg)	1.51	1.33	0.944	1.69	1.38
	Lithium (Li)-Total (mg/kg)	1.62	1.40	1.04	2.74	1.96
	Magnesium (Mg)-Total (mg/kg)	2180	2960	2130	3610	4170
	Manganese (Mn)-Total (mg/kg)	505	428	335	287	370
	Mercury (Hg)-Total (mg/kg)	0.0281	0.0268	0.0365	0.0234	0.0217
	Molybdenum (Mo)-Total (mg/kg)	1.24	0.689	1.10	0.704	0.453
	Nickel (Ni)-Total (mg/kg)	7.41	9.37	5.87	9.71	24.0
	Phosphorus (P)-Total (mg/kg)	6400	7610	8410	5590	5640
	Potassium (K)-Total (mg/kg)	12300	11200	6420	5200	7530
	Rubidium (Rb)-Total (mg/kg)	4.15	6.75	4.87	4.82	4.71
	Selenium (Se)-Total (mg/kg)	1.44	1.38	2.91	1.23	0.87
	Sodium (Na)-Total (mg/kg)	6070	3270	2170	2530	2000
	Strontium (Sr)-Total (mg/kg)	22.1	28.0	23.3	33.5	22.2
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Thallium (Tl)-Total (mg/kg)	0.0220	0.0184	0.0212	0.0190	0.0134
	Tin (Sn)-Total (mg/kg)	<0.10	0.15	<0.10	<0.10	<0.10
	Uranium (U)-Total (mg/kg)	0.669	0.580	0.681	0.458	0.410
	Vanadium (V)-Total (mg/kg)	17.2	18.4	9.44	25.0	19.7
	Zinc (Zn)-Total (mg/kg)	85.4	141	109	80.8	113
	Zirconium (Zr)-Total (mg/kg)	2.67	4.14	2.77	4.79	2.72

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1669031-7	L1669031-9	L1669031-10	L1669031-11	L1669031-12
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	04-SEP-15	05-SEP-15	05-SEP-15	06-SEP-15	06-SEP-15
	Sampled Time					
	Client ID	LWC-1	LMC-2	LMC-3	LBC-1	LBC-2
TISSUE						
Physical Tests	% Moisture (%)	79.9	77.5	79.5	78.8	81.9
Metals	Aluminum (Al)-Total (mg/kg)	1510	3280	2120	2070	2230
	Antimony (Sb)-Total (mg/kg)	0.043	0.168	0.105	0.240	0.225
	Arsenic (As)-Total (mg/kg)	1.25	3.80	2.29	7.44	7.44
	Barium (Ba)-Total (mg/kg)	71.5	138	64.3	79.2	84.0
	Beryllium (Be)-Total (mg/kg)	0.121	0.139	0.109	0.171	0.201
	Bismuth (Bi)-Total (mg/kg)	0.020	0.051	0.030	0.315	0.235
	Boron (B)-Total (mg/kg)	<1.0	4.1	2.1	1.0	<1.0
	Cadmium (Cd)-Total (mg/kg)	1.25	0.323	0.265	3.86	4.31
	Calcium (Ca)-Total (mg/kg)	2260	3800	2950	3780	2770
	Cesium (Cs)-Total (mg/kg)	0.169	0.346	0.204	0.714	1.53
	Chromium (Cr)-Total (mg/kg)	5.51	12.1	7.23	6.68	7.01
	Cobalt (Co)-Total (mg/kg)	2.36	3.65	1.71	5.04	7.32
	Copper (Cu)-Total (mg/kg)	28.8	39.0	29.2	66.1	56.7
	Iron (Fe)-Total (mg/kg)	3520	7410	4990	4900	7400
	Lead (Pb)-Total (mg/kg)	0.706	2.03	1.33	3.57	3.98
	Lithium (Li)-Total (mg/kg)	0.91	3.06	1.30	1.06	1.60
	Magnesium (Mg)-Total (mg/kg)	2000	2660	2000	2750	2460
	Manganese (Mn)-Total (mg/kg)	533	502	400	802	893
	Mercury (Hg)-Total (mg/kg)	0.0298	0.0318	0.0284	0.043	0.0419
	Molybdenum (Mo)-Total (mg/kg)	0.770	1.41	1.51	1.20	1.56
	Nickel (Ni)-Total (mg/kg)	5.88	10.7	7.07	6.62	14.6
	Phosphorus (P)-Total (mg/kg)	7900	6220	6790	7010	7750
	Potassium (K)-Total (mg/kg)	6890	8960	10700	5970	7180
	Rubidium (Rb)-Total (mg/kg)	4.23	3.82	2.99	8.33	10.9
	Selenium (Se)-Total (mg/kg)	1.62	2.24	2.18	1.06	1.24
	Sodium (Na)-Total (mg/kg)	2620	2500	6470	2770	3350
	Strontium (Sr)-Total (mg/kg)	29.1	26.2	27.0	36.7	29.1
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Thallium (Tl)-Total (mg/kg)	0.0135	0.0334	0.0185	0.0505	0.0628
	Tin (Sn)-Total (mg/kg)	<0.10	0.16	<0.10	0.11	<0.10
	Uranium (U)-Total (mg/kg)	0.318	0.529	0.566	1.88	1.23
	Vanadium (V)-Total (mg/kg)	12.2	18.3	15.5	13.9	16.1
	Zinc (Zn)-Total (mg/kg)	99.1	117	80.7	173	152
	Zirconium (Zr)-Total (mg/kg)	2.79	4.31	2.61	5.00	3.93

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1669031-13	L1669031-14	L1669031-15	L1669031-17	L1669031-18
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	06-SEP-15	06-SEP-15	07-SEP-15	01-SEP-15	01-SEP-15
	Sampled Time					
	Client ID	LBC-3	LBC-5	LBC-4	LMC-4 DUP	LMC-5
TISSUE						
Physical Tests	% Moisture (%)	79.7	77.1	81.1	80.4	83.3
Metals	Aluminum (Al)-Total (mg/kg)	1440	2070	2890	1980	3650
	Antimony (Sb)-Total (mg/kg)	0.192	0.197	0.218	0.084	0.112
	Arsenic (As)-Total (mg/kg)	5.41	7.05	7.59	3.26	4.08
	Barium (Ba)-Total (mg/kg)	64.2	76.2	78.5	109	118
	Beryllium (Be)-Total (mg/kg)	0.143	0.159	0.166	0.106	0.204
	Bismuth (Bi)-Total (mg/kg)	0.157	0.232	0.295	0.031	0.055
	Boron (B)-Total (mg/kg)	<1.0	<1.0	<1.0	4.2	5.3
	Cadmium (Cd)-Total (mg/kg)	3.25	3.95	4.08	0.216	0.284
	Calcium (Ca)-Total (mg/kg)	2740	2750	3050	2670	4190
	Cesium (Cs)-Total (mg/kg)	0.624	0.654	0.828	0.177	0.354
	Chromium (Cr)-Total (mg/kg)	9.63	7.21	8.86	7.21	14.3
	Cobalt (Co)-Total (mg/kg)	3.24	4.30	6.04	2.86	3.83
	Copper (Cu)-Total (mg/kg)	41.0	67.2	66.0	50.0	60.1
	Iron (Fe)-Total (mg/kg)	3450	6340	6310	5120	9760
	Lead (Pb)-Total (mg/kg)	2.29	2.61	2.86	1.43	2.12
	Lithium (Li)-Total (mg/kg)	0.62	1.20	1.68	1.55	3.27
	Magnesium (Mg)-Total (mg/kg)	1930	2530	3390	2230	3390
	Manganese (Mn)-Total (mg/kg)	440	796	795	624	551
	Mercury (Hg)-Total (mg/kg)	0.040	0.040	0.0506	0.0361	0.0448
	Molybdenum (Mo)-Total (mg/kg)	0.943	1.23	1.07	2.16	4.19
	Nickel (Ni)-Total (mg/kg)	6.31	7.07	9.71	9.20	12.4
	Phosphorus (P)-Total (mg/kg)	6620	8290	8960	7270	5910
	Potassium (K)-Total (mg/kg)	6510	6590	7200	13200	13500
	Rubidium (Rb)-Total (mg/kg)	8.16	10.7	9.97	3.27	3.47
	Selenium (Se)-Total (mg/kg)	0.99	1.05	1.14	1.73	2.16
	Sodium (Na)-Total (mg/kg)	2460	2740	2870	5280	8110
	Strontium (Sr)-Total (mg/kg)	42.6	37.9	30.7	27.6	34.5
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	0.020	<0.020	<0.020
	Thallium (Tl)-Total (mg/kg)	0.0476	0.0636	0.0526	0.0194	0.0305
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	0.20
	Uranium (U)-Total (mg/kg)	2.39	2.00	1.14	0.488	0.714
	Vanadium (V)-Total (mg/kg)	8.10	13.0	19.3	14.1	33.6
	Zinc (Zn)-Total (mg/kg)	179	224	175	144	118
	Zirconium (Zr)-Total (mg/kg)	3.32	2.99	5.37	3.63	5.13

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1669031-19	L1669031-20	L1669031-21	L1669031-23	L1669031-26
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	01-SEP-15	02-SEP-15	03-SEP-15	05-SEP-15	04-SEP-15
	Sampled Time					
	Client ID	LMC-5 DUP	LWC-2 DUP	LWC-5 (DUP)	LMC-3 DUP	LWC-1 DUP
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	81.0	87.9	75.4	78.3	88.6
Metals	Aluminum (Al)-Total (mg/kg)	3770	1790	1010	1900	686
	Antimony (Sb)-Total (mg/kg)	0.105	0.050	0.061	0.128	0.044
	Arsenic (As)-Total (mg/kg)	3.90	2.55	1.71	2.96	1.42
	Barium (Ba)-Total (mg/kg)	129	155	136	91.4	76.7
	Beryllium (Be)-Total (mg/kg)	0.204	0.160	0.160	0.146	0.087
	Bismuth (Bi)-Total (mg/kg)	0.060	0.032	0.012	0.042	0.026
	Boron (B)-Total (mg/kg)	4.0	2.5	3.7	2.4	1.2
	Cadmium (Cd)-Total (mg/kg)	0.261	1.18	0.681	0.360	1.94
	Calcium (Ca)-Total (mg/kg)	3710	3100	2020	3220	3170
	Cesium (Cs)-Total (mg/kg)	0.404	0.233	0.142	0.293	0.100
	Chromium (Cr)-Total (mg/kg)	13.0	22.5	5.74	7.15	7.04
	Cobalt (Co)-Total (mg/kg)	4.05	4.56	3.16	1.94	2.49
	Copper (Cu)-Total (mg/kg)	61.1	26.8	21.2	25.4	30.2
	Iron (Fe)-Total (mg/kg)	9750	4640	3210	5580	2430
	Lead (Pb)-Total (mg/kg)	2.40	1.11	0.989	1.75	0.499
	Lithium (Li)-Total (mg/kg)	3.29	1.47	1.06	1.76	<0.50
	Magnesium (Mg)-Total (mg/kg)	3330	2500	1810	1800	1860
	Manganese (Mn)-Total (mg/kg)	664	358	365	397	625
	Mercury (Hg)-Total (mg/kg)	0.0517	0.030	0.0308	0.0366	0.046
	Molybdenum (Mo)-Total (mg/kg)	3.72	0.874	0.463	1.07	0.949
	Nickel (Ni)-Total (mg/kg)	12.5	8.92	6.43	6.36	4.91
	Phosphorus (P)-Total (mg/kg)	6250	8820	5520	5420	12700
	Potassium (K)-Total (mg/kg)	11300	11800	6500	6330	11200
	Rubidium (Rb)-Total (mg/kg)	3.39	7.62	3.31	3.11	8.88
	Selenium (Se)-Total (mg/kg)	1.90	1.95	1.00	1.90	2.50
	Sodium (Na)-Total (mg/kg)	6890	4060	1840	3270	4240
	Strontium (Sr)-Total (mg/kg)	35.5	31.6	24.4	36.0	53.0
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Thallium (Tl)-Total (mg/kg)	0.0353	0.0153	0.0120	0.0267	0.0123
	Tin (Sn)-Total (mg/kg)	0.18	0.11	<0.10	0.12	<0.10
	Uranium (U)-Total (mg/kg)	0.474	0.402	0.489	0.513	0.208
	Vanadium (V)-Total (mg/kg)	30.4	11.9	10.0	13.3	5.25
	Zinc (Zn)-Total (mg/kg)	129	167	137	117	126
	Zirconium (Zr)-Total (mg/kg)	5.49	4.34	4.41	4.80	1.72

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1669031-30	L1669031-33			
	Description	Tissue	Tissue			
	Sampled Date	05-SEP-15	05-SEP-15			
	Sampled Time					
	Client ID	LMC-1	LMC-2 DUP			
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	86.9				
Metals	Aluminum (Al)-Total (mg/kg)	2250	3340			
	Antimony (Sb)-Total (mg/kg)	0.134	0.112			
	Arsenic (As)-Total (mg/kg)	3.54	3.52			
	Barium (Ba)-Total (mg/kg)	123	188			
	Beryllium (Be)-Total (mg/kg)	0.115	0.150			
	Bismuth (Bi)-Total (mg/kg)	0.032	0.053			
	Boron (B)-Total (mg/kg)	6.2	4.7			
	Cadmium (Cd)-Total (mg/kg)	0.409	0.306			
	Calcium (Ca)-Total (mg/kg)	3020	3370			
	Cesium (Cs)-Total (mg/kg)	0.251	0.354			
	Chromium (Cr)-Total (mg/kg)	7.27	11.7			
	Cobalt (Co)-Total (mg/kg)	2.88	3.51			
	Copper (Cu)-Total (mg/kg)	37.2	40.5			
	Iron (Fe)-Total (mg/kg)	5220	7210			
	Lead (Pb)-Total (mg/kg)	1.38	2.10			
	Lithium (Li)-Total (mg/kg)	1.96	2.83			
	Magnesium (Mg)-Total (mg/kg)	2640	2690			
	Manganese (Mn)-Total (mg/kg)	635	540			
	Mercury (Hg)-Total (mg/kg)	0.0231	0.0209			
	Molybdenum (Mo)-Total (mg/kg)	0.843	1.07			
	Nickel (Ni)-Total (mg/kg)	9.43	10.3			
	Phosphorus (P)-Total (mg/kg)	9230	6430			
	Potassium (K)-Total (mg/kg)	14600	9050			
	Rubidium (Rb)-Total (mg/kg)	3.88	3.68			
	Selenium (Se)-Total (mg/kg)	2.17	2.01			
	Sodium (Na)-Total (mg/kg)	3620	2520			
	Strontium (Sr)-Total (mg/kg)	37.0	25.9			
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020			
	Thallium (Tl)-Total (mg/kg)	0.0196	0.0347			
	Tin (Sn)-Total (mg/kg)	<0.10	0.14			
	Uranium (U)-Total (mg/kg)	0.346	0.521			
	Vanadium (V)-Total (mg/kg)	15.2	17.1			
	Zinc (Zn)-Total (mg/kg)	190	111			
	Zirconium (Zr)-Total (mg/kg)	3.34	3.74			

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-DRY-MICR-CVAF-VA	Tissue	Mercury in Tissue by CVAFS Micro (DRY)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

ALS Test Code	Matrix	Test Description	Method Reference**
MET-DRY-MICR-HRMS-VA	Tissue	Metals in Tissue by HR-ICPMS Micro (DRY)	EPA 200.3/200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on dry weight basis.

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

ALS Test Code	Matrix	Test Description	Method Reference**
MOISTURE-TISS-VA	Tissue	% Moisture in Tissues	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Chain of Custody Numbers:

1 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-DRY-MICR-CVAF-VA	**Tissue**							
Batch R3287026								
WG2183590-4 CRM		**VA-NIST-1547**						
Mercury (Hg)-Total			100.5		%		70-130	09-OCT-15
WG2183590-5 CRM		**VA-NIST-1566B**						
Mercury (Hg)-Total			85.4		%		70-130	09-OCT-15
WG2183590-6 LCS								
Mercury (Hg)-Total			95.6		%		70-130	09-OCT-15
WG2183590-1 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	09-OCT-15
WG2183590-2 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	09-OCT-15
Batch R3291412								
WG2195490-4 CRM		**VA-NIST-1566B**						
Mercury (Hg)-Total			100.2		%		70-130	16-OCT-15
WG2195490-1 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	16-OCT-15
WG2195490-2 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	16-OCT-15
Batch R3331476								
WG2225464-5 CRM		**VA-NIST-1566B**						
Mercury (Hg)-Total			98.8		%		70-130	14-DEC-15
WG2225464-6 LCS								
Mercury (Hg)-Total			99.6		%		70-130	14-DEC-15
WG2225464-1 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	14-DEC-15
WG2225464-2 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	14-DEC-15
Batch R3344754								
WG2233356-3 CRM		**VA-NIST-1547**						
Mercury (Hg)-Total			108.3		%		70-130	22-DEC-15
WG2233356-4 CRM		**VA-NIST-1566B**						
Mercury (Hg)-Total			101.8		%		70-130	22-DEC-15
WG2233356-5 LCS								
Mercury (Hg)-Total			107.2		%		70-130	22-DEC-15
WG2233356-1 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	22-DEC-15
WG2233356-2 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	22-DEC-15
MET-DRY-MICR-HRMS-VA	**Tissue**							

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MICR-HRMS-VA	**Tissue**							
Batch R3292162								
WG2183590-4 CRM		**VA-NIST-1547**						
Aluminum (Al)-Total			74.3		%		70-130	15-OCT-15
Antimony (Sb)-Total			0.019		mg/kg		0.01-0.03	15-OCT-15
Arsenic (As)-Total			0.067		mg/kg		0.03-0.09	15-OCT-15
Barium (Ba)-Total			96.3		%		70-130	15-OCT-15
Boron (B)-Total			123.0		%		70-130	15-OCT-15
Cadmium (Cd)-Total			0.029		mg/kg		0.016-0.036	15-OCT-15
Calcium (Ca)-Total			80.4		%		70-130	15-OCT-15
Cesium (Cs)-Total			88.3		%		70-130	15-OCT-15
Chromium (Cr)-Total			84.8		%		70-130	15-OCT-15
Cobalt (Co)-Total			0.054		mg/kg		0.034-0.074	15-OCT-15
Copper (Cu)-Total			102.5		%		70-130	15-OCT-15
Iron (Fe)-Total			99.0		%		70-130	15-OCT-15
Lead (Pb)-Total			118.2		%		70-130	15-OCT-15
Magnesium (Mg)-Total			95.8		%		70-130	15-OCT-15
Manganese (Mn)-Total			84.0		%		70-130	15-OCT-15
Molybdenum (Mo)-Total			0.049		mg/kg		0.006-0.086	15-OCT-15
Nickel (Ni)-Total			0.40		mg/kg		0.27-0.67	15-OCT-15
Phosphorus (P)-Total			95.3		%		70-130	15-OCT-15
Potassium (K)-Total			90.6		%		70-130	15-OCT-15
Rubidium (Rb)-Total			75.3		%		70-130	15-OCT-15
Selenium (Se)-Total			0.11		mg/kg		0.02-0.22	15-OCT-15
Sodium (Na)-Total			35		mg/kg		12-52	15-OCT-15
Strontium (Sr)-Total			80.6		%		70-130	15-OCT-15
Thallium (Tl)-Total			109.7		%		70-130	15-OCT-15
Tin (Sn)-Total			0.10		mg/kg		0.01-0.21	15-OCT-15
Uranium (U)-Total			90.1		%		70-130	15-OCT-15
Vanadium (V)-Total			0.26		mg/kg		0.17-0.47	15-OCT-15
Zinc (Zn)-Total			104.7		%		70-130	15-OCT-15
WG2183590-5 CRM		**VA-NIST-1566B**						
Antimony (Sb)-Total			0.009		mg/kg		0-0.018	15-OCT-15
Arsenic (As)-Total			93.6		%		70-130	15-OCT-15
Barium (Ba)-Total			94.1		%		70-130	15-OCT-15
Boron (B)-Total			112.4		%		70-130	15-OCT-15
Cadmium (Cd)-Total			99.4		%		70-130	15-OCT-15

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MICR-HRMS-VA	**Tissue**							
Batch R3292162								
WG2183590-5 CRM		**VA-NIST-1566B**						
Calcium (Ca)-Total			97.3		%		70-130	15-OCT-15
Chromium (Cr)-Total			0.23		mg/kg		0.06-0.46	15-OCT-15
Cobalt (Co)-Total			88.6		%		70-130	15-OCT-15
Copper (Cu)-Total			78.3		%		70-130	15-OCT-15
Iron (Fe)-Total			93.0		%		70-130	15-OCT-15
Lead (Pb)-Total			98.3		%		70-130	15-OCT-15
Magnesium (Mg)-Total			94.7		%		70-130	15-OCT-15
Manganese (Mn)-Total			89.2		%		70-130	15-OCT-15
Molybdenum (Mo)-Total			97.3		%		70-130	15-OCT-15
Nickel (Ni)-Total			94.2		%		70-130	15-OCT-15
Phosphorus (P)-Total			90.5		%		70-130	15-OCT-15
Potassium (K)-Total			85.5		%		70-130	15-OCT-15
Rubidium (Rb)-Total			79.8		%		70-130	15-OCT-15
Selenium (Se)-Total			96.3		%		70-130	15-OCT-15
Sodium (Na)-Total			80.9		%		70-130	15-OCT-15
Strontium (Sr)-Total			87.4		%		70-130	15-OCT-15
Uranium (U)-Total			103.1		%		70-130	15-OCT-15
Vanadium (V)-Total			94.0		%		70-130	15-OCT-15
Zinc (Zn)-Total			74.9		%		70-130	15-OCT-15
WG2183590-6 LCS								
Aluminum (Al)-Total			73.3		%		70-130	15-OCT-15
Antimony (Sb)-Total			84.2		%		70-130	15-OCT-15
Arsenic (As)-Total			105.3		%		70-130	15-OCT-15
Barium (Ba)-Total			101.2		%		70-130	15-OCT-15
Beryllium (Be)-Total			89.8		%		70-130	15-OCT-15
Bismuth (Bi)-Total			91.7		%		70-130	15-OCT-15
Boron (B)-Total			94.0		%		70-130	15-OCT-15
Cadmium (Cd)-Total			98.6		%		70-130	15-OCT-15
Calcium (Ca)-Total			124.8		%		70-130	15-OCT-15
Cesium (Cs)-Total			80.0		%		70-130	15-OCT-15
Chromium (Cr)-Total			98.0		%		70-130	15-OCT-15
Cobalt (Co)-Total			102.4		%		70-130	15-OCT-15
Copper (Cu)-Total			92.0		%		70-130	15-OCT-15
Iron (Fe)-Total			94.8		%		70-130	15-OCT-15

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MICR-HRMS-VA	**Tissue**							
Batch R3292162								
WG2183590-6 LCS								
Lead (Pb)-Total			81.3		%		70-130	15-OCT-15
Lithium (Li)-Total			84.8		%		70-130	15-OCT-15
Magnesium (Mg)-Total			91.5		%		70-130	15-OCT-15
Manganese (Mn)-Total			120.9		%		70-130	15-OCT-15
Molybdenum (Mo)-Total			89.0		%		70-130	15-OCT-15
Nickel (Ni)-Total			94.2		%		70-130	15-OCT-15
Potassium (K)-Total			93.1		%		70-130	15-OCT-15
Rubidium (Rb)-Total			78.7		%		70-130	15-OCT-15
Selenium (Se)-Total			97.1		%		70-130	15-OCT-15
Sodium (Na)-Total			96.0		%		70-130	15-OCT-15
Strontium (Sr)-Total			91.0		%		70-130	15-OCT-15
Tellurium (Te)-Total			98.9		%		70-130	15-OCT-15
Thallium (Tl)-Total			88.4		%		70-130	15-OCT-15
Tin (Sn)-Total			79.2		%		70-130	15-OCT-15
Uranium (U)-Total			113.6		%		70-130	15-OCT-15
Vanadium (V)-Total			91.8		%		70-130	15-OCT-15
Zinc (Zn)-Total			97.0		%		70-130	15-OCT-15
Zirconium (Zr)-Total			88.2		%		70-130	15-OCT-15
WG2183590-1 MB								
Antimony (Sb)-Total			<0.010		mg/kg		0.01	15-OCT-15
Arsenic (As)-Total			<0.030		mg/kg		0.03	15-OCT-15
Barium (Ba)-Total			<0.050		mg/kg		0.05	15-OCT-15
Beryllium (Be)-Total			<0.010		mg/kg		0.01	15-OCT-15
Boron (B)-Total			<1.0		mg/kg		1	15-OCT-15
Cadmium (Cd)-Total			<0.010		mg/kg		0.01	15-OCT-15
Calcium (Ca)-Total			<20		mg/kg		20	15-OCT-15
Cesium (Cs)-Total			<0.0050		mg/kg		0.005	15-OCT-15
Chromium (Cr)-Total			<0.20		mg/kg		0.2	15-OCT-15
Cobalt (Co)-Total			<0.020		mg/kg		0.02	15-OCT-15
Copper (Cu)-Total			<0.20		mg/kg		0.2	15-OCT-15
Lead (Pb)-Total			<0.050		mg/kg		0.05	15-OCT-15
Lithium (Li)-Total			<0.50		mg/kg		0.5	15-OCT-15
Molybdenum (Mo)-Total			<0.040		mg/kg		0.04	15-OCT-15
Nickel (Ni)-Total			<0.20		mg/kg		0.2	15-OCT-15

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MICR-HRMS-VA	**Tissue**							
Batch R3292162								
WG2183590-1 MB								
Phosphorus (P)-Total			<10		mg/kg		10	15-OCT-15
Potassium (K)-Total			<20		mg/kg		20	15-OCT-15
Rubidium (Rb)-Total			<0.050		mg/kg		0.05	15-OCT-15
Selenium (Se)-Total			<0.10		mg/kg		0.1	15-OCT-15
Sodium (Na)-Total			<20		mg/kg		20	15-OCT-15
Strontium (Sr)-Total			<0.10		mg/kg		0.1	15-OCT-15
Tellurium (Te)-Total			<0.020		mg/kg		0.02	15-OCT-15
Thallium (Tl)-Total			<0.0020		mg/kg		0.002	15-OCT-15
Tin (Sn)-Total			<0.10		mg/kg		0.1	15-OCT-15
Uranium (U)-Total			<0.0020		mg/kg		0.002	15-OCT-15
Vanadium (V)-Total			<0.10		mg/kg		0.1	15-OCT-15
Zinc (Zn)-Total			<1.0		mg/kg		1	15-OCT-15
Zirconium (Zr)-Total			<0.20		mg/kg		0.2	15-OCT-15
WG2183590-2 MB								
Aluminum (Al)-Total			<5.0		mg/kg		5	15-OCT-15
Antimony (Sb)-Total			<0.010		mg/kg		0.01	15-OCT-15
Barium (Ba)-Total			<0.050		mg/kg		0.05	15-OCT-15
Beryllium (Be)-Total			<0.010		mg/kg		0.01	15-OCT-15
Bismuth (Bi)-Total			<0.010		mg/kg		0.01	15-OCT-15
Boron (B)-Total			<1.0		mg/kg		1	15-OCT-15
Cadmium (Cd)-Total			<0.010		mg/kg		0.01	15-OCT-15
Calcium (Ca)-Total			<20		mg/kg		20	15-OCT-15
Cesium (Cs)-Total			<0.0050		mg/kg		0.005	15-OCT-15
Chromium (Cr)-Total			<0.20		mg/kg		0.2	15-OCT-15
Cobalt (Co)-Total			<0.020		mg/kg		0.02	15-OCT-15
Copper (Cu)-Total			<0.20		mg/kg		0.2	15-OCT-15
Lead (Pb)-Total			<0.050		mg/kg		0.05	15-OCT-15
Lithium (Li)-Total			<0.50		mg/kg		0.5	15-OCT-15
Molybdenum (Mo)-Total			<0.040		mg/kg		0.04	15-OCT-15
Nickel (Ni)-Total			<0.20		mg/kg		0.2	15-OCT-15
Phosphorus (P)-Total			<10		mg/kg		10	15-OCT-15
Potassium (K)-Total			<20		mg/kg		20	15-OCT-15
Rubidium (Rb)-Total			<0.050		mg/kg		0.05	15-OCT-15
Selenium (Se)-Total			<0.10		mg/kg		0.1	15-OCT-15

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MICR-HRMS-VA	**Tissue**							
Batch R3292162								
WG2183590-2 MB								
Sodium (Na)-Total			<20		mg/kg		20	15-OCT-15
Strontium (Sr)-Total			<0.10		mg/kg		0.1	15-OCT-15
Tellurium (Te)-Total			<0.020		mg/kg		0.02	15-OCT-15
Thallium (Tl)-Total			<0.0020		mg/kg		0.002	15-OCT-15
Tin (Sn)-Total			<0.10		mg/kg		0.1	15-OCT-15
Uranium (U)-Total			<0.0020		mg/kg		0.002	15-OCT-15
Vanadium (V)-Total			<0.10		mg/kg		0.1	15-OCT-15
Zinc (Zn)-Total			<1.0		mg/kg		1	15-OCT-15
Zirconium (Zr)-Total			<0.20		mg/kg		0.2	15-OCT-15
Batch R3295635								
WG2183590-6 LCS								
Phosphorus (P)-Total			72.4		%		70-130	19-OCT-15
WG2183590-1 MB								
Aluminum (Al)-Total			<5.0		mg/kg		5	19-OCT-15
Bismuth (Bi)-Total			<0.010		mg/kg		0.01	19-OCT-15
Iron (Fe)-Total			<5.0		mg/kg		5	19-OCT-15
Magnesium (Mg)-Total			<2.0		mg/kg		2	19-OCT-15
Manganese (Mn)-Total			<0.050		mg/kg		0.05	19-OCT-15
WG2183590-2 MB								
Arsenic (As)-Total			<0.030		mg/kg		0.03	19-OCT-15
Iron (Fe)-Total			<5.0		mg/kg		5	19-OCT-15
Magnesium (Mg)-Total			<2.0		mg/kg		2	19-OCT-15
Manganese (Mn)-Total			<0.050		mg/kg		0.05	19-OCT-15
Batch R3323944								
WG2225464-5 CRM		**VA-NIST-1566B**						
Antimony (Sb)-Total			0.006		mg/kg		0-0.018	24-NOV-15
Arsenic (As)-Total			96.3		%		70-130	24-NOV-15
Barium (Ba)-Total			96.5		%		70-130	24-NOV-15
Calcium (Ca)-Total			98.5		%		70-130	24-NOV-15
Chromium (Cr)-Total			0.22		mg/kg		0.06-0.46	24-NOV-15
Cobalt (Co)-Total			82.5		%		70-130	24-NOV-15
Copper (Cu)-Total			75.1		%		70-130	24-NOV-15
Iron (Fe)-Total			98.0		%		70-130	24-NOV-15
Lead (Pb)-Total			92.6		%		70-130	24-NOV-15

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MICR-HRMS-VA	**Tissue**							
Batch R3323944								
WG2225464-5 CRM		**VA-NIST-1566B**						
Magnesium (Mg)-Total			89.0		%		70-130	24-NOV-15
Manganese (Mn)-Total			90.7		%		70-130	24-NOV-15
Molybdenum (Mo)-Total			89.2		%		70-130	24-NOV-15
Nickel (Ni)-Total			85.9		%		70-130	24-NOV-15
Phosphorus (P)-Total			97.5		%		70-130	24-NOV-15
Potassium (K)-Total			86.6		%		70-130	24-NOV-15
Rubidium (Rb)-Total			75.6		%		70-130	24-NOV-15
Selenium (Se)-Total			103.8		%		70-130	24-NOV-15
Sodium (Na)-Total			86.7		%		70-130	24-NOV-15
Strontium (Sr)-Total			128.0		%		70-130	24-NOV-15
Uranium (U)-Total			113.6		%		70-130	24-NOV-15
Vanadium (V)-Total			86.5		%		70-130	24-NOV-15
Zinc (Zn)-Total			82.2		%		70-130	24-NOV-15
WG2225464-6 LCS								
Aluminum (Al)-Total			75.5		%		70-130	24-NOV-15
Antimony (Sb)-Total			80.3		%		70-130	24-NOV-15
Arsenic (As)-Total			125.0		%		70-130	24-NOV-15
Barium (Ba)-Total			101.2		%		70-130	24-NOV-15
Beryllium (Be)-Total			122.6		%		70-130	24-NOV-15
Bismuth (Bi)-Total			103.1		%		70-130	24-NOV-15
Boron (B)-Total			95.3		%		70-130	24-NOV-15
Cadmium (Cd)-Total			99.3		%		70-130	24-NOV-15
Calcium (Ca)-Total			99.9		%		70-130	24-NOV-15
Cesium (Cs)-Total			72.6		%		70-130	24-NOV-15
Chromium (Cr)-Total			105.5		%		70-130	24-NOV-15
Cobalt (Co)-Total			109.4		%		70-130	24-NOV-15
Copper (Cu)-Total			112.7		%		70-130	24-NOV-15
Iron (Fe)-Total			111.5		%		70-130	24-NOV-15
Lead (Pb)-Total			70.2		%		70-130	24-NOV-15
Lithium (Li)-Total			99.1		%		70-130	24-NOV-15
Magnesium (Mg)-Total			94.9		%		70-130	24-NOV-15
Manganese (Mn)-Total			115.6		%		70-130	24-NOV-15
Molybdenum (Mo)-Total			80.0		%		70-130	24-NOV-15
Nickel (Ni)-Total			115.8		%		70-130	24-NOV-15

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MICR-HRMS-VA	**Tissue**							
Batch R3323944								
WG2225464-6 LCS								
Potassium (K)-Total			91.9		%		70-130	24-NOV-15
Rubidium (Rb)-Total			70.8		%		70-130	24-NOV-15
Selenium (Se)-Total			103.7		%		70-130	24-NOV-15
Sodium (Na)-Total			89.8		%		70-130	24-NOV-15
Strontium (Sr)-Total			98.4		%		70-130	24-NOV-15
Tellurium (Te)-Total			122.5		%		70-130	24-NOV-15
Thallium (Tl)-Total			86.3		%		70-130	24-NOV-15
Tin (Sn)-Total			86.4		%		70-130	24-NOV-15
Vanadium (V)-Total			98.3		%		70-130	24-NOV-15
Zinc (Zn)-Total			117.0		%		70-130	24-NOV-15
Zirconium (Zr)-Total			99.6		%		70-130	24-NOV-15
WG2225464-1 MB								
Aluminum (Al)-Total			<5.0		mg/kg		5	24-NOV-15
Antimony (Sb)-Total			<0.010		mg/kg		0.01	24-NOV-15
Arsenic (As)-Total			<0.030		mg/kg		0.03	24-NOV-15
Barium (Ba)-Total			<0.050		mg/kg		0.05	24-NOV-15
Beryllium (Be)-Total			<0.010		mg/kg		0.01	24-NOV-15
Bismuth (Bi)-Total			<0.010		mg/kg		0.01	24-NOV-15
Boron (B)-Total			<1.0		mg/kg		1	24-NOV-15
Cadmium (Cd)-Total			<0.010		mg/kg		0.01	24-NOV-15
Calcium (Ca)-Total			<20		mg/kg		20	24-NOV-15
Cesium (Cs)-Total			<0.0050		mg/kg		0.005	24-NOV-15
Chromium (Cr)-Total			<0.20		mg/kg		0.2	24-NOV-15
Cobalt (Co)-Total			<0.020		mg/kg		0.02	24-NOV-15
Copper (Cu)-Total			<0.20		mg/kg		0.2	24-NOV-15
Iron (Fe)-Total			<5.0		mg/kg		5	24-NOV-15
Lead (Pb)-Total			<0.050		mg/kg		0.05	24-NOV-15
Lithium (Li)-Total			<0.50		mg/kg		0.5	24-NOV-15
Magnesium (Mg)-Total			<2.0		mg/kg		2	24-NOV-15
Manganese (Mn)-Total			<0.050		mg/kg		0.05	24-NOV-15
Molybdenum (Mo)-Total			<0.040		mg/kg		0.04	24-NOV-15
Nickel (Ni)-Total			<0.20		mg/kg		0.2	24-NOV-15
Phosphorus (P)-Total			<10		mg/kg		10	24-NOV-15
Potassium (K)-Total			<20		mg/kg		20	24-NOV-15

ALS Environmental

Quality Control Report

Workorder: L1669031 Report Date: 18-JAN-16

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MICR-HRMS-VA	**Tissue**							
Batch R3323944								
WG2225464-1 MB								
Rubidium (Rb)-Total			<0.050		mg/kg		0.05	24-NOV-15
Selenium (Se)-Total			<0.10		mg/kg		0.1	24-NOV-15
Sodium (Na)-Total			<20		mg/kg		20	24-NOV-15
Strontium (Sr)-Total			<0.10		mg/kg		0.1	24-NOV-15
Tellurium (Te)-Total			<0.020		mg/kg		0.02	24-NOV-15
Thallium (Tl)-Total			<0.0020		mg/kg		0.002	24-NOV-15
Tin (Sn)-Total			<0.10		mg/kg		0.1	24-NOV-15
Uranium (U)-Total			<0.0020		mg/kg		0.002	24-NOV-15
Vanadium (V)-Total			<0.10		mg/kg		0.1	24-NOV-15
Zinc (Zn)-Total			<1.0		mg/kg		1	24-NOV-15
Zirconium (Zr)-Total			<0.20		mg/kg		0.2	24-NOV-15
WG2225464-2 MB								
Aluminum (Al)-Total			<5.0		mg/kg		5	24-NOV-15
Antimony (Sb)-Total			<0.010		mg/kg		0.01	24-NOV-15
Arsenic (As)-Total			<0.030		mg/kg		0.03	24-NOV-15
Barium (Ba)-Total			<0.050		mg/kg		0.05	24-NOV-15
Beryllium (Be)-Total			<0.010		mg/kg		0.01	24-NOV-15
Bismuth (Bi)-Total			<0.010		mg/kg		0.01	24-NOV-15
Boron (B)-Total			<1.0		mg/kg		1	24-NOV-15
Cadmium (Cd)-Total			<0.010		mg/kg		0.01	24-NOV-15
Calcium (Ca)-Total			<20		mg/kg		20	24-NOV-15
Cesium (Cs)-Total			<0.0050		mg/kg		0.005	24-NOV-15
Chromium (Cr)-Total			<0.20		mg/kg		0.2	24-NOV-15
Cobalt (Co)-Total			<0.020		mg/kg		0.02	24-NOV-15
Copper (Cu)-Total			<0.20		mg/kg		0.2	24-NOV-15
Iron (Fe)-Total			<5.0		mg/kg		5	24-NOV-15
Lead (Pb)-Total			<0.050		mg/kg		0.05	24-NOV-15
Lithium (Li)-Total			<0.50		mg/kg		0.5	24-NOV-15
Magnesium (Mg)-Total			<2.0		mg/kg		2	24-NOV-15
Manganese (Mn)-Total			<0.050		mg/kg		0.05	24-NOV-15
Molybdenum (Mo)-Total			<0.040		mg/kg		0.04	24-NOV-15
Nickel (Ni)-Total			<0.20		mg/kg		0.2	24-NOV-15
Phosphorus (P)-Total			<10		mg/kg		10	24-NOV-15
Potassium (K)-Total			<20		mg/kg		20	24-NOV-15

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MICR-HRMS-VA	**Tissue**							
Batch R3323944								
WG2225464-2 MB								
Rubidium (Rb)-Total			<0.050		mg/kg		0.05	24-NOV-15
Selenium (Se)-Total			<0.10		mg/kg		0.1	24-NOV-15
Sodium (Na)-Total			<20		mg/kg		20	24-NOV-15
Strontium (Sr)-Total			<0.10		mg/kg		0.1	24-NOV-15
Tellurium (Te)-Total			<0.020		mg/kg		0.02	24-NOV-15
Thallium (Tl)-Total			<0.0020		mg/kg		0.002	24-NOV-15
Tin (Sn)-Total			<0.10		mg/kg		0.1	24-NOV-15
Uranium (U)-Total			<0.0020		mg/kg		0.002	24-NOV-15
Vanadium (V)-Total			<0.10		mg/kg		0.1	24-NOV-15
Zinc (Zn)-Total			<1.0		mg/kg		1	24-NOV-15
Zirconium (Zr)-Total			<0.20		mg/kg		0.2	24-NOV-15
Batch R3326476								
WG2225464-5 CRM		**VA-NIST-1566B**						
Boron (B)-Total			106.4		%		70-130	04-DEC-15
Cadmium (Cd)-Total			119.2		%		70-130	04-DEC-15
Batch R3344321								
WG2233356-3 CRM		**VA-NIST-1547**						
Aluminum (Al)-Total			76.7		%		70-130	21-DEC-15
Antimony (Sb)-Total			0.016		mg/kg		0.01-0.03	21-DEC-15
Arsenic (As)-Total			0.062		mg/kg		0.03-0.09	21-DEC-15
Barium (Ba)-Total			92.8		%		70-130	21-DEC-15
Boron (B)-Total			91.0		%		70-130	21-DEC-15
Cadmium (Cd)-Total			0.026		mg/kg		0.016-0.036	21-DEC-15
Calcium (Ca)-Total			93.6		%		70-130	21-DEC-15
Cesium (Cs)-Total			88.7		%		70-130	21-DEC-15
Chromium (Cr)-Total			75.8		%		70-130	21-DEC-15
Cobalt (Co)-Total			0.041		mg/kg		0.034-0.074	21-DEC-15
Copper (Cu)-Total			90.0		%		70-130	21-DEC-15
Iron (Fe)-Total			99.1		%		70-130	21-DEC-15
Lead (Pb)-Total			95.0		%		70-130	21-DEC-15
Magnesium (Mg)-Total			90.3		%		70-130	21-DEC-15
Manganese (Mn)-Total			92.8		%		70-130	21-DEC-15
Molybdenum (Mo)-Total			0.039		mg/kg		0.006-0.086	21-DEC-15
Nickel (Ni)-Total			0.35		mg/kg		0.27-0.67	21-DEC-15

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MICR-HRMS-VA	**Tissue**							
Batch R3344321								
WG2233356-3 CRM		**VA-NIST-1547**						
Phosphorus (P)-Total			92.8		%		70-130	21-DEC-15
Potassium (K)-Total			87.9		%		70-130	21-DEC-15
Rubidium (Rb)-Total			88.9		%		70-130	21-DEC-15
Selenium (Se)-Total			0.11		mg/kg		0.02-0.22	21-DEC-15
Sodium (Na)-Total			29		mg/kg		12-52	21-DEC-15
Strontium (Sr)-Total			92.8		%		70-130	21-DEC-15
Thallium (Tl)-Total			89.2		%		70-130	21-DEC-15
Tin (Sn)-Total			0.09		mg/kg		0.01-0.21	21-DEC-15
Uranium (U)-Total			74.6		%		70-130	21-DEC-15
Vanadium (V)-Total			0.21		mg/kg		0.17-0.47	21-DEC-15
Zinc (Zn)-Total			98.5		%		70-130	21-DEC-15
WG2233356-4 CRM		**VA-NIST-1566B**						
Antimony (Sb)-Total			0.006		mg/kg		0-0.018	21-DEC-15
Arsenic (As)-Total			87.0		%		70-130	21-DEC-15
Barium (Ba)-Total			91.9		%		70-130	21-DEC-15
Boron (B)-Total			114.1		%		70-130	21-DEC-15
Cadmium (Cd)-Total			119.5		%		70-130	21-DEC-15
Calcium (Ca)-Total			100.4		%		70-130	21-DEC-15
Chromium (Cr)-Total			0.17		mg/kg		0.06-0.46	21-DEC-15
Cobalt (Co)-Total			78.0		%		70-130	21-DEC-15
Copper (Cu)-Total			83.8		%		70-130	21-DEC-15
Iron (Fe)-Total			103.3		%		70-130	21-DEC-15
Lead (Pb)-Total			70.4		%		70-130	21-DEC-15
Magnesium (Mg)-Total			94.4		%		70-130	21-DEC-15
Manganese (Mn)-Total			99.1		%		70-130	21-DEC-15
Molybdenum (Mo)-Total			91.3		%		70-130	21-DEC-15
Nickel (Ni)-Total			82.9		%		70-130	21-DEC-15
Phosphorus (P)-Total			96.5		%		70-130	21-DEC-15
Potassium (K)-Total			82.7		%		70-130	21-DEC-15
Rubidium (Rb)-Total			98.0		%		70-130	21-DEC-15
Selenium (Se)-Total			89.8		%		70-130	21-DEC-15
Sodium (Na)-Total			81.3		%		70-130	21-DEC-15
Strontium (Sr)-Total			97.8		%		70-130	21-DEC-15
Uranium (U)-Total			100.9		%		70-130	21-DEC-15

Quality Control Report

Workorder: L1669031 Report Date: 18-JAN-16

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MICR-HRMS-VA	**Tissue**							
Batch R3344321								
WG2233356-4 CRM		**VA-NIST-1566B**						
Vanadium (V)-Total			78.9		%		70-130	21-DEC-15
Zinc (Zn)-Total			85.0		%		70-130	21-DEC-15
WG2233356-5 LCS								
Aluminum (Al)-Total			82.8		%		70-130	21-DEC-15
Antimony (Sb)-Total			89.7		%		70-130	21-DEC-15
Arsenic (As)-Total			105.8		%		70-130	21-DEC-15
Barium (Ba)-Total			103.6		%		70-130	21-DEC-15
Beryllium (Be)-Total			122.5		%		70-130	21-DEC-15
Bismuth (Bi)-Total			100.3		%		70-130	21-DEC-15
Boron (B)-Total			95.4		%		70-130	21-DEC-15
Cadmium (Cd)-Total			127.9		%		70-130	21-DEC-15
Calcium (Ca)-Total			96.4		%		70-130	21-DEC-15
Cesium (Cs)-Total			102.0		%		70-130	21-DEC-15
Chromium (Cr)-Total			98.4		%		70-130	21-DEC-15
Cobalt (Co)-Total			126.1		%		70-130	21-DEC-15
Copper (Cu)-Total			99.9		%		70-130	21-DEC-15
Iron (Fe)-Total			93.0		%		70-130	21-DEC-15
Lithium (Li)-Total			106.3		%		70-130	21-DEC-15
Magnesium (Mg)-Total			97.6		%		70-130	21-DEC-15
Manganese (Mn)-Total			120.4		%		70-130	21-DEC-15
Molybdenum (Mo)-Total			98.8		%		70-130	21-DEC-15
Nickel (Ni)-Total			107.6		%		70-130	21-DEC-15
Phosphorus (P)-Total			105.8		%		70-130	21-DEC-15
Potassium (K)-Total			90.1		%		70-130	21-DEC-15
Rubidium (Rb)-Total			102.0		%		70-130	21-DEC-15
Selenium (Se)-Total			99.5		%		70-130	21-DEC-15
Sodium (Na)-Total			91.7		%		70-130	21-DEC-15
Strontium (Sr)-Total			112.2		%		70-130	21-DEC-15
Tellurium (Te)-Total			109.2		%		70-130	21-DEC-15
Thallium (Tl)-Total			98.5		%		70-130	21-DEC-15
Tin (Sn)-Total			97.6		%		70-130	21-DEC-15
Uranium (U)-Total			80.0		%		70-130	21-DEC-15
Vanadium (V)-Total			128.6		%		70-130	21-DEC-15
Zinc (Zn)-Total			89.8		%		70-130	21-DEC-15

ALS Environmental

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MICR-HRMS-VA	**Tissue**							
Batch R3344321								
WG2233356-5 LCS								
Zirconium (Zr)-Total			104.0		%		70-130	21-DEC-15
WG2233356-1 MB								
Aluminum (Al)-Total			<5.0		mg/kg		5	21-DEC-15
Antimony (Sb)-Total			<0.010		mg/kg		0.01	21-DEC-15
Arsenic (As)-Total			<0.030		mg/kg		0.03	21-DEC-15
Barium (Ba)-Total			<0.050		mg/kg		0.05	21-DEC-15
Beryllium (Be)-Total			<0.010		mg/kg		0.01	21-DEC-15
Bismuth (Bi)-Total			<0.010		mg/kg		0.01	21-DEC-15
Boron (B)-Total			<1.0		mg/kg		1	21-DEC-15
Cadmium (Cd)-Total			<0.010		mg/kg		0.01	21-DEC-15
Calcium (Ca)-Total			<20		mg/kg		20	21-DEC-15
Cesium (Cs)-Total			<0.0050		mg/kg		0.005	21-DEC-15
Chromium (Cr)-Total			<0.20		mg/kg		0.2	21-DEC-15
Cobalt (Co)-Total			<0.020		mg/kg		0.02	21-DEC-15
Copper (Cu)-Total			<0.20		mg/kg		0.2	21-DEC-15
Iron (Fe)-Total			<5.0		mg/kg		5	21-DEC-15
Lead (Pb)-Total			<0.050		mg/kg		0.05	21-DEC-15
Lithium (Li)-Total			<0.50		mg/kg		0.5	21-DEC-15
Magnesium (Mg)-Total			<2.0		mg/kg		2	21-DEC-15
Manganese (Mn)-Total			<0.050		mg/kg		0.05	21-DEC-15
Molybdenum (Mo)-Total			<0.040		mg/kg		0.04	21-DEC-15
Nickel (Ni)-Total			<0.20		mg/kg		0.2	21-DEC-15
Phosphorus (P)-Total			<10		mg/kg		10	21-DEC-15
Potassium (K)-Total			<20		mg/kg		20	21-DEC-15
Rubidium (Rb)-Total			<0.050		mg/kg		0.05	21-DEC-15
Selenium (Se)-Total			<0.10		mg/kg		0.1	21-DEC-15
Sodium (Na)-Total			<20		mg/kg		20	21-DEC-15
Strontium (Sr)-Total			<0.10		mg/kg		0.1	21-DEC-15
Tellurium (Te)-Total			<0.020		mg/kg		0.02	21-DEC-15
Thallium (Tl)-Total			<0.0020		mg/kg		0.002	21-DEC-15
Tin (Sn)-Total			<0.10		mg/kg		0.1	21-DEC-15
Uranium (U)-Total			<0.0020		mg/kg		0.002	21-DEC-15
Vanadium (V)-Total			<0.10		mg/kg		0.1	21-DEC-15
Zinc (Zn)-Total			<1.0		mg/kg		1	21-DEC-15

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MICR-HRMS-VA	**Tissue**							
Batch R3344321								
WG2233356-1 MB								
Zirconium (Zr)-Total			<0.20		mg/kg		0.2	21-DEC-15
WG2233356-2 MB								
Aluminum (Al)-Total			<5.0		mg/kg		5	21-DEC-15
Antimony (Sb)-Total			<0.010		mg/kg		0.01	21-DEC-15
Arsenic (As)-Total			<0.030		mg/kg		0.03	21-DEC-15
Barium (Ba)-Total			<0.050		mg/kg		0.05	21-DEC-15
Beryllium (Be)-Total			<0.010		mg/kg		0.01	21-DEC-15
Bismuth (Bi)-Total			<0.010		mg/kg		0.01	21-DEC-15
Boron (B)-Total			<1.0		mg/kg		1	21-DEC-15
Cadmium (Cd)-Total			<0.010		mg/kg		0.01	21-DEC-15
Calcium (Ca)-Total			<20		mg/kg		20	21-DEC-15
Cesium (Cs)-Total			<0.0050		mg/kg		0.005	21-DEC-15
Chromium (Cr)-Total			<0.20		mg/kg		0.2	21-DEC-15
Cobalt (Co)-Total			<0.020		mg/kg		0.02	21-DEC-15
Copper (Cu)-Total			<0.20		mg/kg		0.2	21-DEC-15
Iron (Fe)-Total			<5.0		mg/kg		5	21-DEC-15
Lead (Pb)-Total			<0.050		mg/kg		0.05	21-DEC-15
Lithium (Li)-Total			<0.50		mg/kg		0.5	21-DEC-15
Magnesium (Mg)-Total			<2.0		mg/kg		2	21-DEC-15
Manganese (Mn)-Total			<0.050		mg/kg		0.05	21-DEC-15
Molybdenum (Mo)-Total			<0.040		mg/kg		0.04	21-DEC-15
Nickel (Ni)-Total			<0.20		mg/kg		0.2	21-DEC-15
Phosphorus (P)-Total			<10		mg/kg		10	21-DEC-15
Potassium (K)-Total			<20		mg/kg		20	21-DEC-15
Rubidium (Rb)-Total			<0.050		mg/kg		0.05	21-DEC-15
Selenium (Se)-Total			<0.10		mg/kg		0.1	21-DEC-15
Sodium (Na)-Total			<20		mg/kg		20	21-DEC-15
Strontium (Sr)-Total			<0.10		mg/kg		0.1	21-DEC-15
Tellurium (Te)-Total			<0.020		mg/kg		0.02	21-DEC-15
Thallium (Tl)-Total			<0.0020		mg/kg		0.002	21-DEC-15
Tin (Sn)-Total			<0.10		mg/kg		0.1	21-DEC-15
Uranium (U)-Total			<0.0020		mg/kg		0.002	21-DEC-15
Vanadium (V)-Total			<0.10		mg/kg		0.1	21-DEC-15
Zinc (Zn)-Total			<1.0		mg/kg		1	21-DEC-15

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MICR-HRMS-VA	**Tissue**							
Batch R3344321								
WG2233356-2 MB								
Zirconium (Zr)-Total			<0.20		mg/kg		0.2	21-DEC-15

Client: MINNOW ENVIRONMENTAL INC.
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Contact: Lisa Bowron

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

L1669031-COFC

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Benthic

COC #

Report To	
Company:	Minnow Environmental Inc.
Contact:	Lisa Bowron
Address:	101 - 1025 Hillside Ave. Victoria, BC
Phone:	(250)595-1627 x21 Fax: (250) 595-1625
Invoice To	Same as Report ? ☐ Yes ☑ No
Hardcopy of Invoice with Report?	☑ Yes ☐ No
Company:	Minto Exploration Ltd
Contact:	Cindy Keehn
Address:	Suite 2100 - 510 West Georgia St., Vancouver, BC
Phone:	604-684-8894 Fax: 604-688-2180
Lab Work Order # (lab use only)	

Report Format / Distribution	
☑ Standard ☐ Other	
☑ PDF ☑ Excel ☐ Digital ☐ Fax	
Email 1:	lbowron@minnow.ca
Email 2:	pstecko@minnow.ca
Email 3:	
Client / Project Information	
Job #:	Minnow Project 0073
PO / AFE:	
LSD:	
Quote #:	Q51327
ALS Contact:	Can Dang
Sampler:	Lisa Bowron

Service Requested (Rush for routine analysis subject to availability)

- ◉ Regular (Standard Turnaround Times - Business Days)
- ○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
- ○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
- ○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Short Holding Time • *Rush Processing*

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Moisture (%)	High Resolution ICP-MS scan	Mercury in Tissue by CVAFS		**See Complete Quote #Q51327								Number of Containers
	LMC-4	01-Sep-15		Tissue	X	X	X		X								1
	LMC-5	01-Sep-15		Tissue	X	X	X		X								1
	LWC-2	02-Sep-15		Tissue	X	X	X		X								1
	~~LWC-2~~ LWC-3	02-Sep-15		Tissue	X	X	X		X								1
	LWC-4	03-Sep-15		Tissue	X	X	X		X								1
	LWC-5	03-Sep-15		Tissue	X	X	X		X								1
	LWC-1	04-Sep-15		Tissue	X	X	X		X								1
	LMC-1	05-Sep-15		Tissue	X	X	X		X								1
	LMC-2	05-Sep-15		Tissue	X	X	X		X								1
	LMC-3	05-Sep-15		Tissue	X	X	X		X								1
	LBC-1	06-Sep-15		Tissue	X	X	X		X								1
	LBC-2	06-Sep-15		Tissue	X	X	X		X								1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs. Benthic samples.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Lisa Bowron	7-Sep-15	15:30	[signature]	8-Sep-15	8:45	1.1 °C				
			Twila	Sep 9	14:20	9.8°				

L1669031-COFC

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC #

Benthic

Report To	
Company:	Minnow Environmental Inc.
Contact:	Lisa Bowron
Address:	101 - 1025 Hillside Ave. Victoria, BC
Phone:	(250)595-1627 x21 Fax: (250) 595-1625
Invoice To	Same as Report ? ☐ Yes ☑ No
Hardcopy of Invoice with Report?	☑ Yes ☐ No
Company:	Minto Exploration Ltd
Contact:	Cindy Keehn
Address:	Suite 2100 - 510 West Georgia St., Vancouver, BC
Phone:	604-684-8894 Fax: 604-688-2180
Lab Work Order # (lab use only)	

Report Format / Distribution	
☑ Standard ☐ Other	
☑ PDF ☑ Excel ☐ Digital ☐ Fax	
Email 1:	lbowron@minnow.ca
Email 2:	pstecko@minnow.ca
Email 3:	
Client / Project Information	
Job #:	Minnow Project 0073
PO / AFE:	
LSD:	
Quote #:	Q51327
ALS Contact:	Can Dang
Sampler:	Lisa Bowron

Service Requested (Rush for routine analysis subject to availability)

- ◉ Regular (Standard Turnaround Times - Business Days)
- ○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
- ○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
- ○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Moisture (%)	High Resolution ICP-MS scan	Mercury in Tissue by CVAFS		**See Complete Quote #Q51327								Number of Containers
	LBC-3	06-Sep-15		Tissue	X	X	X		X								1
	LBC-5	〃		〃	X	X	X		X								1
	LBC-4	07-Sep-15		〃	X	X	X		X								1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs. Benthic samples

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Lisa Bowron	Date (dd-mmm-yy) 07-Sep-15	Time (hh-mm) 15:30	Received by:	Date:	Time:	Temperature: °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

8081 Lougheed Highway
Burnaby, British Columbia V5A 1W9
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F: +1 604 253 6700
www.alsglobal.com

January 15, 2016
Minnow Environmental Inc.
101 – 1025 Hillside Ave.
Victoria, BC,
V8T 2A2

Attention: Pierre Stecko,

RE: ALS Corrective Action Report (CAR) #13743 – Incorrect Metals Results Reported for Minnow Project 0073 (ALS File L1669031)

Dear Mr. Stecko,

On September 8, 2015, ALS received fifteen (15) tissue samples from Minnow Environmental Inc. These samples consisted of benthic invertebrate samples submitted in small bags each containing between 0.1 to 1.2 grams of sample.

Upon review of the completed metals results for the above referenced project, Mr. Pierre Stecko of Minnow Environmental contacted ALS to discuss the data. The reported results for these samples appeared very inconsistent with results reported from Minnow's previous year's study at the same site.

ALS Vancouver immediately initiated sample reanalyses for this submission. Nine of the initial fifteen samples had sufficient material remaining for re-digestion. Reanalyses were conducted in replicate, where possible, to allow a better assessment of sample heterogeneity and the representativeness of the original results. None of the original digests were extant at the start of the investigation; they are typically retained for 30 days following analysis.

The reanalysis results did not support the originally reported results, so ALS initiated a more extensive data-based investigation into possible laboratory error. It is not practical to detail all of the possible mechanisms of error considered, but the data reviewed included:

- Results of original metals analyses
- Initial weights of digestion and total sample weights, as received
- Moisture content of original and reanalysis subsamples
- Results of reanalysis of original digests and subsequent redigestions
- Results of analysis of other samples analysed at the same time as Minnow's submission
- Distribution of metals within single samples and between replicates of the same sample

The investigation conclusions were made difficult and delayed by the complex and rare nature of the error mechanism. However, the final complete data set supports the conclusion very well: two of the original samples reported for Minnow Project 0073 (LWC-3 and LMC-2) had correct metals results, while the remaining thirteen samples were incorrect due to a sample mix-up during processing. The moisture results were not impacted.

In order to prevent recurrence of this issue, ALS has implemented the following corrective actions:

- The details of the investigation and error have been discussed with all employees who are part of the team responsible for tissue analysis. An emphasis was placed on the importance of attention to detail, and the impact of incorrect data on ALS' clients.

- Requirements for sample identification, handling, sub-sampling and homogenization during processing have been expanded and clarified in the written procedures used for tissue sample preparation and digestion.

- The original report has been corrected and re-issued. Where multiple sets of data were available, the most representative analytical results have been included in the final report. ALS is confident in the final results now reported for this submission.

We would like to sincerely apologize for the inconvenience caused to Minnow by this error. We hope that this letter provides an explanation of the issue that occurred and addresses how ALS plans to ensure that it does not occur again in the future.

If you would like more details regarding our corrective actions, or if you have suggestions for further ALS improvements, please do not hesitate to contact either of the undersigned.

Sincerely,

Katherine B. Thomas, B.Sc.
Operations Manager – Vancouver

Miles Gropen, B.Sc.
Inorganics Lab Manager – Vancouver

MINNOW ENVIRONMENTAL INC.
ATTN: Lisa Bowron
101 - 1025 Hillside Ave.
Victoria BC V8T 2A2

Date Received: 08-SEP-15
Report Date: 22-SEP-15 15:01 (MT)
Version: FINAL

Client Phone: 250-595-1627

Certificate of Analysis

Lab Work Order #: L1669019

Project P.O. #:	NOT SUBMITTED
Job Reference:	MINNOW PROJECT 0073
C of C Numbers:	1
Legal Site Desc:	

Can Dang
Senior Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1669019-1 Tissue 01-SEP-15 LMC-4	L1669019-2 Tissue 01-SEP-15 LMC-5	L1669019-3 Tissue 02-SEP-15 LWC-2	L1669019-4 Tissue 02-SEP-15 LWC-3	L1669019-5 Tissue 03-SEP-15 LWC-4
Grouping	**Analyte**					
BIOTA						
Field Tests	Area Sampled (cm2)	0	0	0	0	0
Plant Pigments	Chlorophyll a (ug)	28.5	15.8	0.094	0.218	1.16

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1669019-6	L1669019-7	L1669019-8	L1669019-9	L1669019-10
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	03-SEP-15	04-SEP-15	05-SEP-15	05-SEP-15	05-SEP-15
	Sampled Time					
	Client ID	LWC-5	LWC-1	LMC-1	LMC-2	LMC-3
Grouping	**Analyte**					
BIOTA						
Field Tests	Area Sampled (cm2)	0	0	0	0	0
Plant Pigments	Chlorophyll a (ug)	0.120	0.270	31.2	27.5	21.3

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AREA SAMPLED-VA	Biota	Area Sampled (cm2)	Not Applicable
CHLOROA-F-VA	Biota	Chlorophyll a in Biota by Fluorometer	EPA 445.0

This analysis is done using procedures adapted from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b. Note: Biota samples are typically submitted as scrapings on a filter.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

L1669019-COFC

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Chlorophyll α

COC #

Page 1 of 1

Report To	
Company:	Minnow Environmental Inc.
Contact:	Lisa Bowron
Address:	101 - 1025 Hillside Ave. Victoria, BC
Phone:	(250)595-1627 x21 Fax: (250) 595-1625
Invoice To Same as Report ?	☐ Yes ☑ No
Hardcopy of Invoice with Report?	☑ Yes ☐ No
Company:	Minto Explorations Ltd
Contact:	Cindy Keehn
Address:	Suite 2100 - 510 West Georgia St., Vancouver, BC
Phone:	604-684-8894 Fax: 604-688-2180
Lab Work Order # (lab use only)	

Report Format / Distribution	
☑ Standard ☐ Other	
☑ PDF ☑ Excel ☐ Digital ☐ Fax	
Email 1:	lbowron@minnow.ca
Email 2:	pstecko@minnow.ca
Email 3:	
Client / Project Information	
Job #:	Minnow Project 0073
PO / AFE:	
LSD:	
Quote #:	Q51327
ALS Contact:	Can Dang
Sampler:	Lisa Bowron

Service Requested (Rush for routine analysis subject to availability)

- ◉ Regular (Standard Turnaround Times - Business Days)
- ○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
- ○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
- ○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

**See Complete Quote #Q51327

Short Holding Time • *Rush Processing*

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Chlorophyll a	Number of Containers
	LMC-4	01-Sep-15		Tissue	X	1
	LMC-5	01-Sep-15		Tissue	X	1
	LWC-2	02-Sep-15		Tissue	X	1
	LWC-3	02-Sep-15		Tissue	X	1
	LWC-4	03-Sep-15		Tissue	X	1
	LWC-5	03-Sep-15		Tissue	X	1
	LWC-1	04-Sep-15		Tissue	X	1
	LMC-1	05-Sep-15		Tissue	X	1
	LMC-2	05-Sep-15		Tissue	X	1
	LMC-3	05-Sep-15		Tissue	X	1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs. Periphyton samples.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Lisa Bowron	Date (dd-mmm-yy) 7-Sep-15 ~~17-Sep-14~~	Time (hh-mm) 15:30 ~~12:20~~	Received by: [signature]	Date: 8-Sep-15	Time: 8:45	Temperature: 1.1 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

Twik Sept 9 14:20 9.9°

GENF 20.00 Front

Freshwater sediment toxicity testing on samples identified as LWC and LMC

Samples collected September 3-6, 2015

Final Report

Report date:
November 2, 2015

Submitted to:

Minnow Environmental
Victoria, BC

8664 Commerce Court
Burnaby, BC
V5A 4N7

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LIST OF TABLES

LIST OF APPENDICES

SIGNATURE PAGE

Karen Lee, B.Sc.
Testing Manager

Armando Tang, R.P.Bio.
Senior Reviewer

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

1.0 INTRODUCTION

Nautilus Environmental conducted freshwater sediment toxicity tests for Minnow Environmental on samples identified as LWC and LMC. The samples were collected between September 3 to 6, 2015 and delivered to the laboratory in Burnaby, BC on September 14, 2015. Each sample was transported in five 1-L glass jars and were received at a temperature of 17.7°C. The samples were stored in the dark at 4 ± 2°C prior to testing. A 14-d *Hyalella azteca* and a 10-d *Chironomus dilutus* survival and growth sediment toxicity test were conducted on the samples. This report describes the results of these toxicity tests. Copies of laboratory data sheets and printouts of statistical analyses for the tests are provided in Appendices A and B. The chain-of-custody form is provided in Appendix C.

2.0 METHODS

Methods for the toxicity tests are summarized in Tables 1 and 2. Testing was conducted according to procedures described by Environment Canada (1997 and 2013). Statistical analyses for all tests were performed using CETIS (Tidepool Scientific Software, 2013). Ammonia levels were monitored three times a week on the reference sample LWC to ensure that concentrations did not exceed 0.2 mg/L N of un-ionized ammonia. The ammonia concentrations in the overlying water of the samples and control were measured by ALS Environmental, Burnaby and are provided in Appendices A and B.

Table 1. Summary of test conditions: *Hyalella azteca* survival and growth test.

Test organism	*Hyalella azteca*
Test organism source	Aquatic Research Organisms, NH
Test organism age	2 – 9 days old
Test type	Static
Test duration	14 days
Test vessel	375 mL glass container
Test volume	100 mL sediment; 175 mL overlying water
Test replicates	5 field replicates per sample
Number of organisms	10 per replicate
Control water	Moderately-hard synthetic water prepared from dechlorinated municipal water
Test solution renewal	None
Test temperature	23 ± 1°C
Feeding	0.75 mL of YCT and 1.35 mg Tetramin per replicate daily
Light intensity	500 to 1000 lux at water surface
Photoperiod	16 hours light/8 hours dark
Aeration	Gentle aeration throughout test
Test protocol	Environment Canada (2013), EPS 1/RM/33
Statistical software	CETIS (2013)
Test endpoint	Survival and dry weight
Test acceptability criteria for controls	Mean control survival of ≥80% survival and ≥0.1 mg/amphipod dry weight
Reference toxicant	Sodium chloride

Table 2. Summary of test conditions: *Chironomus dilutus* survival and growth test.

Test organism	*Chironomus dilutus*
Test organism source	Aquatic BioSystems, Fort Collins, CO
Test organism age	3rd Instar
Test type	Static
Test duration	10 days
Test vessel	375-mL glass containers
Test volume	100 mL sediment; 175 mL overlying water
Test replicates	5 field replicates per treatment
No. of organisms	10 per replicate
Control water	Moderately-hard synthetic water prepared from dechlorinated municipal water
Test solution renewal	None
Test temperature	23 ± 1°C
Feeding	6.0 mg Tetramin in 1.5 mL suspension per replicate daily
Light intensity	500 – 1000 lux at water surface
Photoperiod	16 hours light/8 hours dark
Aeration	Gentle aeration thoughout test
Test protocol	Environment Canada (1997), EPS 1/RM/32
Statistical software	CETIS (2013)
Test endpoint	Survival and dry weight
Test acceptability criteria for controls	Mean control survival ≥70% survival and ≥0.6 mg/worm dry weight
Reference toxicant	Potassium chloride

3.0 RESULTS

No effects were observed on survival on either *H. azteca* or *C. dilutus* compared to the control sediment or the reference sediment LWC (Tables 3 and 4). There were no significant effects on dry weight on either species except for sample LCW on *H. azteca*, compared to the control sediment. No effects were observed on the dry weight on either species compared to the reference sediment LWC. Measured ammonia concentrations in the overlying water are summarized in Tables 5 and 6.

Table 3. Results: *Hyalella azteca* survival and growth test.

Sample ID	Mean ± SD	
	Survival (%)	**Dry Weight (mg)**
Control Sediment	98.0 ± 4.5	0.26 ± 0.05
LWC	100 ± 0.0	0.20 ± 0.05*
LMC	100 ± 0.0	0.25 ± 0.08

(*) Asterisks indicate samples that were significantly different from the control sediment.
(†) Pluses indicate samples that were significantly differen from the reference sediment (LWC).
SD = Standard Deviation.

Table 4. Results: *Chironomus dilutus* survival and growth test.

Sample ID	Mean ± SD	
	Survival (%)	**Dry Weight (mg)**
Control Sediment	100 ± 0.0	1.71 ± 0.17
LWC	96.0 ± 8.9	2.31 ± 0.13
LMC	96.0 ± 5.5	2.66 ± 0.26

(*) Asterisks indicate samples that were significantly different from the control sediment.
(†) Pluses indicate samples that were significantly differen from the reference sediment (LWC).
SD = Standard Deviation.

Table 5. Summary of total overlying ammonia concentrations for the 14-d *H. azteca* sediment toxicity test.

Sample ID	Overlying Water Total Ammonia (mg/L N)	
	Day 0	**Day 14**
Control Sediment	0.0139	0.0694
LWC	0.182	0.0437
LMC	0.171	0.0221

Table 6. Summary of total overlying ammonia concentrations for the 10-d *C. dilutus* sediment toxicity test.

Sample ID	Overlying Water Total Ammonia (mg/L N)	
	Day 0	Day 10
Control Sediment	0.0186	0.88
LWC	0.263	0.197
LMC	0.369	0.0381

4.0 QA/QC

The health histories of the test organisms used in the exposures were acceptable and met the requirements of the Environment Canada protocols. The tests met all control acceptability criteria and water quality parameters remained within ranges specified in the protocols throughout the tests. Uncertainty associated with these tests is best described by the standard deviation (SD) around the mean.

Results of the reference toxicant tests conducted during the testing program are summarized in Table 7. Results of the tests fell within the range for organism performance of mean and range, based on historical results obtained by the laboratory with these tests. Thus, the sensitivity of the organisms used in the tests were appropriate.

Table 7. Reference toxicant results.

Test Species	Endpoint	Historical Mean (2 SD Range)	CV (%)	Test Date
H. azteca	Survival (LC50): 5.7 g/L NaCl	5.2 (4.3 – 6.3)	10	September 25, 2015
C. dilutus	Survival (LC50): 6.2 g/L KCl	4.5 (2.4 – 8.2)	35	September 29, 2015

SD = Standard Deviation, LC = Lethal Concentration, CV = Coefficient of Variation.

5.0 REFERENCES

Environment Canada. 2013. Biological test method: test for survival and growth in sediment and water using the freshwater amphipod *Hyalella azteca*. Environmental Protection Series EPS 1/RM/33 Second Edition. January 2013. Environment Canada, Method Development and Application Unit, Science and Technology Branch, ON. 150 pp.

Environment Canada. 1997. Biological test method: test for survival and growth in sediment using the larvae of freshwater midges *(Chironomus tentans* and *Chrironomus riparius)*. Environmental Protection Series EPS 1/RM/32. December 1997. Environment Canada, Method Development and Application Section, Environmental Technology Centre, Ottawa, ON. 131 pp.

Tidepool Scientific Software. 2013. CETIS comprehensive environmental toxicity information system, version 1.8.7.16 Tidepool Scientific Software, McKinleyville, CA. 222 pp.

APPENDIX A – *Hyalella azteca* Toxicity Test Data

Hyalella azteca Sediment Test Summary Sheet

Client: Minnow Environmental
Work Order No.: 15719

Start Date: 25-Sep-15
Set up by: KJL/JS

Sample Information:

Sample ID: Various - See Below
Sample Date: Sept 3 - 6, 2015
Date Received: 14-Sep-15
Sample Volume: 5x 1L per sample

Test Organism Information:

Species: *Hyalella azteca*
Supplier: Aquatic Research Organisms, NH
Date received: 25-Sep-15
Age or size (Day 0): 9-days

NaCl Reference Toxicant Results:

Reference Toxicant ID: HA102
Stock Solution ID: n/a
Date Initiated: 25-Sep-15

96-h LC50 (95% CL): 5.7 (4.0 - 8.0)

96-h LC50 Reference Toxicant Mean and Range: 5.2 (4.3 - 6.3) CV (%): 10

Test Results:

Sample ID	Survival ± SD (%)	Average Dry Wt. ± SD (mg)
Control Sediment	98.0 ± 4.5	0.26 ± 0.05
LWC	100.0 ± 0.0	0.20 ± 0.05*
LMC	100.0 ± 0.0	0.25 ± 0.08

* Samples that are significantly different from Control Sediment.

Reviewed by: JOh

Date reviewed: Oct-23/15

Chronic *H. azteca* Sediment Toxicity Test Data Sheet
Freshwater Sediment Water Quality

Client: Minnow Environmental
Work Order No.: 15719

Start Date: Sept 25/15
Termination Date: Oct 9/15
Test Organism: *Hyalella azteca*

Temperature (°C)

Sample ID	Day 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Control Sediment	23.0	22.5	22.5	22.0	22.0	22.0	23.0	22.5	22.5	22.5	22.0	22.0	22.0	22.0	23.0
LWC	23.0	22.5	22.5	22.0	22.0	22.0	23.0	22.5	22.5	22.5	22.0	22.0	22.0	22.0	23.0
LMC	23.0	22.5	22.5	22.0	22.0	22.0	23.0	22.5	22.5	22.5	22.0	22.0	22.0	22.0	23.0
Technician Initials	JS	A	A	JS	JS	JS	JS	JS	A	A	JS	JS	JS	JS	JS

Conductivity (µS)

Sample ID	Day 0	1	2	① 3	4	5	6	7	8	9	10	11	12	13	14
Control Sediment	399	406	420	~~447~~	434	457	447	450	453	456	465	464	464	465	467
LWC	434	443	445	465	481	487	499	506	502	516	530	540	549	553	562
LMC	477	505	542	574	595	612	637	653	651	665	684	728	700	712	721
Technician Initials	JS	A	A	JS	JS	JS	JS	JS	A	A	JS	JS	JS	JS	JS

Dissolved oxygen (mg/L)

Sample ID	Day 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Control Sediment	8.1	7.9	7.9	7.8	8.1	7.9	8.1	8.0	7.9	8.0	7.9	7.8	7.9	8.0	7.9
LWC	7.8	8.0	7.9	7.9	8.0	7.9	7.5	7.9	7.8	7.9	8.0	8.0	8.0	8.0	8.0
LMC	7.9	8.0	8.0	7.9	8.1	8.0	8.0	8.0	7.8	7.9	8.1	8.1	8.0	8.0	8.1
Technician Initials	JS	A	A	JS	JS	JS	JS	KSL	A	A	JS	JS	JS	JS	JS

pH

Sample ID	Day 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Control Sediment	7.7	7.9	7.8	7.6	7.7	7.7	7.7	7.7	7.9	7.9	7.8	7.8	7.6	7.6	7.5
LWC	7.8	8.0	7.9	7.9	8.0	7.9	~~8~~ ②	7.9	8.0	8.1	8.42	8.2	8.1	8.1	8.1
LMC	8.0	8.0	8.1	8.1	8.2	8.2	8.1	8.2	8.2	8.2	8.4 JS	8.4	8.3	8.4	8.3
Technician Initials	JS	A	A	JS	JS	JS	JS	JS	A	A	JS	JS	JS	JS	JS

Comments: ① 424 ② 7.9

Reviewed by: JCh

Date Reviewed: Oct. 23/15

H. azteca Sediment Toxicity Test Data Sheet

Freshwater Sediment 14-d Survival and Weight

Client:	Minnow Environmental	Start Date:	Sept 25/15
Work Order No:	15719	Termination Date:	Oct 9/15
Sample ID:	See below	Test Organism:	*Hyalella azteca*

Sample ID	MG Pan No. red	Rep	No. alive	No. dead	No. missing	Initials	Pan weight (mg)	Pan + organism (mg)	No. weighed	Initials
Control Sediment	1	A	9	0	1	JW	1005.35	1007.97	9	KL/KJL
	2	B	10	0	0	↓	1013.32	1016.18	10	↓
	3	C	10	0	0	↓	1023.34	1025.99	10	↓
	4	D	10	0	0	↓	1020.61	1022.33	10	↓
	5	E	10	0	0	↓	1044.60	1047.47	10	↓
LWC	6	A	10	0	0	JW	981.96	983.90	10	↓
	7	B	10	0	0	↓	1026.06	1027.93	10	↓
	8	C	10	0	0	↓	1020.99	1022.76	10	↓
	9	D	10	0	0	↓	1009.39	1012.25	10	↓
	10	E	10	0	0	↓	1031.86	1033.32	10	↓
LMC	11	A	10	0	0	JW	1012.39	1015.37	10	↓
	12	B	10	0	0	↓	972.38	974.93	10	↓
	13	C	10	0	0	↓	996.99	999.89 KJL	10	↓
	14	D	10	0	0	↓	1007.36	1008.39	10	↓
	15	E	10	0	0	↓	995.28	998.12	10	↓
		A								
		B								
		C								
		D								
		E								

Comments: 10% re-weigh: #2: 1016.14, #12: 974.91

Reviewed by: JOh

Date Reviewed: Oct. 23/15

CETIS Summary Report

Report Date: 20 Oct-15 11:15 (p 1 of 1)
Test Code: 15719 | 02-2906-6230

Hyalella 14-d Survival and Growth Sediment Test — **Nautilus Environmental**

Batch ID:	04-0218-5768	**Test Type:**	Growth-Survival (~~10d~~ 14d)	**Analyst:**	Karen Lee
Start Date:	25 Sep-15	**Protocol:**	EC/EPS 1/RM/33	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	09 Oct-15	**Species:**	Hyalella azteca	**Brine:**	
Duration:	14d 0h	**Source:**	Aquatic Research Organisms, NH	**Age:**	9-d

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sedimen	06-8017-3156	25 Sep-15	25 Sep-15	NA	Minnow Environmental	
LWC	02-1650-3778	03 Sep-15	14 Sep-15 14:15	22d 0h (17.7 °		
LMC	12-8564-7136	05 Sep-15	14 Sep-15 14:15	20d 0h (17.7 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sedimen	Sediment Sample	Minnow Environmental	Control Sediment		
LWC	Sediment Sample	Minnow Environmental	LWC		
LMC	Sediment Sample	Minnow Environmental	LMC		

~~10d~~ 14d Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control Sedimen	5	0.98	0.9245	1	0.9	1	0.02	0.04472	4.56%	0.0%
LWC	5	1	1	1	1	1	0	0	0.0%	-2.04%
LMC	5	1	1	1	1	1	0	0	0.0%	-2.04%

~~10d~~ 14d Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	0.9	1	1	1	1
LWC	1	1	1	1	1
LMC	1	1	1	1	1

~~10d~~ 14d Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	9/10	10/10	10/10	10/10	10/10
LWC	10/10	10/10	10/10	10/10	10/10
LMC	10/10	10/10	10/10	10/10	10/10

Hyalella 14-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	13-5240-5069	**Endpoint:**	~~10d~~ 14d Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	20 Oct-15 11:15	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Batch ID:	04-0218-5768	**Test Type:**	Growth-Survival (10d)	**Analyst:**	Karen Lee
Start Date:	25 Sep-15	**Protocol:**	EC/EPS 1/RM/33	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	09 Oct-15	**Species:**	Hyalella azteca	**Brine:**	
Duration:	14d 0h	**Source:**	Aquatic Research Organisms, NH	**Age:**	9-d

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sedimen	06-8017-3156	25 Sep-15	25 Sep-15	NA	Minnow Environmental	
LWC	02-1650-3778	03 Sep-15	14 Sep-15 14:15	22d 0h (17.7 °		
LMC	12-8564-7136	05 Sep-15	14 Sep-15 14:15	20d 0h (17.7 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sedimen	Sediment Sample	Minnow Environmental	Control Sediment		
LWC	Sediment Sample	Minnow Environmental	LWC		
LMC	Sediment Sample	Minnow Environmental	LMC		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	3.77%	

Wilcoxon Rank Sum Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Control Sedimen		LWC	30	NA	1	8	1.0000	Exact	Non-Significant Effect
		LMC	30	NA	1	8	1.0000	Exact	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.003541244	0.001770622	2	1	0.3966	Non-Significant Effect
Error	0.02124747	0.001770622	12			
Total	0.02478871		14			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	1	8.022	0.4053	Equal Variances
Variances	Levene Equality of Variance	7.111	6.927	0.0092	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.5586	0.8328	<0.0001	Non-normal Distribution

~~10d~~ 14d Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sedimen	5	0.98	0.9245	1	1	0.9	1	0.02	4.56%	0.0%
LWC	5	1	1	1	1	1	1	0	0.0%	-2.04%
LMC	5	1	1	1	1	1	1	0	0.0%	-2.04%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sedimen	5	1.379	1.289	1.47	1.412	1.249	1.412	0.03259	5.28%	0.0%
LWC	5	1.412	1.412	1.412	1.412	1.412	1.412	0	0.0%	-2.36%
LMC	5	1.412	1.412	1.412	1.412	1.412	1.412	0	0.0%	-2.36%

~~10d~~ 14d Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	0.9	1	1	1	1
LWC	1	1	1	1	1
LMC	1	1	1	1	1

Hyalella 14-d Survival and Growth Sediment Test | **Nautilus Environmental**

Analysis ID:	13-5240-5069	**Endpoint:**	10d Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	20 Oct-15 11:15	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

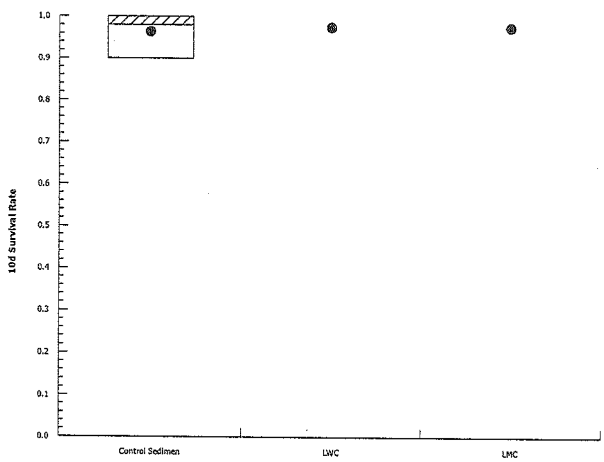
Angular (Corrected) Transformed Detail

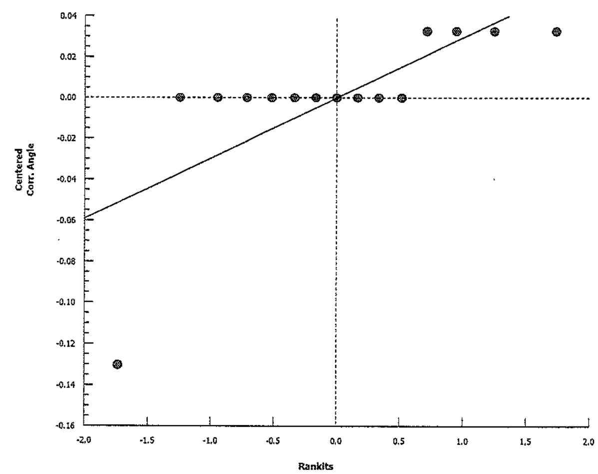
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	1.249	1.412	1.412	1.412	1.412
LWC	1.412	1.412	1.412	1.412	1.412
LMC	1.412	1.412	1.412	1.412	1.412

10d Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	9/10	10/10	10/10	10/10	10/10
LWC	10/10	10/10	10/10	10/10	10/10
LMC	10/10	10/10	10/10	10/10	10/10

Graphics





CETIS Analytical Report

Report Date:	27 Oct-15 18:19 (p 1 of 1)
Test Code:	15719 | 02-2906-6230

Hyalella 14-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	14-1210-1962	**Endpoint:**	~~10d~~ 14 Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	27 Oct-15 18:19	**Analysis:**	Single 2x2 Contingency Table	**Official Results:**	Yes

Batch ID:	04-0218-5768	**Test Type:**	Growth-Survival (~~10d~~ 14)	**Analyst:**	Karen Lee
Start Date:	25 Sep-15	**Protocol:**	EC/EPS 1/RM/33	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	09 Oct-15	**Species:**	Hyalella azteca	**Brine:**	
Duration:	14d 0h	**Source:**	Aquatic Research Organisms, NH	**Age:**	9-d

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
LWC	02-1650-3778	03 Sep-15	14 Sep-15 14:15	22d 0h (17.7 °	Minnow Environmental	
LMC	12-8564-7136	05 Sep-15	14 Sep-15 14:15	20d 0h (17.7 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
LWC	Sediment Sample	Minnow Environmental	LWC		
LMC	Sediment Sample	Minnow Environmental	LMC		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Untransformed		C > T	NA	NA	

Fisher Exact Test

Sample	vs	Sample	Test Stat	P-Value	P-Type	Decision(α:5%)
LWC		LMC	1	1.0000	Exact	Non-Significant Effect

Data Summary

Sample Code		NR	R	NR + R	Prop NR	Prop R	%Effect
LWC	Reference Sed	50	0	50	1	0	0.0%
LMC		50	0	50	1	0	0.0%

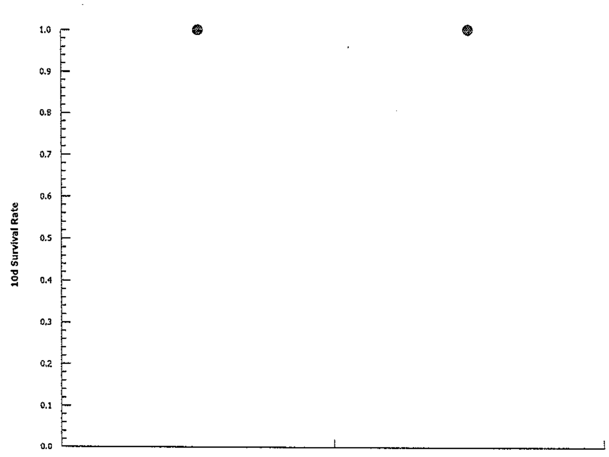
~~10d~~ 14 Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
LWC	1	1	1	1	1
LMC	1	1	1	1	1

~~10d~~ 14 Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
LWC	10/10	10/10	10/10	10/10	10/10
LMC	10/10	10/10	10/10	10/10	10/10

Graphics



CETIS Summary Report

Report Date: 20 Oct-15 11:15 (p 1 of 1)
Test Code: 15719 | 02-2906-6230

Hyalella 14-d Survival and Growth Sediment Test — **Nautilus Environmental**

Batch ID:	04-0218-5768	**Test Type:**	Growth-Survival (~~10d~~ 14d)	**Analyst:**	Karen Lee
Start Date:	25 Sep-15	**Protocol:**	EC/EPS 1/RM/33	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	09 Oct-15	**Species:**	Hyalella azteca	**Brine:**	
Duration:	14d 0h	**Source:**	Aquatic Research Organisms, NH	**Age:**	9-d

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sedimen	06-8017-3156	25 Sep-15	25 Sep-15	NA	Minnow Environmental	
LWC	02-1650-3778	03 Sep-15	14 Sep-15 14:15	22d 0h (17.7 °		
LMC	12-8564-7136	05 Sep-15	14 Sep-15 14:15	20d 0h (17.7 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sedimen	Sediment Sample	Minnow Environmental	Control Sediment		
LWC	Sediment Sample	Minnow Environmental	LWC		
LMC	Sediment Sample	Minnow Environmental	LMC		

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control Sedimen	5	0.2602	0.1977	0.3227	0.172	0.2911	0.02252	0.05035	19.35%	0.0%
LWC	5	0.198	0.1328	0.2632	0.146	0.286	0.02348	0.0525	26.52%	23.91%
LMC	5	0.246	0.1447	0.3473	0.103	0.298	0.03648	0.08157	33.16%	5.47%

Mean Dry Weight-mg Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	0.2911	0.286	0.265	0.172	0.287
LWC	0.194	0.187	0.177	0.286	0.146
LMC	0.298	0.255	0.29	0.103	0.284

Hyalella 14-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	20-4283-2753	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	20 Oct-15 11:15	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes
Batch ID:	04-0218-5768	**Test Type:**	Growth-Survival (10d) 14	**Analyst:**	Karen Lee
Start Date:	25 Sep-15	**Protocol:**	EC/EPS 1/RM/33	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	09 Oct-15	**Species:**	Hyalella azteca	**Brine:**	
Duration:	14d 0h	**Source:**	Aquatic Research Organisms, NH	**Age:**	9-d

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sedimen	06-8017-3156	25 Sep-15	25 Sep-15	NA	Minnow Environmental	
LWC	02-1650-3778	03 Sep-15	14 Sep-15 14:15	22d 0h (17.7 °		
LMC	12-8564-7136	05 Sep-15	14 Sep-15 14:15	20d 0h (17.7 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sedimen	Sediment Sample	Minnow Environmental	Control Sediment		
LWC	Sediment Sample	Minnow Environmental	LWC		
LMC	Sediment Sample	Minnow Environmental	LMC		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	30.6%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Control Sedimen		LWC	1.913	1.86	0.061	8	0.0461	CDF	Significant Effect
		LMC	0.3318	1.86	0.08	8	0.3743	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.01062988	0.005314942	2	1.335	0.2996	Non-Significant Effect
Error	0.04777989	0.003981657	12			
Total	0.05840977		14			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	1.101	9.21	0.5768	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9198	0.8328	0.1916	Normal Distribution

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sedimen	5	0.2602	0.1977	0.3227	0.286	0.172	0.2911	0.02252	19.35%	0.0%
LWC	5	0.198	0.1328	0.2632	0.187	0.146	0.286	0.02348	26.52%	23.91%
LMC	5	0.246	0.1447	0.3473	0.284	0.103	0.298	0.03648	33.16%	5.47%

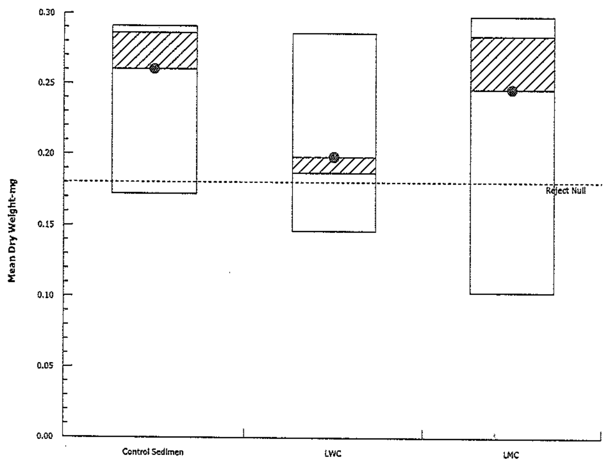
Mean Dry Weight-mg Detail

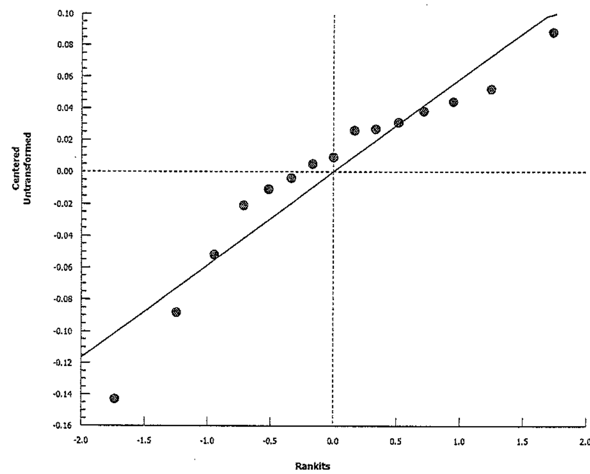
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	0.2911	0.286	0.265	0.172	0.287
LWC	0.194	0.187	0.177	0.286	0.146
LMC	0.298	0.255	0.29	0.103	0.284

Hyalella 14-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	20-4283-2753	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	20 Oct-15 11:15	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Graphics





Hyalella 14-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	14-9531-3934	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	27 Oct-15 18:19	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Batch ID:	04-0218-5768	**Test Type:**	Growth-Survival (10d) 14	**Analyst:**	Karen Lee
Start Date:	25 Sep-15	**Protocol:**	EC/EPS 1/RM/33	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	09 Oct-15	**Species:**	Hyalella azteca	**Brine:**	
Duration:	14d 0h	**Source:**	Aquatic Research Organisms, NH	**Age:**	9-d

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
LWC	02-1650-3778	03 Sep-15	14 Sep-15 14:15	22d 0h (17.7 °	Minnow Environmental	
LMC	12-8564-7136	05 Sep-15	14 Sep-15 14:15	20d 0h (17.7 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
LWC	Sediment Sample	Minnow Environmental	LWC		
LMC	Sediment Sample	Minnow Environmental	LMC		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	40.7%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
LWC		LMC	-1.106	1.86	0.081	8	0.8497	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.005760117	0.005760117	1	1.224	0.3007	Non-Significant Effect
Error	0.03763897	0.004704871	8			
Total	0.04339908		9			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	2.414	23.15	0.4143	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9311	0.7411	0.4592	Normal Distribution

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LWC	5	0.198	0.1328	0.2632	0.187	0.146	0.286	0.02348	26.52%	0.0%
LMC	5	0.246	0.1447	0.3473	0.284	0.103	0.298	0.03648	33.16%	-24.24%

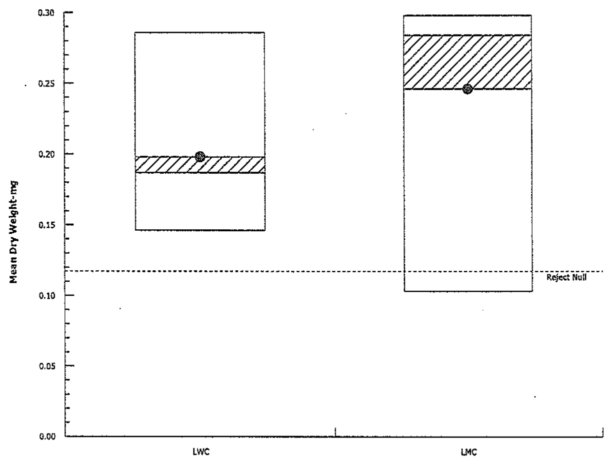
Mean Dry Weight-mg Detail

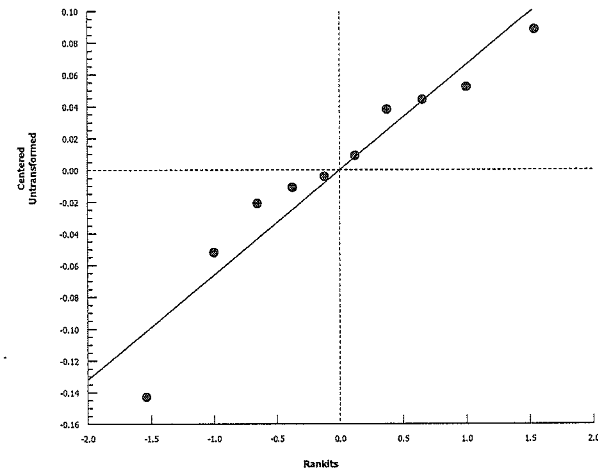
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
LWC	0.194	0.187	0.177	0.286	0.146
LMC	0.298	0.255	0.29	0.103	0.284

Hyalella 14-d Survival and Growth Sediment Test **Nautilus Environmental**

Analysis ID:	14-9531-3934	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	27 Oct-15 18:19	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Graphics





Client: Minnow Environmental

W.O.#: 15719

Hardness and Alkalinity Datasheet

	Sample ID	Sample Date	Alkalinity: Sample Volume (mL)	Alkalinity: (mL) 0.02N HCL/H_2SO_4 used to pH 4.5	Alkalinity: (mL) of 0.02N HCL/H_2SO_4 used to pH 4.2	Alkalinity: Total Alkalinity (mg/L$CaCO_3$)	Hardness: Sample Volume (mL)	Hardness: Volume of 0.01M EDTA Used (mL)	Hardness: Total Hardness (mg/L $CaCO_3$)	Technician
	Hyal									
Day 0 Hyal	Control Sediment	Sept 25/15	50	2.9	3.0	56	50	6.0	120	JS
	LWC	↓	50	4.7	4.9	90	50	~~7.1~~ JS 6.8	13~~2~~6 JS	JS
	LMC	↓	50	5.7	5.9	110	50	7.1	142	JS
Day 14	Control Sediment	Oct 9/15	50	2.3	2.4	44	50	6.3	126	SSD
	LWC	↓	50	7.9	8.1	154	50	6.7	134	SSD
	LMC	↓	50	12.3	12.5	242	50	7.5	150	SSD

Notes:

Reviewed by: JOu

Date Reviewed: Oct. 23/15

Nautilus Environmental
Sediment Toxicity Test - Water Quality Data For Ammonia

Client : Minnow Environmental

Work Order No: 15719

Species : *H. azteca*

Sample Type: Overlying ammonia

Date Measured: See below

Date	Sample ID	Temperature (°C)	pH	Total Ammonia (mg/L)	Unionized Ammonia (mg/L) N	Tech Init
Sept25	LWC	23.0	7.8	0.34	0.009	JS
Sept28	↓	22.0	7.9	0.97	0.030	JS
Sept30	↓	22.0	7.9	0.68	0.021	JS
Oct2	↓	22.5	7.9	1.69	0.053	JS
Oct5	↓	22.0	8.2	1.60	0.100	JS
Oct7	↓	22.0	8.1	0.68	0.033	JS

Comments:

Reviewed by: JGl

Date Reviewed: Oct-23/15

Client : Minnow Environmental
W.O.: 15719

Table of PKa values

Temperature (°C)	TDS (mg/L)			Salinity (g/kg)		
	0	*250*	*2000*	*10*	*20*	*30*
12	9.662	9.699	9.754	9.788	9.819	9.837
15	9.564	9.601	9.655	9.688	9.719	9.737
18	9.465	9.502	9.557	9.588	9.619	9.636
20	9.401	9.438	9.492	9.523	9.554	9.571
22		9.391				
23	9.307	9.344	9.398	9.426	9.459	9.476
24		9.314				
25	9.246	9.283	9.337	9.366	9.397	9.414

In-house measured Ammonia

Date	Sample ID	Temperature (C)	pH	Total Ammonia Kit Reading (mg/L)	Dilution Factor	Total Ammonia (as N) (mg/L)	pKa	Unionized Ammonia (mg/L)
25-Sep-15	LWC	23.0	7.8	0.34	1	0.34	9.344	**0.009446**
28-Sep-15	LWC	22.0	7.9	0.97	1	0.97	9.391	**0.030337**
30-Sep-15	LWC	22.0	7.9	0.68	1	0.68	9.391	**0.021267**
2-Oct-15	LWC	22.5	7.9	1.69	1	1.69	9.391	**0.052855**
5-Oct-15	LWC	22.0	8.2	1.60	1	1.60	9.391	**0.096830**
7-Oct-15	LWC	22.0	8.1	0.68	1	0.68	9.391	**0.033101**

JGL
Oct. 23/15

APPENDIX B – *Chironomus dilutus* Toxicity Test Data

Chironomus dilutus Sediment Test Summary Sheet

Client: Minnow Environmental
Work Order No.: 15718

Start Date: 29-Sep-15
Set up by: KJL/JS

Sample Information:

Sample ID: Various - See Below
Sample Date: Sept 3 - 6, 2015
Date Received: 14-Sep-15
Sample Volume: 5x 1L per sample

Test Organism Information:

Species: *C. dilutus*
Supplier: Aquatic Biosystems, CO
Date received: 25-Sep-15
Age or size (Day 0): 3rd in-star

KCl Reference Toxicant Results:

Reference Toxicant ID: CT49
Stock Solution ID: n/a
Date Initiated: 29-Sep-15

96-h LC50 (95% CL): 6.2 (5.2 - 7.3)

96-h LC50 Reference Toxicant Mean and Range: 4.5 (2.4 - 8.2) CV (%): 35

Test Results:

Sample ID	Survival ± SD (%)	Average Dry Wt. ± SD (mg)
Control Sediment	100.0 ± 0.0	1.71 ± 0.17
LWC	96.0 ± 8.9	2.31 ± 0.13
LMC	96.0 ± 5.5	2.66 ± 0.26

Reviewed by: JOle

Date reviewed: Oct 30/15

10-d Chironomid Sediment Toxicity Test Data Sheet
Freshwater Sediment 10-d Water Quality

Client: Minnow Environmental
W.O #: 15718

Start Date: 29-Sep-15
Termination Date: 09-Oct-15
Test Organism: *Chironomus dilutus*

Temperature (°C)

Sample ID	Day										
	0	1	2	3	4	5	6	7	8	9	10
Control Sediment	22.0	22.0	23.0	22.5	22.5	22.5	22.0	22.0	22.0	22.0	23.0
LCW	22.0	22.0	23.0	22.5	22.5	22.6	22.0	22.0	22.0	22.0	23.0
LMC	22.0	22.0	23.0	22.5	22.5	22.5	22.0	22.0	22.0	22.0	23.0
Technician Initials	JS	JS	JS	JS	[illegible]	[illegible]	JS	JS	JS	JS	JS

Conductivity (µS)

Sample ID	Day										
	0	1	2	3	4	5	6	7	8	9	10
Control Sediment	398	404	410	420	453	443	464	461	465	466	469
LCW	435	439	455	465	~~512~~ 462	475	492	495	500	493	503
LMC	493	521	565	587	643	613	635	647	652	670	681
Technician Initials	JS	JS	JS	JS	[illegible]	[illegible]	JS	JS	JS	JS	JS

Dissolved oxygen (mg/L)

Sample ID	Day										
	0	1	2	3	4	5	6	7	8	9	10
Control Sediment	8.1	7.7	7.7	8.0	7.9	8.0	7.9	7.8	7.9	8.0	8.1
LCW	8.2	7.8	7.9	8.0	7.8	7.9	8.0	8.0	8.0 JS	8.0	8.0
LMC	8.2	7.8	7.9	8.0	7.8	7.9	7.8	8.0	7.~~8~~3	7.~~8~~3 JS	7.5
Technician Initials	JS	JS	JS	KJL	[illegible]	[illegible]	JS	JS	JS	JS	JS

pH

Sample ID	Day										
	0	1	2	3	4	5	6	7	8	9	10
Control Sediment	7.7	7.6	7.6	7.7	7.9	8.0	7.7	7.9	7.7	7.7	7.6
LCW	7.8	7.8	7.7	7.8	8.0	7.9	8.0	8.1	~~7.9~~ ① JS	8.0	7.9
LMC	8.0	8.0	7.9	8.0	8.0	7.9	8.0	8.2	8.1	8.2	8.1
Technician Initials	JS	JS	JS	JS	[illegible]	[illegible]	JS	JS	JS	JS	JS

Comments: ① 8.0

Reviewed by: JOL

Date Reviewed: Oct. 23/15

10-d Chironomid Sediment Toxicity Test Data Sheet

Freshwater Sediment 10-d Survival and Weight

Client: Minnow Environmental
W.O. #: 15718
Sample ID: Various

Start Date: Sept 29/15
Termination Date: Oct 9/15
Test Organism: *Chironomus dilutus*

Sample ID	ME Pan No. Black	Rep	No. alive	No. dead	No. missing	Initials	Pan weight (mg)	Pan + organism (mg)	No. weighed	Initials
Control Sediment	1	A	10	0	0	KJL	1029.85	1045.37	10	KL/KJL
	2	B	10	0	0	↓	977.26	995.86	10	↓
	3	C	10	0	0	↓	1002.64	1019.02	10	↓
	4	D	10	0	0	↓	1000.29	1015.93	10	↓
	5	E	10	0	0	↓	1003.69	1022.92	10	↓
LWC	6	A	10	0	0	JW	976.82	1000.23	10	↓
	7	B	8	0	2	↓	992.55	1010.82	8	↓
	8	C	10	0	0	↓	989.75	1014.76	10	↓
	9	D	10	0	0	↓	1034.64	1057.55	10	↓
	10	E	10	0	0	↓	1035.75	1057.22	10	↓
LMC	11	A	10	0	0	KJL	~~121~~ KL 1021.50	1045.56	10	↓
	12	B	9	0	1	↓	1009.31	1037.10	9	↓
	13	C	9	0	1	↓	1034.28	1057.5~~8~~9	9	↓
	14	D	10	0	0	↓	1039.6~~3~~ KL 4	1065.33 KL	10	↓
	15	E	10	0	0	↓	1023.24	1049.88	10	↓
		A								
		B								
		C								
		D								
		E								

Comments: 10% re-weigh: #3: 1019.04, #12: 1037.09

Reviewed by: JOu

Date Reviewed: Oct. 23/15

CETIS Summary Report

Report Date:	27 Oct-15 18:25 (p 1 of 1)
Test Code:	15718 | 05-3550-6268

Chironomus 10-d Survival and Growth Sediment Test — **Nautilus Environmental**

Batch ID:	13-1384-4592	**Test Type:**	Growth-Survival (10d)	**Analyst:**	Karen Lee
Start Date:	29 Sep-15	**Protocol:**	EC/EPS 1/RM/32	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	09 Oct-15	**Species:**	Chironomus dilutus	**Brine:**	
Duration:	10d 0h	**Source:**	Aquatic Biosystems, CO	**Age:**	3rd

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sedimen	00-2005-5065	29 Sep-15	29 Sep-15	NA	Minnow Environmental	
LWC	02-1650-3778	03 Sep-15	14 Sep-15 14:15	26d 0h (17.7 °		
LMC	12-8564-7136	05 Sep-15	14 Sep-15 14:15	24d 0h (17.7 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sedimen	Sediment Sample	Minnow Environmental	Control Sediment		
LWC	Sediment Sample	Minnow Environmental	LWC		
LMC	Sediment Sample	Minnow Environmental	LMC		

10d Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control Sedimen	5	1	1	1	1	1	0	0	0.0%	0.0%
LWC	5	0.96	0.8489	1	0.8	1	0.04	0.08944	9.32%	4.0%
LMC	5	0.96	0.892	1	0.9	1	0.02449	0.05477	5.71%	4.0%

10d Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	1	1	1	1	1
LWC	1	0.8	1	1	1
LMC	1	0.9	0.9	1	1

10d Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	10/10	10/10	10/10	10/10	10/10
LWC	10/10	8/10	10/10	10/10	10/10
LMC	10/10	9/10	9/10	10/10	10/10

CETIS Analytical Report

Test Code: 15718 | 05-3550-6268

Chironomus 10-d Survival and Growth Sediment Test — Nautilus Environmental

Analysis ID:	03-7552-9595	**Endpoint:**	10d Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	20 Oct-15 11:09	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Batch ID:	13-1384-4592	**Test Type:**	Growth-Survival (10d)	**Analyst:**	Karen Lee
Start Date:	29 Sep-15	**Protocol:**	EC/EPS 1/RM/32	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	09 Oct-15	**Species:**	Chironomus ~~tentans~~ riparius	**Brine:**	
Duration:	10d 0h	**Source:**	Aquatic Biosystems, CO	**Age:**	3rd

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sedimen	00-2005-5065	29 Sep-15	29 Sep-15	NA	Minnow Environmental	
LWC	02-1650-3778	03 Sep-15	14 Sep-15 14:15	26d 0h (17.7 °		
LMC	12-8564-7136	05 Sep-15	14 Sep-15 14:15	24d 0h (17.7 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sedimen	Sediment Sample	Minnow Environmental	Control Sediment		
LWC	Sediment Sample	Minnow Environmental	LWC		
LMC	Sediment Sample	Minnow Environmental	LMC		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	7.09%	

Wilcoxon Rank Sum Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Control Sedimen		LWC	25	NA	1	8	0.5000	Exact	Non-Significant Effect
		LMC	22.5	NA	1	8	0.2222	Exact	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.01330837	0.006654185	2	0.7517	0.4925	Non-Significant Effect
Error	0.1062265	0.008852208	12			
Total	0.1195349		14			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	0.7776	8.022	0.4881	Equal Variances
Variances	Levene Equality of Variance	5.709	6.927	0.0181	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.7455	0.8328	0.0008	Non-normal Distribution

10d Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sedimen	5	1	1	1	1	1	1	0	0.0%	0.0%
LWC	5	0.96	0.8489	1	1	0.8	1	0.04	9.32%	4.0%
LMC	5	0.96	0.892	1	1	0.9	1	0.02449	5.71%	4.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sedimen	5	1.412	1.412	1.412	1.412	1.412	1.412	0	0.0%	0.0%
LWC	5	1.351	1.182	1.52	1.412	1.107	1.412	0.06097	10.09%	4.32%
LMC	5	1.347	1.236	1.458	1.412	1.249	1.412	0.03992	6.63%	4.62%

10d Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	1	1	1	1	1
LWC	1	0.8	1	1	1
LMC	1	0.9	0.9	1	1

Chironomus 10-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID: 03-7552-9595 **Endpoint:** 10d Survival Rate **CETIS Version:** CETISv1.8.7
Analyzed: 20 Oct-15 11:09 **Analysis:** Nonparametric-Two Sample **Official Results:** Yes

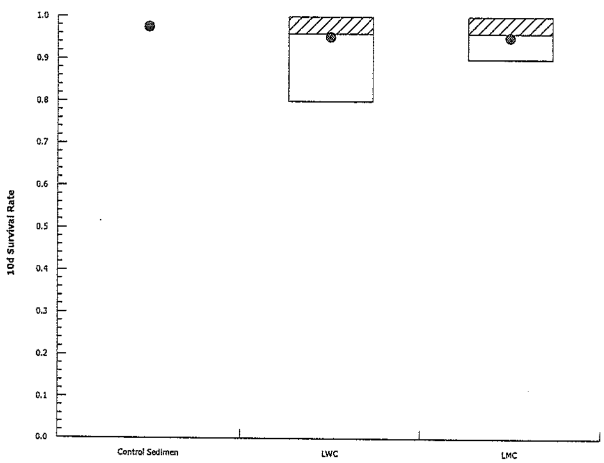
Angular (Corrected) Transformed Detail

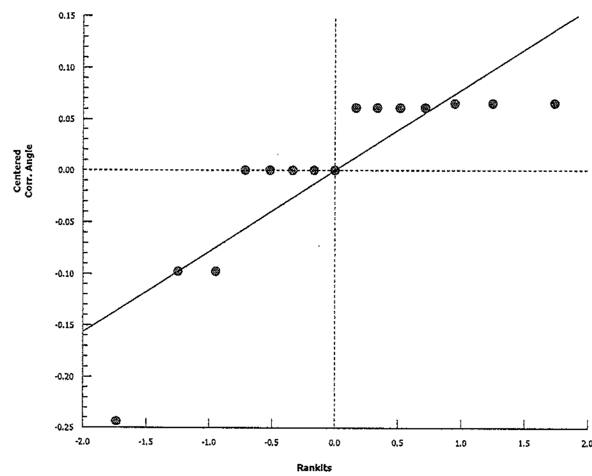
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	1.412	1.412	1.412	1.412	1.412
LWC	1.412	1.107	1.412	1.412	1.412
LMC	1.412	1.249	1.249	1.412	1.412

10d Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	10/10	10/10	10/10	10/10	10/10
LWC	10/10	8/10	10/10	10/10	10/10
LMC	10/10	9/10	9/10	10/10	10/10

Graphics





CETIS Analytical Report

Report Date:	27 Oct-15 18:25 (p 1 of 1)
Test Code:	15718 | 05-3550-6268

Chironomus 10-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	12-6788-0084	**Endpoint:**	10d Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	27 Oct-15 18:24	**Analysis:**	Single 2x2 Contingency Table	**Official Results:**	Yes

Batch ID:	13-1384-4592	**Test Type:**	Growth-Survival (10d)	**Analyst:**	Karen Lee
Start Date:	29 Sep-15	**Protocol:**	EC/EPS 1/RM/32	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	09 Oct-15	**Species:**	Chironomus dilutus	**Brine:**	
Duration:	10d 0h	**Source:**	Aquatic Biosystems, CO	**Age:**	3rd

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
LWC	02-1650-3778	03 Sep-15	14 Sep-15 14:15	26d 0h (17.7 °	Minnow Environmental	
LMC	12-8564-7136	05 Sep-15	14 Sep-15 14:15	24d 0h (17.7 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
LWC	Sediment Sample	Minnow Environmental	LWC		
LMC	Sediment Sample	Minnow Environmental	LMC		

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Untransformed		C > T	NA	NA	

Fisher Exact Test

Sample	vs	Sample	Test Stat	P-Value	P-Type	Decision(α:5%)
LWC		LMC	0.6913	0.6913	Exact	Non-Significant Effect

Data Summary

Sample Code		NR	R	NR + R	Prop NR	Prop R	%Effect
LWC	Reference Sed	48	2	50	0.96	0.04	0.0%
LMC		48	2	50	0.96	0.04	0.0%

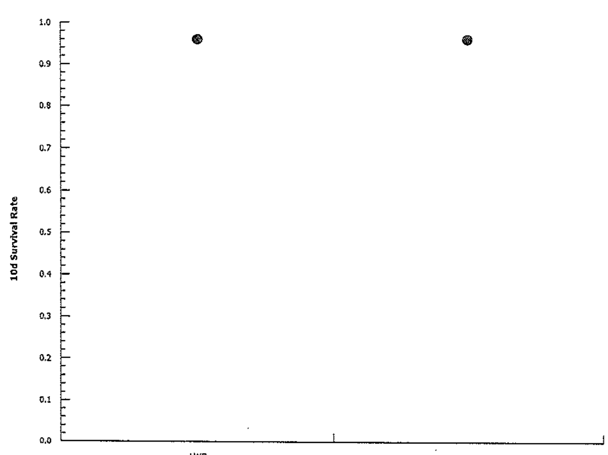
10d Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
LWC	1	0.8	1	1	1
LMC	1	0.9	0.9	1	1

10d Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
LWC	10/10	8/10	10/10	10/10	10/10
LMC	10/10	9/10	9/10	10/10	10/10

Graphics



CETIS Summary Report

Report Date: 27 Oct-15 18:25 (p 1 of 1)
Test Code: 15718 | 05-3550-6268

Chironomus 10-d Survival and Growth Sediment Test — **Nautilus Environmental**

Batch ID:	13-1384-4592	**Test Type:**	Growth-Survival (10d)	**Analyst:**	Karen Lee
Start Date:	29 Sep-15	**Protocol:**	EC/EPS 1/RM/32	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	09 Oct-15	**Species:**	Chironomus dilutus	**Brine:**	
Duration:	10d 0h	**Source:**	Aquatic Biosystems, CO	**Age:**	3rd

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sedimen	00-2005-5065	29 Sep-15	29 Sep-15	NA	Minnow Environmental	
LWC	02-1650-3778	03 Sep-15	14 Sep-15 14:15	26d 0h (17.7 °		
LMC	12-8564-7136	05 Sep-15	14 Sep-15 14:15	24d 0h (17.7 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sedimen	Sediment Sample	Minnow Environmental	Control Sediment		
LWC	Sediment Sample	Minnow Environmental	LWC		
LMC	Sediment Sample	Minnow Environmental	LMC		

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control Sedimen	5	1.707	1.493	1.922	1.552	1.923	0.07723	0.1727	10.11%	0.0%
LWC	5	2.313	2.154	2.471	2.147	2.501	0.05702	0.1275	5.51%	-35.45%
LMC	5	2.663	2.346	2.98	2.406	3.088	0.1142	0.2553	9.58%	-55.99%

Mean Dry Weight-mg Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	1.552	1.86	1.638	1.564	1.923
LWC	2.341	2.284	2.501	2.291	2.147
LMC	2.406	3.088	2.59	2.569	2.664

CETIS Analytical Report

Chironomus 10-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	15-2417-3693	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	14 Oct-15 9:39	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Batch ID:	13-1384-4592	**Test Type:**	Growth-Survival (10d)	**Analyst:**	Karen Lee
Start Date:	29 Sep-15	**Protocol:**	EC/EPS 1/RM/32	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	09 Oct-15	**Species:**	Chironomus ~~tentans~~ dilutus	**Brine:**	
Duration:	10d 0h	**Source:**	Aquatic Biosystems, CO	**Age:**	3rd

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Control Sedimen	00-2005-5065	29 Sep-15	29 Sep-15	NA	Minnow Environmental	
LWC	02-1650-3778	03 Sep-15	14 Sep-15 14:15	26d 0h (17.7 °		
LMC	12-8564-7136	05 Sep-15	14 Sep-15 14:15	24d 0h (17.7 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Control Sedimen	Sediment Sample	Minnow Environmental	Control Sediment		
LWC	Sediment Sample	Minnow Environmental	LWC		
LMC	Sediment Sample	Minnow Environmental	LMC		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	15.0%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Control Sedimen		LWC	-6.306	1.86	0.179	8	0.9999	CDF	Non-Significant Effect
		LMC	-6.936	1.86	0.256	8	0.9999	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	2.3387	1.16935	2	31.54	<0.0001	Significant Effect
Error	0.4449682	0.03708068	12			
Total	2.783668		14			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	1.723	9.21	0.4225	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9311	0.8328	0.2830	Normal Distribution

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control Sedimen	5	1.707	1.493	1.922	1.638	1.552	1.923	0.07723	10.11%	0.0%
LWC	5	2.313	2.154	2.471	2.291	2.147	2.501	0.05702	5.51%	-35.45%
LMC	5	2.663	2.346	2.98	2.59	2.406	3.088	0.1142	9.58%	-55.99%

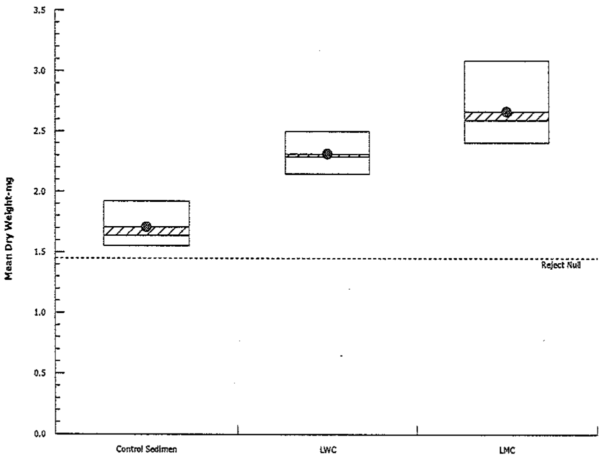
Mean Dry Weight-mg Detail

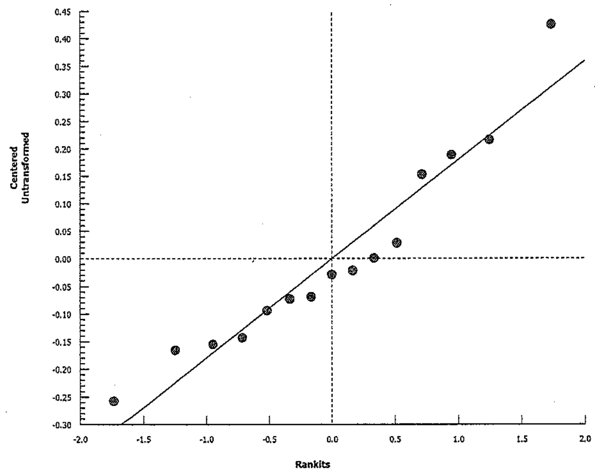
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control Sedimen	1.552	1.86	1.638	1.564	1.923
LWC	2.341	2.284	2.501	2.291	2.147
LMC	2.406	3.088	2.59	2.569	2.664

Chironomus 10-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	15-2417-3693	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	14 Oct-15 9:39	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Graphics





Chironomus 10-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	17-5162-6328	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	27 Oct-15 18:25	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Batch ID:	13-1384-4592	**Test Type:**	Growth-Survival (10d)	**Analyst:**	Karen Lee
Start Date:	29 Sep-15	**Protocol:**	EC/EPS 1/RM/32	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	09 Oct-15	**Species:**	Chironomus dilutus	**Brine:**	
Duration:	10d 0h	**Source:**	Aquatic Biosystems, CO	**Age:**	3rd

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
LWC	02-1650-3778	03 Sep-15	14 Sep-15 14:15	26d 0h (17.7 °	Minnow Environmental	
LMC	12-8564-7136	05 Sep-15	14 Sep-15 14:15	24d 0h (17.7 °		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
LWC	Sediment Sample	Minnow Environmental	LWC		
LMC	Sediment Sample	Minnow Environmental	LMC		

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	10.3%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
LWC		LMC	-2.748	1.86	0.237	8	0.9874	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.3073074	0.3073074	1	7.549	0.0252	Significant Effect
Error	0.3256716	0.04070896	8			
Total	0.632979		9			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	4.008	23.15	0.2074	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9062	0.7411	0.2560	Normal Distribution

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LWC	5	2.313	2.154	2.471	2.291	2.147	2.501	0.05702	5.51%	0.0%
LMC	5	2.663	2.346	2.98	2.59	2.406	3.088	0.1142	9.58%	-15.16%

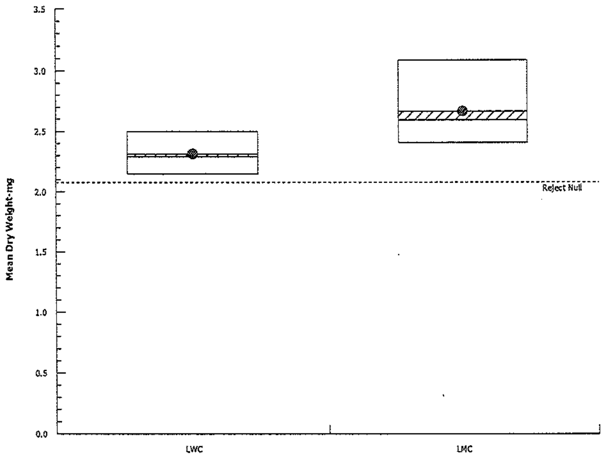
Mean Dry Weight-mg Detail

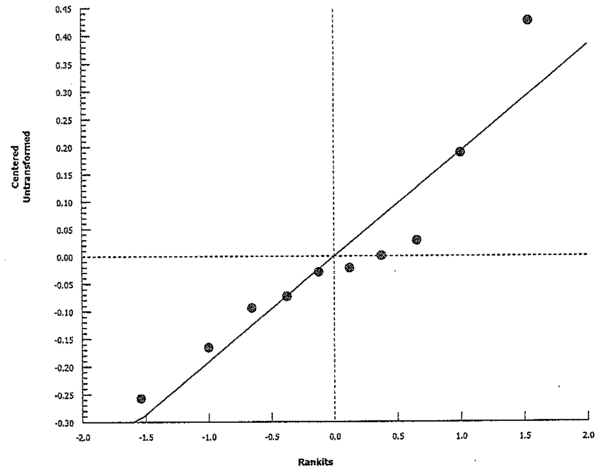
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
LWC	2.341	2.284	2.501	2.291	2.147
LMC	2.406	3.088	2.59	2.569	2.664

Chironomus 10-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis ID:	17-5162-6328	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	27 Oct-15 18:25	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Graphics





Client: Minnow Environmental

W.O.#: 15718

Hardness and Alkalinity Datasheet

Chiron

	Sample ID	Sample Date	Alkalinity: Sample Volume (mL)	Alkalinity: (mL) 0.02N HCL/H_2SO_4 used to pH 4.5	Alkalinity: (mL) of 0.02N HCL/H_2SO_4 used to pH 4.2	Alkalinity: Total Alkalinity (mg/L$CaCO_3$)	Hardness: Sample Volume (mL)	Hardness: Volume of 0.01M EDTA Used (mL)	Hardness: Total Hardness (mg/L $CaCO_3$)	Technician
Day 0	Control Sed.	Sept 29/15	50	2.7	2.8	52	50	5.9	118	SSD
	LWC	↓	50	5.1	5.2	100	50	5.7	114	SSD
	LMC	↓	50	6.0	6.1	118	50	5.0	100	SSD
Day 10	Control Sed.	Oct 9/15	50	2.8	2.9	54	50	6.1	122	SSD
	LWC	↓	50	7.2	7.4	140	50	5.9	118	SSD
	LMC	↓	50	10.4	10.6	204	50	6.0	120	SSD

Notes:

Reviewed by: JOL

Date Reviewed: Oct. 23/15

Sediment Description Data Sheet

Client: Minnow Environmental
Work Order No.: 15718-719

Date: Sept 24/15
Test Organism: *H. azteca/C. dilutus*

Sample ID	Grain Size	Colour	Odour	Debris	Other	Initials
LWC - 1	wet clay	dark brown	~~sulphur~~	–	–	KJL
LWC - 2	↓	↓		–	–	↓
LWC - 3	↓	↓		–	–	↓
LWC - 4	↓	↓		–	–	↓
LWC - 5	↓	↓		–	–	↓
LMC - 1	wet clay	dark brown	none	none	none	JS
LMC - 2	wet clay	dark brown	none	none	twigs	JS
LMC - 3	wet clay	dark brown	none	none	twigs	JS
LMC - 4	clay	dark brown	none	none	grass	JS
LMC - 5	clay	dark brown	–	–		KJL

Reviewed by: JGL

Date Reviewed: Oct. 23/15

APPENDIX C - Chain of Custody Form

Nautilus Environmental

TESTING LOCATION (Please Circle)

Burnaby
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary
#4 6125 12th St S.E.
Calgary, Alberta, Canada
T2H 2K1
Phone 403.253.7121

15718 15719

Chain of Custody

Date__________Page___of___

Sample Collection By:

Report to:

Company	Minnow Environmental
Address	101-1025 Hillside Ave
City/State/Zip	Victoria, BC, V8T 2A2
Contact	Lisa Bowron
Phone	250-595-1627 x21
Email	lbowron@minnow.ca

Invoice To:

Company	Minto Explorations Ltd
Address	Suite 2100-510 West Georgia St
City/State/Zip	Vancouver BC, V6B 0M3
Contact	Cindy Keeho
Phone	604-884-8894
Email	CKeeho@capstonemining.com

ANALYSES REQUIRED

	SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	NO. OF CONTAINERS	COMMENTS	Chironomus dilutus → 10 day	Hyalella azteca → 14 day	Receipt Temperature (°C)
1	LWC-4	03-Sep-15		Sediment	1L glass	1		X	X	17.7
2	LWC-5	03-Sep-15		Sediment	1L glass	1		X	X	↓
3	LWC-1	04-Sep-15		Sediment	1L glass	1		X	X	
4	LWC-2	04-Sep-15		Sediment	1L glass	1		X	X	
5	LWC-3	04-Sep-15		Sediment	1L glass	1		X	X	
6	LMC-4	05-Sep-15		Sediment	1L glass	1		X	X	
7	LMC-5	05-Sep-15		Sediment	1L glass	1		X	X	
8	LMC-1	06-Sep-15		Sediment	1L glass	1		X	X	
9	LMC-2	06-Sep-15		Sediment	1L glass	1		X	X	
10	LMC-3	06-Sep-15		Sediment	1L glass	1		X	X	↓

PROJECT INFORMATION

Client:	Minnow 0033
PO No.:	
Shipped Via:	

SAMPLE RECEIPT

Total No. of Containers	10
Received Good Condition?	Y
Matches Test Schedule?	Y

RELINQUISHED BY (CLIENT)

(Signature) Lisa Bowron (Time) 7:29
(Printed Name) Lisa Bowron (Date) Sept 7/15
(Company) Minnow Environmental

RELINQUISHED BY (COURIER)

(Signature) (Time)
(Printed Name) (Date)
(Company)

SPECIAL INSTRUCTIONS/COMMENTS:

RECEIVED BY (COURIER)

(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY (LABORATORY)

(Signature) NY (Time) 14:15
(Printed Name) Nao Yamamoto (Date) Sept 14/15
(Company) Nautilus

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

LWC is reference site.

APPENDIX D

PERIPHYTON COMMUNITY DATA

Table D.1: Density of periphyton community sampled at lower Wolverine Creek (reference) and lower Minto Creek (exposure), Minto Mine WUL, 2015. All data are presented as cells/cm^2.

Sample Location		Lower Wolverine Creek					Lower Minto Creek				
		LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
Sample Date		4-Sep-15	2-Sep-15	2-Sep-15	3-Sep-15	3-Sep-15	5-Sep-15	5-Sep-15	5-Sep-15	1-Sep-15	1-Sep-15
Group	**Genera and species**										
Cyanophyte	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	-	-	-	-	3.0	-	-	-	-	-
	Pseudoanabaena sp.	23	-	-	16	-	1,595	-	-	-	4,486
	Phormidium autumnale Agardh	-	-	-	-	-	133	-	1,682	2,422	4,486
	Heteroleibeinia profunda Komarek	-	17	42	24	16	2,260	33,005	14,131	2,692	18,393
	Chamaesiphon incrustans Smith	-	-	-	-	31	3,456	13,138	-	-	-
	Clastidium cylindricum Whelden	1.4	-	14	-	-	-	-	-	-	-
	Homoeothrix varians Komarek & Kalina	-	-	-	-	-	17,413	62,805	54,506	40,375	56,525
Diatoms	Cymbella minuta Kutzing	4.2	3.3	4.7	-	3.0	-	641	2,692	1,346	897
	Synedra acus v. radians (Kutzing) Hustedt	-	-	-	-	-	-	-	-	-	1,346
	Nitzschia clausii Hantzsch	-	-	-	-	-	-	-	673	-	-
	Achnanthes minutissima Kutzing	135	337	230	152	113	5,981	3,525	12,449	8,613	14,804
	Nitzschia fonticola Grunow	-	-	4.7	-	4.5	133	-	-	269	1,346
	Nitzschia linearis W. Smith	1.4	6.6	4.7	-	1.5	399	641	336	1,346	4,037
	Nitzschia sigmoidea (Ehenberg) W. Smith	-	3.3	-	-	-	-	-	336	807	-
	Encyonema silesiacum (Bleisch) D.G. Mann	1.4	6.6	12	3.2	-	133	-	1,009	269	-
	Diatoma vulgare Bory	5.6	53	24	26	13	-	-	-	-	-
	Cymbella prostrata (Berkeley) Cleve	-	-	-	1.6	-	-	-	-	-	-
	Surirella ovata Kutzing	-	-	-	-	-	-	-	336	-	-
	Navicula radiosa Kutzing	1.4	-	-	-	-	133	641	336	269	449
	Gomphonema minutum	5.6	56	19	9.6	5.9	133	320	2,019	807	1,794
	Nitzschia palea (Kutzing) W. Smith	-	-	4.7	4.8	-	14,754	641	-	-	-
	Cocconies disculus Schum.	-	3.3	-	-	-	-	320	-	-	-
	Diatoma elongatum Agardh	-	-	-	3.2	3.0	-	-	-	-	-
	Anomoenies vitrea Ross	-	-	-	-	-	665	-	-	-	-
	Gomphonema angustum Agardh	-	-	-	-	-	-	-	336	-	-
	Navicula exigua (Greg.) Muller	-	3.3	2.4	-	-	-	961	673	1,615	449
	Fragilaria capucina Grunow	-	-	-	-	-	-	-	-	1,077	897
	Hannaea arcus Patrick	2.8	-	-	-	-	-	-	-	-	-
	Meridion circulare Agardh	-	-	19	3.2	3.0	-	-	-	269	-
Red Algae	Audouinella / Chantransia stage. Red alga	-	-	12	-	-	8,906	-	-	4,037	-

Table D.2: Biomass of periphyton community sampled at lower Wolverine Creek (reference) and lower Minto Creek (exposure), Minto Mine WUL, 2015. All data are presented as μg/cm^2.

Sample Location		Lower Wolverine Creek					Lower Minto Creek				
		LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
Sample Date		4-Sep-15	2-Sep-15	2-Sep-15	3-Sep-15	3-Sep-15	5-Sep-15	5-Sep-15	5-Sep-15	1-Sep-15	1-Sep-15
Group	**Genera and species**										
Cyanophyta	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	-	-	-	-	0.00059	-	-	-	-	-
	Pseudoanabaena sp.	0.00028	-	-	0.00015	-	0.034	-	-	-	0.095
	Phormidium autumnale Agardh	-	-	-	-	-	0.56	-	5.0	7.1	12
	Heteroleibeinia profunda Komarek	-	0.00093	0.0030	0.0012	0.00083	0.17	2.2	0.77	0.18	0.90
	Chamaesiphon incrustans Smith	-	-	-	-	0.00086	0.10	0.20	-	-	-
	Clastidium cylindricum Whelden	0.000090	-	0.00069	-	-	-	-	-	-	-
	Homoeothrix varians Komarek & Kalina	-	-	-	-	-	2.8	11	11	9.4	9.3
Diatoms	Cymbella minuta Kutzing	0.0013	0.0011	0.0018	-	0.0012	-	0.23	1.0	0.41	0.27
	Synedra acus v. radians (Kutzing) Hustedt	-	-	-	-	-	-	-	-	-	0.051
	Nitzschia clausii Hantzsch	-	-	-	-	-	-	-	0.12	-	-
	Achnanthes minutissima Kutzing	0.0093	0.024	0.015	0.010	0.0072	0.46	0.25	0.83	0.68	0.99
	Nitzschia fonticola Grunow	-	-	0.00028	-	0.00026	0.0072	-	-	0.017	0.070
	Nitzschia linearis W. Smith	0.00038	0.0076	0.0013	-	0.00043	0.19	0.17	0.16	0.29	1.9
	Nitzschia sigmoidea (Ehenberg) W. Smith	-	0.047	-	-	-	-	-	0.91	1.7	-
	Encyonema silesiacum (Bleisch) D.G. Mann	0.0017	0.0078	0.013	0.0038	-	0.14	-	1.2	0.32	-
	Diatoma vulgare Bory	0.0015	0.013	0.0058	0.0064	0.0032	-	-	-	-	-
	Cymbella prostrata (Berkeley) Cleve	-	-	-	0.035	-	-	-	-	-	-
	Surirella ovata Kutzing	-	-	-	-	-	-	-	2.2	-	-
	Navicula radiosa Kutzing	0.0026	-	-	-	-	0.26	1.2	1.0	0.62	0.88
	Gomphonema minutum	0.0022	0.024	0.0073	0.0040	0.00079	0.058	0.092	0.88	0.32	0.84
	Nitzschia palea (Kutzing) W. Smith	-	-	0.0037	0.0039	-	12	0.55	-	-	-
	Cocconies disculus Schum.	-	0.0051	-	-	-	-	0.41	-	-	-
	Diatoma elongatum Agardh	-	-	-	0.00055	0.00045	-	-	-	-	-
	Anomoenies vitrea Ross	-	-	-	-	-	0.21	-	-	-	-
	Gomphonema angustum Agardh	-	-	-	-	-	-	-	0.37	-	-
	Navicula exigua (Greg.) Muller	-	0.00076	0.00091	-	-	-	0.21	0.24	0.46	0.10
	Fragilaria capucina Grunow	-	-	-	-	-	-	-	-	0.23	0.85
	Hannaea arcus Patrick	0.0018	-	-	-	-	-	-	-	-	-
	Meridion circulare Agardh	-	-	0.018	0.0034	0.0046	-	-	-	0.25	-
Red Algae	Audouinella / Chantransia stage. Red alga	-	-	0.0076	-	-	4.8	-	-	1.2	-

Table D.3: Summary statistics for periphyton density collected at lower Wolverine Creek and lower Minto Creek stations, Minto Mine WUL, 2015. All data are presented as cells/cm^2.

Sample Location		Lower Wolverine Creek (Reference)					Lower Minto Creek (Exposure)				
		Mean	Median	Minimum	Maximum	Standard Deviation	Mean	Median	Minimum	Maximum	Standard Deviation
Group	**Genera and species**										
Cyanophyte	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	3.0	3.0	3.0	3.0	0	-	-	-	-	-
	Pseudoanabaena sp.	19	19	16	23	4.7	3,041	3,041	1,595	4,486	2,044
	Phormidium autumnale Agardh	-	-	-	-	-	2,181	2,052	133	4,486	1,809
	Heteroleibeinia profunda Komarek	25	20	16	42	12	14,096	14,131	2,260	33,005	12,710
	Chamaesiphon incrustans Smith	31	31	31	31	0	8,297	8,297	3,456	13,138	6,846
	Clastidium cylindricum Whelden	7.8	7.8	1.4	14	9.0	-	-	-	-	-
	Homoeothrix varians Komarek & Kalina	-	-	-	-	-	46,325	54,506	17,413	62,805	18,124
Diatoms	Cymbella minuta Kutzing	3.8	3.8	3.0	4.7	0.80	1,394	1,122	641	2,692	913
	Synedra acus v. radians (Kutzing) Hustedt	-	-	-	-	-	1,346	1,346	1,346	1,346	0
	Nitzschia clausii Hantzsch	-	-	-	-	-	673	673	673	673	0
	Achnanthes minutissima Kutzing	194	152	113	337	92	9,074	8,613	3,525	14,804	4,604
	Nitzschia fonticola Grunow	4.6	4.6	4.5	4.7	0	583	269	133	1,346	664
	Nitzschia linearis W. Smith	3.6	3.1	1.4	6.6	2.6	1,352	641	336	4,037	1,554
	Nitzschia sigmoidea (Ehenberg) W. Smith	3.3	3.3	3.3	3.3	0	572	572	336	807	333
	Encyonema silesiacum (Bleisch) D.G. Mann	5.7	4.9	1.4	12	4.6	470	269	133	1,009	472
	Diatoma vulgare Bory	24	24	5.6	53	18	-	-	-	-	-
	Cymbella prostrata (Berkeley) Cleve	1.6	1.6	1.6	1.6	0	-	-	-	-	-
	Surirella ovata Kutzing	-	-	-	-	-	336	336	336	336	0
	Navicula radiosa Kutzing	1.4	1.4	1.4	1.4	0	366	336	133	641	192
	Gomphonema minutum	19	10	5.6	56	21	1,015	807	133	2,019	854
	Nitzschia palea (Kutzing) W. Smith	4.7	4.7	4.7	4.8	0	7,698	7,698	641	14,754	9,980
	Cocconies disculus Schum.	3.3	3.3	3.3	3.3	0	320	320	320	320	0
	Diatoma elongatum Agardh	3.1	3.1	3.0	3.2	0	-	-	-	-	-
	Anomoenies vitrea Ross	-	-	-	-	-	665	665	665	665	0
	Gomphonema angustum Agardh	-	-	-	-	-	336	336	336	336	0
	Navicula exigua (Greg.) Muller	2.8	2.8	2.4	3.3	0.68	924	817	449	1,615	506
	Fragilaria capucina Grunow	-	-	-	-	-	987	987	897	1,077	127
	Hannaea arcus Patrick	2.8	2.8	2.8	2.8	0	-	-	-	-	-
	Meridion circulare Agardh	8.3	3.2	3.0	19	9.1	269	269	269	269	0
Red Algae	Audouinella / Chantransia stage. Red alga	12	12	12	12	0	6,472	6,472	4,037	8,906	3,442

Table D.4: Summary statistics for periphyton biomass collected at lower Wolverine Creek and lower Minto Creek stations, Minto Mine WUL, 2015. All data are presented as μg/cm^2.

Sample Location		Lower Wolverine Creek (Reference)					Lower Minto Creek (Exposure)				
		Mean	Median	Minimum	Maximum	Standard Deviation	Mean	Median	Minimum	Maximum	Standard Deviation
Group	**Genera and species**										
Cyanophyte	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	0.00059	0.00059	0.00059	0.00059	0	-	-	-	-	-
	Pseudoanabaena sp.	0.00022	0.00022	0.00015	0.00028	0.000092	0.064	0.064	0.034	0.095	0.043
	Phormidium autumnale Agardh	-	-	-	-	-	6.1	6.0	0.56	12	4.6
	Heteroleibeinia profunda Komarek	0.0015	0.0010	0.00083	0.0030	0.0010	0.85	0.77	0.17	2.2	0.83
	Chamaesiphon incrustans Smith	0.00086	0.00086	0.00086	0.00086	0	0.15	0.15	0.10	0.20	0.070
	Clastidium cylindricum Whelden	0.00039	0.00039	0.000090	0.00069	0.00042	-	-	-	-	-
	Homoeothrix varians Komarek & Kalina	-	-	-	-	-	8.7	9.4	2.8	11	3.4
Diatoms	Cymbella minuta Kutzing	0.0014	0.0013	0.0011	0.0018	0.00031	0.48	0.34	0.23	1.0	0.36
	Synedra acus v. radians (Kutzing) Hustedt	-	-	-	-	-	0.051	0.051	0.051	0.051	0
	Nitzschia clausii Hantzsch	-	-	-	-	-	0.12	0.12	0.12	0.12	0
	Achnanthes minutissima Kutzing	0.013	0.010	0.0072	0.024	0.0066	0.64	0.68	0.25	1.0	0.29
	Nitzschia fonticola Grunow	0.00027	0.00027	0.00026	0.00028	0.000014	0.031	0.017	0.0072	0.070	0.034
	Nitzschia linearis W. Smith	0.0024	0.00084	0.00038	0.0076	0.0035	0.6	0.19	0.16	1.9	0.78
	Nitzschia sigmoidea (Ehenberg) W. Smith	0.047	0.047	0.047	0.047	0	1.3	1.3	0.91	1.7	0.57
	Encyonema silesiacum (Bleisch) D.G. Mann	0.0065	0.0058	0.0017	0.013	0.0050	0.55	0.32	0.14	1.2	0.56
	Diatoma vulgare Bory	0.0060	0.00576	0.0015	0.013	0.0044	-	-	-	-	-
	Cymbella prostrata (Berkeley) Cleve	0.035	0.035	0.035	0.035	0	-	-	-	-	-
	Surirella ovata Kutzing	-	-	-	-	-	2.2	2.2	2.2	2.2	0
	Navicula radiosa Kutzing	-	-	-	-	-	0.79	0.88	0.26	1.2	0.36
	Gomphonema minutum	0.0076	0.0040	0.00079	0.024	0.0094	0.44	0.32	0.058	0.88	0.40
	Nitzschia palea (Kutzing) W. Smith	0.0038	0.0038	0.0037	0.0039	0.00014	6.1	6.1	0.55	12	7.9
	Cocconies disculus Schum.	0.0051	0.0051	0.0051	0.0051	0	0.41	0.41	0.41	0.41	0
	Diatoma elongatum Agardh	0.00050	0.00050	0.00045	0.00055	0.000071	-	-	-	-	-
	Anomoenies vitrea Ross	-	-	-	-	-	0.21	0.21	0.21	0.21	0
	Gomphonema angustum Agardh	-	-	-	-	-	0.37	0.37	0.37	0.37	0
	Navicula exigua (Greg.) Muller	0.00084	0.00084	0.00076	0.00091	0.00011	0.25	0.22	0.10	0.46	0.15
	Fragilaria capucina Grunow	-	-	-	-	-	0.54	0.54	0.23	0.85	0.44
	Hannaea arcus Patrick	0.0018	0.0018	0.0018	0.0018	0	-	-	-	-	-
	Meridion circulare Agardh	0.0086	0.0046	0.0034	0.018	0.0079	0.25	0.25	0.25	0.25	0
Red Algae	Audouinella / Chantransia stage. Red alga	0.0076	0.0076	0.0076	0.0076	0	3.0	3.0	1.2	4.8	2.5

Table D.5: Presence/absence of periphyton taxa at lower Wolverine Creek (reference) and lower Minto Creek (exposure), Minto Mine WUL, 2015.

Sample Location		Lower Wolverine Creek					Lower Minto Creek				
		LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
Group	**Genera and species**										
Cyanophyte	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	0	0	0	0	1	0	0	0	0	0
	Pseudoanabaena sp.	1	0	0	1	0	1	0	0	0	1
	Phormidium autumnale Agardh	0	0	0	0	0	1	0	1	1	1
	Heteroleibeinia profunda Komarek	0	1	1	1	1	1	1	1	1	1
	Chamaesiphon incrustans Smith	0	0	0	0	1	1	1	0	0	0
	Clastidium cylindricum Whelden	1	0	1	0	0	0	0	0	0	0
	Homoeothrix varians Komarek & Kalina	0	0	0	0	0	1	1	1	1	1
Diatoms	Cymbella minuta Kutzing	1	1	1	0	1	0	1	1	1	1
	Synedra acus v. radians (Kutzing) Hustedt	0	0	0	0	0	0	0	0	0	1
	Nitzschia clausii Hantzsch	0	0	0	0	0	0	0	1	0	0
	Achnanthes minutissima Kutzing	1	1	1	1	1	1	1	1	1	1
	Nitzschia fonticola Grunow	0	0	1	0	1	1	0	0	1	1
	Nitzschia linearis W. Smith	1	1	1	0	1	1	1	1	1	1
	Nitzschia sigmoidea (Ehenberg) W. Smith	0	1	0	0	0	0	0	1	1	0
	Encyonema silesiacum (Bleisch) D.G. Mann	1	1	1	1	0	1	0	1	1	0
	Diatoma vulgare Bory	1	1	1	1	1	0	0	0	0	0
	Cymbella prostrata (Berkeley) Cleve	0	0	0	1	0	0	0	0	0	0
	Surirella ovata Kutzing	0	0	0	0	0	0	0	1	0	0
	Navicula radiosa Kutzing	1	0	0	0	0	1	1	1	1	1
	Gomphonema minutum	1	1	1	1	1	1	1	1	1	1
	Nitzschia palea (Kutzing) W. Smith	0	0	1	1	0	1	1	0	0	0
	Cocconies disculus Schum.	0	1	0	0	0	0	1	0	0	0
	Diatoma elongatum Agardh	0	0	0	1	1	0	0	0	0	0
	Anomoenies vitrea Ross	0	0	0	0	0	1	0	0	0	0
	Gomphonema angustum Agardh	0	0	0	0	0	0	0	1	0	0
	Navicula exigua (Greg.) Muller	0	1	1	0	0	0	1	1	1	1
	Fragilaria capucina Grunow	0	0	0	0	0	0	0	0	1	1
	Hannaea arcus Patrick	1	0	0	0	0	0	0	0	0	0
	Meridion circulare Agardh	0	0	1	1	1	0	0	0	1	0
Red Algae	Audouinella / Chantransia stage. Red alga	0	0	1	0	0	1	0	0	1	0
	Taxa Total	**10**	**10**	**13**	**10**	**11**	**14**	**11**	**14**	**15**	**13**

PERIPHYTON COMMUNITY ANALYSIS

PROVIDED BY:

PLANKTON R US INC.

(WINNIPEG, MB)

Epilithic algal biomass (μg/cm2) for project 0073 for Minnow Environmental Inc. for 2015

R = QAQC recount

Location	date	Cyanobacteria μg/cm^2	Diatom μg/cm^2	Red Algae μg/cm^2	Total μg/cm^2
LMC-1	5/Sep/15	3.647	13.005	4.775	21.427
LMC-2	5/Sep/15	13.392	3.109	0.000	16.501
LMC-3	5/Sep/15	16.950	8.865	0.000	25.815
LMC-4	1/Sep/15	16.628	5.318	1.240	23.186
LMC-4R	1/Sep/15	12.395	6.581	1.571	20.547
LMC-5	1/Sep/15	21.798	5.998	0.000	27.795
LWC-1	4/Sep/15	0.000	0.021	0.000	0.021
LWC-2	2/Sep/15	0.001	0.129	0.000	0.130
LWC-3	2/Sep/15	0.004	0.067	0.008	0.078
LWC-4	3/Sep/15	0.001	0.068	0.000	0.069
LWC-5	3/Sep/15	0.002	0.018	0.000	0.020

Epilithic algal density (cells/cm2) for project 0073 for Minnow Environmental Inc. for 2015

R = QAQC recount

Location	date	Cyanobacteria cells/cm^2	Diatom cells/cm^2	Red Algae cells/cm^2	Total cells/cm^2
LMC-1	5/Sep/15	24856	22331	8906	56093
LMC-2	5/Sep/15	108948	7690	0	116638
LMC-3	5/Sep/15	70319	21197	0	91516
LMC-4	1/Sep/15	45489	16688	4037	66214
LMC-4R	1/Sep/15	42528	14535	5114	62177
LMC-5	1/Sep/15	83890	26019	0	109909
LWC-1	4/Sep/15	24	158	0	182
LWC-2	2/Sep/15	17	473	0	489
LWC-3	2/Sep/15	56	325	12	393
LWC-4	3/Sep/15	40	203	0	243
LWC-5	3/Sep/15	50	147	0	197

Epilithic algal species data for project 0073 for Minnow Environmental Inc. for 2015

**** 1st number in species code = group 1=cyanophyte 5=diatoms 8= red algae**
**** total daily biomass is sum of all species on a date**

R = QAQC recount

Location	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume µ^3
LMC-1	5-Sep-15	1077	Pseudoanabaena sp.	1595	0.034	3.00	3.00	21.20
LMC-1	5-Sep-15	1122	Phormidium autumnale Agardh	133	0.564	136.00	6.30	4239.50
LMC-1	5-Sep-15	1131	Heteroleibeinia profunda Komarek	2260	0.175	24.60	2.00	77.30
LMC-1	5-Sep-15	1223	Chamaesiphon incrustans Smith	3456	0.101	6.20	3.00	29.20
LMC-1	5-Sep-15	1239	Homoeothrix varians Komarek & Kalina	17413	2.774	46.00	2.10	159.30
LMC-1	5-Sep-15	5702	Achnanthes minutissima Kutzing	5981	0.459	18.30	4.00	76.70
LMC-1	5-Sep-15	5767	Nitzschia fonticola Grunow	133	0.007	19.00	3.30	54.20
LMC-1	5-Sep-15	5768	Nitzschia linearis W. Smith	399	0.192	51.00	6.00	480.70
LMC-1	5-Sep-15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	133	0.138	26.40	10.00	1036.70
LMC-1	5-Sep-15	5870	Navicula radiosa Kutzing	133	0.264	76.00	10.00	1989.70
LMC-1	5-Sep-15	5873	Gomphonema minutum	133	0.058	26.00	8.00	435.60
LMC-1	5-Sep-15	5874	Nitzschia palea (Kutzing) W. Smith	14754	11.681	84.00	6.00	791.70
LMC-1	5-Sep-15	5882	Anomoenies vitrea Ross	665	0.207	33.00	6.00	311.00
LMC-1	5-Sep-15	8001	Audouinella / Chantransia stage. Red alga	8906	4.775	16.00	8.00	536.20
LMC-2	5-Sep-15	1131	Heteroleibeinia profunda Komarek	33005	2.208	21.30	2.00	66.90
LMC-2	5-Sep-15	1223	Chamaesiphon incrustans Smith	13138	0.200	6.00	2.20	15.20
LMC-2	5-Sep-15	1239	Homoeothrix varians Komarek & Kalina	62805	10.985	46.00	2.20	174.90
LMC-2	5-Sep-15	5311	Cymbella minuta Kutzing	641	0.230	14.30	8.00	359.40
LMC-2	5-Sep-15	5702	Achnanthes minutissima Kutzing	3525	0.251	17.00	4.00	71.20
LMC-2	5-Sep-15	5768	Nitzschia linearis W. Smith	641	0.172	53.00	4.40	268.60
LMC-2	5-Sep-15	5870	Navicula radiosa Kutzing	641	1.191	71.00	10.00	1858.80
LMC-2	5-Sep-15	5873	Gomphonema minutum	320	0.092	23.00	6.90	286.70
LMC-2	5-Sep-15	5874	Nitzschia palea (Kutzing) W. Smith	641	0.550	91.00	6.00	857.70
LMC-2	5-Sep-15	5875	Cocconies disculus Schum.	320	0.414	25.20	14.00	1293.10
LMC-2	5-Sep-15	5910	Navicula exigua (Greg.) Muller	961	0.208	23.00	6.00	216.80
LMC-3	5-Sep-15	1122	Phormidium autumnale Agardh	1682	5.042	106.00	6.00	2997.10
LMC-3	5-Sep-15	1131	Heteroleibeinia profunda Komarek	14131	0.767	17.30	2.00	54.30
LMC-3	5-Sep-15	1239	Homoeothrix varians Komarek & Kalina	54506	11.141	59.00	2.10	204.40
LMC-3	5-Sep-15	5311	Cymbella minuta Kutzing	2692	1.003	16.00	7.70	372.50
LMC-3	5-Sep-15	5541	Nitzschia clausii Hantzsch	673	0.118	42.00	4.00	175.90
LMC-3	5-Sep-15	5702	Achnanthes minutissima Kutzing	12449	0.829	15.90	4.00	66.60
LMC-3	5-Sep-15	5768	Nitzschia linearis W. Smith	336	0.162	51.00	6.00	480.70
LMC-3	5-Sep-15	5769	Nitzschia sigmoidea (Ehenberg) W. Smith	336	0.907	103.00	10.00	2696.50
LMC-3	5-Sep-15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	1009	1.189	30.00	10.00	1178.10
LMC-3	5-Sep-15	5866	Surirella ovata Kutzing	336	2.169	76.00	18.00	6446.50
LMC-3	5-Sep-15	5870	Navicula radiosa Kutzing	336	1.002	79.00	12.00	2978.20
LMC-3	5-Sep-15	5873	Gomphonema minutum	2019	0.879	26.00	8.00	435.60
LMC-3	5-Sep-15	5884	Gomphonema angustum Agardh	336	0.370	42.00	10.00	1099.60
LMC-3	5-Sep-15	5910	Navicula exigua (Greg.) Muller	673	0.236	29.00	6.80	351.10
LMC-4	1-Sep-15	1122	Phormidium autumnale Agardh	2422	7.055	103.00	6.00	2912.30
LMC-4	1-Sep-15	1131	Heteroleibeinia profunda Komarek	2692	0.178	21.00	2.00	66.00
LMC-4	1-Sep-15	1239	Homoeothrix varians Komarek & Kalina	40375	9.395	56.00	2.30	232.70
LMC-4	1-Sep-15	5311	Cymbella minuta Kutzing	1346	0.414	16.00	7.00	307.90
LMC-4	1-Sep-15	5702	Achnanthes minutissima Kutzing	8613	0.678	18.80	4.00	78.70
LMC-4	1-Sep-15	5767	Nitzschia fonticola Grunow	269	0.017	24.00	3.20	64.30
LMC-4	1-Sep-15	5768	Nitzschia linearis W. Smith	1346	0.287	51.00	4.00	213.60
LMC-4	1-Sep-15	5769	Nitzschia sigmoidea (Ehenberg) W. Smith	807	1.712	81.00	10.00	2120.60
LMC-4	1-Sep-15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	269	0.317	30.00	10.00	1178.10
LMC-4	1-Sep-15	5870	Navicula radiosa Kutzing	269	0.622	73.00	11.00	2312.50
LMC-4	1-Sep-15	5873	Gomphonema minutum	807	0.325	24.00	8.00	402.10
LMC-4	1-Sep-15	5910	Navicula exigua (Greg.) Muller	1615	0.460	25.00	6.60	285.10
LMC-4	1-Sep-15	5916	Fragilaria capucina Grunow	1077	0.230	51.00	4.00	213.60
LMC-4	1-Sep-15	5986	Meridion circulare Agardh	269	0.254	36.00	10.00	942.50
LMC-4	1-Sep-15	8001	Audouinella / Chantransia stage. Red alga	4037	1.240	16.30	6.00	307.20
LMC-4R	1-Sep-15	1077	Pseudoanabaena sp.	2692	0.057	3.00	3.00	21.20
LMC-4R	1-Sep-15	1122	Phormidium autumnale Agardh	1346	3.919	103.00	6.00	2912.30
LMC-4R	1-Sep-15	1131	Heteroleibeinia profunda Komarek	3230	0.213	21.00	2.00	66.00
LMC-4R	1-Sep-15	1239	Homoeothrix varians Komarek & Kalina	35261	8.205	56.00	2.30	232.70
LMC-4R	1-Sep-15	5311	Cymbella minuta Kutzing	807	0.249	16.00	7.00	307.90
LMC-4R	1-Sep-15	5702	Achnanthes minutissima Kutzing	6998	0.551	18.80	4.00	78.70
LMC-4R	1-Sep-15	5768	Nitzschia linearis W. Smith	1077	0.230	51.00	4.00	213.60
LMC-4R	1-Sep-15	5769	Nitzschia sigmoidea (Ehenberg) W. Smith	807	1.712	81.00	10.00	2120.60
LMC-4R	1-Sep-15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	807	0.951	30.00	10.00	1178.10
LMC-4R	1-Sep-15	5870	Navicula radiosa Kutzing	807	1.867	73.00	11.00	2312.50
LMC-4R	1-Sep-15	5873	Gomphonema minutum	1346	0.541	24.00	8.00	402.10
LMC-4R	1-Sep-15	5910	Navicula exigua (Greg.) Muller	1077	0.307	25.00	6.60	285.10
LMC-4R	1-Sep-15	5916	Fragilaria capucina Grunow	807	0.172	51.00	4.00	213.60
LMC-4R	1-Sep-15	8001	Audouinella / Chantransia stage. Red alga	5114	1.571	16.30	6.00	307.20
LMC-5	1-Sep-15	1077	Pseudoanabaena sp.	4486	0.095	3.00	3.00	21.20
LMC-5	1-Sep-15	1122	Phormidium autumnale Agardh	4486	11.543	91.00	6.00	2573.00
LMC-5	1-Sep-15	1131	Heteroleibeinia profunda Komarek	18393	0.901	15.60	2.00	49.00
LMC-5	1-Sep-15	1239	Homoeothrix varians Komarek & Kalina	56525	9.259	43.10	2.20	163.80
LMC-5	1-Sep-15	5311	Cymbella minuta Kutzing	897	0.266	15.00	7.10	296.90
LMC-5	1-Sep-15	5519	Synedra acus v. radians (Kutzing) Hustedt	1346	0.051	36.00	2.00	37.70
LMC-5	1-Sep-15	5702	Achnanthes minutissima Kutzing	14804	0.992	16.00	4.00	67.00

Epilithic algal species data for project 0073 for Minnow Environmental Inc. for 2015

**** 1st number in species code = group 1=cyanophyte 5=diatoms 8= red algae**
**** total daily biomass is sum of all species on a date**

R = QAQC recount

Location	Date	Species code	Speceis name	density cells/cm^2	biomass µg/cm^2	length µ	width µ	cell volume µ^3
LMC-5	1-Sep-15	5767	Nitzschia fonticola Grunow	1346	0.070	22.00	3.00	51.80
LMC-5	1-Sep-15	5768	Nitzschia linearis W. Smith	4037	1.941	51.00	6.00	480.70
LMC-5	1-Sep-15	5870	Navicula radiosa Kutzing	449	0.881	75.00	10.00	1963.50
LMC-5	1-Sep-15	5873	Gomphonema minutum	1794	0.842	28.00	8.00	469.10
LMC-5	1-Sep-15	5910	Navicula exigua (Greg.) Muller	449	0.101	24.00	6.00	226.20
LMC-5	1-Sep-15	5916	Fragilaria capucina Grunow	897	0.854	101.00	6.00	951.90
LWC-1	4-Sep-15	1077	Pseudoanabaena sp.	23	0.000	3.00	2.30	12.50
LWC-1	4-Sep-15	1238	Clastidium cylindricum Whelden	1	0.000	7.30	4.00	61.20
LWC-1	4-Sep-15	5311	Cymbella minuta Kutzing	4	0.001	15.00	7.30	313.90
LWC-1	4-Sep-15	5702	Achnanthes minutissima Kutzing	135	0.009	16.30	4.00	68.30
LWC-1	4-Sep-15	5768	Nitzschia linearis W. Smith	1	0.000	56.00	4.30	271.10
LWC-1	4-Sep-15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	1	0.002	30.00	10.00	1178.10
LWC-1	4-Sep-15	5860	Diatoma vulgare Bory	6	0.001	28.00	6.00	263.90
LWC-1	4-Sep-15	5870	Navicula radiosa Kutzing	1	0.003	69.00	10.00	1806.40
LWC-1	4-Sep-15	5873	Gomphonema minutum	6	0.002	23.60	8.00	395.40
LWC-1	4-Sep-15	5917	Hannaea arcus Patrick	3	0.002	69.00	6.00	650.30
LWC-2	2-Sep-15	1131	Heteroleibeinia profunda Komarek	17	0.001	17.90	2.00	56.20
LWC-2	2-Sep-15	5311	Cymbella minuta Kutzing	3	0.001	16.00	7.30	334.80
LWC-2	2-Sep-15	5702	Achnanthes minutissima Kutzing	337	0.024	16.80	4.00	70.40
LWC-2	2-Sep-15	5768	Nitzschia linearis W. Smith	7	0.008	69.00	8.00	1156.10
LWC-2	2-Sep-15	5769	Nitzschia sigmoidea (Ehenberg) W. Smith	3	0.047	210.00	16.00	14074.30
LWC-2	2-Sep-15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	7	0.008	30.00	10.00	1178.10
LWC-2	2-Sep-15	5860	Diatoma vulgare Bory	53	0.013	26.00	6.00	245.00
LWC-2	2-Sep-15	5873	Gomphonema minutum	56	0.024	25.30	8.00	423.90
LWC-2	2-Sep-15	5875	Cocconies disculus Schum.	3	0.005	26.00	15.00	1531.50
LWC-2	2-Sep-15	5910	Navicula exigua (Greg.) Muller	3	0.001	24.30	6.00	229.00
LWC-3	2-Sep-15	1131	Heteroleibeinia profunda Komarek	42	0.003	22.60	2.00	71.00
LWC-3	2-Sep-15	1238	Clastidium cylindricum Whelden	14	0.001	7.20	3.60	48.90
LWC-3	2-Sep-15	5311	Cymbella minuta Kutzing	5	0.002	15.30	8.00	384.50
LWC-3	2-Sep-15	5702	Achnanthes minutissima Kutzing	230	0.015	15.60	4.00	65.30
LWC-3	2-Sep-15	5767	Nitzschia fonticola Grunow	5	0.000	22.40	3.20	60.10
LWC-3	2-Sep-15	5768	Nitzschia linearis W. Smith	5	0.001	55.00	4.30	266.20
LWC-3	2-Sep-15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	12	0.013	28.00	10.00	1099.60
LWC-3	2-Sep-15	5860	Diatoma vulgare Bory	24	0.006	26.00	6.00	245.00
LWC-3	2-Sep-15	5873	Gomphonema minutum	19	0.007	23.00	8.00	385.40
LWC-3	2-Sep-15	5874	Nitzschia palea (Kutzing) W. Smith	5	0.004	83.00	6.00	782.30
LWC-3	2-Sep-15	5910	Navicula exigua (Greg.) Muller	2	0.001	23.00	8.00	385.40
LWC-3	2-Sep-15	5986	Meridion circulare Agardh	19	0.018	36.00	10.00	942.50
LWC-3	2-Sep-15	8001	Audouinella / Chantransia stage. Red alga	12	0.008	19.30	8.00	646.70
LWC-4	3-Sep-15	1077	Pseudoanabaena sp.	16	0.000	3.10	2.00	9.70
LWC-4	3-Sep-15	1131	Heteroleibeinia profunda Komarek	24	0.001	15.30	2.00	48.10
LWC-4	3-Sep-15	5702	Achnanthes minutissima Kutzing	152	0.010	16.30	4.00	68.30
LWC-4	3-Sep-15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	3	0.004	30.00	10.00	1178.10
LWC-4	3-Sep-15	5860	Diatoma vulgare Bory	26	0.006	26.60	6.00	250.70
LWC-4	3-Sep-15	5865	Cymbella prostrata (Berkeley) Cleve	2	0.035	106.00	23.00	22020.20
LWC-4	3-Sep-15	5873	Gomphonema minutum	10	0.004	25.00	8.00	418.90
LWC-4	3-Sep-15	5874	Nitzschia palea (Kutzing) W. Smith	5	0.004	86.00	6.00	810.50
LWC-4	3-Sep-15	5881	Diatoma elongatum Agardh	3	0.001	41.00	4.00	171.70
LWC-4	3-Sep-15	5986	Meridion circulare Agardh	3	0.003	41.00	10.00	1073.40
LWC-5	3-Sep-15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis aı	3	0.001	63.00	2.00	197.90
LWC-5	3-Sep-15	1131	Heteroleibeinia profunda Komarek	16	0.001	16.30	2.00	51.20
LWC-5	3-Sep-15	1223	Chamaesiphon incrustans Smith	31	0.001	6.30	2.90	27.70
LWC-5	3-Sep-15	5311	Cymbella minuta Kutzing	3	0.001	16.30	8.00	409.70
LWC-5	3-Sep-15	5702	Achnanthes minutissima Kutzing	113	0.007	15.30	4.00	64.10
LWC-5	3-Sep-15	5767	Nitzschia fonticola Grunow	4	0.000	21.60	3.20	57.90
LWC-5	3-Sep-15	5768	Nitzschia linearis W. Smith	1	0.000	57.00	4.40	288.90
LWC-5	3-Sep-15	5860	Diatoma vulgare Bory	13	0.003	25.50	6.00	240.30
LWC-5	3-Sep-15	5873	Gomphonema minutum	6	0.001	24.00	4.60	133.00
LWC-5	3-Sep-15	5881	Diatoma elongatum Agardh	3	0.000	36.10	4.00	151.20
LWC-5	3-Sep-15	5986	Meridion circulare Agardh	3	0.005	41.00	12.00	1545.70

APPENDIX E

BENTHIC INVERTEBRATE COMMUNITY DATA

Table E.1: Benthic Invertebrates collected by Hess sampler and screened through a 500 µm sieve. Values reported as number of organisms per sample, Minto Mine WUL, 2015.

Invertebrate	Lower Wolverine Creek (Reference)					Lower Big Creek (Reference)					Lower Minto Creek (Exposure)				
	LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	LBC-1	LBC-2	LBC-3	LBC-4	LBC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
Phylum: Arthropoda															
Subphylum: Hexapoda															
Class: Insecta															
Order: Ephemeroptera															
Family: Ameletidae															
Ameletus					1			2						1	
Family: Baetidae					4										
Acentrella sp.					2										
Baetis	1	2	1	3	8	4	2	1	1	5					
Baetis tricaudatus group	3	1	6	8	10			1		9					
Family: Ephemerellidae			1		1	2		1		12					
Drunella doddsii			1	6	3	1				1					
Drunella spinifera				1	1	3	3		1	3					
Ephemerella			1		1										
Serratella					1										
Family: Heptageniidae	3	2	2	1	1		2	11	6	8					
Cinygmula sp.					1										
Order: Plecoptera															
Family: Capniidae		1					1	3	1				2	4	14
Family: Chloroperlidae	3			1	2					1					
Haploperla sp.		1								1					
Paraperla sp.								1							
Suwallia									1						
Family: Leuctridae					1									2	
Family: Nemouridae					1						4	8	106	4	40
Nemoura						1				3	41	71	300	55	182
Ostrocerca sp.												5	14		6
Prostoia											2				2
Zapada cinctipes	1									2					
Family: Perlodidae	1	1			5		1	1		1					
Diura sp.				1											
Isoperla sp.	7	1	3	4	8					6					
Order: Trichoptera															
Family: Glossosomatidae					1										
Glossosoma	14		1		1	1		1							
Family: Limnephilidae	2			1	4								16	4	26
Dicosmoecus atripes							1								
Family: Rhyacophilidae															
Rhyacophila										1					
Rhyacophila brunnea/vemna group	3			1	1	1									

Table E.1: Benthic Invertebrates collected by Hess sampler and screened through a 500 µm sieve. Values reported as number of organisms per sample, Minto Mine WUL, 2015.

Invertebrate	Lower Wolverine Creek (Reference)					Lower Big Creek (Reference)					Lower Minto Creek (Exposure)				
	LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	LBC-1	LBC-2	LBC-3	LBC-4	LBC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
Order: Coleoptera					2	1		1							
Order: Diptera				1	1								2		
Family: Ceratopogonidae															
Ceratopogon sp.													4		
Culicoides															2
Family: Chironomidae	3		7	3	4	1	3	5		2		7	2	1	6
Subfamily: Chironominae															
Tribe: Chironomini															
Stictochironomus			1												2
Tribe: Tanytarsini															
Micropsectra				1							4		18	30	314
Neostempellina reissi															2
Rheotanytarsus						3		4	1	1					
Subfamily: Diamesinae															
Tribe: Diamesini															
Diamesa													2		
Pagastia	2	1		3	5	3		1		5					
Potthastia longimana group										1					
Pseudodiamesa sp.											1				2
Subfamily: Orthocladiinae															
Brillia sp.											4	1	6	1	2
Eukiefferiella				1	1						20		96	4	
Eukiefferiella claripennis group												35			
Eukiefferiella devonica group										1					2
Hydrobaenus															4
Limnophyes sp.					1						2	1	4	1	4
Orthocladius		1	4	1		5	1	6	1	7	9	4	22	6	34
Orthocladius lignicola					1						1				
Parakiefferiella											1				
Paraphaenocladius sp.													2		8
Pseudosmittia sp.							1				1				
Tvetenia															
Tvetenia bavarica group	4	2	7	1	4	2	1	2	1	3	10	20	34	1	16
Family: Dolichopodidae										1					
Family: Empididae					1										
Clinocera sp.											1	1			2
Family: Muscidae															
Limnophora sp.												1			
Family: Psychodidae															
Pericoma/Telmatoscopus sp.								1							4

Table E.1: Benthic Invertebrates collected by Hess sampler and screened through a 500 µm sieve. Values reported as number of organisms per sample, Minto Mine WUL, 2015.

Invertebrate	Lower Wolverine Creek (Reference)					Lower Big Creek (Reference)					Lower Minto Creek (Exposure)				
	LWC-1	LWC-2	LWC-3	LWC-4	LWC-5	LBC-1	LBC-2	LBC-3	LBC-4	LBC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
Family: Simuliidae	1		1	1	1		1								
Helodon sp.		2													
Prosimulium					1		1							1	
Simulium	1			1	1		1	1		3			2		
Family: Tipulidae															
Dicranota	3	2		1	1		11		4	6	2		10	6	12
Ormosia sp.								1		2					
Tipula														1	2
Subphylum: Chelicerata															
Class: Arachnida															
Order: Trombidiformes								1							
Family: Hygrobatidae															
Hygrobates						1	1								
Family: Lebertiidae															
Lebertia		1				1				4					
Family: Sperchontidae															
Sperchon			1							2	3	2	2		2
Order:Oribatei															
Family:Oribatidae															
Oribatida				1			1				1				4
Phylum: Mollusca															
Class: Bivalvia															
Order: Veneroida															
Family: Pisidiidae															
Pisidium										1					
Phylum: Annelida															
Subphylum: Clitellata															
Class:Oligochaeta		1													
Order: Lumbriculida															
Family: Lumbriculidae															
Rhynchelmis sp.								1					2		
Order: Tubificida															
Family: Enchytraeidae															
Enchytraeus			1	2	3	2	19	4	4	6	7	5	4		
Family: Naididae		2				3	1	13		5			28		
Stylaria sp.									1				2		
Totals:	**52**	**21**	**38**	**44**	**85**	**35**	**52**	**63**	**22**	**103**	**114**	**161**	**680**	**122**	**694**

Table E.2: Benthic invertebrate community metrics by station for samples collected by Hess sampler, Minto Mine WUL, 2015.

Area	Station	Density (organisms/m^2)	Number of Taxa	BC Distance to LWC Median	BC Distance to LBC Median	BC Distance to Combined Reference Median	Simpson's D	Simpson's E[a]	Ephemeroptera (%)	Plecoptera (%)	Trichoptera (%)	EPT (%)	Chironomids (%)	CA Axis-1 (33.4%)	CA Axis-2 (16.2%)
Lower Wolverine Creek (Reference)	LWC-1	160	13	0.40	0.69	0.85	0.86	0.53	13	23	37	73	17	377	99
	LWC-2	67	13	0.41	0.42	0.77	0.92	0.90	24	19	0	43	19	274	-2.5
	LWC-3	100	13	0.31	0.63	0.76	0.86	0.57	32	7.9	2.6	42	50	253	26
	LWC-4	133	19	0.28	0.66	0.87	0.90	0.53	43	14	4.5	61	23	355	57
	LWC-5	250	28	0.42	0.71	0.84	0.92	0.45	40	20	8.2	68	19	339	48
Lower Big Creek (Reference)	LBC-1	107	15	0.65	0.43	0.71	0.91	0.74	29	2.9	5.7	37	40	274	-31
	LBC-2	160	16	0.70	0.50	0.71	0.78	0.28	13	3.8	1.9	19	12	219	-67
	LBC-3	190	20	0.70	0.41	0.71	0.88	0.42	25	7.9	1.6	35	29	221	-61
	LBC-4	73	11	0.70	0.23	0.65	0.84	0.58	36	9.1	0	45	14	249	-56
	LBC-5	297	25	0.55	0.45	0.63	0.94	0.68	37	14	1.0	51	19	275	-13
Lower Minto Creek (Exposure)	LMC-1	367	16	0.90	0.83	0.48	0.80	0.32	0	41	0	41	46	-43	-73
	LMC-2	487	11	0.94	0.89	0.62	0.68	0.29	0	52	0	52	42	-57	-62
	LMC-3	1907	20	0.97	0.94	0.87	0.69	0.16	0	62	2.4	64	27	-70	-71
	LMC-4	390	14	0.93	0.85	0.52	0.70	0.24	0.82	53	3.3	57	36	-74	24
	LMC-5	2160	23	0.98	0.97	0.88	0.68	0.14	0	35	3.7	39	57	-93	87

[a] Calculated as recommended by Environment Canada 2012

Table E.3: Summary of Benthic Invertebrate Community Characteristics, and Statistical Comparisons Among Areas, Minto Mine WUL, 2015.

	Overall 3-group ANOVA				3-group ANOVA Post-hoc Comparisons[1,2]				2-group ANOVA for Estimation of Effect Size		
Metric	**Test Type**	**Significant Difference Among Areas?**	**p-value**	**Power**	**(I) Area**	**(J) Area**	**Significant Difference Between Areas?**	**p-value**	**Power**	**Magnitude of Difference (# of SDs)[3]**	**Minimum Detectable Effect Size (# of SDs)[4]**
Density (Individuals/m^2)	ANOVA	YES	0.002	0.990	lower Wolverine Creek	lower Minto Creek	YES	0.003	0.975	13.2	-
					lower Big Creek	lower Minto Creek	YES	0.006	0.948	10.4	-
					lower Big Creek	lower Wolverine Creek	NO	1.000	0.125	-	0.017
Number of Taxa	Kruskal-Wallis	NO	0.925	-	lower Wolverine Creek	lower Minto Creek	NO	0.751	-	-	-
					lower Big Creek	lower Minto Creek	NO	0.833	-	-	-
					lower Big Creek	lower Wolverine Creek	NO	0.751	-	-	-
EPT (%)	ANOVA	YES	0.074	0.656	lower Wolverine Creek	lower Minto Creek	NO	1.000	0.198	-	1.7
					lower Big Creek	lower Minto Creek	NO	0.367	0.504	-	1.8
					lower Big Creek	lower Wolverine Creek	YES	0.083	0.694	1.6	-
Chironomids (%)	ANOVA	YES	0.064	0.684	lower Wolverine Creek	lower Minto Creek	NO	0.295	0.789	-	0.0035
					lower Big Creek	lower Minto Creek	YES	0.073	0.713	1.6	-
					lower Big Creek	lower Wolverine Creek	NO	1.000	0.162	-	0.0035
BC Distance to LWC Median	Kruskal-Wallis	YES	0.002	-	lower Wolverine Creek	lower Minto Creek	YES	0.009	-	-	-
					lower Big Creek	lower Minto Creek	YES	0.009	-	-	-
					lower Big Creek	lower Wolverine Creek	YES	0.009	-	-	-
BC Distance to LBC Median	ANOVA	YES	0.000	1.000	lower Wolverine Creek	lower Minto Creek	YES	0.002	0.994	2.3	-
					lower Big Creek	lower Minto Creek	YES	0.000	1.000	4.7	-
					lower Big Creek	lower Wolverine Creek	YES	0.012	0.881	2.1	-
BC Distance to Combined Reference Median	ANOVA	YES	0.000	1.000	lower Wolverine Creek	lower Minto Creek	YES	0.000	1.000	3.6	-
					lower Big Creek	lower Minto Creek	YES	0.000	1.000	6.3	-
					lower Big Creek	lower Wolverine Creek	NO	0.174	0.485	-	3.4
Simpson's Diversity	Kruskal-Wallis	YES	0.012	-	lower Wolverine Creek	lower Minto Creek	YES	0.009	-	-	-
					lower Big Creek	lower Minto Creek	YES	0.016	-	-	-
					lower Big Creek	lower Wolverine Creek	NO	0.602	-	-	-
Simpson's Evenness	ANOVA	YES	0.001	0.992	lower Wolverine Creek	lower Minto Creek	YES	0.002	0.997	2.1	-
					lower Big Creek	lower Minto Creek	YES	0.006	0.942	1.7	-
					lower Big Creek	lower Wolverine Creek	NO	1.000	0.150	-	1.5
CA Axis-1 (33.4%)	ANOVA	YES	0.000	1.000	lower Wolverine Creek	lower Minto Creek	YES	0.000	1.000	7.2	-
					lower Big Creek	lower Minto Creek	YES	0.000	1.000	1.7	-
					lower Big Creek	lower Wolverine Creek	NO	0.108	0.786	-	1.7
CA Axis-2 (16.2%)	ANOVA	YES	0.032	0.795	lower Wolverine Creek	lower Minto Creek	NO	0.331	0.493	-	4.5
					lower Big Creek	lower Minto Creek	NO	0.849	0.187	-	3.0
					lower Big Creek	lower Wolverine Creek	YES	0.009	0.995	4.0	-

Highlighted values indicate significance at the $p < 0.10$ level

[1] p-value obtained from post-hoc analysis of 1-way ANOVA among all areas (post-hoc analyses protected for multiple comparisons)

[2] Bonferroni post-hoc Test, or Tamhane's T2 Test where variances were found to be heterogeneous by Levene's Test. Individual Mann-Whitney U-tests conducted between sites if data could not be normalized.

[3] Magnitude calculated by comparing the difference between the reference and exposure area means to the reference area standard deviation (SD) [(exposure mean - reference mean) / standard deviation of the reference mean]

[4] Minimum effect size detectable calculated based on variance as square root of MSE from ANOVA and alpha = beta = 0.10. Minimum effect size reported as the minimum number of standard deviations detectable based on reference area standard deviation.

Table E.4: Benthic Analyses - ANOVA results, Minto Mine WUL, 2015.

Dependent Variable	Mean Square	F (ANOVA)	p-value	Observed Power
Density (Individuals/m^2)	0.082	11	0.002	0.990
Number of Taxa	-	-	0.925	-
EPT (%)	157	3.3	0.074	0.656
Chironomids (%)	0.00031	3.5	0.064	0.684
Oligochaetes (%)	-	-	0.980	-
Simpson's Diversity	-	-	0.012	-
Simpson's Evenness	0.023	12	0.001	0.992
BC Distance to LWC Median	-	-	0.002	-
BC Distance to LBC Median	0.0095	32	0.000	0.992
BC Distance to Combined Reference Median	-	-	0.174	-
CA Axis-1 (33.4%)	1,314	161	0.000	1.000
CA Axis-2 (16.2%)	2,364	4.6	0.032	0.795
Median Intermediate Axis Length (cm)	0.17	0.077	0.926	0.115
Median Embeddedness (%)	-	-	0.143	-
Water Velocity (m/s)	0.0028	2.2	0.149	0.513
Depth (m)	0.011	1.9	0.195	0.454
Temperature (°C)	0.97	4.4	0.038	0.638
DO (%)	4	10	0.003	0.943
Specific Conductivity (µS/cm)	-	-	0.005	-
pH	0.012	12	0.002	0.969
% cobble	-	-	0.883	-
% gravel	-	-	0.682	-
% sand and finer	-	-	0.490	-

Indicates p-value < 0.10

Table E.5: Pearson correlation of station Correspondence Analysis (CA) axes scores with benthic taxa.

Invertebrate	CA Axis-1 (33.4%)		CA Axis-2 (16.2%)	
	Pearson r-value	p-value	Pearson r-value	p-value
Ameletus	0.028	0.922	-0.049	0.861
Baetis sp.	0.644	0.010	0.216	0.440
Baetis tricaudatus group	0.594	0.019	0.462	0.083
Drunella doddsii	0.474	0.074	0.391	0.150
Drunella spinifera	0.417	0.122	-0.204	0.465
Ephemerella	0.296	0.285	0.294	0.288
Heptageniidae	0.438	0.102	-0.183	0.514
Capniidae	-0.521	0.047	0.340	0.216
Chloroperlidae	0.682	0.005	0.466	0.080
Leuctridae	-0.222	0.426	0.246	0.377
Nemouridae	-0.688	0.005	-0.118	0.676
Perlodidae	0.637	0.011	0.551	0.033
Glossosomatidae	0.399	0.141	0.513	0.051
Limnephilidae	-0.550	0.034	0.312	0.258
Rhyacophila brunnea/vemna group	0.535	0.040	0.589	0.021
Coleoptera	0.343	0.210	0.059	0.833
Stictochironomus sp.	-0.312	0.258	0.465	0.080
Micropsectra sp.	-0.469	0.078	0.427	0.112
Rheotanytarsus sp.	0.238	0.394	-0.336	0.221
Pagastia sp.	0.630	0.012	0.334	0.223
Pseudodiamesa sp.	-0.525	0.045	0.255	0.358
Brillia sp.	-0.730	0.002	-0.329	0.232
Eukiefferiella	-0.446	0.095	-0.351	0.200
Eukiefferiella devonica group	-0.296	0.285	0.384	0.158
Limnophyes sp.	-0.773	0.001	0.009	0.974
Orthocladius	-0.688	0.005	0.088	0.756
Paraphaenocladius sp.	-0.492	0.063	0.352	0.198
Pseudosmittia sp.	-0.180	0.521	-0.431	0.109
Tvetenia bavarica group	-0.672	0.006	-0.229	0.411
Empididae	-0.510	0.052	0.230	0.409
Pericoma/Telmatoscopus sp.	-0.380	0.163	0.363	0.183
Simuliidae	0.494	0.061	0.189	0.500
Dicranota sp.	-0.439	0.102	0.018	0.948
Ormosia sp.	0.196	0.484	-0.144	0.608
Tipula sp.	-0.547	0.035	0.462	0.083
Hygrobates sp.	0.183	0.513	-0.289	0.296
Lebertia sp.	0.248	0.372	-0.053	0.851
Sperchon sp.	-0.658	0.008	-0.259	0.351
Oribatida	-0.384	0.158	0.348	0.204
Rhynchelmis sp.	-0.301	0.276	-0.392	0.148
Enchytraeus sp.	-0.011	0.968	-0.582	0.023
Naididae	-0.259	0.352	-0.424	0.115

Indicates absolute r-values > 0.50 (grey)

Indicates p-value < 0.05 (blue)

Table E.6: Correspondence analysis axes results and station scores using benthic invertebrate abundances at the lowest practical level of taxonomic resolution.

	CA Axis-1 (33.4%)	CA Axis-2 (16.2%)
Eigenvalue	0.696	0.338
Relative Inertia (%)	33.4	16.2
Monte Carlo p-value	0.765	0.995
LMC 1	-43.5	-73.2
LMC 2	-56.8	-62.1
LMC 3	-69.9	-71.2
LMC 4	-73.8	24.0
LMC 5	-93.4	87.0
LWC 1	377.1	99.0
LWC 2	274.2	-2.5
LWC 3	252.9	25.6
LWC 4	354.7	56.6
LWC 5	338.5	48.3
LBC 1	273.9	-31.4
LBC 2	219.5	-66.9
LBC 3	221.3	-61.4
LBC 4	249.3	-55.7
LBC 5	275.4	-12.9

Table E.7: Intermediate axis length and embeddedness of 100 rocks washed during Hess sampling at benthic invertebrate stations, Minto Mine WUL, 2015.

Rock Number	Lower Wolverine Creek									
	LWC-1		LWC-2		LWC-3		LWC-4		LWC-5	
	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)
1	9.2		7.5		8.1		5.6		6.7	
2	2.3		4.8		4.6		4.0		6.1	
3	7.5		4.5		4.0		6.6		8.6	
4	9.4		5.0		10.7		5.2		5.1	
5	2.1		4.9		3.7		6.1		8.3	
6	8.0		2.5		6.0		5.4		3.1	
7	6.8		2.9		4.5		3.6		4.0	
8	10.0		3.0		9.3		4.9		2.2	
9	3.6		7.0		5.3		1.8		2.6	
10	5.8	0	4.2	0	6.2	0	3.4	0	6.8	0
11	3.5		5.4		10.7		3.9		6.4	
12	5.0		3.7		5.4		6.9		3.0	
13	3.6		5.9		2.5		4.8		4.1	
14	4.9		7.7		2.8		4.3		4.3	
15	7.8		7.2		2.7		4.9		3.2	
16	3.1		3.9		2.8		2.9		6.1	
17	6.5		4.5		2.9		2.9		12.4	
18	3.8		11.6		5.6		6.2		10.2	
19	4.0		3.4		4.3		3.7		5.9	
20	4.0	50	5.5	25	3.2	50	2.6	50	6.5	25
21	3.2		3.1		3.7		5.4		3.7	
22	1.9		4.3		3.5		9.6		5.6	
23	3.2		4.1		3.2		4.2		8.0	
24	2.1		8.5		5.7		8.7		5.5	
25	1.9		8.8		6.7		4.8		5.1	
26	2.9		7.6		9.5		6.8		3.0	
27	4.0		4.6		3.2		7.9		2.8	
28	5.3		3.6		4.2		2.2		6.5	
29	3.9		5.2		3.5		3.3		3.6	
30	4.0	25	2.2	0	3.0	0	4.1	50	5.2	0
31	3.7		11.1		4.7		4.3		2.6	
32	4.6		4.1		2.0		2.0		3.1	
33	6.3		4.4		5.6		4.6		8.5	
34	3.5		7.3		5.0		5.6		3.2	
35	2.8		2.6		2.0		2.4		3.7	
36	2.2		3.9		3.6		7.7		3.5	
37	2.6		3.2		3.3		5.2		5.0	
38	10.5		3.5		5.3		5.7		2.2	
39	2.5		5.1		3.9		2.4		4.7	
40	4.1	25	5.9	0	4.2	25	5.6	25	2.6	50
41	3.0		4.5		4.1		7.6		2.9	
42	1.9		4.3		6.9		3.6		5.0	
43	3.7		4.6		3.9		4.0		3.2	
44	5.8		7.4		2.5		8.7		3.2	
45	3.8		4.6		11.5		7.2		10.4	
46	4.0		4.3		3.5		3.8		7.6	
47	4.5		6.7		5.5		9.7		7.0	
48	2.3		4.2		4.6		11.2		8.6	
49	2.0		4.3		6.0		8.2		4.3	
50	4.1	0	6.2	25	6.6	25	6.6	0	6.1	50
51	3.4		3.5		4.1		2.6		4.0	
52	4.0		3.0		5.2		2.7		4.0	
53	4.7		3.9		5.9		3.2		3.9	
54	3.2		3.7		2.5		2.2		5.7	
55	4.6		8.5		3.2		4.8		3.5	
56	2.2		6.5		3.0		3.3		8.0	
57	4.3		4.0		3.5		4.7		7.0	
58	3.1		6.1		3.7		5.2		9.4	
59	2.3		4.3		4.5		1.8		3.2	
60	3.5	25	4.5	0	3.3	0	3.3	25	2.6	0
61	3.3		5.0		3.8		7.6		2.8	
62	3.5		3.9		3.1		3.6		3.8	
63	4.5		4.6		3.6		4.5		3.8	
64	3.2		4.6		3.0		3.9		3.4	
65	3.1		4.6		2.2		6.3		3.9	
66	12.4		3.7		2.0		2.7		7.2	
67	3.6		3.6		2.9		10.6		7.8	
68	4.3		3.5		2.3		8.0		6.6	
69	3.9		4.8		4.2		3.3		6.0	
70	4.4	0	4.8	50	2.2	0	3.0	0	5.7	0
71	4.3		2.9		3.2		3.8		5.8	
72	1.8		2.5		2.4		3.4		4.0	
73	2.3		3.2		3.6		5.0		4.3	
74	3.1		2.5		4.7		4.3		2.8	
75	3.2		2.8		3.7		5.0		4.1	
76	3.0		4.1		3.1		3.6		6.6	
77	4.0		3.6		3.3		4.3		3.2	
78	3.9		4.5		5.1		4.5		5.3	
79	3.7		3.7		4.3		4.8		4.2	
80	10.0	25	3.7	50	3.2	50	2.9	0	4.3	25
81	3.7		4.6		4.7		7.3		4.7	
82	2.5		2.7		3.7		9.6		3.1	
83	2.6		3.0		4.2		7.1		6.5	
84	2.8		3.3		3.1		4.5		3.4	
85	2.3		3.6		3.9		2.3		4.1	
86	3.3		4.3		3.5		8.0		3.1	
87	2.7		3.2		2.9		2.8		3.2	
88	2.5		3.3		2.1		5.7		3.0	
89	2.7		4.1		3.3		4.5		6.2	
90	3.3	0	4.7	0	3.7	25	3.9	0	3.7	0
91	2.3		4.2		2.3		4.5		3.2	
92	2.8		3.9		3.1		2.1		3.2	
93	2.2		2.1		2.0		6.1		4.2	
94	2.3		3.0		2.6		4.5		2.3	
95	2.6		2.6		2.3		7.2		3.4	
96	2.1		3.8		2.3		4.5		2.3	
97	2.4		3.2		2.6		5.6		3.0	
98	2.7		3.0		2.3		3.6		3.3	
99	2.2		3.7		2.5		5.7		3.6	
100	2.2	25	2.3	25	2.2	0	4.6	50	2.9	25
Minimum	**1.8**		**2.1**		**2.0**		**1.8**		**2.2**	
Maximum	**12.4**		**11.6**		**11.5**		**11.2**		**12.4**	
Mean	**3.9**		**4.5**		**4.1**		**5.0**		**4.8**	
Geometric mean	**3.6**		**4.3**		**3.8**		**4.6**		**4.4**	
Median	**3.5**	**25**	**4.2**	**13**	**3.6**	**13**	**4.5**	**13**	**4.1**	**13**

Note: intermediate axis length is the second longest axis on a rock. Embeddedness refers to how deeply the rock is surrounded or buried by other substrate.

Table E.7: Intermediate axis length and embeddedness of 100 rocks washed during Hess sampling at benthic invertebrate stations, Minto Mine WUL, 2015.

Rock Number	**Lower Big Creek**									
	LBC-1		LBC-2		LBC-3		LBC-4		LBC-5	
	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)
1	5.8		7.4		5.6		9.9		5.0	
2	4.0		3.1		6.2		8.7		5.7	
3	7.6		4.0		4.3		7.6		4.5	
4	3.6		2.7		7.8		9.3		2.6	
5	2.1		2.2		4.5		8.4		3.1	
6	2.3		6.1		6.3		6.6		5.1	
7	3.3		4.6		5.5		6.8		5.1	
8	2.7		4.4		6.5		7.9		2.7	
9	7.0		3.7		6.6		9.2		5.4	
10	6.2	0	5.9	0	3.4	0	7.0	0	2.4	0
11	4.8		4.5		3.6		6.2		10.1	
12	3.2		8.2		2.7		8.0		4.5	
13	9.0		4.1		7.3		5.6		4.7	
14	4.5		6.2		2.8		5.0		3.9	
15	5.5		4.4		4.3		8.0		3.9	
16	3.1		4.1		3.5		5.9		6.3	
17	3.0		2.3		6.4		11.7		3.8	
18	4.6		3.5		3.6		13.0		3.7	
19	5.5		2.9		8.2		6.7		6.8	
20	5.3	50	2.7	25	2.8	25	9.8	25	3.6	25
21	3.1		3.2		5.0		6.6		4.1	
22	4.2		4.1		4.2		4.2		2.3	
23	3.3		2.8		3.7		5.0		4.4	
24	4.7		4.5		2.9		3.5		3.6	
25	5.3		2.6		3.2		7.6		4.1	
26	3.3		3.0		4.5		6.7		2.9	
27	5.2		3.7		4.8		8.0		2.5	
28	5.5		6.8		5.5		3.5		7.9	
29	2.9		5.5		4.5		3.3		3.2	
30	7.3	25	7.5	25	5.9	0	5.8	25	8.9	50
31	3.0		6.5		6.6		3.5		4.3	
32	4.6		3.7		4.0		4.5		4.9	
33	4.3		2.6		4.9		3.0		4.1	
34	4.2		4.8		3.8		3.2		5.4	
35	4.7		4.7		4.7		3.0		4.0	
36	4.8		8.5		3.3		4.5		4.3	
37	3.1		4.1		3.3		3.5		5.5	
38	3.5		3.4		3.4		4.0		2.4	
39	3.4		2.2		5.4		3.3		6.6	
40	1.9	0	3.1	0	4.9	0	3.9	25	2.0	0
41	3.4		4.0		4.2		3.6		3.7	
42	3.0		2.3		3.8		3.9		5.1	
43	3.3		3.2		3.0		3.7		3.6	
44	2.8		3.2		4.0		4.6		3.5	
45	4.4		3.2		3.0		4.0		3.1	
46	2.7		2.3		4.4		3.0		6.0	
47	3.3		2.2		3.7		2.5		2.5	
48	4.3		5.8		6.8		2.3		2.8	
49	4.0		3.3		5.4		3.0		3.9	
50	3.3	0	4.4	0	4.0	0	4.0	0	4.7	0
51	3.5		5.6		4.0		3.5		3.7	
52	3.8		2.1		4.3		3.3		3.1	
53	3.3		5.6		2.9		2.8		2.2	
54	5.2		5.9		3.1		3.5		6.5	
55	7.0		1.8		3.1		2.5		2.8	
56	3.2		4.5		3.0		2.4		3.9	
57	4.5		2.0		4.8		2.6		8.3	
58	4.1		3.3		5.2		3.0		7.5	
59	3.0		3.8		4.6		2.1		4.2	
60	3.8	0	2.2	50	3.7	0	2.4	0	4.4	0
61	5.2		4.4		5.5		2.0		2.7	
62	5.2		4.2		5.6		2.1		2.7	
63	4.2		3.5		3.0		2.3		4.2	
64	4.0		2.4		4.0		2.0		4.0	
65	2.4		3.9		3.5		6.6		4.1	
66	2.5		2.0		3.2		8.5		4.9	
67	3.4		2.6		3.2		6.7		4.1	
68	3.9		4.0		8.9		9.3		4.1	
69	2.7		2.2		3.6		8.5		5.1	
70	4.9	25	4.2	0	3.1	0	6.0	0	4.6	0
71	3.4		2.9		4.5		10.7		2.2	
72	3.3		2.0		3.2		7.5		2.5	
73	3.1		2.6		5.1		4.7		4.0	
74	3.0		2.9		4.5		5.4		5.7	
75	2.4		1.9		5.5		6.6		4.1	
76	4.5		4.2		6.9		4.6		3.5	
77	3.7		2.8		3.7		8.0		5.5	
78	2.9		6.8		4.3		6.0		6.7	
79	2.6		2.1		3.6		4.6		3.0	
80	3.0	0	2.3	25	3.7	50	3.5	50	3.0	25
81	2.6		1.8		2.7		4.7		3.3	
82	3.2		2.2		7.7		7.3		3.5	
83	2.8		4.1		3.1		5.6		6.1	
84	3.6		2.2		2.9		5.6		5.0	
85	4.3		4.8		2.9		4.6		3.0	
86	3.4		5.0		5.3		4.4		4.6	
87	3.1		4.4		3.1		3.8		5.3	
88	3.1		2.7		3.0		3.0		4.1	
89	2.3		3.0		3.1		3.2		4.9	
90	3.1	0	3.4	25	3.5	25	4.0	25	3.6	0
91	2.8		2.5		3.3		4.2		4.6	
92	4.6		2.2		4.5		3.6		7.1	
93	2.5		3.0		3.6		3.8		4.0	
94	3.2		7.3		4.3		3.8		2.6	
95	2.7		2.5		3.4		4.8		5.6	
96	4.0		3.8		4.9		4.0		3.7	
97	2.2		4.4		4.9		3.0		4.5	
98	3.1		3.1		4.2		3.6		2.9	
99	3.7		4.5		3.9		3.3		2.5	
100	2.8	25	2.5	0	3.7	0	3.0	0	3.1	50
Minimum	**1.9**		**1.8**		**2.7**		**2.0**		**2.0**	
Maximum	**9.0**		**8.5**		**8.9**		**13.0**		**10.1**	
Mean	**3.8**		**3.8**		**4.4**		**5.1**		**4.3**	
Geometric mean	**3.7**		**3.5**		**4.2**		**4.6**		**4.1**	
Median	**3.4**	**0**	**3.5**	**13**	**4.0**	**0**	**4.5**	**13**	**4.1**	**0**

Note: intermediate axis length is the second longest axis on a rock. Embeddedness refers to how deeply the rock is surrounded or buried by other substrate.

Table E.7: Intermediate axis length and embeddedness of 100 rocks washed during Hess sampling at benthic invertebrate stations, Minto Mine WUL, 2015.

Rock Number	Lower Minto Creek									
	LMC-1		LMC-2		LMC-3		LMC-4		LMC-5	
	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)
1	5.1		11.9		6.8		4.6		6.8	
2	4.8		3.8		2.7		7.4		4.5	
3	8.5		3.4		9.9		5.1		5.9	
4	4.7		7.7		7.1		6.2		4.8	
5	3.2		3.6		2.6		5.7		5.1	
6	4.6		4.6		6.4		7.7		9.2	
7	7.4		5.4		3.3		5.7		5.3	
8	4.0		3.7		3.3		3.8		6.1	
9	5.3		4.6		2.6		2.6		5.9	
10	3.3	0	8.6	0	4.7	0	3.9	0	5.0	0
11	4.0		4.1		8.2		4.6		8.4	
12	3.1		6.3		6.2		4.0		3.5	
13	3.6		7.6		5.5		5.8		3.9	
14	3.0		4.0		3.0		4.7		6.7	
15	3.9		7.0		2.8		3.7		4.3	
16	3.9		4.4		2.7		5.9		3.4	
17	4.3		10.2		3.1		8.0		4.0	
18	2.6		2.9		4.6		5.6		4.8	
19	4.1		2.2		4.0		4.3		4.0	
20	2.1	0	4.0	25	7.1	50	9.7	50	5.7	0
21	5.1		3.8		3.7		4.2		3.0	
22	3.2		4.5		3.8		3.6		6.8	
23	5.2		2.2		3.1		5.3		4.2	
24	4.4		6.7		4.6		4.8		4.1	
25	2.7		3.6		3.1		6.1		4.5	
26	5.3		3.0		4.0		3.3		3.8	
27	3.1		3.8		4.3		4.6		4.3	
28	7.4		3.2		5.0		5.4		6.5	
29	3.4		3.3		3.2		4.2		7.5	
30	3.7	50	3.2	50	3.6	0	3.1	0	4.2	25
31	3.8		4.4		5.2		3.5		4.6	
32	2.6		6.0		2.2		3.7		6.3	
33	4.5		3.4		4.5		2.9		3.9	
34	2.3		4.7		2.8		2.7		6.0	
35	5.5		3.2		3.7		3.5		4.2	
36	7.1		3.5		7.1		4.5		5.4	
37	5.3		2.2		5.1		4.9		6.1	
38	4.5		2.5		3.6		3.5		4.0	
39	4.0		9.8		3.3		2.8		4.5	
40	5.2	25	4.7	25	2.3	25	3.2	50	7.6	50
41	4.0		4.5		2.6		5.6		4.3	
42	2.6		3.1		2.8		3.8		5.3	
43	3.2		6.8		3.0		3.0		7.7	
44	2.1		7.8		4.0		4.2		3.2	
45	2.7		3.5		3.6		2.1		3.9	
46	1.9		1.8		3.8		2.1		4.1	
47	1.9		4.6		5.3		3.9		4.7	
48	3.5		4.6		4.5		4.6		5.7	
49	5.3		2.6		2.5		5.0		3.0	
50	6.6	25	3.0	0	2.9	0	3.4	50	5.5	
51	3.8		4.4		5.0		4.1		4.7	
52	5.2		4.9		3.6		4.2		5.0	
53	3.4		5.5		2.7		3.8		5.3	
54	5.2		3.3		3.1		4.2		3.7	
55	4.7		2.5		4.1		4.0		4.4	
56	2.9		3.7		3.6		2.9		4.0	
57	2.8		4.7		4.9		3.3		4.8	
58	3.7		4.2		2.6		3.1		6.2	
59	3.9		4.0		4.7		3.1		3.5	
60	6.4	0	2.3	0	3.1	0	3.0	0	4.0	0
61	4.3		5.2		2.6		3.2		2.6	
62	3.8		3.7		2.7		3.8		6.4	
63	3.4		3.9		2.1		2.3		6.0	
64	4.3		2.8		4.8		4.4		3.8	
65	2.9		4.0		2.2		3.0		5.1	
66	2.2		3.3		2.5		2.2		5.6	
67	5.9		4.2		2.9		3.2		4.9	
68	4.5		2.3		5.2		2.9		3.7	
69	3.0		3.4		4.3		4.8		5.6	
70	4.0	50	6.5	25	3.8	0	3.0	0	4.3	25
71	9.9		5.0		4.1		2.5		3.6	
72	7.8		4.6		4.2		5.6		3.7	
73	3.4		7.2		2.3		3.4		2.7	
74	3.0		3.3		2.3		5.5		5.4	
75	2.5		3.2		3.2		4.0		2.7	
76	6.0		5.0		4.1		3.2		3.7	
77	5.6		3.3		2.2		3.2		5.1	
78	5.0		3.2		5.1		2.9		4.4	
79	4.4		2.1		3.9		2.4		6.1	
80	6.2	0	4.3	0	3.5	50	4.1	0	4.0	0
81	5.2		3.7		2.9		3.5		2.8	
82	5.1		4.5		2.9		2.3		4.2	
83	4.0		2.7		3.6		2.4		3.8	
84	6.0		3.3		4.7		2.8		4.6	
85	4.2		4.3		4.0		2.8		2.5	
86	3.5		4.7		4.2		4.1		5.1	
87	5.2		3.2		2.6		3.2		4.1	
88	4.0		3.8		3.9		2.8		4.0	
89	6.1		2.6		3.6		3.3		4.9	
90	4.0	0	4.3	50	4.2	0	2.8	25	5.1	25
91	4.9		3.3		2.9		4.0		3.2	
92	5.0		3.9		3.4		3.4		4.0	
93	4.2		2.7		4.6		3.9		4.7	
94	3.6		3.2		4.3		3.0		4.2	
95	4.0		3.1		2.8		3.4		4.8	
96	4.6		4.7		3.6		2.5		2.5	
97	3.0		2.9		2.6		3.1		2.9	
98	2.5		2.4		3.4		3.4		5.0	
99	5.1		3.0		3.1		3.2		3.6	
100	5.2	25	3.5	25	2.6	25	2.9	0	3.5	0
Minimum	**1.9**		**1.8**		**2.1**		**2.1**		**2.5**	
Maximum	**9.9**		**11.9**		**9.9**		**9.7**		**9.2**	
Mean	**4.3**		**4.2**		**3.9**		**3.9**		**4.7**	
Geometric mean	**4.1**		**4.0**		**3.7**		**3.8**		**4.5**	
Median	**4.0**	**13**	**3.8**	**25**	**3.6**	**0**	**3.7**	**0**	**4.5**	**0**

Note: intermediate axis length is the second longest axis on a rock. Embeddedness refers to how deeply the rock is surrounded or buried by other substrate.

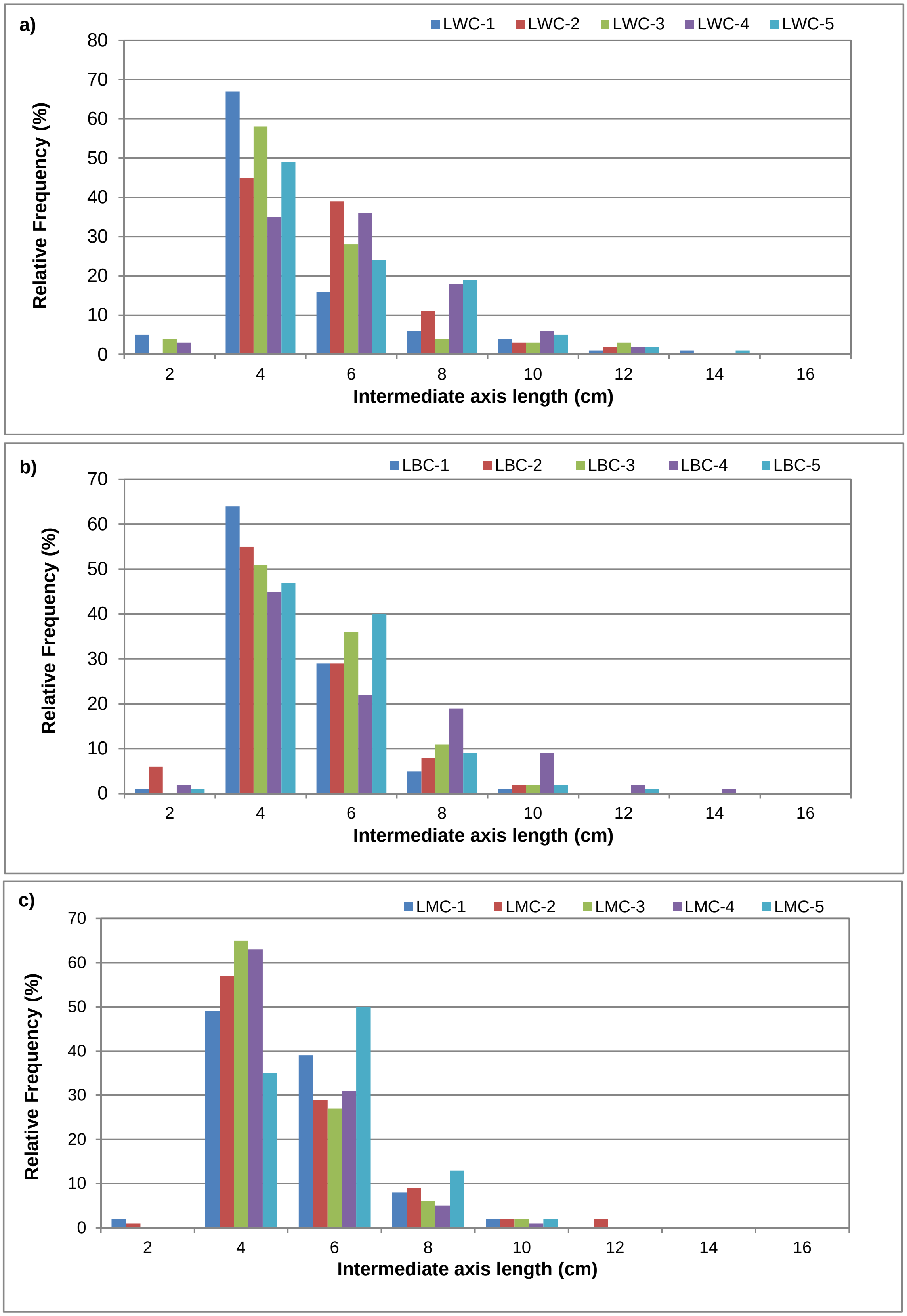


Figure E.1: Intermediate axis length of 100 rocks measured at five benthic stations in a) lower Wolverine Creek, b) lower Big Creek and c) lower Minto Creek.

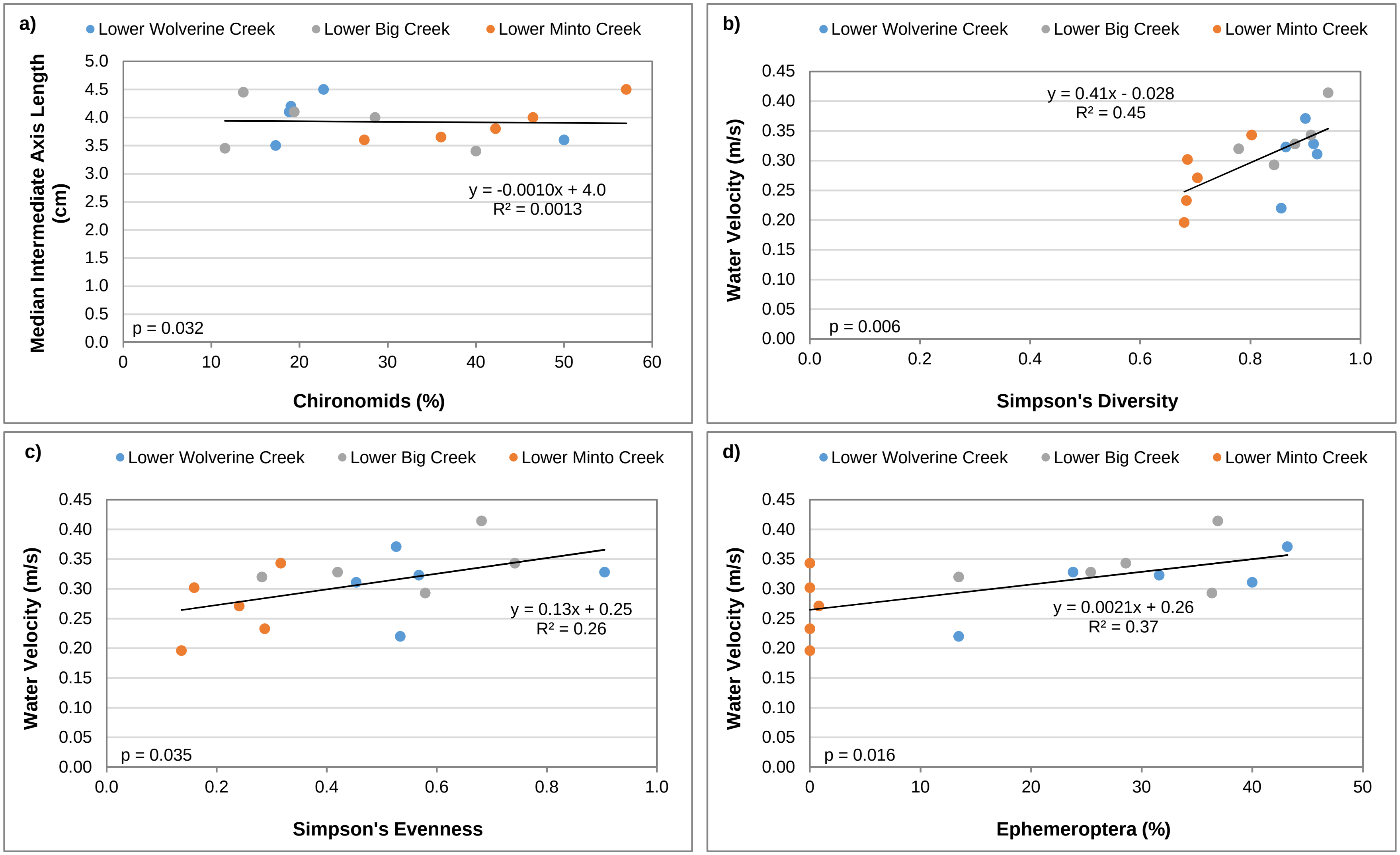


Figure E.2: Scatterplots of relationships ($p < 0.050$) between selected benthic invertebrate community metrics and a) Chironomids, b) Simpson's Diversity c) Simpson's Evenness and d) Ephemeroptera, Minto Mine WUL, 2015.

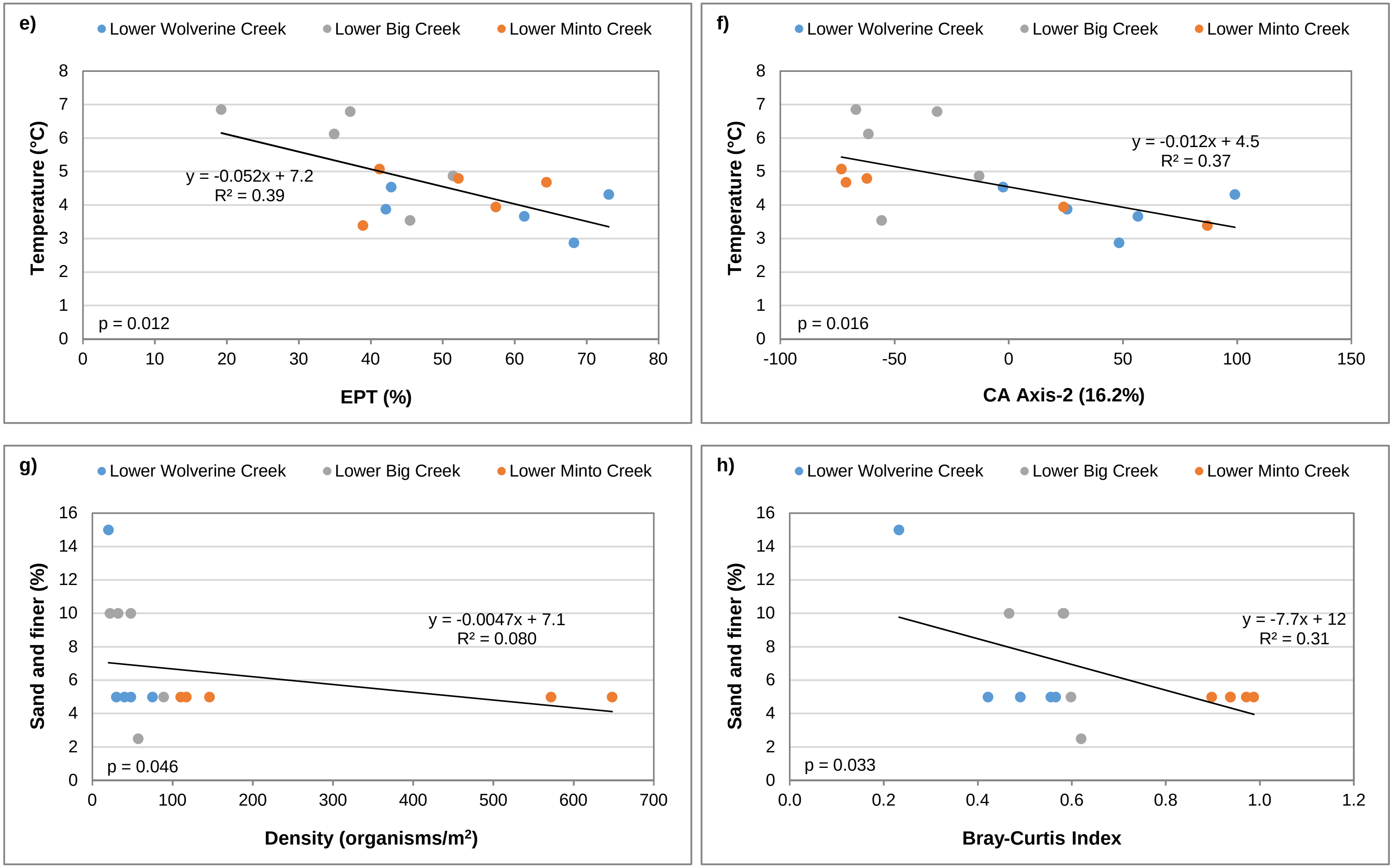


Figure E.2: Scatterplots of relationships ($p < 0.050$) between selected benthic invertebrate community metrics and e) EPT, f) CA Axis-2 g) density and h) Bray-Curtis Index, Minto Mine WUL, 2015.

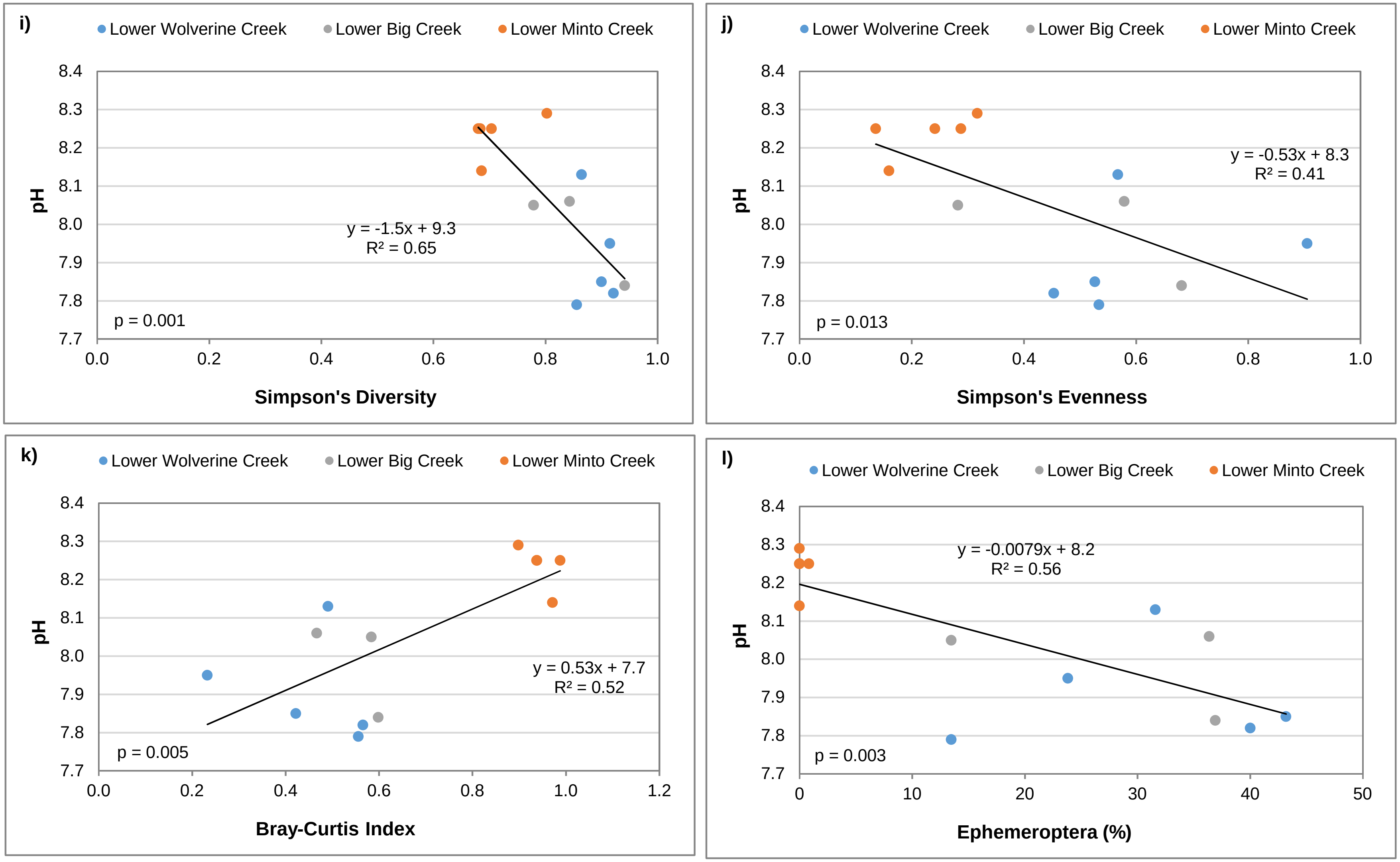


Figure E.2: Scatterplots of relationships ($p < 0.050$) between selected benthic invertebrate community metrics and i) Simpson's Diversity, j) Simpson's Evenness, k) Bray-Curtis Index and l) eEphemeroptera, Minto Mine WUL, 2015.

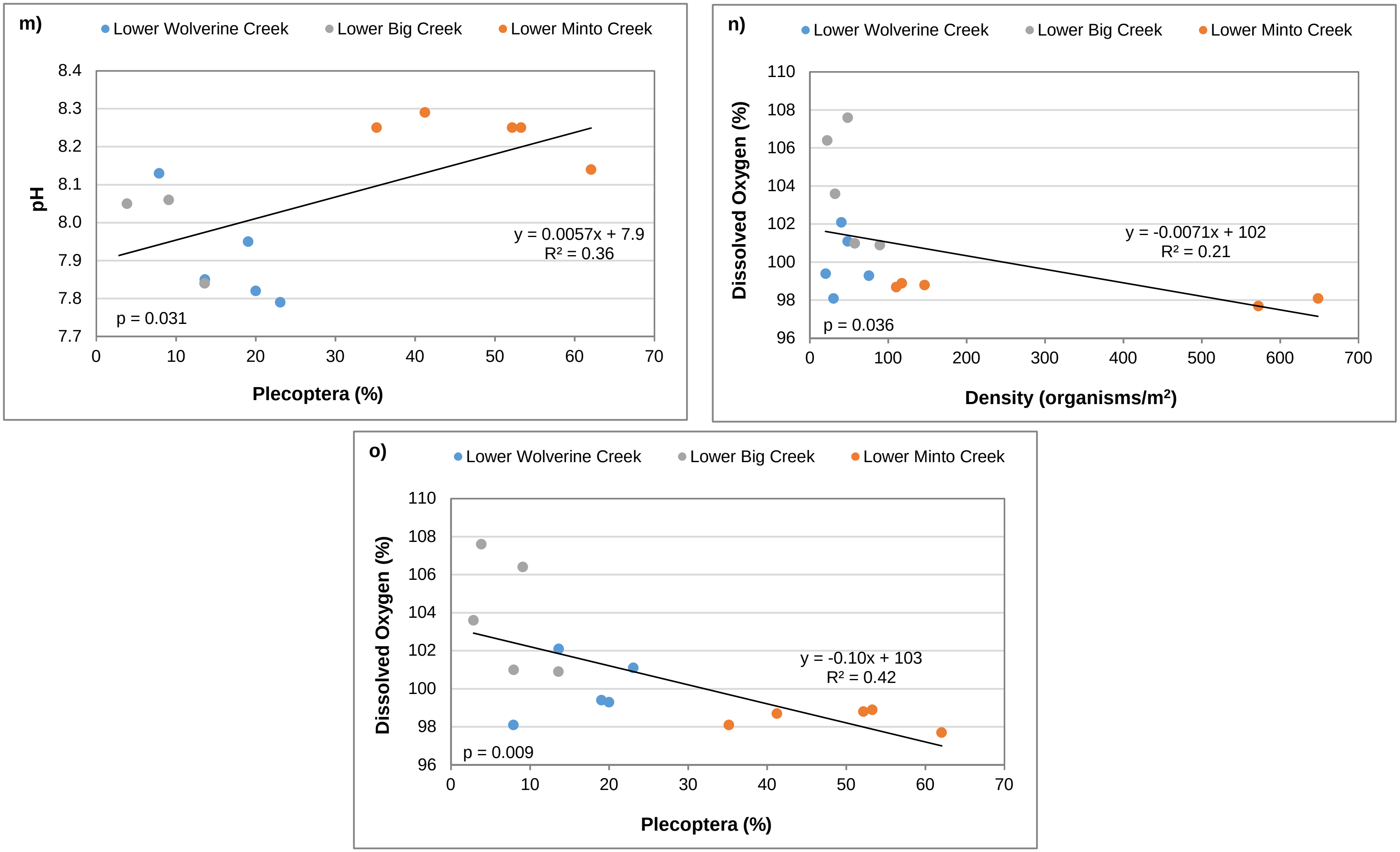


Figure E.2: Scatterplots of relationships ($p < 0.050$) between selected benthic invertebrate community metrics and m) Plecoptera, n) Density and o) Plecoptera, Minto Mine WUL, 2015.

BENTHIC INVERTEBRATE COMMUNITY ANALYSIS

PROVIDED BY:

CORDILLERA CONSULTING

(SUMMERLAND, BC)

Cordillera Consulting

Project: Minto WUL Monitoring 2015
Minnow (Victoria), Lisa Bowron
Taxonomist: Sue Salter
suesalter@cordilleraconsulting.ca
250-494-7553

Site:	LMC	LMC	LMC	LMC	LMC	LWC	LWC	LWC	LWC	LWC	LBC	LBC	LBC	LBC	LBC
Sample:	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
CC#:	CC160560	CC160561	CC160562	CC160563	CC160564	CC160565	CC160566	CC160567	CC160568	CC160569	CC160570	CC160571	CC160572	CC160573	CC160574
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Ameletidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus	0	0	0	1	0	0	0	0	0	1	0	0	2	0	0
| Family: Baetidae	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0
Acentrella sp.	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Baetis	0	0	0	0	0	1	2	1	3	8	4	2	1	1	5
Baetis tricaudatus group	0	0	0	0	0	3	1	6	8	10	0	0	1	0	9
| Family: Ephemerellidae	0	0	0	0	0	0	0	1	0	1	2	0	1	0	12
Drunella doddsii	0	0	0	0	0	0	0	1	6	3	1	0	0	0	1
Drunella spinifera	0	0	0	0	0	0	0	0	1	1	3	3	0	1	3
Ephemerella	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Serratella	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
| Family: Heptageniidae	0	0	0	0	0	3	2	2	1	1	0	2	11	6	8
Cinygmula sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Plecoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Capniidae	0	0	2	4	14	0	1	0	0	0	0	1	3	1	0
| Family: Chloroperlidae	0	0	0	0	0	3	0	0	1	2	0	0	0	0	1
Haploperla sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Paraperla sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Suwallia	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
| Family: Leuctridae	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0
| Family: Nemouridae	4	8	106	4	40	0	0	0	0	1	0	0	0	0	0
Nemoura	41	71	300	55	182	0	0	0	0	0	1	0	0	0	3
Ostrocerca sp.	0	5	14	0	6	0	0	0	0	0	0	0	0	0	0
Prostoia	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Zapada cinctipes	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
| Family: Perlodidae	0	0	0	0	0	1	1	0	0	5	0	1	1	0	1
Diura sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Isoperla sp.	0	0	0	0	0	7	1	3	4	8	0	0	0	0	6
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trichoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Glossosomatidae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Glossosoma	0	0	0	0	0	14	0	1	0	1	1	0	1	0	0

Site:	LMC	LMC	LMC	LMC	LMC	LWC	LWC	LWC	LWC	LWC	LBC	LBC	LBC	LBC	LBC
Sample:	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
CC#:	CC160560	CC160561	CC160562	CC160563	CC160564	CC160565	CC160566	CC160567	CC160568	CC160569	CC160570	CC160571	CC160572	CC160573	CC160574
| Family: Limnephilidae	0	0	16	4	26	2	0	0	1	4	0	0	0	0	0
Dicosmoecus atripes	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
| Family: Rhyacophilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhyacophila brunnea/vemna grou	0	0	0	0	0	3	0	0	1	1	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Coleoptera	0	0	0	0	0	0	0	0	0	2	1	0	1	0	0
| Order: Diptera	0	0	2	0	0	0	0	0	1	1	0	0	0	0	0
| Family: Ceratopogonidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogon sp.	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Culicoides	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
| Family: Chironomidae	0	7	2	1	6	3	0	7	3	4	1	3	5	0	2
| Subfamily: Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictochironomus	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0
| Tribe: Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micropsectra	4	0	18	30	314	0	0	0	1	0	0	0	0	0	0
Neostempellina reissi	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Rheotanytarsus	0	0	0	0	0	0	0	0	0	0	3	0	4	1	1
| Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Diamesini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diamesa	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Pagastia	0	0	0	0	0	2	1	0	3	5	3	0	1	0	5
Potthastia longimana group	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Pseudodiamesa sp.	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0
| Subfamily: Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brillia sp.	4	1	6	1	2	0	0	0	0	0	0	0	0	0	0
Eukiefferiella	20	0	96	4	0	0	0	0	1	1	0	0	0	0	0
Eukiefferiella claripennis group	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0
Eukiefferiella devonica group	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1
Hydrobaenus	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
Limnophyes sp.	2	1	4	1	4	0	0	0	0	1	0	0	0	0	0
Orthocladius	9	4	22	6	34	0	1	4	1	0	5	1	6	1	7
Orthocladius lignicola	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Parakiefferiella	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraphaenocladius sp.	0	0	2	0	8	0	0	0	0	0	0	0	0	0	0
Pseudosmittia sp.	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Tvetenia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tvetenia bavarica group	10	20	34	1	16	4	2	7	1	4	2	1	2	1	3
| Family: Dolichopodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
| Family: Empididae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

Site:	LMC	LMC	LMC	LMC	LMC	LWC	LWC	LWC	LWC	LWC	LBC	LBC	LBC	LBC	LBC
Sample:	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
CC#:	CC160560	CC160561	CC160562	CC160563	CC160564	CC160565	CC160566	CC160567	CC160568	CC160569	CC160570	CC160571	CC160572	CC160573	CC160574
Clinocera sp.	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0
| Family: Muscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnophora sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Psychodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pericoma/Telmatoscopus sp.	0	0	0	0	4	0	0	0	0	0	0	0	1	0	0
| Family: Simuliidae	0	0	0	0	0	1	0	1	1	1	0	1	0	0	0
Helodon sp.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Prosimulium	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0
Simulium	0	0	2	0	0	1	0	0	1	1	0	1	1	0	3
| Family: Tipulidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicranota	2	0	10	6	12	3	2	0	1	1	0	11	0	4	6
Ormosia sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Tipula	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trombidiformes	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
| Family: Hygrobatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobates	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
| Family: Lebertiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebertia	0	0	0	0	0	0	1	0	0	0	1	0	0	0	4
| Family: Sperchontidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchon	3	2	2	0	2	0	0	1	0	0	0	0	0	0	2
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Oribatei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Oribatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oribatida	1	0	0	0	4	0	0	0	1	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Bivalvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Veneroida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Pisidiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pisidium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
| Order: Lumbriculida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lumbriculidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhynchelmis sp.	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Enchytraeidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enchytraeus	7	5	4	0	0	0	0	1	2	3	2	19	4	4	6
| Family: Naididae	0	0	28	0	0	0	2	0	0	0	3	1	13	0	5
Stylaria sp.	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0
Totals:	**114**	**161**	**680**	**122**	**694**	**52**	**21**	**38**	**44**	**85**	**35**	**52**	**63**	**22**	**103**

Site:	LMC	LMC	LMC	LMC	LMC	LWC	LWC	LWC	LWC	LWC	LBC	LBC	LBC	LBC	LBC
Sample:	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
CC#:	CC160560	CC160561	CC160562	CC160563	CC160564	CC160565	CC160566	CC160567	CC160568	CC160569	CC160570	CC160571	CC160572	CC160573	CC160574
Taxa present but not included:															
Terrestrials	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Entognatha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Collembola	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Nemata	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0
Totals:	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**4**	**0**	**0**

Project: Minto WUL Monitoring 2015
Minnow (Victoria), Lisa Bowron
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Site:	LMC	LMC	LMC	LMC	LMC	LWC	LWC	LWC	LWC
Sample:	1	2	3	4	5	1	2	3	4
CC#:	CC160560	CC160561	CC160562	CC160563	CC160564	CC160565	CC160566	CC160567	CC160568
Richness Measures									
Species Richness	18	13	23	16	25	16	15	15	22
EPT Richness	3	3	5	6	6	10	7	8	10
Ephemeroptera Richness				1		3	3	6	5
Plecoptera Richness	3	3	4	4	5	4	4	1	3
Trichoptera Richness			1	1	1	3		1	2
Chironomidae Richness	10	6	9	7	12	3	3	4	6
Oligochaeta Richness	1	1	4				2	1	1
Non-Chiro. Non-Olig. Richness									
Abundance Measures									
Corrected Abundance	114	161	680	122	694	52	21	38	44
EPT Abundance	47	84	438	70	270	38	9	16	27
Dominance Measures									
1st Dominant Taxon	Nemoura	Nemoura	Nemoura	Nemoura	Micropsectra	Glossosoma	Baetis	Chironomidae	Baetis tricaudatus grou
1st Dominant Abundance	41	71	300	55	314	14	2	7	8
2nd Dominant Taxon	Eukiefferiella	Eukiefferiella claripenn	Nemouridae	Micropsectra	Nemoura	Isoperla sp.	Dicranota	Tvetenia bavarica grou	Drunella doddsii
2nd Dominant Abundance	20	35	106	30	182	7	2	7	6
3rd Dominant Taxon	Tvetenia bavarica group	Tvetenia bavarica grou	Eukiefferiella	Orthocladius	Nemouridae	Tvetenia bavarica grou	Helodon sp.	Baetis tricaudatus grou	Isoperla sp.
3rd Dominant Abundance	10	20	96	6	40	4	2	6	4
% 1 Dominant Taxon	35.96%	44.10%	44.12%	45.08%	45.24%	26.92%	9.52%	18.42%	18.18%
% 2 Dominant Taxa	17.54%	21.74%	15.59%	24.59%	26.22%	13.46%	9.52%	18.42%	13.64%
% 3 Dominant Taxa	8.77%	12.42%	14.12%	4.92%	5.76%	7.69%	9.52%	15.79%	9.09%
Community Composition									
% Ephemeroptera				0.82%		13.46%	23.81%	31.58%	43.18%
% Plecoptera	41.23%	52.17%	62.06%	53.28%	35.16%	23.08%	19.05%	7.89%	13.64%
% Trichoptera			2.35%	3.28%	3.75%	36.54%		2.63%	4.55%
% EPT	41.23%	52.17%	64.41%	57.38%	38.90%	73.08%	42.86%	42.11%	61.36%
% Diptera	49.12%	43.48%	30.00%	42.62%	60.23%	26.92%	38.10%	52.63%	31.82%
% Oligochaeta	6.14%	3.11%	5.29%				14.29%	2.63%	4.55%
% Baetidae						7.69%	14.29%	18.42%	25.00%
% Chironomidae	46.49%	42.24%	27.35%	36.07%	57.06%	17.31%	19.05%	50.00%	22.73%
% Odonata									
Functional Group Composition									
% Predators	6.14%	2.48%	2.35%	4.92%	3.17%	32.69%	28.57%	10.53%	22.73%
% Shredder-Herbivores	44.74%	52.80%	62.94%	54.10%	35.45%	1.92%	4.76%		

Site:	LMC	LMC	LMC	LMC	LMC	LWC	LWC	LWC	LWC
Sample:	1	2	3	4	5	1	2	3	4
CC#:	CC160560	CC160561	CC160562	CC160563	CC160564	CC160565	CC160566	CC160567	CC160568
% Collector-Gatherers	31.58%	18.63%	19.71%	35.25%	59.94%	23.08%	47.62%	57.89%	59.09%
% Scrapers						26.92%		2.63%	
% MH									
% CF			0.29%	0.82%		3.85%	9.52%	2.63%	4.55%
% OM	17.54%	21.74%	14.12%	4.10%	0.58%				2.27%
% PA									
% Piercer-Herbivore									
% Gatherer									
% Unclassified		4.35%	0.59%	0.82%	0.86%	11.54%	9.52%	26.32%	11.36%
Functional Group Richness									
Predators Richness	4	3	3	1	5	5	5	2	7
Shredder-Herbivores Richness	4	4	5	5	6	1	1		
Collector-Gatherers Richness	9	4	11	6	11	5	7	8	9
Scrapers Richness						1		1	
MH Richness									
CF Richness			1	1		2	1	1	2
OM Richness	1	1	1	2	2				1
PA Richness									
Piercer-Herbivore Richness									
Gatherer Richness									
Unclassified		1	2	1	1	2	1	3	3
Diversity/Evenness Measures									
Shannon-Weiner H' (log 10)	0.94	0.75	0.84	0.78	0.79	1.06	1.15	1.03	1.21
Shannon-Weiner H' (log 2)	3.13	2.49	2.79	2.58	2.61	3.52	3.82	3.42	4.01
Shannon-Weiner H' (log e)	2.17	1.73	1.93	1.79	1.81	2.44	2.65	2.37	2.78
Simpson's Index (D)	0.18	0.26	0.25	0.27	0.28	0.10	0.03	0.10	0.06
Simpson's Index of Diversity (1 - D)	0.82	0.74	0.75	0.73	0.72	0.90	0.97	0.90	0.94
Simpson's Reciprocal Index (1/D)	5.67	3.85	4.08	3.74	3.56	9.61	35.00	10.49	16.03
Biotic Indices									
Hilsenhoff Biotic Index	4.64	4.04	3.71	3.57	4.88	2.70	5.07	5.38	4.88

Cordillera Consulting

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250-494-7553

Site:	LWC	LBC	LBC	LBC	LBC	LBC
Sample:	5	1	2	3	4	5
CC#:	CC160569	CC160570	CC160571	CC160572	CC160573	CC160574
Richness Measures						
Species Richness	35	17	18	22	11	29
EPT Richness	21	7	6	9	5	13
Ephemeroptera Richness	12	4	3	5	3	6
Plecoptera Richness	5	1	2	3	2	6
Trichoptera Richness	4	2	1	1		1
Chironomidae Richness	6	5	4	5	3	7
Oligochaeta Richness	1	2	2	3	2	2
Non-Chiro. Non-Olig. Richness						
Abundance Measures						
Corrected Abundance	85	35	52	63	22	103
EPT Abundance	58	13	10	22	10	53
Dominance Measures						
1st Dominant Taxon	Baetis tricaudatus grou	Orthocladius	Enchytraeus	Naididae	Heptageniidae	Ephemerellidae
1st Dominant Abundance	10	5	19	13	6	12
2nd Dominant Taxon	Baetis	Baetis	Dicranota	Heptageniidae	Dicranota	Baetis tricaudatus group
2nd Dominant Abundance	8	4	11	11	4	9
3rd Dominant Taxon	Isoperla sp.	Drunella spinifera	Drunella spinifera	Orthocladius	Enchytraeus	Heptageniidae
3rd Dominant Abundance	8	3	3	6	4	8
% 1 Dominant Taxon	11.76%	14.29%	36.54%	20.63%	27.27%	11.65%
% 2 Dominant Taxa	9.41%	11.43%	21.15%	17.46%	18.18%	8.74%
% 3 Dominant Taxa	9.41%	8.57%	5.77%	9.52%	18.18%	7.77%
Community Composition						
% Ephemeroptera	40.00%	28.57%	13.46%	25.40%	36.36%	36.89%
% Plecoptera	20.00%	2.86%	3.85%	7.94%	9.09%	13.59%
% Trichoptera	8.24%	5.71%	1.92%	1.59%		0.97%
% EPT	68.24%	37.14%	19.23%	34.92%	45.45%	51.46%
% Diptera	25.88%	40.00%	38.46%	33.33%	31.82%	31.07%
% Oligochaeta	3.53%	14.29%	38.46%	28.57%	22.73%	10.68%
% Baetidae	28.24%	11.43%	3.85%	3.17%	4.55%	13.59%
% Chironomidae	18.82%	40.00%	11.54%	28.57%	13.64%	19.42%
% Odonata						
Functional Group Composition						
% Predators	24.71%	20.00%	32.69%	6.35%	27.27%	25.24%
% Shredder-Herbivores	2.35%	2.86%	1.92%	4.76%	4.55%	4.85%

Site:	LWC	LBC	LBC	LBC	LBC	LBC
Sample:	5	1	2	3	4	5
CC#:	CC160569	CC160570	CC160571	CC160572	CC160573	CC160574
% Collector-Gatherers	56.47%	57.14%	48.08%	52.38%	36.36%	42.72%
% Scrapers	2.35%	2.86%		1.59%		
% MH						
% CF	3.53%	8.57%	5.77%	7.94%	4.55%	4.85%
% OM	1.18%		1.92%			0.97%
% PA						
% Piercer-Herbivore						
% Gatherer						
% Unclassified	9.41%	8.57%	9.62%	26.98%	27.27%	21.36%
Functional Group Richness						
Predators Richness	8	5	5	4	3	10
Shredder-Herbivores Richness	2	1	1	1	1	2
Collector-Gatherers Richness	14	7	6	11	5	10
Scrapers Richness	2	1		1		
MH Richness						
CF Richness	3	1	3	2	1	3
OM Richness	1		1			1
PA Richness						
Piercer-Herbivore Richness						
Gatherer Richness						
Unclassified	5	2	2	3	1	3
Diversity/Evenness Measures						
Shannon-Weiner H' (log 10)	1.40	1.16	0.95	1.14	0.91	1.34
Shannon-Weiner H' (log 2)	4.65	3.85	3.16	3.79	3.03	4.44
Shannon-Weiner H' (log e)	3.22	2.67	2.19	2.62	2.10	3.08
Simpson's Index (D)	0.04	0.05	0.18	0.09	0.12	0.05
Simpson's Index of Diversity (1 - D)	0.96	0.95	0.82	0.91	0.88	0.95
Simpson's Reciprocal Index (1/D)	23.33	19.19	5.67	11.16	8.56	21.18
Biotic Indices						
Hilsenhoff Biotic Index	4.30	5.57	6.73	7.07	6.07	5.29

Cordillera Consulting

Project: Minto WUL Monitoring 2015
Minnow (Victoria), Lisa Bowron
Taxonomist: Sue Salter
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Site:	LMC	LMC	LMC	LMC	LMC	LWC	LWC	LWC	LWC	LWC	LBC	LBC	LBC	LBC	LBC
Sample:	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
CC#:	CC160560	CC160561	CC160562	CC160563	CC160564	CC160565	CC160566	CC160567	CC160568	CC160569	CC160570	CC160571	CC160572	CC160573	CC160574
Sieve Size:	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
SubSample %:	100	100	50	100	50	100	100	100	100	100	100	100	100	100	100
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Ameletidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus	0	0	0	1	0	0	0	0	0	1	0	0	2	0	0
| Family: Baetidae	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0
Acentrella sp.	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Baetis	0	0	0	0	0	1	2	1	3	8	4	2	1	1	5
Baetis tricaudatus group	0	0	0	0	0	3	1	6	8	10	0	0	1	0	9
| Family: Ephemerellidae	0	0	0	0	0	0	0	1	0	1	2	0	1	0	12
Drunella doddsii	0	0	0	0	0	0	0	1	6	3	1	0	0	0	1
Drunella spinifera	0	0	0	0	0	0	0	0	1	1	3	3	0	1	3
Ephemerella	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Serratella	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
| Family: Heptageniidae	0	0	0	0	0	3	2	2	1	1	0	2	11	6	8
Cinygmula sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Plecoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Capniidae	0	0	1	4	7	0	1	0	0	0	0	1	3	1	0
| Family: Chloroperlidae	0	0	0	0	0	3	0	0	1	2	0	0	0	0	1
Haploperla sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Paraperla sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Suwallia	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

Site:	LMC	LMC	LMC	LMC	LMC	LWC	LWC	LWC	LWC	LWC	LBC	LBC	LBC	LBC	LBC
Sample:	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
CC#:	CC160560	CC160561	CC160562	CC160563	CC160564	CC160565	CC160566	CC160567	CC160568	CC160569	CC160570	CC160571	CC160572	CC160573	CC160574
Sieve Size:	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
SubSample %:	100	100	50	100	50	100	100	100	100	100	100	100	100	100	100
| Family: Leuctridae	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0
| Family: Nemouridae	4	8	53	4	20	0	0	0	0	1	0	0	0	0	0
Nemoura	41	71	150	55	91	0	0	0	0	0	1	0	0	0	3
Ostrocerca sp.	0	5	7	0	3	0	0	0	0	0	0	0	0	0	0
Prostoia	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Zapada cinctipes	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
| Family: Perlodidae	0	0	0	0	0	1	1	0	0	5	0	1	1	0	1
Diura sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Isoperla sp.	0	0	0	0	0	7	1	3	4	8	0	0	0	0	6
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trichoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Glossosomatidae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Glossosoma	0	0	0	0	0	14	0	1	0	1	1	0	1	0	0
| Family: Limnephilidae	0	0	8	4	13	2	0	0	1	4	0	0	0	0	0
Dicosmoecus atripes	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
| Family: Rhyacophilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhyacophila brunnea/vemna grou	0	0	0	0	0	3	0	0	1	1	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Coleoptera	0	0	0	0	0	0	0	0	0	2	1	0	1	0	0
| Order: Diptera	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0
| Family: Ceratopogonidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogon sp.	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Culicoides	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
| Family: Chironomidae	0	7	1	1	3	3	0	7	3	4	1	3	5	0	2
| Subfamily: Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictochironomus	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
| Tribe: Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micropsectra	4	0	9	30	157	0	0	0	1	0	0	0	0	0	0
Neostempellina reissi	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Rheotanytarsus	0	0	0	0	0	0	0	0	0	0	3	0	4	1	1
| Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Diamesini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diamesa	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Pagastia	0	0	0	0	0	2	1	0	3	5	3	0	1	0	5
Potthastia longimana group	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Pseudodiamesa sp.	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Site:	LMC	LMC	LMC	LMC	LMC	LWC	LWC	LWC	LWC	LWC	LBC	LBC	LBC	LBC	LBC
Sample:	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
CC#:	CC160560	CC160561	CC160562	CC160563	CC160564	CC160565	CC160566	CC160567	CC160568	CC160569	CC160570	CC160571	CC160572	CC160573	CC160574
Sieve Size:	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
SubSample %:	100	100	50	100	50	100	100	100	100	100	100	100	100	100	100
| Subfamily: Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brillia sp.	4	1	3	1	1	0	0	0	0	0	0	0	0	0	0
Eukiefferiella	20	0	48	4	0	0	0	0	1	1	0	0	0	0	0
Eukiefferiella claripennis group	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0
Eukiefferiella devonica group	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Hydrobaenus	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Limnophyes sp.	2	1	2	1	2	0	0	0	0	1	0	0	0	0	0
Orthocladius	9	4	11	6	17	0	1	4	1	0	5	1	6	1	7
Orthocladius lignicola	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Parakiefferiella	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraphaenocladius sp.	0	0	1	0	4	0	0	0	0	0	0	0	0	0	0
Pseudosmittia sp.	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Tvetenia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tvetenia bavarica group	10	20	17	1	8	4	2	7	1	4	2	1	2	1	3
| Family: Dolichopodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
| Family: Empididae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Clinocera sp.	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0
| Family: Muscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnophora sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Psychodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pericoma/Telmatoscopus sp.	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0
| Family: Simuliidae	0	0	0	0	0	1	0	1	1	1	0	1	0	0	0
Helodon sp.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Prosimulium	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0
Simulium	0	0	1	0	0	1	0	0	1	1	0	1	1	0	3
| Family: Tipulidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicranota	2	0	5	6	6	3	2	0	1	1	0	11	0	4	6
Ormosia sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Tipula	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trombidiformes	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
| Family: Hygrobatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hygrobates	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
| Family: Lebertiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebertia	0	0	0	0	0	0	1	0	0	0	1	0	0	0	4
| Family: Sperchontidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchon	3	2	1	0	1	0	0	1	0	0	0	0	0	0	2
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Site:	LMC	LMC	LMC	LMC	LMC	LWC	LWC	LWC	LWC	LWC	LBC	LBC	LBC	LBC	LBC
Sample:	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
CC#:	CC160560	CC160561	CC160562	CC160563	CC160564	CC160565	CC160566	CC160567	CC160568	CC160569	CC160570	CC160571	CC160572	CC160573	CC160574
Sieve Size:	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
SubSample %:	100	100	50	100	50	100	100	100	100	100	100	100	100	100	100
| Order: Oribatei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Oribatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oribatida	1	0	0	0	2	0	0	0	1	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Bivalvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Veneroida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Pisidiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pisidium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
| Order: Lumbriculida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lumbriculidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhynchelmis sp.	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Enchytraeidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enchytraeus	7	5	2	0	0	0	0	1	2	3	2	19	4	4	6
| Family: Naididae	0	0	14	0	0	0	2	0	0	0	3	1	13	0	5
Stylaria sp.	0	.	1	0	0	0	0	0	0	0	0	0	0	1	0
Totals:	**114**	**161**	**340**	**122**	**347**	**52**	**21**	**38**	**44**	**85**	**35**	**52**	**63**	**22**	**103**

Taxa present but not included:

Terrestrials	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Entognatha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Collembola	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Nemata	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0
Totals:	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**4**	**0**	**0**

Cordillera Consulting

Project: Minto WUL Monitoring 2015
Minnow (Victoria), Lisa Bowron
Taxonomist: Sue Salter
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Site - LMC Sample - 1, CC# - CC160560, Percent sampled = 100, Sieve size = 500		
Sperchon	Adult	3
Oribatida	Juvenile/Dam	1
Dicranota	Larvae	2
Clinocera sp.	Larvae	1
Nemouridae	Juvenile/Dam	4
Nemoura	Larvae	41
Prostoia	Larvae	2
Pseudodiamesa sp.	Larvae	1
Brillia sp.	Larvae	4
Orthocladius lignicola	Larvae	1
Orthocladius	Larvae	9
Tvetenia bavarica group	Larvae	10
Eukiefferiella	Larvae	20
Pseudosmittia sp.	Larvae	1
Micropsectra	Larvae	4
Parakiefferiella	Larvae	1
Limnophyes sp.	Larvae	2
Enchytraeus	None	7
Total:		**114**

Site - LMC Sample - 2, CC# - CC160561, Percent sampled = 100, Sieve size = 500		
Enchytraeus	None	5
Chironomidae	Pupa	7
Eukiefferiella claripennis group	Larvae	35
Orthocladius	Larvae	4
Limnophyes sp.	Larvae	1
Brillia sp.	Larvae	1
Tvetenia bavarica group	Larvae	20
Nemoura	Larvae	71
Ostrocerca sp.	Larvae	5
Nemouridae	Juvenile/Dam	8
Sperchon	Adult	2
Clinocera sp.	Larvae	1
Limnophora sp.	Larvae	1
Total:		**161**

Site - LMC Sample - 3, CC# - CC160562, Percent sampled = 50, Sieve size = 500		
Sperchon	Adult	1
Dicranota	Larvae	5
Simulium	Larvae	1
Ceratopogon sp.	Larvae	2
Diptera	Juvenile/Dam	1
Limnephilidae	Juvenile/Dam	8
Nemoura	Larvae	150
Nemouridae	Juvenile/Dam	53
Capniidae	Juvenile/Dam	1
Ostrocerca sp.	Larvae	7
Stylaria sp.	None	1
Rhynchelmis sp.	None	1
Enchytraeus	None	2
Naididae	None	14
Chironomidae	Pupa	1
Tvetenia bavarica group	Larvae	17
Diamesa	Larvae	1
Orthocladius	Larvae	11
Micropsectra	Larvae	9
Brillia sp.	Larvae	3
Paraphaenocladius sp.	Larvae	1
Limnophyes sp.	Larvae	2
Eukiefferiella	Larvae	48
Total:		**340**

Site - LMC Sample - 4, CC# - CC160563, Percent sampled = 100, Sieve size = 500		
Micropsectra	Larvae	30
Chironomidae	Pupa	1
Orthocladius	Larvae	6
Eukiefferiella	Larvae	4
Brillia sp.	Larvae	1
Tvetenia bavarica group	Larvae	1
Limnophyes sp.	Larvae	1
Ameletus	Larvae	1
Limnephilidae	Juvenile/Dam	4
Dicranota	Larvae	6
Tipula	Larvae	1
Prosimulium	Larvae	1
Capniidae	Juvenile/Dam	4
Nemoura	Larvae	55
Nemouridae	Juvenile/Dam	4
Leuctridae	Juvenile/Dam	2
Total:		**122**

Site - LMC Sample - 5, CC# - CC160564, Percent sampled = 50, Sieve size = 500		
Sperchon	Adult	1
Oribatida	Juvenile/Dam	2
Dicranota	Larvae	6
Pericoma/Telmatoscopus sp.	Larvae	2
Tipula	Larvae	1
Culicoides	Larvae	1
Clinocera sp.	Larvae	1
Limnephilidae	Juvenile/Dam	12
Limnephilidae	Pupa	1
Nemoura	Larvae	91
Nemouridae	Juvenile/Dam	20
Ostrocerca sp.	Larvae	3
Capniidae	Juvenile/Dam	7
Prostoia	Larvae	1
Chironomidae	Pupa	3
Pseudodiamesa sp.	Larvae	1
Tvetenia bavarica group	Larvae	8
Paraphaenocladius sp.	Larvae	4
Limnophyes sp.	Larvae	2
Brillia sp.	Larvae	1
Orthocladius	Larvae	17
Stictochironomus	Larvae	1
Hydrobaenus	Larvae	2
Eukiefferiella devonica group	Larvae	1
Neostempellina reissi	Larvae	1
Micropsectra	Larvae	157
Total:		**347**

Site - LWC Sample - 1, CC# - CC160565, Percent sampled = 100, Sieve size = 500		
Chironomidae	Pupa	3
Simuliidae	Pupa	1
Pagastia	Larvae	2
Tvetenia bavarica group	Larvae	4
Rhyacophila brunnea/vemna group	Larvae	3
Glossosoma	Larvae	14
Limnephilidae	Juvenile/Dam	2
Heptageniidae	Juvenile/Dam	3
Baetis	Juvenile/Dam	1
Baetis tricaudatus group	Larvae	3
Dicranota	Larvae	3
Simulium	Larvae	1
Chloroperlidae	Juvenile/Dam	3
Perlodidae	Juvenile/Dam	1
Zapada cinctipes	Larvae	1
Isoperla sp.	Larvae	7
Total:		**52**

Site - LWC Sample - 2, CC# - CC160566, Percent sampled = 100, Sieve size = 500		
Perlodidae	Juvenile/Dam	1
Haploperla sp.	Larvae	1
Capniidae	Juvenile/Dam	1
Isoperla sp.	Larvae	1
Lebertia	Adult	1
Helodon sp.	Larvae	2
Dicranota	Larvae	2
Heptageniidae	Juvenile/Dam	2
Baetis	Juvenile/Dam	2
Baetis tricaudatus group	Larvae	1
Tvetenia bavarica group	Larvae	2
Pagastia	Larvae	1
Orthocladius	Larvae	1
Naididae	Larvae	2
Oligochaeta	None	1
Total:		**21**

Site - LWC Sample - 3, CC# - CC160567, Percent sampled = 100, Sieve size = 500		
Enchytraeus	None	1
Chironomidae	Pupa	7
Tvetenia bavarica group	Larvae	7
Stictochironomus	Larvae	1
Orthocladius	Larvae	4
Heptageniidae	Juvenile/Dam	2
Ephemerella	Larvae	1
Ephemerellidae	Juvenile/Dam	1
Drunella doddsii	Larvae	1
Baetis	Juvenile/Dam	1
Baetis tricaudatus group	Larvae	6
Sperchon	Adult	1
Simuliidae	Juvenile/Dam	1
Glossosoma	Larvae	1
Isoperla sp.	Larvae	3
Total:		**38**

Site - LWC Sample - 4, CC# - CC160568, Percent sampled = 100, Sieve size = 500		
Oribatida	Juvenile/Dam	1
Limnephilidae	Juvenile/Dam	1
Rhyacophila brunnea/vemna group	Larvae	1
Drunella doddsii	Larvae	6
Drunella spinifera	Larvae	1
Heptageniidae	Juvenile/Dam	1
Baetis	Juvenile/Dam	3
Baetis tricaudatus group	Larvae	8
Simuliidae	Pupa	1
Simulium	Larvae	1
Diptera	Juvenile/Dam	1
Dicranota	Larvae	1
Isoperla sp.	Larvae	4
Chloroperlidae	Juvenile/Dam	1
Diura sp.	Larvae	1
Enchytraeus	None	2
Chironomidae	Pupa	3
Tvetenia bavarica group	Larvae	1
Eukiefferiella	Larvae	1
Orthocladius	Larvae	1
Micropsectra	Larvae	1
Pagastia	Larvae	3
Total:		**44**

Site - LWC Sample - 5, CC# - CC160569, Percent sampled = 100, Sieve size = 500			
Enchytraeus	None	3	
Pagastia	Larvae	5	
Chironomidae	Pupa	4	
Tvetenia bavarica group	Larvae	4	
Orthocladius lignicola	Larvae	1	
Limnophyes sp.	Larvae	1	
Eukiefferiella	Larvae	1	
Isoperla sp.	Larvae	8	
Perlodidae	Juvenile/Dam	5	
Nemouridae	Juvenile/Dam	1	
Chloroperlidae	Juvenile/Dam	2	
Leuctridae	Juvenile/Dam	1	
Drunella doddsii	Larvae	3	
Drunella spinifera	Larvae	1	
Ephemerella	Larvae	1	
Ephemerellidae	Juvenile/Dam	1	
Serratella	Larvae	1	
Glossosoma	Larvae	1	
Glossosomatidae	Juvenile/Dam	1	
Rhyacophila brunnea/vemna group	Larvae	1	
Limnephilidae	Juvenile/Dam	4	
Baetidae	Juvenile/Dam	4	
Baetis	Juvenile/Dam	8	
Baetis tricaudatus group	Larvae	10	
Acentrella sp.	Juvenile/Dam	2	
Dicranota	Larvae	1	
Simuliidae	Juvenile/Dam	1	
Simulium	Larvae	1	
Prosimulium	Larvae	1	
Diptera	Juvenile/Dam	1	
Empididae	Juvenile/Dam	1	
Heptageniidae	Juvenile/Dam	1	
Cinygmula sp.	Larvae	1	
Ameletus	Larvae	1	
Coleoptera	Adult	1	terrestrial
Coleoptera	Juvenile/Dam	1	
Total:		**85**	

Site - LBC Sample - 1, CC# - CC160570, Percent sampled = 100, Sieve size = 500			
Baetis	Juvenile/Dam	4	
Drunella doddsii	Larvae	1	
Drunella spinifera	Larvae	3	
Ephemerellidae	Juvenile/Dam	2	
Hygrobates	Adult	1	
Lebertia	Adult	1	
Nemoura	Larvae	1	
Glossosoma	Larvae	1	
Rhyacophila brunnea/vemna group	Larvae	1	
Coleoptera	Juvenile/Dam	1	terrestrial
Enchytraeus	None	2	
Naididae	None	3	
Chironomidae	Pupa	1	
Pagastia	Larvae	3	
Tvetenia bavarica group	Larvae	2	
Orthocladius	Larvae	5	
Rheotanytarsus	Larvae	3	
Total:		**35**	

Site - LBC Sample - 2, CC# - CC160571, Percent sampled = 100, Sieve size = 500		
Naididae	None	1
Enchytraeus	None	19
Orthocladius	Larvae	1
Pseudosmittia sp.	Larvae	1
Tvetenia bavarica group	Larvae	1
Chironomidae	None	3
Perlodidae	Juvenile/Dam	1
Heptageniidae	Juvenile/Dam	2
Capniidae	Juvenile/Dam	1
Hygrobates	Adult	1
Oribatida	Juvenile/Dam	1
Drunella spinifera	Larvae	3
Baetis	Juvenile/Dam	2
Dicranota	Larvae	11
Prosimulium	Larvae	1
Simuliidae	Juvenile/Dam	1
Simulium	Larvae	1
Dicosmoecus atripes	Larvae	1
Total:		**52**

Site - LBC Sample - 3, CC# - CC160572, Percent sampled = 100, Sieve size = 500		
Perlodidae	Juvenile/Dam	1
Capniidae	Juvenile/Dam	3
Paraperla sp.	Larvae	1
Simulium	Larvae	1
Ormosia sp.	Larvae	1
Trombidiformes	Juvenile/Dam	1
Glossosoma	Larvae	1
Coleoptera	Juvenile/Dam	1
Ameletus	Larvae	2
Ephemerellidae	Juvenile/Dam	1
Heptageniidae	Juvenile/Dam	11
Baetis	Juvenile/Dam	1
Baetis tricaudatus group	Larvae	1
Naididae	None	13
Rhynchelmis sp.	None	1
Enchytraeus	None	4
Chironomidae	Pupa	5
Pericoma/Telmatoscopus sp.	Larvae	1
Pagastia	Larvae	1
Tvetenia bavarica group	Larvae	2
Orthocladius	Larvae	6
Rheotanytarsus	Larvae	4
Total:		**63**

Site - LBC Sample - 4, CC# - CC160573, Percent sampled = 100, Sieve size = 500		
Enchytraeus	None	4
Stylaria sp.	None	1
Rheotanytarsus	Larvae	1
Tvetenia bavarica group	Larvae	1
Orthocladius	Larvae	1
Heptageniidae	Juvenile/Dam	6
Dicranota	Larvae	4
Drunella spinifera	Larvae	1
Capniidae	Juvenile/Dam	1
Baetis	Juvenile/Dam	1
Suwallia	Larvae	1
Total:		**22**

Site - LBC Sample - 5, CC# - CC160574, Percent sampled = 100, Sieve size = 500		
Baetis	Juvenile/Dam	5
Baetis tricaudatus group	Larvae	9
Ephemerellidae	Juvenile/Dam	12
Drunella doddsii	Larvae	1
Drunella spinifera	Larvae	3
Heptageniidae	Juvenile/Dam	8
Sperchon	Adult	2
Lebertia	Adult	4
Rhyacophila	Juvenile/Dam	1
Pisidium	None	1
Dicranota	Larvae	6
Ormosia sp.	Larvae	2
Simulium	Larvae	3
Dolichopodidae	Larvae	1
Isoperla sp.	Larvae	6
Perlodidae	Juvenile/Dam	1
Haploperla sp.	Larvae	1
Chloroperlidae	Juvenile/Dam	1
Zapada cinctipes	Larvae	2
Nemoura	Larvae	3
Enchytraeus	None	6
Naididae	None	5
Chironomidae	Pupa	2
Orthocladius	Larvae	7
Tvetenia bavarica group	Larvae	3
Eukiefferiella devonica group	Larvae	1
Rheotanytarsus	Larvae	1
Pagastia	Larvae	5
Potthastia longimana group	Larvae	1
Total:		**103**

Cordillera Consulting

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Minnow (Victoria), Lisa Bowron
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Client	Project	Site	Sample	CC#	500 micron fraction	
					% Sampled	# Invertebrates
Minnow (Victoria)	Minto WUL Monitoring 2015	LMC	1	CC160560	100%	115
Minnow (Victoria)	Minto WUL Monitoring 2015	LMC	2	CC160561	100%	161
Minnow (Victoria)	Minto WUL Monitoring 2015	LMC	3	CC160562	50%	340
Minnow (Victoria)	Minto WUL Monitoring 2015	LMC	4	CC160563	100%	122
Minnow (Victoria)	Minto WUL Monitoring 2015	LMC	5	CC160564	50%	347
Minnow (Victoria)	Minto WUL Monitoring 2015	LWC	1	CC160565	100%	52
Minnow (Victoria)	Minto WUL Monitoring 2015	LWC	2	CC160566	100%	22
Minnow (Victoria)	Minto WUL Monitoring 2015	LWC	3	CC160567	100%	39
Minnow (Victoria)	Minto WUL Monitoring 2015	LWC	4	CC160568	100%	45
Minnow (Victoria)	Minto WUL Monitoring 2015	LWC	5	CC160569	100%	85
Minnow (Victoria)	Minto WUL Monitoring 2015	LBC	1	CC160570	100%	35
Minnow (Victoria)	Minto WUL Monitoring 2015	LBC	2	CC160571	100%	52
Minnow (Victoria)	Minto WUL Monitoring 2015	LBC	3	CC160572	100%	67
Minnow (Victoria)	Minto WUL Monitoring 2015	LBC	4	CC160573	100%	22
Minnow (Victoria)	Minto WUL Monitoring 2015	LBC	5	CC160574	100%	103

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	Functional Feeding Groups	ITIS Number	Tolerance	Voltinism
Phylum: Arthropoda	Unclassified	82696		UV
Subphylum: Hexapoda	Unclassified	563886		UV
| Class: Insecta	Unclassified	99208		UV
| Order: Ephemeroptera	Collector-Gatherer	100502		UV
| Family: Ameletidae	Unclassified	568544		UV
Ameletus	Collector-Gatherer	100996		UV
| Family: Baetidae	Collector-Gatherer	100755	4	Unclassified
Acentrella sp.	Collector-Gatherer	100801	4	Unclassified
Baetis	Collector-Gatherer	100800	5	MV
Baetis tricaudatus group	Collector-Gatherer	100800A	6	Unclassified
| Family: Ephemerellidae	Unclassified	101232		Unclassified
Drunella doddsii	Collector-Gatherer	101365		UV
Drunella spinifera	Predator	101385		Unclassified
Ephemerella	Collector-Gatherer	101233	1	UV
Serratella	Collector-Gatherer	101395	2	UV
| Family: Heptageniidae	Unclassified	100504		Unclassified
Cinygmula sp.	Scraper	100557	4	Unclassified
| Order: Plecoptera	Unclassified	102467		Unclassified
| Family: Capniidae	Shredder-Herbivore	102643		Unclassified
| Family: Chloroperlidae	Predator	103202		Unclassified
Haploperla sp.	Predator	103260		Unclassified
Paraperla sp.	Predator	103233		Unclassified
Suwallia	Predator	103254	1	Unclassified
| Family: Leuctridae	Shredder-Herbivore	102840		Unclassified
| Family: Nemouridae	Shredder-Herbivore	102517		Unclassified
Nemoura	Shredder-Herbivore	102526	1	Unclassified
Ostrocerca sp.	Shredder-Herbivore	102622	2	Unclassified
Prostoia	Shredder-Herbivore	102584		Unclassified
Zapada cinctipes	Shredder-Herbivore	102594	2	UV
| Family: Perlodidae	Predator	102994	2	Unclassified
Diura sp.	Predator	103094	2	Unclassified
Isoperla sp.	Predator	102995	2	UV
| Order: Trichoptera	Unclassified	115095		Unclassified
| Family: Glossosomatidae	Unclassified	117120		Unclassified
Glossosoma	Scraper	117159	1	Unclassified
| Family: Limnephilidae	Collector-Gatherer	115933		Unclassified
Dicosmoecus atripes	Omnivore	116266	1	MV
| Family: Rhyacophilidae	Unclassified	115096		Unclassified
Rhyacophila	Predator	115097		Unclassified
Rhyacophila brunnea/vemna group	Predator	115097D	1	
| Order: Coleoptera	Predator	109216		
| Order: Diptera	Unclassified	118831		
| Family: Ceratopogonidae	Predator	127076	6	
Ceratopogon sp.	Predator	127564	6	
Culicoides	Predator	127340	6	
| Family: Chironomidae	Unclassified	127917	6	
| Subfamily: Chironominae	Collector-Gatherer	129228	9	
| Tribe: Chironomini	Collector-Gatherer	129229	9	
Stictochironomus	Collector-Gatherer	129785	9	
| Tribe: Tanytarsini	Collector-Gatherer	129872	7	
Micropsectra	Collector-Gatherer	129890	7	
Neostempellina reissi	Collector-Gatherer	127917Q	2	
Rheotanytarsus	Collector-Filterer	129952	6	
| Subfamily: Diamesinae	Collector-Gatherer	128341	5	
| Tribe: Diamesini	Collector-Gatherer	128351	5	
Diamesa	Collector-Gatherer	128355	5	
Pagastia	Collector-Gatherer	128401	1	
Potthastia longimana group	Collector-Gatherer	128408	2	
Pseudodiamesa sp.	Collector-Gatherer	128416	6	

| Subfamily: Orthocladiinae	Unclassified	128457	5	
Brillia sp.	Shredder-Herbivore	128477	5	
Eukiefferiella	Omnivore	128689	8	
Eukiefferiella claripennis group	Omnivore	128689C	8	
Eukiefferiella devonica group	Omnivore	128689F	8	
Hydrobaenus	Collector-Gatherer	128750	8	
Limnophyes sp.	Collector-Gatherer	128776	8	
Orthocladius	Collector-Gatherer	128874	6	
Orthocladius lignicola	Collector-Gatherer	128913	6	
Parakiefferiella	Collector-Gatherer	128968	4	
Paraphaenocladius sp.	Collector-Gatherer	128989	4	
Pseudosmittia sp.	Collector-Gatherer	129071		
Tvetenia	Collector-Gatherer	129197	5	
Tvetenia bavarica group	Collector-Gatherer	129197B	5	
| Family: Dolichopodidae	Predator	136824	4	
| Family: Empididae	Predator	135830	6	
Clinocera sp.	Predator	135849	6	
| Family: Muscidae	Unclassified	150025	6	
Limnophora sp.	Predator	150730	6	
| Family: Psychodidae	Unclassified	125351	4	
Pericoma/Telmatoscopus sp.	Collector-Gatherer	125514	4	
| Family: Simuliidae	Collector-Filterer	126640	6	
Helodon sp.	Collector-Filterer	126640		
Prosimulium	Collector-Filterer	126703	3	
Simulium	Collector-Filterer	126774	6	
| Family: Tipulidae	Shredder-Herbivore	118840	3	
Dicranota	Predator	121027	3	
Ormosia sp.	Collector-Gatherer	120830	3	
Tipula	Omnivore	119037	4	
Subphylum: Chelicerata	Unclassified	82697	5	
| Class: Arachnida	Predator	82708	5	
| Order: Trombidiformes	Predator	82769	5	
| Family: Hygrobatidae	Unclassified	83281	8	Unclassified
Hygrobates	Predator	83297	8	Unclassified
| Family: Lebertiidae	Predator	83033	8	Unclassified
Lebertia	Predator	83034	8	Unclassified
| Family: Sperchontidae	Unclassified	895710	8	Unclassified
Sperchon	Predator	83006	8	Unclassified
| Order: Oribatei	Predator	83544	5	
| Family: Oribatidae	Predator	83538	5	
Oribatida	Predator	83538	5	
Phylum: Mollusca	Unclassified	69458	8	
| Class: Bivalvia	Unclassified	79118	8	
| Order: Veneroida	Unclassified	80384	8	
| Family: Pisidiidae	Collector-Filterer	81388	8	
Pisidium	Collector-Filterer	81400	8	
Phylum: Annelida	Unclassified	64357	5	
Subphylum: Clitellata	Unclassified	568832	5	
| Class: Oligochaeta	Collector-Gatherer	68422	5	
| Order: Lumbriculida	Unclassified	68439	8	
| Family: Lumbriculidae	Collector-Gatherer	68440	8	
Rhynchelmis sp.	Collector-Gatherer	68463	8	
| Order: Tubificida	Unclassified	68498	10	
| Family: Enchytraeidae	Collector-Gatherer	68510	10	
Enchytraeus	Collector-Gatherer	68531	10	
| Family: Naididae	Collector-Gatherer	68854	10	
Stylaria sp.	Collector-Gatherer	68871	10	

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Phylum	Sub Phylum	Class	Order	Family	Subfamily	Tribe	Taxonomy	ITIS Code	Functional Feeding Group	Maturity	Name	Site	Sample	CC#
Arthropoda	Chelicerata	Arachnida	Trombidiforme	Sperchontidae			Sperchon	83006	P	Adult	Sperchon	LMC	1	CC160560
Arthropoda	Chelicerata	Arachnida	Oribatei	Oribatidae			Oribatida	83538	P	Juvenile/Damaged	Oribatida	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Dicranota	121027	P	Larvae	Dicranota	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Diptera	Empididae			Clinocera sp.	135849	P	Larvae	Clinocera sp.	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae				102517	SH	Juvenile/Damaged	Nemouridae	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae			Nemoura	102526	SH	Larvae	Nemoura	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae			Prostoia	102584	SH	Larvae	Prostoia	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesini	Pseudodiamesa sp.	128416	CG	Larvae	Pseudodiamesa sp.	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Brillia sp.	128477	SH	Larvae	Brillia sp.	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius lignicola	128913	CG	Larvae	Orthocladius lignicola	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius	128874	CG	Larvae	Orthocladius	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Eukiefferiella	128689	OM	Larvae	Eukiefferiella	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Pseudosmittia sp.	129071	CG	Larvae	Pseudosmittia sp.	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	Tanytarsini	Micropsectra	129890	CG	Larvae	Micropsectra	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Parakiefferiella	128968	CG	Larvae	Parakiefferiella	LMC	1	CC160560
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Limnophyes sp.	128776	CG	Larvae	Limnophyes sp.	LMC	1	CC160560
Annelida	Clitellata	Oligochaeta	Tubificida	Enchytraeidae			Enchytraeus	68531	CG	None	Enchytraeus	LMC	1	CC160560
Annelida	Clitellata	Oligochaeta	Tubificida	Enchytraeidae			Enchytraeus	68531	CG	None	Enchytraeus	LMC	2	CC160561
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae				127917		Pupa	Chironomidae	LMC	2	CC160561
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Eukiefferiella claripennis group	128689C	OM	Larvae	Eukiefferiella claripennis group	LMC	2	CC160561
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius	128874	CG	Larvae	Orthocladius	LMC	2	CC160561
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Limnophyes sp.	128776	CG	Larvae	Limnophyes sp.	LMC	2	CC160561
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Brillia sp.	128477	SH	Larvae	Brillia sp.	LMC	2	CC160561
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LMC	2	CC160561
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae			Nemoura	102526	SH	Larvae	Nemoura	LMC	2	CC160561
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae			Ostrocerca sp.	102622	SH	Larvae	Ostrocerca sp.	LMC	2	CC160561
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae				102517	SH	Juvenile/Damaged	Nemouridae	LMC	2	CC160561
Arthropoda	Chelicerata	Arachnida	Trombidiforme	Sperchontidae			Sperchon	83006	P	Adult	Sperchon	LMC	2	CC160561
Arthropoda	Hexapoda	Insecta	Diptera	Empididae			Clinocera sp.	135849	P	Larvae	Clinocera sp.	LMC	2	CC160561
Arthropoda	Hexapoda	Insecta	Diptera	Muscidae			Limnophora sp.	150730	P	Larvae	Limnophora sp.	LMC	2	CC160561
Arthropoda	Chelicerata	Arachnida	Trombidiforme	Sperchontidae			Sperchon	83006	P	Adult	Sperchon	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Dicranota	121027	P	Larvae	Dicranota	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae			Simulium	126774	CF	Larvae	Simulium	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Diptera	Ceratopogonidae			Ceratopogon sp.	127564	P	Larvae	Ceratopogon sp.	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Diptera					118831		Juvenile/Damaged	Diptera	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Trichoptera	Limnephilidae				115933	CG	Juvenile/Damaged	Limnephilidae	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae			Nemoura	102526	SH	Larvae	Nemoura	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae				102517	SH	Juvenile/Damaged	Nemouridae	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Plecoptera	Capniidae				102643	SH	Juvenile/Damaged	Capniidae	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae			Ostrocerca sp.	102622	SH	Larvae	Ostrocerca sp.	LMC	3	CC160562

Phylum	Sub Phylum	Class	Order	Family	Subfamily	Tribe	Taxonomy	ITIS Code	Functional Feeding Group	Maturity	Name	Site	Sample	CC#
Annelida	Clitellata	Oligochaeta	Tubificida	Naididae			Stylaria sp.	68871	CG	None	Stylaria sp.	LMC	3	CC160562
Annelida	Clitellata	Oligochaeta	Lumbriculida	Lumbriculidae			Rhynchelmis sp.	68463	CG	None	Rhynchelmis sp.	LMC	3	CC160562
Annelida	Clitellata	Oligochaeta	Tubificida	Enchytraeidae			Enchytraeus	68531	CG	None	Enchytraeus	LMC	3	CC160562
Annelida	Clitellata	Oligochaeta	Tubificida	Naididae				68854	CG	None	Naididae	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae				127917		Pupa	Chironomidae	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesini	Diamesa	128355	CG	Larvae	Diamesa	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius	128874	CG	Larvae	Orthocladius	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	Tanytarsini	Micropsectra	129890	CG	Larvae	Micropsectra	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Brillia sp.	128477	SH	Larvae	Brillia sp.	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Paraphaenocladius sp.	128989	CG	Larvae	Paraphaenocladius sp.	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Limnophyes sp.	128776	CG	Larvae	Limnophyes sp.	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Eukiefferiella	128689	OM	Larvae	Eukiefferiella	LMC	3	CC160562
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	Tanytarsini	Micropsectra	129890	CG	Larvae	Micropsectra	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae				127917		Pupa	Chironomidae	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius	128874	CG	Larvae	Orthocladius	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Eukiefferiella	128689	OM	Larvae	Eukiefferiella	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Brillia sp.	128477	SH	Larvae	Brillia sp.	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Limnophyes sp.	128776	CG	Larvae	Limnophyes sp.	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ameletidae			Ameletus	100996	CG	Larvae	Ameletus	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Trichoptera	Limnephilidae				115933	CG	Juvenile/Damaged	Limnephilidae	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Dicranota	121027	P	Larvae	Dicranota	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Tipula	119037	OM	Larvae	Tipula	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae			Prosimulium	126703	CF	Larvae	Prosimulium	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Plecoptera	Capniidae				102643	SH	Juvenile/Damaged	Capniidae	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae			Nemoura	102526	SH	Larvae	Nemoura	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae				102517	SH	Juvenile/Damaged	Nemouridae	LMC	4	CC160563
Arthropoda	Hexapoda	Insecta	Plecoptera	Leuctridae				102840	SH	Juvenile/Damaged	Leuctridae	LMC	4	CC160563
Arthropoda	Chelicerata	Arachnida	Trombidiforme	Sperchontidae			Sperchon	83006	P	Adult	Sperchon	LMC	5	CC160564
Arthropoda	Chelicerata	Arachnida	Oribatei	Oribatidae			Oribatida	83538	P	Juvenile/Damaged	Oribatida	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Dicranota	121027	P	Larvae	Dicranota	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Psychodidae			Pericoma/Telmatoscopus sp.	125514	CG	Larvae	Pericoma/Telmatoscopus sp.	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Tipula	119037	OM	Larvae	Tipula	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Ceratopogonidae			Culicoides	127340	P	Larvae	Culicoides	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Empididae			Clinocera sp.	135849	P	Larvae	Clinocera sp.	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Trichoptera	Limnephilidae				115933	CG	Juvenile/Damaged	Limnephilidae	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Trichoptera	Limnephilidae				115933	CG	Pupa	Limnephilidae	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae			Nemoura	102526	SH	Larvae	Nemoura	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae				102517	SH	Juvenile/Damaged	Nemouridae	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae			Ostrocerca sp.	102622	SH	Larvae	Ostrocerca sp.	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Plecoptera	Capniidae				102643	SH	Juvenile/Damaged	Capniidae	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae			Prostoia	102584	SH	Larvae	Prostoia	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae				127917		Pupa	Chironomidae	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesini	Pseudodiamesa sp.	128416	CG	Larvae	Pseudodiamesa sp.	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Paraphaenocladius sp.	128989	CG	Larvae	Paraphaenocladius sp.	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Limnophyes sp.	128776	CG	Larvae	Limnophyes sp.	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Brillia sp.	128477	SH	Larvae	Brillia sp.	LMC	5	CC160564

Phylum	Sub Phylum	Class	Order	Family	Subfamily	Tribe	Taxonomy	ITIS Code	Functional Feeding Group	Maturity	Name	Site	Sample	CC#
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius	128874	CG	Larvae	Orthocladius	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	Chironomini	Stictochironomus	129785	CG	Larvae	Stictochironomus	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Hydrobaenus	128750	CG	Larvae	Hydrobaenus	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Eukiefferiella devonica group	128689F	OM	Larvae	Eukiefferiella devonica group	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	Tanytarsini	Neostempellina reissi	127917Q	CG	Larvae	Neostempellina reissi	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	Tanytarsini	Micropsectra	129890	CG	Larvae	Micropsectra	LMC	5	CC160564
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae				127917		Pupa	Chironomidae	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae				126640	CF	Pupa	Simuliidae	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesini	Pagastia	128401	CG	Larvae	Pagastia	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Trichoptera	Rhyacophilidae			Rhyacophila brunnea/vemna gr	115097D	P	Larvae	Rhyacophila brunnea/vemna gr	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Trichoptera	Glossosomatidae			Glossosoma	117159	SC	Larvae	Glossosoma	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Trichoptera	Limnephilidae				115933	CG	Juvenile/Damaged	Limnephilidae	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Ephemeropter	Heptageniidae				100504		Juvenile/Damaged	Heptageniidae	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis	100800	CG	Juvenile/Damaged	Baetis	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis tricaudatus group	100800A	CG	Larvae	Baetis tricaudatus group	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Dicranota	121027	P	Larvae	Dicranota	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae			Simulium	126774	CF	Larvae	Simulium	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Plecoptera	Chloroperlidae				103202	P	Juvenile/Damaged	Chloroperlidae	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Plecoptera	Perlodidae				102994	P	Juvenile/Damaged	Perlodidae	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae			Zapada cinctipes	102594	SH	Larvae	Zapada cinctipes	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Plecoptera	Perlodidae			Isoperla sp.	102995	P	Larvae	Isoperla sp.	LWC	1	CC160565
Arthropoda	Hexapoda	Insecta	Plecoptera	Perlodidae				102994	P	Juvenile/Damaged	Perlodidae	LWC	2	CC160566
Arthropoda	Hexapoda	Insecta	Plecoptera	Chloroperlidae			Haploperla sp.	103260	P	Larvae	Haploperla sp.	LWC	2	CC160566
Arthropoda	Hexapoda	Insecta	Plecoptera	Capniidae				102643	SH	Juvenile/Damaged	Capniidae	LWC	2	CC160566
Arthropoda	Hexapoda	Insecta	Plecoptera	Perlodidae			Isoperla sp.	102995	P	Larvae	Isoperla sp.	LWC	2	CC160566
Arthropoda	Chelicerata	Arachnida	Trombidiforme	Lebertiidae			Lebertia	83034	P	Adult	Lebertia	LWC	2	CC160566
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae			Helodon sp.	126640	CF	Larvae	Helodon sp.	LWC	2	CC160566
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Dicranota	121027	P	Larvae	Dicranota	LWC	2	CC160566
Arthropoda	Hexapoda	Insecta	Ephemeropter	Heptageniidae				100504		Juvenile/Damaged	Heptageniidae	LWC	2	CC160566
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis	100800	CG	Juvenile/Damaged	Baetis	LWC	2	CC160566
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis tricaudatus group	100800A	CG	Larvae	Baetis tricaudatus group	LWC	2	CC160566
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LWC	2	CC160566
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesini	Pagastia	128401	CG	Larvae	Pagastia	LWC	2	CC160566
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius	128874	CG	Larvae	Orthocladius	LWC	2	CC160566
Annelida	Clitellata	Oligochaeta	Tubificida	Naididae				68854	CG	Larvae	Naididae	LWC	2	CC160566
Annelida	Clitellata	Oligochaeta						68422	CG	None	Oligochaeta	LWC	2	CC160566
Annelida	Clitellata	Oligochaeta	Tubificida	Enchytraeidae			Enchytraeus	68531	CG	None	Enchytraeus	LWC	3	CC160567
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae				127917		Pupa	Chironomidae	LWC	3	CC160567
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LWC	3	CC160567
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	Chironomini	Stictochironomus	129785	CG	Larvae	Stictochironomus	LWC	3	CC160567
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius	128874	CG	Larvae	Orthocladius	LWC	3	CC160567
Arthropoda	Hexapoda	Insecta	Ephemeropter	Heptageniidae				100504		Juvenile/Damaged	Heptageniidae	LWC	3	CC160567
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae			Ephemerella	101233	CG	Larvae	Ephemerella	LWC	3	CC160567
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae				101232		Juvenile/Damaged	Ephemerellidae	LWC	3	CC160567
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae			Drunella doddsii	101365	CG	Larvae	Drunella doddsii	LWC	3	CC160567
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis	100800	CG	Juvenile/Damaged	Baetis	LWC	3	CC160567
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis tricaudatus group	100800A	CG	Larvae	Baetis tricaudatus group	LWC	3	CC160567
Arthropoda	Chelicerata	Arachnida	Trombidiforme	Sperchontidae			Sperchon	83006	P	Adult	Sperchon	LWC	3	CC160567

Phylum	Sub Phylum	Class	Order	Family	Subfamily	Tribe	Taxonomy	ITIS Code	Functional Feeding Group	Maturity	Name	Site	Sample	CC#
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae				126640	CF	Juvenile/Damaged	Simuliidae	LWC	3	CC160567
Arthropoda	Hexapoda	Insecta	Trichoptera	Glossosomatidae			Glossosoma	117159	SC	Larvae	Glossosoma	LWC	3	CC160567
Arthropoda	Hexapoda	Insecta	Plecoptera	Perlodidae			Isoperla sp.	102995	P	Larvae	Isoperla sp.	LWC	3	CC160567
Arthropoda	Chelicerata	Arachnida	Oribatei	Oribatidae			Oribatida	83538	P	Juvenile/Damaged	Oribatida	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Trichoptera	Limnephilidae				115933	CG	Juvenile/Damaged	Limnephilidae	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Trichoptera	Rhyacophilidae			Rhyacophila brunnea/vemna gr	115097D	P	Larvae	Rhyacophila brunnea/vemna gr	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae			Drunella doddsii	101365	CG	Larvae	Drunella doddsii	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae			Drunella spinifera	101385	P	Larvae	Drunella spinifera	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Ephemeropter	Heptageniidae				100504		Juvenile/Damaged	Heptageniidae	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis	100800	CG	Juvenile/Damaged	Baetis	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis tricaudatus group	100800A	CG	Larvae	Baetis tricaudatus group	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae				126640	CF	Pupa	Simuliidae	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae			Simulium	126774	CF	Larvae	Simulium	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Diptera					118831		Juvenile/Damaged	Diptera	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Dicranota	121027	P	Larvae	Dicranota	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Plecoptera	Perlodidae			Isoperla sp.	102995	P	Larvae	Isoperla sp.	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Plecoptera	Chloroperlidae				103202	P	Juvenile/Damaged	Chloroperlidae	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Plecoptera	Perlodidae			Diura sp.	103094	P	Larvae	Diura sp.	LWC	4	CC160568
Annelida	Clitellata	Oligochaeta	Tubificida	Enchytraeidae			Enchytraeus	68531	CG	None	Enchytraeus	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae				127917		Pupa	Chironomidae	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Eukiefferiella	128689	OM	Larvae	Eukiefferiella	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius	128874	CG	Larvae	Orthocladius	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	Tanytarsini	Micropsectra	129890	CG	Larvae	Micropsectra	LWC	4	CC160568
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesini	Pagastia	128401	CG	Larvae	Pagastia	LWC	4	CC160568
Annelida	Clitellata	Oligochaeta	Tubificida	Enchytraeidae			Enchytraeus	68531	CG	None	Enchytraeus	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesini	Pagastia	128401	CG	Larvae	Pagastia	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae				127917		Pupa	Chironomidae	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius lignicola	128913	CG	Larvae	Orthocladius lignicola	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Limnophyes sp.	128776	CG	Larvae	Limnophyes sp.	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Eukiefferiella	128689	OM	Larvae	Eukiefferiella	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Plecoptera	Perlodidae			Isoperla sp.	102995	P	Larvae	Isoperla sp.	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Plecoptera	Perlodidae				102994	P	Juvenile/Damaged	Perlodidae	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae				102517	SH	Juvenile/Damaged	Nemouridae	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Plecoptera	Chloroperlidae				103202	P	Juvenile/Damaged	Chloroperlidae	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Plecoptera	Leuctridae				102840	SH	Juvenile/Damaged	Leuctridae	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae			Drunella doddsii	101365	CG	Larvae	Drunella doddsii	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae			Drunella spinifera	101385	P	Larvae	Drunella spinifera	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae			Ephemerella	101233	CG	Larvae	Ephemerella	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae				101232		Juvenile/Damaged	Ephemerellidae	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae			Serratella	101395	CG	Larvae	Serratella	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Trichoptera	Glossosomatidae			Glossosoma	117159	SC	Larvae	Glossosoma	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Trichoptera	Glossosomatidae				117120		Juvenile/Damaged	Glossosomatidae	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Trichoptera	Rhyacophilidae			Rhyacophila brunnea/vemna gr	115097D	P	Larvae	Rhyacophila brunnea/vemna gr	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Trichoptera	Limnephilidae				115933	CG	Juvenile/Damaged	Limnephilidae	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae				100755	CG	Juvenile/Damaged	Baetidae	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis	100800	CG	Juvenile/Damaged	Baetis	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis tricaudatus group	100800A	CG	Larvae	Baetis tricaudatus group	LWC	5	CC160569

Phylum	Sub Phylum	Class	Order	Family	Subfamily	Tribe	Taxonomy	ITIS Code	Functional Feeding Group	Maturity	Name	Site	Sample	CC#
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Acentrella sp.	100801	CG	Juvenile/Damaged	Acentrella sp.	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Dicranota	121027	P	Larvae	Dicranota	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae				126640	CF	Juvenile/Damaged	Simuliidae	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae			Simulium	126774	CF	Larvae	Simulium	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae			Prosimulium	126703	CF	Larvae	Prosimulium	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Diptera					118831		Juvenile/Damaged	Diptera	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Diptera	Empididae				135830	P	Juvenile/Damaged	Empididae	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Ephemeropter	Heptageniidae				100504		Juvenile/Damaged	Heptageniidae	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Ephemeropter	Heptageniidae			Cinygmula sp.	100557	SC	Larvae	Cinygmula sp.	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ameletidae			Ameletus	100996	CG	Larvae	Ameletus	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Coleoptera					109216	P	Adult	Coleoptera	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Coleoptera					109216	P	Juvenile/Damaged	Coleoptera	LWC	5	CC160569
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis	100800	CG	Juvenile/Damaged	Baetis	LBC	1	CC160570
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae			Drunella doddsii	101365	CG	Larvae	Drunella doddsii	LBC	1	CC160570
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae			Drunella spinifera	101385	P	Larvae	Drunella spinifera	LBC	1	CC160570
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae				101232		Juvenile/Damaged	Ephemerellidae	LBC	1	CC160570
Arthropoda	Chelicerata	Arachnida	Trombidiforme	Hygrobatidae			Hygrobates	83297	P	Adult	Hygrobates	LBC	1	CC160570
Arthropoda	Chelicerata	Arachnida	Trombidiforme	Lebertiidae			Lebertia	83034	P	Adult	Lebertia	LBC	1	CC160570
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae			Nemoura	102526	SH	Larvae	Nemoura	LBC	1	CC160570
Arthropoda	Hexapoda	Insecta	Trichoptera	Glossosomatidae			Glossosoma	117159	SC	Larvae	Glossosoma	LBC	1	CC160570
Arthropoda	Hexapoda	Insecta	Trichoptera	Rhyacophilidae			Rhyacophila brunnea/vemna gr	115097D	P	Larvae	Rhyacophila brunnea/vemna gr	LBC	1	CC160570
Arthropoda	Hexapoda	Insecta	Coleoptera					109216	P	Juvenile/Damaged	Coleoptera	LBC	1	CC160570
Annelida	Clitellata	Oligochaeta	Tubificida	Enchytraeidae			Enchytraeus	68531	CG	None	Enchytraeus	LBC	1	CC160570
Annelida	Clitellata	Oligochaeta	Tubificida	Naididae				68854	CG	None	Naididae	LBC	1	CC160570
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae				127917		Pupa	Chironomidae	LBC	1	CC160570
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesini	Pagastia	128401	CG	Larvae	Pagastia	LBC	1	CC160570
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LBC	1	CC160570
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius	128874	CG	Larvae	Orthocladius	LBC	1	CC160570
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	Tanytarsini	Rheotanytarsus	129952	CF	Larvae	Rheotanytarsus	LBC	1	CC160570
Annelida	Clitellata	Oligochaeta	Tubificida	Naididae				68854	CG	None	Naididae	LBC	2	CC160571
Annelida	Clitellata	Oligochaeta	Tubificida	Enchytraeidae			Enchytraeus	68531	CG	None	Enchytraeus	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius	128874	CG	Larvae	Orthocladius	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Pseudosmittia sp.	129071	CG	Larvae	Pseudosmittia sp.	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae				127917		None	Chironomidae	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Plecoptera	Perlodidae				102994	P	Juvenile/Damaged	Perlodidae	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Ephemeropter	Heptageniidae				100504		Juvenile/Damaged	Heptageniidae	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Plecoptera	Capniidae				102643	SH	Juvenile/Damaged	Capniidae	LBC	2	CC160571
Arthropoda	Chelicerata	Arachnida	Trombidiforme	Hygrobatidae			Hygrobates	83297	P	Adult	Hygrobates	LBC	2	CC160571
Arthropoda	Chelicerata	Arachnida	Oribatei	Oribatidae			Oribatida	83538	P	Juvenile/Damaged	Oribatida	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae			Drunella spinifera	101385	P	Larvae	Drunella spinifera	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis	100800	CG	Juvenile/Damaged	Baetis	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Dicranota	121027	P	Larvae	Dicranota	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae			Prosimulium	126703	CF	Larvae	Prosimulium	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae				126640	CF	Juvenile/Damaged	Simuliidae	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae			Simulium	126774	CF	Larvae	Simulium	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Trichoptera	Limnephilidae			Dicosmoecus atripes	116266	OM	Larvae	Dicosmoecus atripes	LBC	2	CC160571
Arthropoda	Hexapoda	Insecta	Plecoptera	Perlodidae				102994	P	Juvenile/Damaged	Perlodidae	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Plecoptera	Capniidae				102643	SH	Juvenile/Damaged	Capniidae	LBC	3	CC160572

Phylum	Sub Phylum	Class	Order	Family	Subfamily	Tribe	Taxonomy	ITIS Code	Functional Feeding Group	Maturity	Name	Site	Sample	CC#
Arthropoda	Hexapoda	Insecta	Plecoptera	Chloroperlidae			Paraperla sp.	103233	P	Larvae	Paraperla sp.	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae			Simulium	126774	CF	Larvae	Simulium	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Ormosia sp.	120830	CG	Larvae	Ormosia sp.	LBC	3	CC160572
Arthropoda	Chelicerata	Arachnida	Trombidiformes					82769	P	Juvenile/Damaged	Trombidiformes	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Trichoptera	Glossosomatidae			Glossosoma	117159	SC	Larvae	Glossosoma	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Coleoptera					109216	P	Juvenile/Damaged	Coleoptera	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ameletidae			Ameletus	100996	CG	Larvae	Ameletus	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae				101232		Juvenile/Damaged	Ephemerellidae	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Ephemeropter	Heptageniidae				100504		Juvenile/Damaged	Heptageniidae	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis	100800	CG	Juvenile/Damaged	Baetis	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis tricaudatus group	100800A	CG	Larvae	Baetis tricaudatus group	LBC	3	CC160572
Annelida	Clitellata	Oligochaeta	Tubificida	Naididae				68854	CG	None	Naididae	LBC	3	CC160572
Annelida	Clitellata	Oligochaeta	Lumbriculida	Lumbriculidae			Rhynchelmis sp.	68463	CG	None	Rhynchelmis sp.	LBC	3	CC160572
Annelida	Clitellata	Oligochaeta	Tubificida	Enchytraeidae			Enchytraeus	68531	CG	None	Enchytraeus	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae				127917		Pupa	Chironomidae	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Diptera	Psychodidae			Pericoma/Telmatoscopus sp.	125514	CG	Larvae	Pericoma/Telmatoscopus sp.	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesini	Pagastia	128401	CG	Larvae	Pagastia	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius	128874	CG	Larvae	Orthocladius	LBC	3	CC160572
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	Tanytarsini	Rheotanytarsus	129952	CF	Larvae	Rheotanytarsus	LBC	3	CC160572
Annelida	Clitellata	Oligochaeta	Tubificida	Enchytraeidae			Enchytraeus	68531	CG	None	Enchytraeus	LBC	4	CC160573
Annelida	Clitellata	Oligochaeta	Tubificida	Naididae			Stylaria sp.	68871	CG	None	Stylaria sp.	LBC	4	CC160573
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	Tanytarsini	Rheotanytarsus	129952	CF	Larvae	Rheotanytarsus	LBC	4	CC160573
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LBC	4	CC160573
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius	128874	CG	Larvae	Orthocladius	LBC	4	CC160573
Arthropoda	Hexapoda	Insecta	Ephemeropter	Heptageniidae				100504		Juvenile/Damaged	Heptageniidae	LBC	4	CC160573
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Dicranota	121027	P	Larvae	Dicranota	LBC	4	CC160573
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae			Drunella spinifera	101385	P	Larvae	Drunella spinifera	LBC	4	CC160573
Arthropoda	Hexapoda	Insecta	Plecoptera	Capniidae				102643	SH	Juvenile/Damaged	Capniidae	LBC	4	CC160573
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis	100800	CG	Juvenile/Damaged	Baetis	LBC	4	CC160573
Arthropoda	Hexapoda	Insecta	Plecoptera	Chloroperlidae			Suwallia	103254	P	Larvae	Suwallia	LBC	4	CC160573
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis	100800	CG	Juvenile/Damaged	Baetis	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Ephemeropter	Baetidae			Baetis tricaudatus group	100800A	CG	Larvae	Baetis tricaudatus group	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae				101232		Juvenile/Damaged	Ephemerellidae	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae			Drunella doddsii	101365	CG	Larvae	Drunella doddsii	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Ephemeropter	Ephemerellidae			Drunella spinifera	101385	P	Larvae	Drunella spinifera	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Ephemeropter	Heptageniidae				100504		Juvenile/Damaged	Heptageniidae	LBC	5	CC160574
Arthropoda	Chelicerata	Arachnida	Trombidiforme	Sperchontidae			Sperchon	83006	P	Adult	Sperchon	LBC	5	CC160574
Arthropoda	Chelicerata	Arachnida	Trombidiforme	Lebertiidae			Lebertia	83034	P	Adult	Lebertia	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Trichoptera	Rhyacophilidae			Rhyacophila	115097	P	Juvenile/Damaged	Rhyacophila	LBC	5	CC160574
Mollusca		Bivalvia	Veneroida	Pisidiidae			Pisidium	81400	CF	None	Pisidium	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Dicranota	121027	P	Larvae	Dicranota	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae			Ormosia sp.	120830	CG	Larvae	Ormosia sp.	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae			Simulium	126774	CF	Larvae	Simulium	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Diptera	Dolichopodidae				136824	P	Larvae	Dolichopodidae	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Plecoptera	Perlodidae			Isoperla sp.	102995	P	Larvae	Isoperla sp.	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Plecoptera	Perlodidae				102994	P	Juvenile/Damaged	Perlodidae	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Plecoptera	Chloroperlidae			Haploperla sp.	103260	P	Larvae	Haploperla sp.	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Plecoptera	Chloroperlidae				103202	P	Juvenile/Damaged	Chloroperlidae	LBC	5	CC160574

Phylum	Sub Phylum	Class	Order	Family	Subfamily	Tribe	Taxonomy	ITIS Code	Functional Feeding Group	Maturity	Name	Site	Sample	CC#
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae			Zapada cinctipes	102594	SH	Larvae	Zapada cinctipes	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae			Nemoura	102526	SH	Larvae	Nemoura	LBC	5	CC160574
Annelida	Clitellata	Oligochaeta	Tubificida	Enchytraeidae			Enchytraeus	68531	CG	None	Enchytraeus	LBC	5	CC160574
Annelida	Clitellata	Oligochaeta	Tubificida	Naididae				68854	CG	None	Naididae	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae				127917		Pupa	Chironomidae	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Orthocladius	128874	CG	Larvae	Orthocladius	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Tvetenia bavarica group	129197B	CG	Larvae	Tvetenia bavarica group	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae		Eukiefferiella devonica group	128689F	OM	Larvae	Eukiefferiella devonica group	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	Tanytarsini	Rheotanytarsus	129952	CF	Larvae	Rheotanytarsus	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesini	Pagastia	128401	CG	Larvae	Pagastia	LBC	5	CC160574
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesini	Potthastia longimana group	128408	CG	Larvae	Potthastia longimana group	LBC	5	CC160574

Count	Percent Sampled	Seive Size	Season	Reach	Site	Transect	Parent
3	100	500					
1	100	500					
2	100	500					
1	100	500					
4	100	500					
41	100	500					
2	100	500					
1	100	500					
4	100	500					
1	100	500					
9	100	500					
10	100	500					
20	100	500					
1	100	500					
4	100	500					
1	100	500					
2	100	500					
7	100	500					
5	100	500					
7	100	500					
35	100	500					
4	100	500					
1	100	500					
1	100	500					
20	100	500					
71	100	500					
5	100	500					
8	100	500					
2	100	500					
1	100	500					
1	100	500					
1	50	500					
5	50	500					
1	50	500					
2	50	500					
1	50	500					
8	50	500					
150	50	500					
53	50	500					
1	50	500					
7	50	500					

Count	Percent Sampled	Seive Size	Season	Reach	Site	Transect	Parent
1	50	500					
1	50	500					
2	50	500					
14	50	500					
1	50	500					
17	50	500					
1	50	500					
11	50	500					
9	50	500					
3	50	500					
1	50	500					
2	50	500					
48	50	500					
30	100	500					
1	100	500					
6	100	500					
4	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
4	100	500					
6	100	500					
1	100	500					
1	100	500					
4	100	500					
55	100	500					
4	100	500					
2	100	500					
1	50	500					
2	50	500					
6	50	500					
2	50	500					
1	50	500					
1	50	500					
1	50	500					
12	50	500					
1	50	500					
91	50	500					
20	50	500					
3	50	500					
7	50	500					
1	50	500					
3	50	500					
1	50	500					
8	50	500					
4	50	500					
2	50	500					
1	50	500					

Count	Percent Sampled	Seive Size	Season	Reach	Site	Transect	Parent
17	50	500					
1	50	500					
2	50	500					
1	50	500					
1	50	500					
157	50	500					
3	100	500					
1	100	500					
2	100	500					
4	100	500					
3	100	500					
14	100	500					
2	100	500					
3	100	500					
1	100	500					
3	100	500					
3	100	500					
1	100	500					
3	100	500					
1	100	500					
1	100	500					
7	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
2	100	500					
2	100	500					
2	100	500					
2	100	500					
1	100	500					
2	100	500					
1	100	500					
1	100	500					
2	100	500					
1	100	500					
1	100	500					
7	100	500					
7	100	500					
1	100	500					
4	100	500					
2	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
6	100	500					
1	100	500					

Count	Percent Sampled	Seive Size	Season	Reach	Site	Transect	Parent
1	100	500					
1	100	500					
3	100	500					
1	100	500					
1	100	500					
1	100	500					
6	100	500					
1	100	500					
1	100	500					
3	100	500					
8	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
4	100	500					
1	100	500					
1	100	500					
2	100	500					
3	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
3	100	500					
3	100	500					
5	100	500					
4	100	500					
4	100	500					
1	100	500					
1	100	500					
1	100	500					
8	100	500					
5	100	500					
1	100	500					
2	100	500					
1	100	500					
3	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
4	100	500					
4	100	500					
8	100	500					
10	100	500					

Count	Percent Sampled	Seive Size	Season	Reach	Site	Transect	Parent
2	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
4	100	500					
1	100	500					
3	100	500					
2	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
2	100	500					
3	100	500					
1	100	500					
3	100	500					
2	100	500					
5	100	500					
3	100	500					
1	100	500					
19	100	500					
1	100	500					
1	100	500					
1	100	500					
3	100	500					
1	100	500					
2	100	500					
1	100	500					
1	100	500					
1	100	500					
3	100	500					
2	100	500					
11	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
3	100	500					

Count	Percent Sampled	Seive Size	Season	Reach	Site	Transect	Parent
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
2	100	500					
1	100	500					
11	100	500					
1	100	500					
1	100	500					
13	100	500					
1	100	500					
4	100	500					
5	100	500					
1	100	500					
1	100	500					
2	100	500					
6	100	500					
4	100	500					
4	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
6	100	500					
4	100	500					
1	100	500					
1	100	500					
1	100	500					
1	100	500					
5	100	500					
9	100	500					
12	100	500					
1	100	500					
3	100	500					
8	100	500					
2	100	500					
4	100	500					
1	100	500					
1	100	500					
6	100	500					
2	100	500					
3	100	500					
1	100	500					
6	100	500					
1	100	500					
1	100	500					
1	100	500					

Count	Percent Sampled	Seive Size	Season	Reach	Site	Transect	Parent
2	100	500					
3	100	500					
6	100	500					
5	100	500					
2	100	500					
7	100	500					
3	100	500					
1	100	500					
1	100	500					
5	100	500					
1	100	500					

Cordillera Consulting

Project: Minto WUL Monitoring 2015
Minnow (Victoria), Lisa Bowron
Taxonomist: Sue Salter
suesalter@cordilleraconsulting.ca
250-494-7553

		Total from Sample	Percent Efficiency
Site - QC Sample - QC 1, CC# - CC160561, Percent sampled = 100, Sieve size = 500			
Chironomidae	1		
Trombidiformes	1		
Total:	**2**	**161**	**99%**
Site - QC Sample - QC 2, CC# - CC160572, Percent sampled = 100, Sieve size = 500			
No Invertebrates Found	0		
Total:	**0**	**67**	**100%**