Mount Polley Mine
Supplemental Aquatic Monitoring - 2011

Report Prepared for:

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1.0 INTRODUCTION

1.1 Site Description

The Mount Polley Mining Corporation, a division of the Imperial Metals Corporation, owns and operates the Mount Polley copper-gold mine located eight kilometres south-west of Likely, British Columbia and 56 kilometres north-east of Williams Lake, British Columbia (Figure 1.1). The Mount Polley Mine operated from August 1997 to September 2001 at which point it was placed on care and maintenance due to low metal prices. The Mount Polley Mine officially re-opened in March 2005 as a result of improved metal prices and the discovery of significant new ore reserves. The mine currently employs over 350 people and has a projected life span of more than four years (to the third quarter of 2016).

Mining at Mount Polley is currently focused on the Springer Pit (Figure 1.1). Several pits have been mined out, including the Cariboo Pit (2001), the Bell Pit (2008), the Wight Pit (2009), the Southeast Pit (2010) and the Pond Zone Pit (2010). Future open pit mining is planned for the Boundary Zone, the C2 Zone and the WX Zone (Figure 1.1). Additional targets of exploration include the Junction Zone, the North Slope Zone and beneath the Cariboo Pit. In addition to the open pits and exploration targets, the Mount Polley Mine site includes a crusher and mill (concentrator), a Tailings Storage Facility (TSF) that receives mill tailings, waste rock disposal sites, seepage collection ponds, haul roads, access roads, and a number of small buildings and storage areas (Figure 1.1). Offices are located in the main (mill) building. In 2010, the Mount Polley Mine processed an average of approximately 20,000 tonnes or ore per day and produced 34.8 million pounds of copper, 46,771 ounces of gold and 206,812 ounces of silver. Concentrates are trucked from the Mount Polley Mill (load-out building) to facilities at the Port of Vancouver, from where they are shipped overseas for smelting.

1.2 Study Background

During the first stage of operation (1997-2001), water (tailings supernatant) from the TSF was recycled for re-use in the milling process. Some additional water was drawn from Polley Lake to provide volume sufficient for use in milling and for optimal functioning of the TSF. Following the placement of the Mount Polley Mine on care and maintenance (September 2001), water was allowed to accumulate in the TSF, TSF water was managed by pumping it to the mined-out Cariboo Pit, and water from the Main Embankment Seepage Collection Pond (which collects seepage, limited runoff and

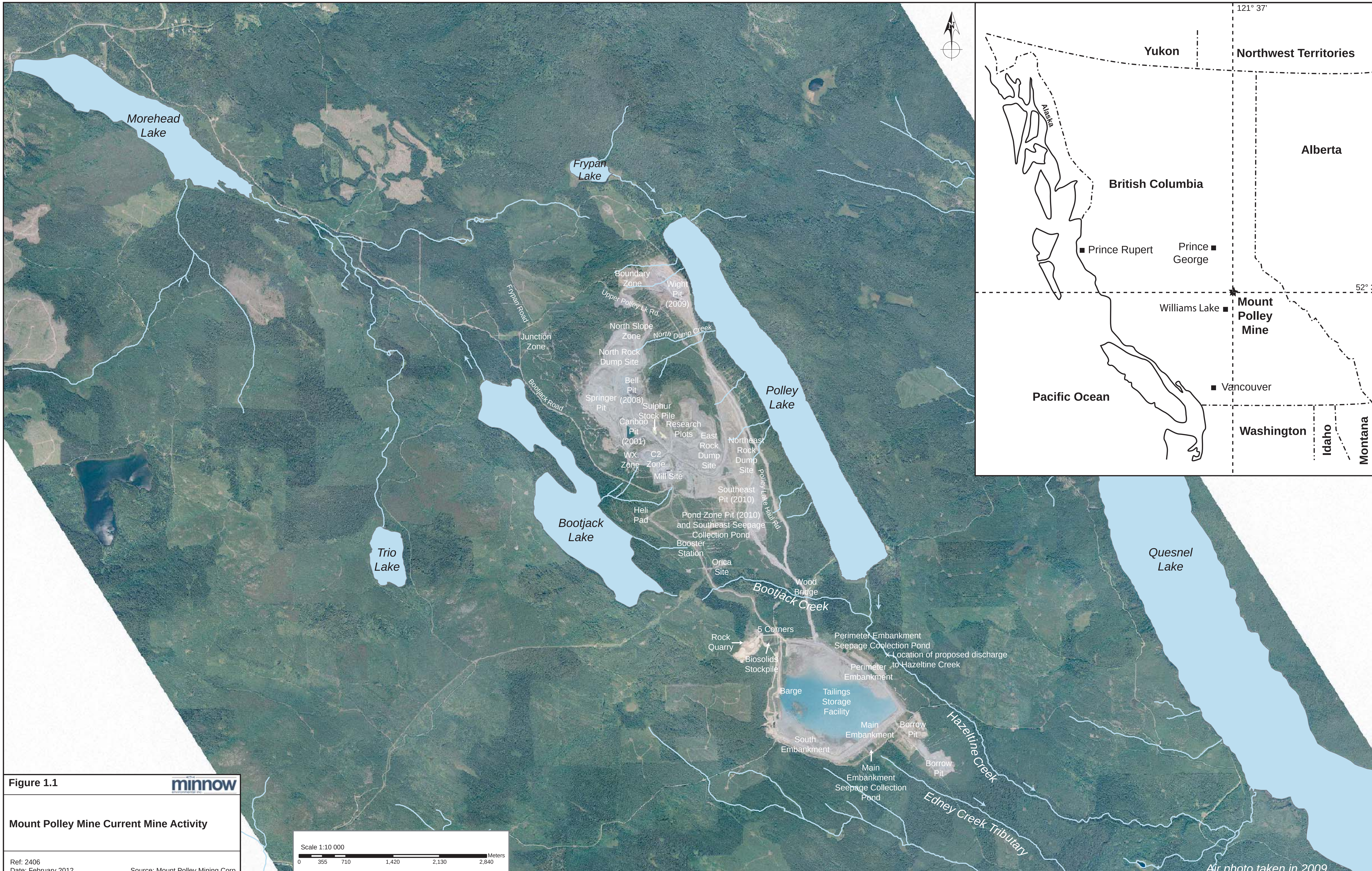


Figure 1.1

minnow environmental inc.

Mount Polley Mine Current Mine Activity

Ref: 2406
Date: February 2012

Source: Mount Polley Mining Corp.

precipitation) was permitted to discharge into the north-east tributary of Edney Creek (Permit # PE-11678 under the British Columbia *Environmental Management Act*; Appendix A). At the time of re-opening in 2005, the Mount Polley Mine had a substantial accumulation of water in the TSF. Despite the careful management of water at the Mount Polley Mine through the application of best management practices (e.g., water recycling, storage in mined-out pits, use in dust suppression), the current and future Mount Polley water balance indicates surplus water (KPL 2009). Accordingly, the Mount Polley Mine has a need to eliminate excess water to maintain optimal geotechnical performance of the TSF.

In accordance with the identified need to eliminate water from the mine site, the Mount Polley Mine has undertaken a Technical Assessment to support an application for an amendment of Permit PE-11678 under the British Columbia *Environmental Management Act* to allow the discharge of excess water to Hazeltine Creek (MPMC 2009). The Technical Assessment Report was independently reviewed in 2011 and the review report (Olding 2011) included a number of recommendations. Following reviews of the Technical Assessment Report and the Mount Polley Annual Environment Report, the British Columbia Ministry of Environment made some additional recommendations. In response to the recommendations, and to support Mount Polley in the final determination of the most suitable location for discharge, Minnow Environmental Inc. (Minnow) conducted additional physical, chemical and biological data collections in August and October, 2011 (Table 1.1).

1.3 Objectives

The objective of the Supplemental Aquatic Monitoring (2011) was to augment available information relevant to the application for Mount Polley effluent discharge to Hazeltine Creek (Table 1.1) and to use it as the basis for recommendations for future monitoring.

1.4 Report Organization

This report is organized as follows. The methods utilized in reconnaissance and in physical, chemical and biological characterization are presented in Section 2.0. Section 3.0 presents the results of the physical characterization of the proposed discharge location. Section 4.0 presents the results of the reconnaissance of Hazeltine Creek for erosion potential, sediment deposition and aquatic macrophytes. Section 5.0 presents the results of creek productivity characterization, and Section 6.0 provides supplemental selenium monitoring data. A summary of the study findings and recommendations for

Table 1.1: Supplemental Aquatic Environmental Monitoring at the Mount Polley Mine - 2011.

Component	Purpose
Physical characterization of proposed discharge location	To identify any concerns over the proposed discharge location and, if necessary, identify alternate locations
Hazeltine Creek reconnaissance of erosion potential	To identify a location (or locations) of greatest potential for physical change (erosion) with increased flow to be adopted as a long-term monitoring station
Hazeltine Creek reconnaissance of sediment deposition	To identify locations of sediment deposition (if any) that could be included in future monitoring
Hazeltine Creek reconnaissance of aquatic macrophytes	To identify the most common aquatic macrophytes in Hazeltine Creek and thereby support the selection of sentinel species for future monitoring, and to establish a station (or stations) for long-term monitoring
Hazeltine Creek productivity characterization	To further characterize nutrient and trophic status of Hazeltine Creek (nutrient concentrations, chlorophyll a concentrations and periphyton)
Selenium monitoring - sediment and periphyton	To continue to collect samples for the characterization of selenium concentrations in aquatic food chains waterbodies in the vicinity of the Mount Polley Mine prior to mine discharge into Hazeltine Creek

future studies are provided in Section 7.0. Finally, references cited throughout this report are listed in Section 8.0.

2.0 METHODS

From August 22nd to 25th, 2011, Minnow Environmental Inc. implemented a field program focused on the physical, chemical and biological characterization of Hazeltine Creek and Edney Creek near the Mount Polley mine. This involved a complete reconnaissance of Hazeltine Creek, from a proposed discharge location near the mine to the creek's outlet at Quesnel Lake. Field observations were focused on locating and identifying areas of sediment deposition, areas most susceptible to erosion, the presence of aquatic macrophytes, and suitable macrophyte and periphyton sampling locations. Samples of macrophytes found growing in stream were taken throughout the length of creek examined. Samples of periphyton were collected at water quality monitoring Stations W7 and W11 (Figure 2.1), with concurrent water samples. Finally, sediment was sampled by hand coring at water quality monitoring Station W8 on Edney Creek. A second field program was completed November 22-23, 2011 to further characterize the potential discharge area at Hazeltine Creek, and to collect data which would support the eventual selection of a specific discharge location.

2.1 Discharge Location Characterization

Physical characterization of the proposed discharge location was carried out in August and November 2011. Prior to the August 2011 program, Mount Polley staff had designated a potential discharge location on Hazeltine Creek by marking it with flagging tape. This location was characterized in August 2011 by measurements of the maximum slope a discharge pipe would need to be installed on, stream morphological measurements, field observations, global positioning system (GPS) waypoints and photographs. The results of this characterization raised some concerns regarding the presence of a braid in the creek, which could result in suboptimal mixing. Another visit by Minnow staff provided further assessment of the area in November 2011.

The November 2011 field program involved a closer inspection of the area of creek which was sufficiently close to the future polishing pond to receive discharge. Supporting data collected included field notes, photographs, stream morphology measurements, substrate characterization and total station measurements using a Nikon Nivo 3.M. Stream morphology was measured in cross sections with a chain, compass and measuring tape. Substrate characterization was performed in-stream using the CABIN 100 pebble count protocol, which involves measuring 100 randomly selected rocks sampled from the stream by "intermediate diameter," which is the measurement perpendicular to the longest axis of the rock (Environment Canada 2010). Bank

Figure 2.1

minnow

Mount Polley Mine Site and Surrounding Area

Ref: 2406
Date: March 2012

Source: Mount Polley Mining Corp.

substrate material was characterized based on one 10 kg sample collected at a depth of 30-60 cm into three plastic bags and shipped to Knight Piesold Consulting for particle size analysis. Finally, horizontal and vertical measurements were taken using the total station to measure the location of key features in the area.

2.2 Hazeltine & Edney Creek Reconnaissance

2.2.1 Water Quality

Water quality samples were collected by Mount Polley staff as part of their regular monitoring program, one sample at W7 and one at W11 on August 25, 2011. Water samples were collected by hand in nalgene bottles and stored at 4°C for less than 24 hours until shipped to the ALS Environmental laboratory in Burnaby. Laboratory analysis included physical properties and concentrations of nutrients, anions, organic carbon, total metals and dissolved metals.

Data quality assessment was conducted on the water quality results, and indicated good data quality (Appendix B). The data were summarized and evaluated in comparison to the lowest British Columbia Water Quality Gudelines (BCWQGs; BCMOE 2006a; BCMOE 2006b) and Canadian Council of Ministers of the Environment water quality guidelines (CWQGs; CCME 1999). Particular consideration was given to analytes which had been previously designated “priority analytes” in the Mount Polley Mining Corporation Technical Assessment (MPMC 2009).

2.2.2 Identification of Depositional Sections and Sediment Sampling

For areas in Hazeltine Creek in which aquatic sediment deposition was observed, GPS coordinates were recorded and the approximate surface area and average depth of the deposit were measured or visually estimated. Field notes were used to record all observations. Five sediment samples were collected from Edney Creek at Station W8. This was done using a 5 cm diameter hand corer provided by the BCMOE in Williams Lake to collect a 20-30 cm core of the sediment from the creek bed. The top 2 cm of the core was extruded from the core tube into a tray and collected into a 250 mL amber glass sample jar by pouring and spooning with a stainless steel spoon. Care was taken not to lose any of the fine flocculated material at the surface of each core. Each sample represented a composite of three separate cores to yield sufficient sample volume. The jars containing samples were shipped within 24 hours in a cooler to ALS Laboratories in Burnaby, BC. Laboratory analysis of sediment samples included organic carbon content and metal concentrations.

A data quality assessment was performed on the sediment quality results, and indicated good data quality (Appendix B). The data were summarized and compared to Canadian and British Columbia sediment quality guidelines for the protection of aquatic life (SQGs; BCMOE 2006b) as well as sediment quality data from previous studies at Station W8 (HKP 1996; Beak 2000; Morrow 2003; Minnow 2009). The mean and standard deviation of the five sample results were used for comparison with SQGs. In calculating mean and standard deviation, any values reported as less than the method detection limit (MDL) were converted to half the MDL. Particular consideration was given to analytes which had been previously designated “priority analytes” in the Mount Polley Mining Corporation Technical Assessment (2009). Analytes which were greater than SQGs were then plotted against sediment concentrations obtained from Station W8 in previous studies, including total organic carbon to account for potential differences in sample composition.

2.2.3 Aquatic Macrophyte Identification and Tissue Quality Analysis

Samples of water crowfoot (*Ranunculus aquatilis*), water parsley (*Sparganium emersum*), a pondweed (*Potamogeton* sp.), and green algae samples were collected from Hazeltine Creek. Tapegrass (*Vallisneria americana*), another type of pondweed (*Potamogeton* sp.), and creeping spearwort (*Ranunculus flammula*) were collected at the Hazeltine Creek outlet (delta) to Quesnel Lake. Samples of aquatic macrophytes were identified using field guides and with the assistance of BCMOE, and were then collected into resealable plastic bags. Approximately 100 grams of plant tissue was collected for five replicates of each species. Samples were as free of root material as possible to best emulate what a browsing animal would likely ingest. Care was taken not to disturb the surrounding sediment to avoid contamination of the plant surface. The bags containing the samples were stored at approximately 4°C in a refrigerator and shipped to ALS Laboratories in Burnaby, BC. All macrophyte tissue collected was analyzed for moisture content and metal concentrations. At areas with aquatic macrophyte growth in Hazeltine Creek, GPS coordinates and descriptions were recorded.

Data quality assessment was performed on the macrophyte tissue quality results, and indicated good data quality (Appendix B). The data were summarized and tabulated for the purpose of comparison to future study results. The mean and standard deviation of the five replicates for each species were used for summary purposes. I n calculating the mean and standard deviation, any values reported as less than the MDL were converted to half the MDL. Analytes which had been previously designated “priority analytes” in the

Mount Polley Mining Corporation Technical Assessment (2009) were highlighted for particular consideration.

2.2.4 Periphyton Taxonomy

Periphyton samples were collected at Stations W7 and W11 for analysis of community taxonomy, one sample per site. A set of ten grabs per station was collected into a wide-mouth plastic jar to create a composite sample. Each grab was collected from a 33 cm^2 area of rock from the stream using a rubber template to delineate the area. Periphyton was scraped from rocks with a stainless steel brush. Collecting the loosened material involved the use of a syringe to collect the material and inject it into the sample bottle, followed by rinsing the loosened material off the rock surface and rubber template into the sample bottle with water collected from the stream. Samples for periphyton taxonomy were preserved using Lugol's solution and subsequently shipped to Fraser Environmental Services in Surrey, BC. Samples were analyzed for taxonomic identification and organism counts to the species/variant level. To support these samples, *in situ* water quality measurements were taken using a YSI water quality meter, and measurements of flow were made using a YSI/SonTec Flow Tracker ADV (Acoustic Doppler Velocimeter).

Data were summarized by percent composition at the phylum level, and by the metrics of density, taxon richness, Simpson's evenness, and Simpson's diversity. Any life stages which could not be conclusively identified as separate taxa were omitted from calculations of all metrics but total density. Taxon richness was calculated with and without values reported with a less than (<) qualifier, providing presence/absence and quantitative richness, respectively. Simpson's Evenness ("E") index was computed according to formulae presented by Smith and Wilson (1996). This index takes 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).

2.2.5 Assessment of the Potential for Bank Erosion

The entire length of Hazeltine Creek from the proposed discharge area to Quesnel Lake was examined in search of an ideal location for monitoring bank erosion. The most important criterion for such a monitoring location was the presence of visible existing bank erosion which would be most likely to increase as a result of higher flows in Hazeltine Creek. Secondary to this was the preference for a readily accessible monitoring location. Upon identification of a section of creek which appeared to fit these criteria, GPS coordinates and stream morphology measurements were recorded. The section was marked with flagging tape and photographic documentation was made. The stream cross section between the flagged points was then measured using a measuring tape. This process was intended to establish the site for the future monitoring of stream dimensions. Using the GPS coordinates and flagging tape as a guide, the same section can be measured at an appropriate frequency to determine the physical stability of the stream.

2.3 Hazeltine Creek Productivity Assessment

2.3.1 Nutrients in Water

Water quality samples collected at W7 and W11 (described above, Section 2.2.1) were analyzed for ammonia, nitrate, nitrite, total nitrogen, orthophosphate, phosphorus (dissolved and total), and organic carbon. Concentrations of these analytes were compared to applicable water quality guidelines and routine water quality monitoring data (KPL 2011).

2.3.2 Periphyton Chlorophyll a

Periphyton samples were collected at W7 and W11 for analysis of chlorophyll a, one sample per site. A set of ten grabs per station was collected into a wide-mouth plastic jar to create a composite sample. Each replicate was collected from a 33 cm^2 area of rock as described in section 2.2.3 above. Chlorophyll a samples were filtered onto 0.45 µm filter paper using an evacuation chamber. The filter paper was then wrapped in foil and shipped in a cooler immediately to ALS Laboratories in Burnaby, BC.

Data quality assessment was performed on the chlorophyll a results, and indicated good data quality (Appendix B). The data were then summarized and tabulated. Chlorophyll a samples were converted to chlorophyll a content per unit area for comparison with BCWQG and baseline study results (HKP 1996; HKP 1997).

2.4 Supplemental Selenium Monitoring

2.4.1 Water and Sediment Selenium

The water and sediment samples described above in Sections 2.2.1 and 2.2.2, respectively, were analyzed for selenium concentration. The results were summarized and tabulated along with the other water and sediment analytes for the purpose of future comparison. Selenium concentrations in water were compared to long-term routine monitoring data using temporal plots. Selenium concentrations in sediment were evaluated relative to concentrations reported in previous studies to identify potential temporal change (HKP 1996; Beak 2000; Morrow 2003; Minnow 2009).

2.4.2 Aquatic Macrophyte Tissue Selenium

Selenium concentrations were measured in the samples of aquatic macrophyte tissue described in Section 2.2.4. The results were summarized and tabulated along with the other analytes for the purpose of future comparison. Selenium concentrations in macrophyte samples which were collected along the length of the creek (as opposed to at the outlet to Quesnel Lake) were examined further to identify potential spatial trends. This was done by creating a regression plot of the samples for each species in the order they were collected, upstream to downstream. Significant trends were considered those with $R^2 > 0.95$.

2.4.3 Periphyton Selenium

Periphyton samples were collected at Stations W7 and W11 for analysis of selenium, one sample per site. Periphyton was collected from rocks as described above in section 2.2.3, but without concern for measuring the surface area sampled. A total of approximately 10 g of wet material was collected for each composite. Jars containing composite samples were shipped within 24 hours to ALS Laboratories in Burnaby, BC.

Data quality assessment was performed on the periphyton selenium results, and indicated good data quality (Appendix B). The data were then summarized and tabulated. The mean and standard deviation of the five selenium samples for each area were used for summary purposes. In calculating mean and standard deviation, any values reported as less than the MDL were converted to half the MDL to minimize bias toward a higher concentration of analyte in the tissue. Mean selenium in periphyton was compared to a previous study (Minnow 2011a) to identify potential trends.

3.0 DISCHARGE LOCATION CHARACTERIZATION

3.1 August 2011 Field Program

A potential discharge conveyance pathway to Hazeltine Creek and the corresponding location of discharge to Hazeltine Creek, as marked by Mount Polley staff (Figure 2.1), was characterized in August 2011. Characterization of this section of Hazeltine Creek was summarized in a memorandum to the Mount Polley Mine in September 2011 (Minnow 2011b; Appendix C). A key finding of this characterization was that Hazeltine Creek split into two channels (i.e. braided) around an island, beginning approximately 20 m upstream of the flagged potential discharge location (Figure 2.1). The two channels converged once again approximately 50 m downstream of the start of the braid. Upstream of the braid, the creek flowed in a well-defined single channel.

3.2 November 2011 Field Program

In response to the documentation of braiding in August 2011, the area upstream of the initially proposed discharge location was characterized in November 2011. This characterization identified a more suitable discharge location approximately 90 m upstream of the previously mentioned braided section of Hazeltine Creek (Figure 2.1). Characterization of this section of Hazeltine Creek was also summarized in a memorandum to the Mount Polley Mine, submitted in December 2011 (Minnow 2011c; Appendix C). The key finding of this characterization was that the 90 m stretch of creek upstream of the start of braiding flowed as a well defined, single channel which would be more suitable for effective effluent mixing.

4.0 HAZELTINE & EDNEY CREEK RECONNAISSANCE

4.1 Field Observations

Characterization of Hazeltine Creek included field observations made during a walk of the creek (August 22nd and 24th, 2011; Appendices D and E). Braiding observed downstream of the initially identified potential discharge location continued until approximately 200 m upstream of Station W7, where there was an area of deep water observed to have significant sediment deposition (Figure 2.1). The next significant change observed in the creek was that fish sightings decreased with further distance downstream of Station W7. Approximately 800 m downstream of Station W7, the stream velocity increased substantially. The resulting erosional habitat in this section of the creek was observed to represent good habitat for potential future monitoring of the erosional benthic invertebrate community. Further downstream, the creek flowed into a gorge, confined by bedrock on both sides. Barriers to fish passage likely explained the lack of fish observed in this area. Downstream of this section, near the Mitchell Bay Road bridge, many fish were observed once again. The creek slowed and widened as it approached Quesnel Lake at Station W11. On each side of the mouth of the creek, a panoramic series of photographs were taken from points which were marked by GPS and with flagging tape to allow for future photographic monitoring of this area over time (Appendices D and E).

4.2 Water Quality

No analytes were elevated above BC and CCME water quality guidelines at stations W7 and W11 (Table 4.1; Appendix F). However, concentrations of phosphorus were greater than the BCWQG for lakes (BCMOE 2006a) and fall in the meso-eutrophic range at Station W7 and the mesotrophic range at Station W11 (CCME 1999).

Concentrations of several analytes (turbidity, ammonia, phosphorus, sulphate, total and dissolved aluminum, dissolved molybdenum and dissolved selenium) were found to be present at higher concentrations (more than 25% higher) at Station W7 than at Station W11 in August 2011. Verification against routine monitoring data confirmed that these analytes were consistently present at greater concentration at W7 than at W11, perhaps indicative of a modest mine-related influence at W7 that is subsequently reduced at W11 due to dilution.

Table 4.1: Water quality at Hazeltine Creek stations W7 and W11, August 2011.

	Analyte	Units	BCWQG[1]		CCME WQG[2]	Station W7	Station W11
			30-d Chronic	Maximum			
Physical	Conductivity	µS/cm	-	700*	-	207	232
	Hardness (as $CaCO_3$)	**mg/L**	**-**	**-**	**-**	**105**	**121**
	pH	pH units	-	6.5 - 9.0	6.5 - 8.5	8.04	7.94
	Total Suspended Solids	**mg/L**	**-**	**-**	**-**	**3.0**	**3.3**
	Total Dissolved Solids	mg/L	-	-	-	141	154
	Turbidity	NTU	-	-	-	1.33	0.45
Nutrients, Anions and Organic Carbon	Alkalinity, Total (as $CaCO_3$)	mg/L	-	-	-	82.6	105
	Ammonia (as N)	mg/L	0.13[a]	0.97[a]	0.13/0.97[a]	0.0116	0.0068
	Chloride (Cl)	**mg/L**	**100**	**150**	**120**	**<0.50**	**<0.50**
	Nitrate and Nitrite (as N)	mg/L	-	10	100	0.0269	0.0469
	Nitrate (as N)	**mg/L**	**3**	**10**	**13**	**0.0269**	**0.0469**
	Nitrite (as N)	**mg/L**	**0.02**	**0.06**	**0.06**	**<0.0010**	**<0.0010**
	Total Nitrogen		-	-	-	0.280	0.280
	Orthophosphate-Dissolved (as P)	mg/L	-	-	-	0.0051	0.0064
	Phosphorus - Total dissolved	mg/L	-	-	-	0.0102	0.0108
	Phosphorus (P)-Total	**mg/L**	**-**		**0.004**	**0.0237**	**0.0129**
	Sulfate (SO_4)	**mg/L**	**-**	**100**	**1,000**	**27.2**	**19.7**
	Dissolved Organic Carbon	**mg/L**	**-**	**-**	**-**	**5.82**	**6.43**
	Total Organic Carbon	mg/L	-	-	-	-	-
Total metals	Aluminum (Al)-Total	mg/L	5	5	0.05[b]	0.0430	0.0224
	Antimony (Sb)-Total	mg/L	-	0.014*	-	<0.00010	<0.00010
	Arsenic (As)-Total	mg/L	-	0.005	0.005	0.00051	0.00073
	Barium (Ba)-Total	mg/L	1	5	1	0.00689	0.0166
	Beryllium (Be)-Total	mg/L	-	0.004*	0.1	<0.00010	<0.00010
	Bismuth (Bi)-Total	mg/L	-	-	-	<0.00050	<0.00050
	Boron (B)-Total	mg/L	-	0.5	0.5	0.023	0.023
	Cadmium (Cd)-Total	**mg/L**	**-**	**0.00002*[c]**	**0.00002[c]**	**<0.000010**	**<0.000010**
	Calcium (Ca)-Total	mg/L	-	-	-	32.5	37.0
	Chromium (Cr)-Total	mg/L	-	0.001	0.001	<0.00050	<0.00050
	Cobalt (Co)-Total	mg/L	0.004	0.11	0.05	<0.00010	<0.00010
	Copper (Cu)-Total	**mg/L**	**0.002[c]**	**0.0070[c]**	**0.002[c]**	**0.00162**	**0.00165**
	Iron (Fe)-Total	**mg/L**	**-**	**1**	**-**	**0.070**	**0.056**
	Lead (Pb)-Total	mg/L	0.0046[c]	0.032[c]	0.001[c]	<0.000050	<0.000050
	Lithium (Li)-Total	mg/L	0.014*	-	2.5	<0.00050	0.00074
	Magnesium (Mg)-Total	mg/L	-	-	-	5.22	7.68
	Manganese (Mn)-Total	mg/L	0.843	0.200*	0.2	0.0233	0.0265
	Molybdenum (Mo)-Total	**mg/L**	**0.01**	**0.05**	**0.01**	**0.00218**	**0.00177**
	Nickel (Ni)-Total	mg/L	-	0.025*[c]	0.025[c]	<0.00050	0.00051
	Potassium (K)-Total	mg/L	-	373	-	0.386	0.665
	Selenium (Se)-Total	**mg/L**	**-**	**0.002**	**0.001**	**0.00062**	**<0.00050**
	Silicon (Si)-Total	mg/L	-	-	-	3.45	4.29
	Silver (Ag)-Total	mg/L	0.00005[c]	0.00010[c]	-	<0.000010	<0.000010
	Sodium (Na)-Total	mg/L	-	-	-	4.74	6.11
	Strontium (Sr)-Total	mg/L	-	-	-	0.247	0.268
	Thallium (Tl)-Total	mg/L	0.0008*	0.0003*	0.8	<0.000010	<0.000010
	Tin (Sn)-Total	mg/L	-	-	-	<0.00010	<0.00010
	Titanium (Ti)-Total	mg/L	-	2	-	<0.010	<0.010
	Uranium (U)-Total	mg/L	-	-	0.015	0.000118	0.000153
	Vanadium (V)-Total	mg/L	-	0.006*	0.1	0.0011	<0.0010
	Zinc (Zn)-Total	mg/L	0.0075[c]	0.033[c]	0.03	<0.0030	<0.0030
Dissolved metals	**Aluminum (Al)-Dissolved**	**mg/L**	**0.050**	**0.100**	**-**	**0.0098**	**0.0074**
	Antimony (Sb)-Dissolved	mg/L	-	-	-	<0.00010	<0.00010
	Arsenic (As)-Dissolved	mg/L	-	-	-	0.00049	0.00070
	Barium (Ba)-Dissolved	mg/L	-	-	-	0.00676	0.0160
	Beryllium (Be)-Dissolved	mg/L	-	-	-	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved	mg/L	-	-	-	<0.00050	<0.00050
	Boron (B)-Dissolved	mg/L	-	-	-	0.023	0.022
	Cadmium (Cd)-Dissolved	mg/L	-	-	-	<0.000010	<0.000010
	Calcium (Ca)-Dissolved	mg/L	-	-	-	33.2	36.2
	Chromium (Cr)-Dissolved	mg/L	-	-	-	<0.00050	<0.00050
	Cobalt (Co)-Dissolved	mg/L	-	-	-	<0.00010	<0.00010
	Copper (Cu)-Dissolved	mg/L	-	-	-	0.00136	0.00139
	Iron (Fe)-Dissolved	**mg/L**	**-**	**0.35**	**0.30**	**<0.030**	**<0.030**
	Lead (Pb)-Dissolved	mg/L	-	-	-	<0.000050	<0.000050
	Lithium (Li)-Dissolved	mg/L	-	-	-	<0.00050	0.00066
	Magnesium (Mg)-Dissolved	mg/L	-	-	-	5.25	7.35
	Manganese (Mn)-Dissolved	mg/L	-	-	-	0.000337	0.0163
	Molybdenum (Mo)-Dissolved	mg/L	-	-	-	0.00218	0.00170
	Nickel (Ni)-Dissolved	mg/L	-	-	-	<0.00050	<0.00050
	Potassium (K)-Dissolved	mg/L	-	-	-	0.385	0.628
	Selenium (Se)-Dissolved	mg/L	-	-	-	0.00067	<0.00050
	Silicon (Si)-Dissolved	mg/L	-	-	-	3.40	4.10
	Silver (Ag)-Dissolved	mg/L	-	-	-	<0.000010	<0.000010
	Sodium (Na)-Dissolved	mg/L	-	-	-	4.91	5.81
	Strontium (Sr)-Dissolved	mg/L	-	-	-	0.249	0.254
	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	-	-	-	0.000118	0.000152
	Vanadium (V)-Dissolved	mg/L	-	-	-	0.0011	<0.0010
	Zinc (Zn)-Dissolved	mg/L	-	-	-	<0.0030	<0.0030

[1] British Columbia Approved Water Quality Guidelines (BCMOE 2006a)

[2] Canadian Council of Ministers of the Environment Water Quality Guidelines (CCME 2005)

[3] Upper limit of baseline, defined as mean + $t_{\alpha 0.05(2)}$ standard deviations (Minnow 2009)

[*] British Columbia Working Water Quality Guidelines (BCMOE 2006b)

[a] Lowest guideline based on highest temperature and pH

[b] Lowest guideline based lowest pH

[c] Lowest guideline based on lowest hardness

(shaded) Concentration greater than guideline

bold Priority analyte according to Mount Polley Mine Technical Assessment (2009)

4.3 Identification of Depositional Sections and Sediment Quality

Depositional areas observed along Hazeltine Creek were mostly insignificant accumulations in backwaters and small shallow pools, likely accumulating and washing away seasonally. The depositional area located 200 m upstream from W7 was one exception (Figure 2.1). Water at this location was deep and slow moving, and the location appeared to be an old beaver pond with an old beaver dam visible at the pond outlet. No recent beaver activity was observed. This location was noted to have potential for future sediment quality monitoring.

Of the priority analytes in sediment at Station W8 in Edney Creek, copper, iron and selenium were reported to be above British Columbia sediment quality guideline lowest effect levels (BCSQG-LELs; Table 4.2; Appendix F). A number of other analytes (arsenic, chromium, manganese and nickel) also exceeded BCSQG-LELs. Manganese was the only analyte with a mean concentration greater than the BCSQG-severe effect level (Table 4.2). No other analytes exceeded BC or CCME sediment quality guidelines.

Previous studies (HKP 1996; Beak 2000; Morrow 2003; Minnow 2009) including baseline also documented concentrations of arsenic, chromium, copper, iron, manganese and nickel greater than guidelines at Station W8 (Figure 4.1). This indicates naturally high concentrations of these metals. Nonetheless, concentrations of arsenic, manganese and selenium appear to have increased from baseline conditions and show a very similar temporal pattern. Selenium, in particular, increased from below the SQG to greater than the SQG (Figure 4.1). Sediment total organic carbon (TOC) content was also taken into consideration in the interpretation of temporal change in metal concentrations, as metal concentrations would be expected to be high in fine sediments with higher TOC content. In sediments collected from 2002 to 2011, TOC also increased substantially; however, greater proportional increases in manganese and selenium suggest that sediment physical properties may not be the only cause of the observed increases in concentrations of these metals.

4.4 Aquatic Macrophyte Identification and Tissue Analysis

Few macrophytes were observed growing in Hazeltine Creek. Species found to be sufficiently abundant for sampling purposes along the length of the creek were a pondweed (*Potamogeton* sp. 1), water crowfoot (*Ranunculus aquatilis*), water parsley (*Sparganium emersum*), and green algae (see photographs in Appendix E). At the mouth of Hazeltine Creek at Quesnel Lake, tapegrass (*Vallisneria americana*), another

Table 4.2: Summary of sediment quality at Edney Creek Station W8, August 2011.

	Analyte	Units	BC Sediment Quality Guidelines[1]	Station W8				
				Method Detection	Sample Size	Number of Non-Detects	Mean[a]	Standard Deviation
Total Organic Carbon		%	-	0.1	5	0	10	0.66
Metals	**Aluminum (Al)**	**mg/kg**	-	**50**	**5**	**0**	**18,480**	**657**
	Antimony (Sb)	mg/kg	-	0.1	5	0	0.38	0.015
	Arsenic (As)	mg/kg	5.9/17[2]	0.05	5	0	16	0.86
	Barium (Ba)	mg/kg	-	0.5	5	0	184	7.5
	Beryllium (Be)	mg/kg	-	0.2	5	0	0.47	0.025
	Bismuth (Bi)	mg/kg	-	0.2	5	5	0.10	0
	Cadmium (Cd)	**mg/kg**	0.6/3.52[2]	**0.8**	**5**	**5**	**0.40**	**0**
	Calcium (Ca)	mg/kg	-	50	5	0	11,364	1,083
	Chromium (Cr)	mg/kg	37.3/90[2]	0.5	5	0	53	2.1
	Cobalt (Co)	mg/kg	-	0.1	5	0	15	0.44
	Copper (Cu)	**mg/kg**	35.7/197[2]	**0.5**	**5**	**0**	**57**	**3.1**
	Iron (Fe)	**mg/kg**	21,200/43,766[3]	**50**	**5**	**0**	**36,400**	**985**
	Lead (Pb)	mg/kg	35/91.3[2]	9 - 8	5	5	4.0	0
	Lithium (Li)	mg/kg	-	1	5	0	22	1.7
	Magnesium (Mg)	mg/kg	-	20	5	0	7,710	379
	Manganese (Mn)	mg/kg	460/1,100[3]	1	5	0	3,128	359
	Mercury (Hg)	mg/kg	0.17/0.486[2]	0.005	5	0	0.10	0.0061
	Molybdenum (Mo)	**mg/kg**	-	**0.5**	**5**	**0**	**1.2**	**0.066**
	Nickel (Ni)	mg/kg	16/75[3]	0.5	5	0	39	1.3
	Phosphorus (P)	**mg/kg**	-	**50**	**5**	**0**	**1,250**	**48**
	Potassium (K)	mg/kg	-	100	5	0	1468	95
	Selenium (Se)	**mg/kg**	2	**0.2**	**5**	**0**	**3.2**	**0.21**
	Silver (Ag)	mg/kg	0.5	0.1	5	0	0.23	0.0055
	Sodium (Na)	mg/kg	-	100	5	0	210	22
	Strontium (Sr)	mg/kg	-	0.5	5	0	108	6.4
	Thallium (Tl)	mg/kg	-	0.05	5	0	0.13	0.0047
	Tin (Sn)	mg/kg	-	2	5	5	1.0	0
	Titanium (Ti)	mg/kg	-	1	5	0	517	64
	Uranium (U)	mg/kg	-	0.05	5	0	1.5	0.068
	Vanadium (V)	mg/kg	-	0.2	5	0	57	2.2
	Zinc (Zn)	mg/kg	123/315[2]	1	5	0	95	2.7

[1] Working guidelines (BCMOE 2006)

[2] Interim sediment quality guideline (ISQG) / probable effect level (PEL)

[3] Lowest effect level (LEL) / severe effect level (SEL)

▭ Concentration greater than guideline (shaded: Arsenic, Chromium, Copper, Iron, Manganese, Nickel and Selenium means)

bold Priority analyte as identified by Mount Polley Mine Technical Assessment (2009)

[a] Calculated using 0.5 x the method detection limit (MDL) where values less than MDL were reported

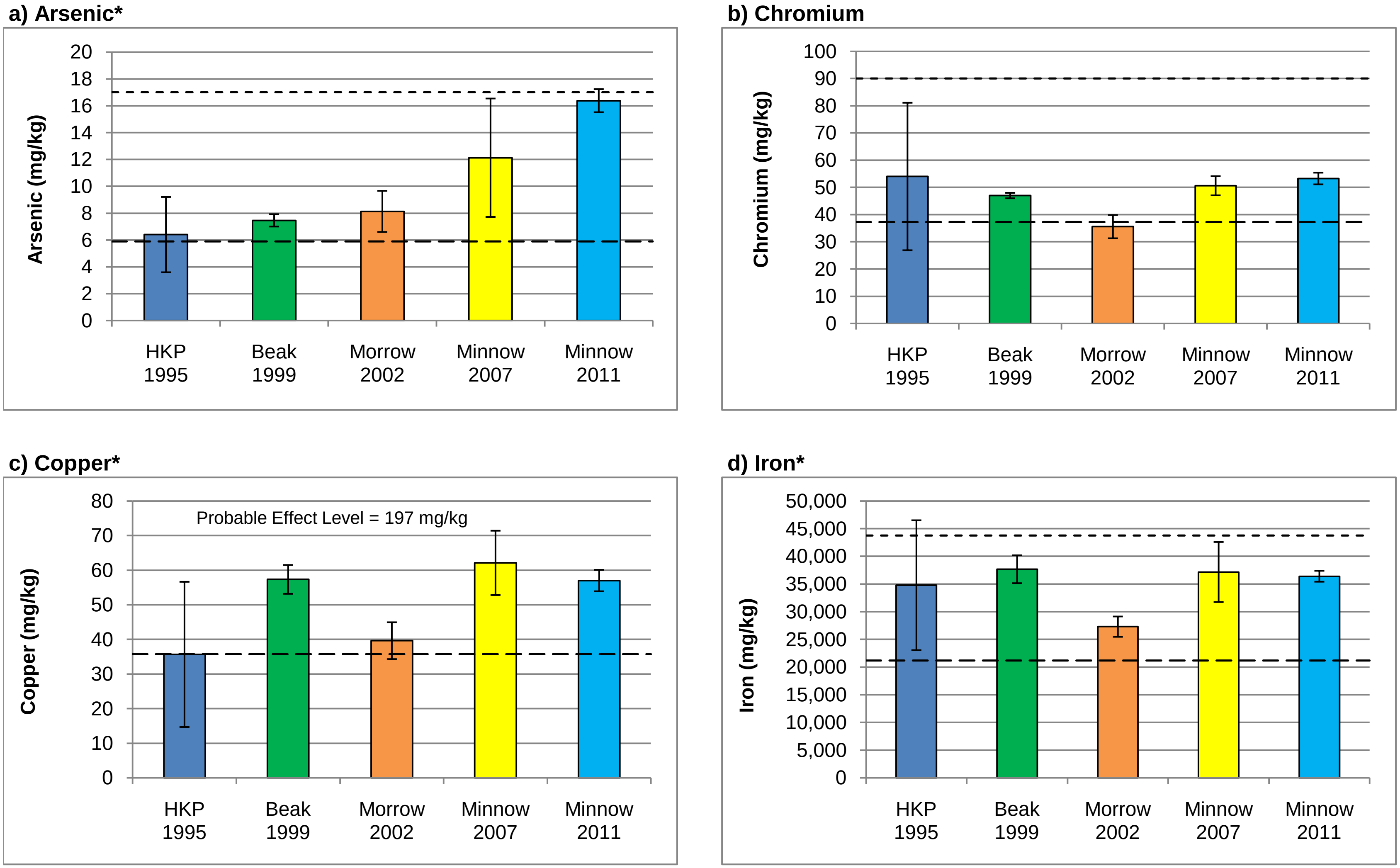


Figure 4.1: Historical concentrations of analytes above guidelines in Edney Creek sediment at station W8 in August 2011.

Error bars denote standard deviation of n samples (1995: n = 6, 1999 - 2007: n = 3, 2011: n = 5).

— — — Interim Sediment Quality Guideline or Lowest Effect Level

- - - - - Probable Effect Level or Severe Effect Level

——— Other BC Working Sediment Quality Guideline

* Priority analyte as identified in the Mount Polley Mine Technical Assessment

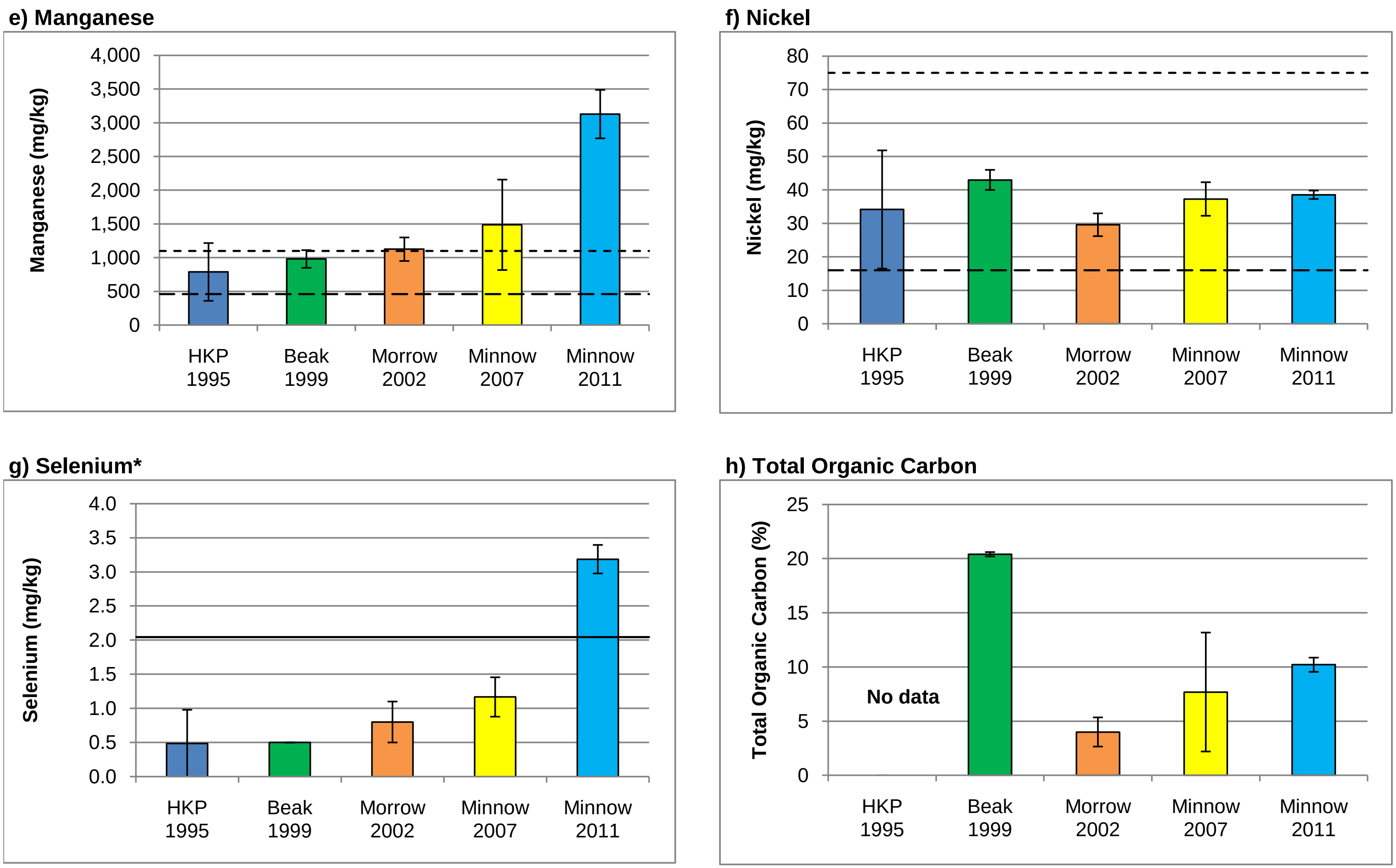


Figure 4.1: Historical concentrations of analytes above guidelines in Edney Creek sediment at station W8 in August 2011.

Error bars denote standard deviation of n samples (1995: n = 6, 1999 - 2007: n = 3, 2011: n = 5).

— — — Interim Sediment Quality Guideline, BC and CCME

- - - - - Probable Effect Level, BC and CCME

——— BC Working Sediment Quality Guideline

* Priority analyte as identified in the Mount Polley Mine Technical Assessment

pondweed (*Potamogeton* sp. 2) and creeping spearwort (*Ranunculus flammula*) were sufficiently abundant for sampling (photographs in Appendix E).

Macrophyte tissue quality analysis provided reference concentrations for metals, including all priority analytes identified in the Mount Polley Technical Assessment (2009), in the above-mentioned species in Hazeltine Creek (Table 4.3; Appendix G).

4.5 Periphyton Taxonomy

Periphyton communities documented at Hazeltine Creek stations W7 and W11 differed in both population density and composition, while the number of species present was similar. Density of cells by area was much greater at W7 than at W11, due largely to the substantial density of the blue-green alga *Homeothrix varians* (Table 4.4; Appendix G). Cell densities were dominated by one phylum, and this differed at each area. At W7, *Cyanophyta* (blue-green algae) made up 99.6% of the community, while *Bacillariophycae* (diatoms) made up 91.7% of the community at W11. Baseline studies including periphyton taxonomy reported community compositions at Station W7 of 99 to 100% diatoms with very little algae in 1995 samples, and 25 to 65% diatoms with significantly more algae in 1996 (HKP 1996; HKP 1997). The limited number of samples and the large gap between the baseline and 2011 data sets makes it difficult to comment on temporal change, but periphyton samples analyzed for this study will serve as a useful reference for future taxonomy studies.

4.6 Assessment of the Potential for Bank Erosion

A section of Hazeltine Creek located approximately 20 m downstream of Station W7 was identified as an easily accessible area which would be particularly prone to erosion relative to the rest of the creek. The stream cross-section was measured at this location (Figure 4.2; Appendix D) and will serve as a basis for evaluating potential erosion following effluent discharge.

Table 4.3: Summary of macrophyte mean[1] tissue quality from Hazeltine Creek, August 2011.

Analyte	Units	Hazeltine Creek, proposed discharge location to W11								Hazeltine Creek mouth at Quesnel Lake					
		Pondweed-a (*Potamogeton* sp.)		Tapegrass (*Vallisneria americana*)		Water Crowfoot (*Ranunculus aquatilis*)		Water Parsley (*Sparganium emersum*)		Creeping Spearwort (*Ranunculus flammula*)		Green Algae		Pondweed-b (*Potamogeton* sp.)	
		Mean	SD[2]	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
% Moisture	%	85	2.3	92	1.4	86	1.3	90	0.89	88	0.13	66	37	88	1.0
Aluminum (Al)-Total	**mg/kg dw[3]**	**4,398**	**2,178**	**925**	**818**	**1,924**	**585**	**216**	**175**	**2,912**	**737**	**4,054**	**3,641**	**2,950**	**554**
Antimony (Sb)-Total	mg/kg dw	0.052	0.012	0.032	0.013	0.049	0.019	0.01	0	0.061	0.0094	0.033	0.026	0.062	0.0075
Arsenic (As)-Total	mg/kg dw	2.3	0.33	1.9	0.90	1.7	0.85	0.11	0.058	4.5	0.83	3.4	3.16	5.0	0.77
Barium (Ba)-Total	mg/kg dw	68	14	52	16	42	11	7.2	3.0	111	11	51	44	147	8
Beryllium (Be)-Total	mg/kg dw	0.132	0.072	0.030	0.026	0.065	0.024	0.01	0	0.099	0.023	0.13	0.11	0.10	0.015
Bismuth (Bi)-Total	mg/kg dw	0.023	0.0156	0.013	0.0076	0.011	0.0047	0.010	0	0.034	0.0038	0.028	0.023	0.029	0.0024
Boron (B)-Total	mg/kg dw	28	8	75	24	45	7	44	5.3	54	12	40	23	63	16
Cadmium (Cd)-Total	**mg/kg dw**	**0.21**	**0.066**	**0.079**	**0.032**	**0.50**	**0.15**	**0.028**	**0.0057**	**0.37**	**0.04**	**0.15**	**0.12**	**0.44**	**0.031**
Calcium (Ca)-Total	mg/kg dw	19,180	6,140	12,940	2,164	10,170	1,557	16,860	3,016	11,260	716	10,401	5,009	11,780	1,043
Cesium (Cs)-Total	mg/kg dw	0.42	0.24	0.10	0.10	0.19	0.039	0.06	0.02	0.33	0.079	0.41	0.37	0.32	0.07
Chromium (Cr)-Total	mg/kg dw	33	36	5.1	4.0	12	3.8	6.0	7.6	19	12	119	231	15	3.7
Cobalt (Co)-Total	mg/kg dw	4.3	1.0	2.7	1.1	3.5	0.5	0.27	0.20	6.7	1.0	3.9	3.9	7.1	0.4
Copper (Cu)-Total	**mg/kg dw**	**32**	**8.4**	**15**	**6.6**	**26**	**3.6**	**7.8**	**0.86**	**27**	**4.4**	**21**	**16**	**28**	**2.1**
Gallium (Ga)-Total	mg/kg dw	1.2	0.58	0.26	0.24	0.52	0.18	0.062	0.057	0.82	0.22	1.2	1.0	0.81	0.15
Iron (Fe)-Total	**mg/kg dw**	**6,680**	**2,672**	**2,062**	**1,381**	**3,686**	**1,620**	**388**	**279**	**6,022**	**1,326**	**6,628**	**6,092**	**5,964**	**765**
Lead (Pb)-Total	mg/kg dw	1.8	1.0	0.52	0.42	0.85	0.24	0.12	0.065	1.7	0.34	1.7	1.6	1.5	0.18
Lithium (Li)-Total	mg/kg dw	3.4	1.9	0.72	0.70	1.2	0.41	0.13	0.063	2.5	0.69	3.6	3.4	2.5	0.52
Magnesium (Mg)-Total	mg/kg dw	2,602	608	3,788	774	2,700	135	3,044	712	3,684	291	3,041	1,408	2,470	157
Manganese (Mn)-Total	mg/kg dw	2,776	1,219	2,936	769	6,382	689	310	83	4,158	991	1,336	1,237	6,654	660
Mercury (Hg)-Total	mg/kg dw	0.054	0.018	0.023	0.0056	0.047	0.0026	0.011	0.0046	0.031	0.0053	0.058	0.053	0.057	0.019
Molybdenum (Mo)-	**mg/kg dw**	**2.1**	**0.68**	**3.2**	**1.3**	**2.3**	**0.17**	**1.1**	**0.36**	**1.0**	**0.11**	**1.4**	**1.19**	**1.0**	**0.24**
Nickel (Ni)-Total	mg/kg dw	16	15	4.2	2.6	6.7	2.0	2.9	3.0	14	5.1	50	92	12	1.5
Phosphorus (P)-Total	**mg/kg dw**	**2,576**	**750**	**4,000**	**692**	**3,072**	**367**	**1,838**	**532**	**2,860**	**400**	**2,538**	**1,466**	**2,278**	**103**
Potassium (K)-Total	mg/kg dw	11,174	5,085	28,680	4,329	18,640	4,086	41,540	10,745	22,680	2,395	18,397	13,035	21,840	2,618
Rhenium (Re)-Total	mg/kg dw	0.01	0	0.01	0	0.01	0	0.036	0.0068	0.012	0.0045	0.012	0.014	0.01	0
Rubidium (Rb)-Total	mg/kg dw	6.6	0.95	4.0	4.4	20	3.6	47	15	25	3.0	23	14	16	1.2
Selenium (Se)-Total	**mg/kg dw**	**3.4**	**0.74**	**0.78**	**0.23**	**2.5**	**0.18**	**0.57**	**0.40**	**0.99**	**0.16**	**1.9**	**1.5**	**1.8**	**0.21**
Sodium (Na)-Total	mg/kg dw	4,632	1,962	5,686	1,509	1,848	326	1,020	1,011	4,056	1,039	656	349	5,738	800
Strontium (Sr)-Total	mg/kg dw	127	19.6	80	7.3	94	10.9	96	24.9	103	7.1	84	34.2	110	4.3
Tellurium (Te)-Total	mg/kg dw	0.016	0.0055	0.02	0	0.012	0.0045	0.02	0	0.018	0.0045	0.010	0.0071	0.02	0
Thallium (Tl)-Total	mg/kg dw	0.042	0.011	0.030	0.0084	0.049	0.0048	0.011	0.0076	0.080	0.010	0.040	0.031	0.033	0.011
Thorium (Th)-Total	mg/kg dw	0.93	0.63	0.14	0.13	0.19	0.12	0.060	0.043	0.87	0.23	0.80	0.77	0.81	0.17
Tin (Sn)-Total	mg/kg dw	0.11	0.072	0.081	0.048	0.016	0.0093	0.047	0.016	0.10	0.014	0.07	0.054	0.19	0.062
Titanium (Ti)-Total	mg/kg dw	222	113	38	40	64	30	14	12	143	39	178	170	137	29
Uranium (U)-Total	mg/kg dw	0.42	0.21	0.090	0.053	0.28	0.11	0.015	0.015	0.28	0.070	0.30	0.28	0.27	0.027
Vanadium (V)-Total	mg/kg dw	18	7.3	4.8	3.2	9.2	3.5	1.0	0.88	14	3.1	17	16	14	2.1
Yttrium (Y)-Total	mg/kg dw	4.4	2.5	1.0	0.69	2.0	0.75	0.14	0.11	3.3	0.65	4.1	3.7	4.1	0.43
Zinc (Zn)-Total	mg/kg dw	29	4.0	33	9.1	37	5.4	20	3.4	51	4.7	24	13	44	2.7
Zirconium (Zr)-Total	mg/kg dw	1.1	1.3	0.31	0.25	0.12	0.045	0.2	0	0.45	0.24	0.79	0.92	0.97	0.29

[1] Calculated using 0.5 times the method detection limit (MDL) where <MDL values were reported

[2] Standard deviation (n = 5), calculated using 0.5 times the MDL where <MDL values were reported

[3] milligrams per kilogram (parts per million) dry weight; mg/kg wet weight data provided in Appendix G

Table 4.4: Periphyton community metrics, Hazeltine Creek 2011.

Metric	W7	W11
Percent composition		
Bacillariophycae (diatoms)	0.25%	91.8%
Chlorophyta (green algae)	0.050%	1.17%
Chrysophyta (golden algae)	0.004%	0.000%
Cyanophyta (blue-green algae)	99.6%	6.94%
Rhodophyta (red algae)	0.12%	0.14%
Total density (cells/cm^2)	21,198,364	2,885,211
Presence/absence richness[1]	59	87
Quantitative richness[2]	34	58
Simpson's evenness	0.018	0.234
Simpson's diversity	0.078	0.928

[1] Taxon richness based on all data

[2] Taxon richness with "<" qualified data and removed

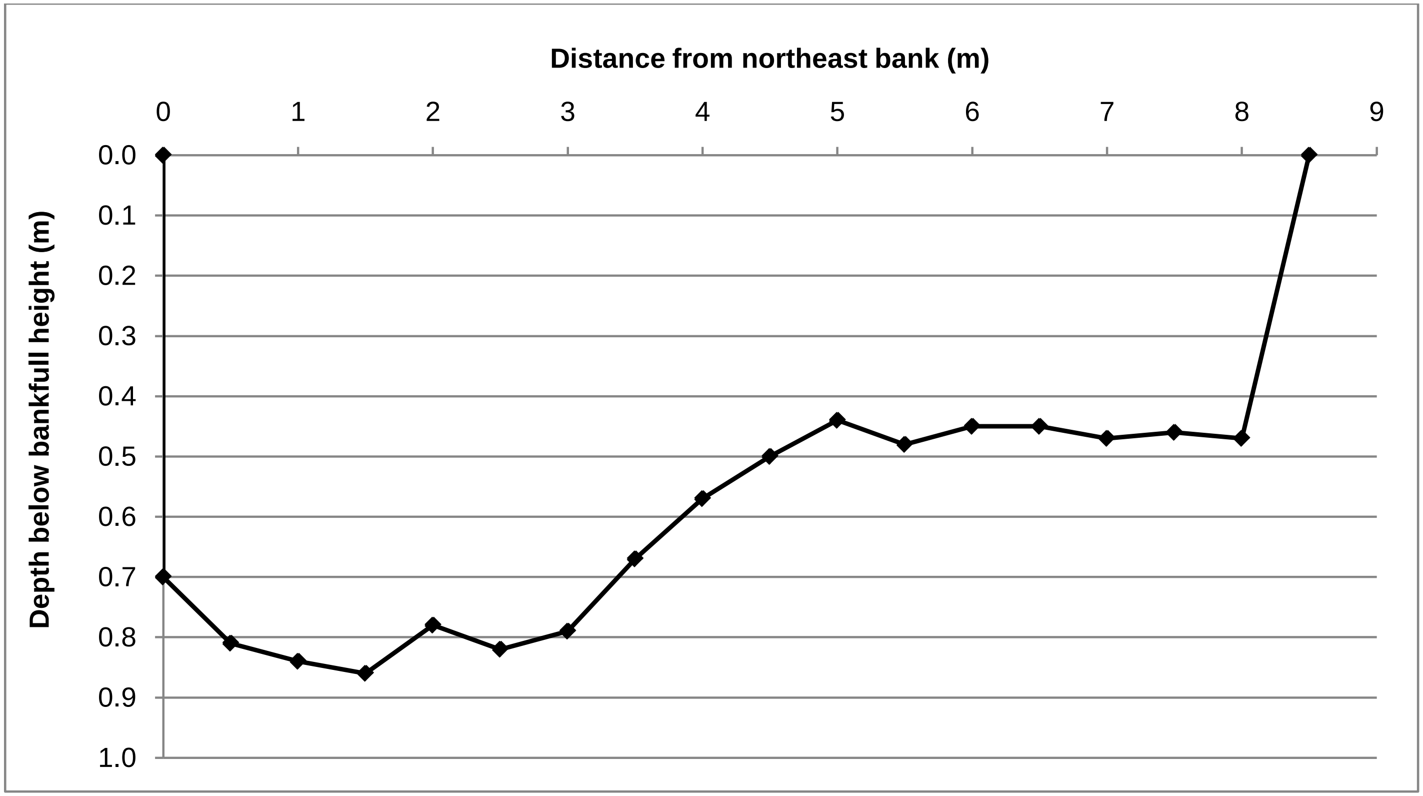


Figure 4.2: Hazeltine Creek cross-section downstream of Station W7, August 2011.

5.0 HAZELTINE CREEK PRODUCTIVITY ASSESSMENT

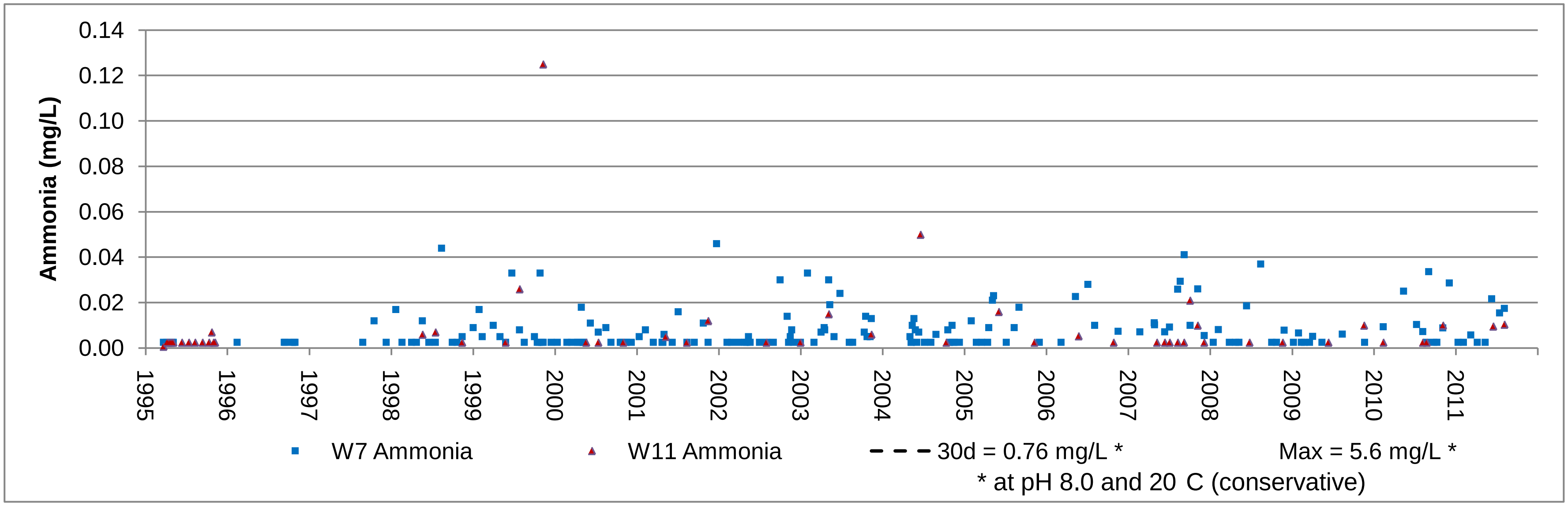
5.1 Nutrients in Water

Nutrient concentrations in water samples from stations W7 and W11 collected in August 25th, 2011 (Table 4.1) were within the range of routine water quality data collected since 1995 (Figure 5.1). Routine monitoring data indicate that ammonia and nitrate at both W7 and W11 have been below BCWQGs, whereas rare elevations above BCWQGs were observed for nitrite in 2008 and 2010 (Figure 5.1). Although there is no available guideline for phosphorus in streams, phosphorus concentrations in Hazeltine Creek were generally greater than the BCWQG range of 0.005 to 0.015 mg/L applicable to lakes. Furthermore, based on the range of phosphorus concentrations in Hazeltine Creek, the creek would be classified as mesotrophic to eutrophic according to the Canadian guidance framework for phosphorus (CCME 1999). Routine water quality monitoring data also indicate that nutrient concentrations are generally greater at Station W7 (upstream) than at Station W11 (downstream), and that most of the higher concentrations of nitrate and total nitrogen have occurred in recent years (Figure 5.1).

5.2 Periphyton Chlorophyll a

Chlorophyll a in periphyton was 14.6 milligrams per square meter of creek surface area (mg/m^2) at Station W7 and 30.6 mg/m^2 at Station W11 (Appendix G), well below the BCWQG of 100 mg/m^2 (BCMOE 2006a). Chlorophyll a in periphyton at Station W7 was also reported in two Mount Polley baseline reports: 9.3 mg/m^2 in 1995 (HKP 1996) and 21.4 mg/m^2 in 1996 (HKP 1997). The chlorophyll content measured at W7 in 2011 was between these two values, suggesting no apparent change in periphyton productivity relative to baseline.

a) Ammonia



b) Nitrate (as N)

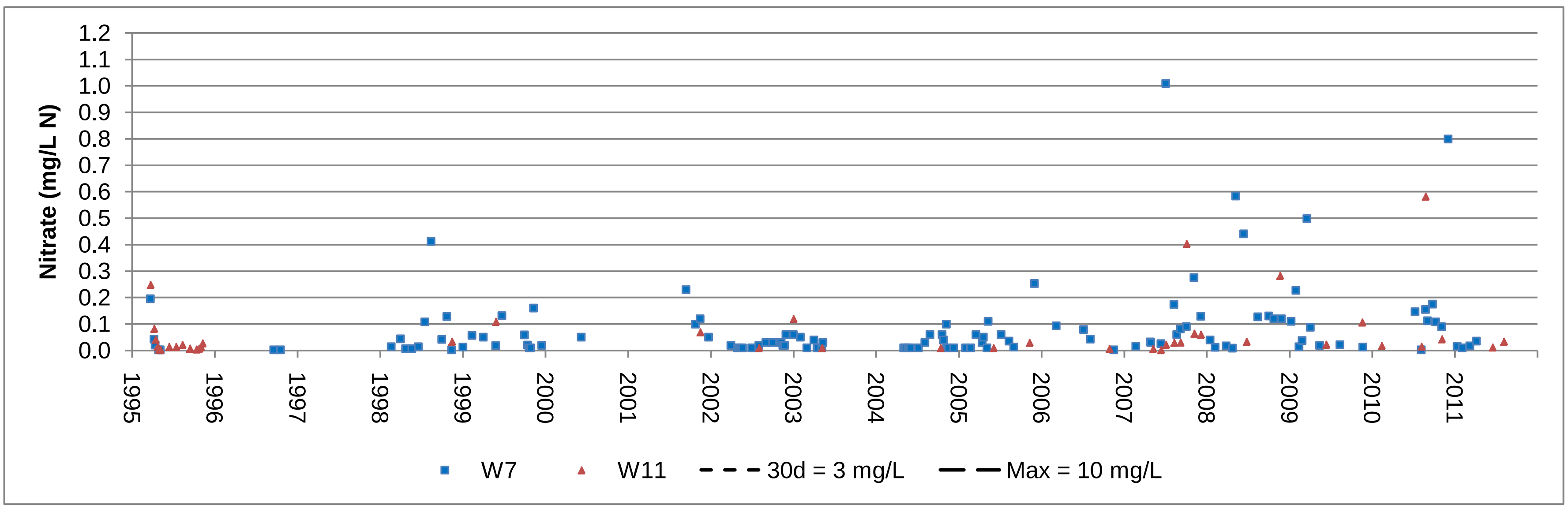
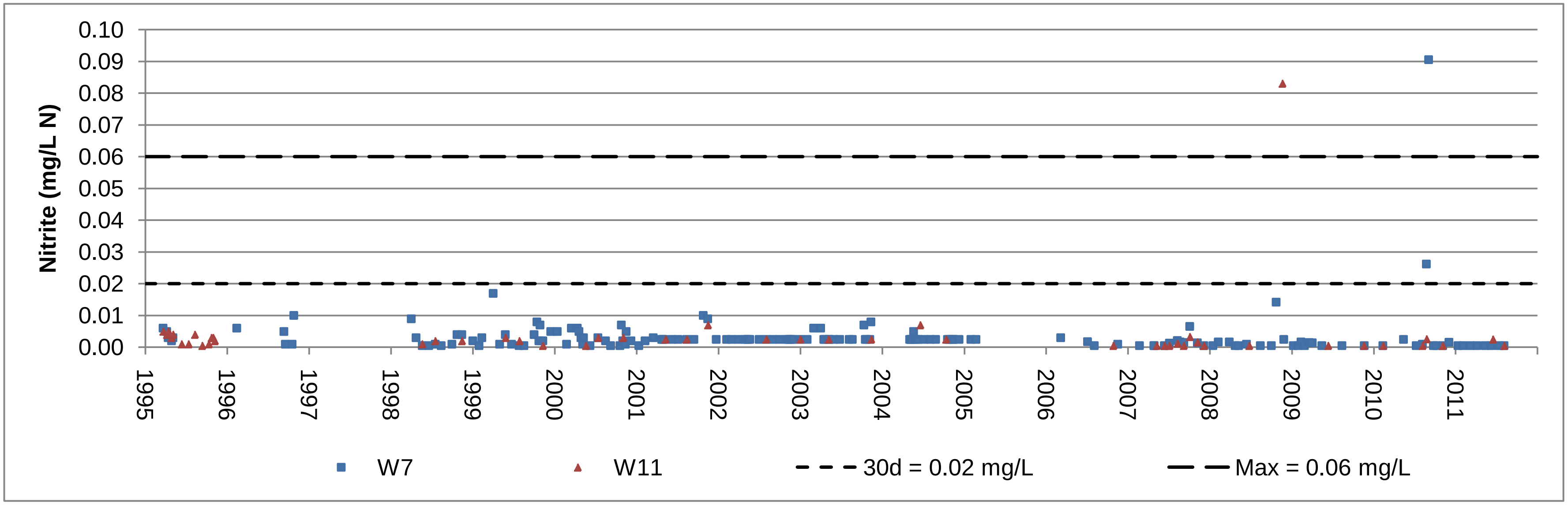


Figure 5.1: Temporal plots of routine water nutrient data from Mount Polley Mine at Hazeltine Creek stations W7 and W11, 1995 - 2011 **(30-day average and maximum BCWQGs presented, as available).**

c) Nitrite (as N)



d) Total Nitrogen

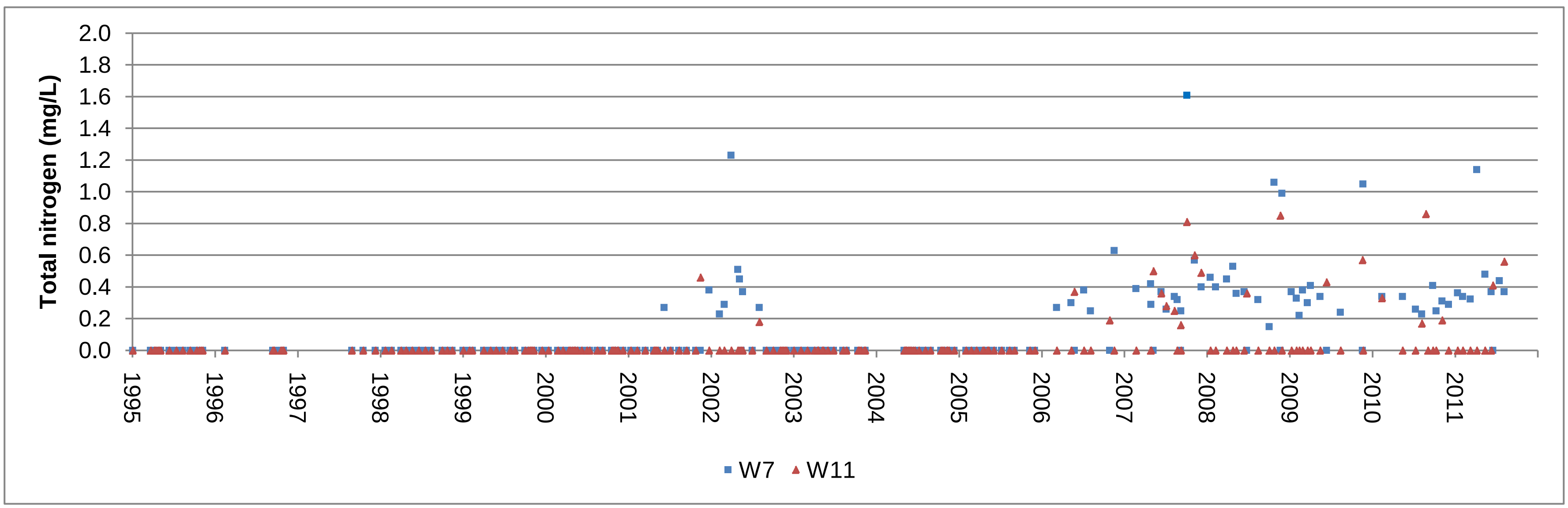
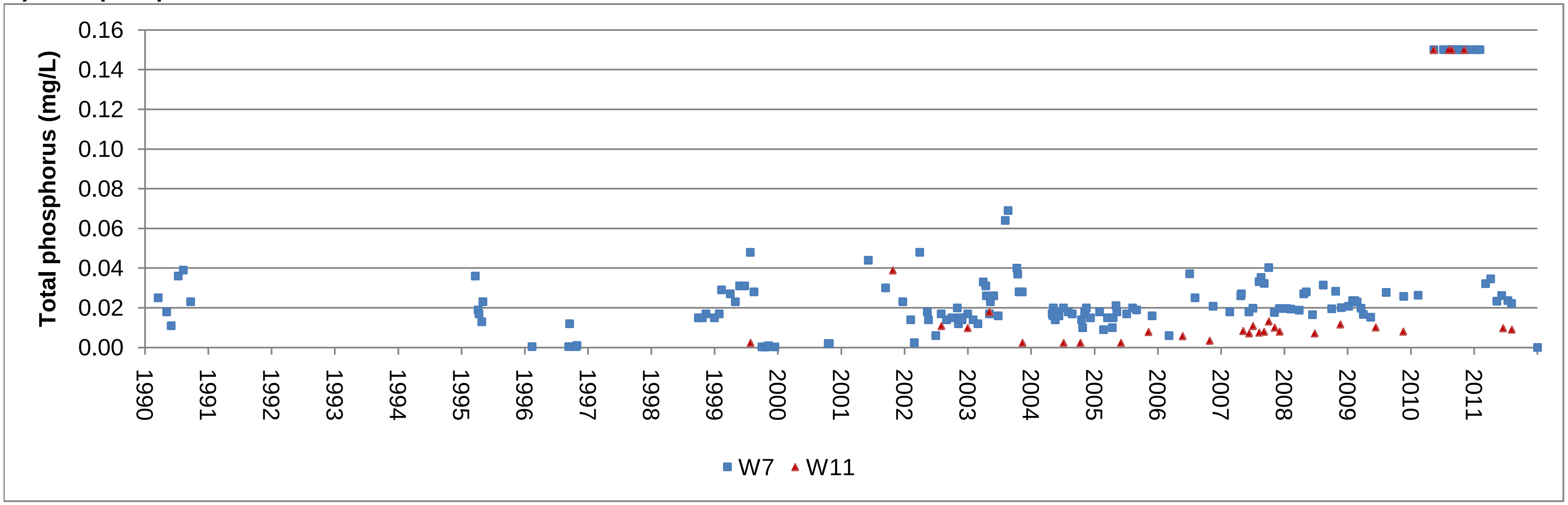


Figure 5.1: Temporal plots of routine water nutrient data from Mount Polley Mine at Hazeltine Creek stations W7 and W11, 1995 - 2011 **(30-day average and maximum BCWQGs presented, as available).**

e) Total phosphorus



f) Dissolved orthophosphate

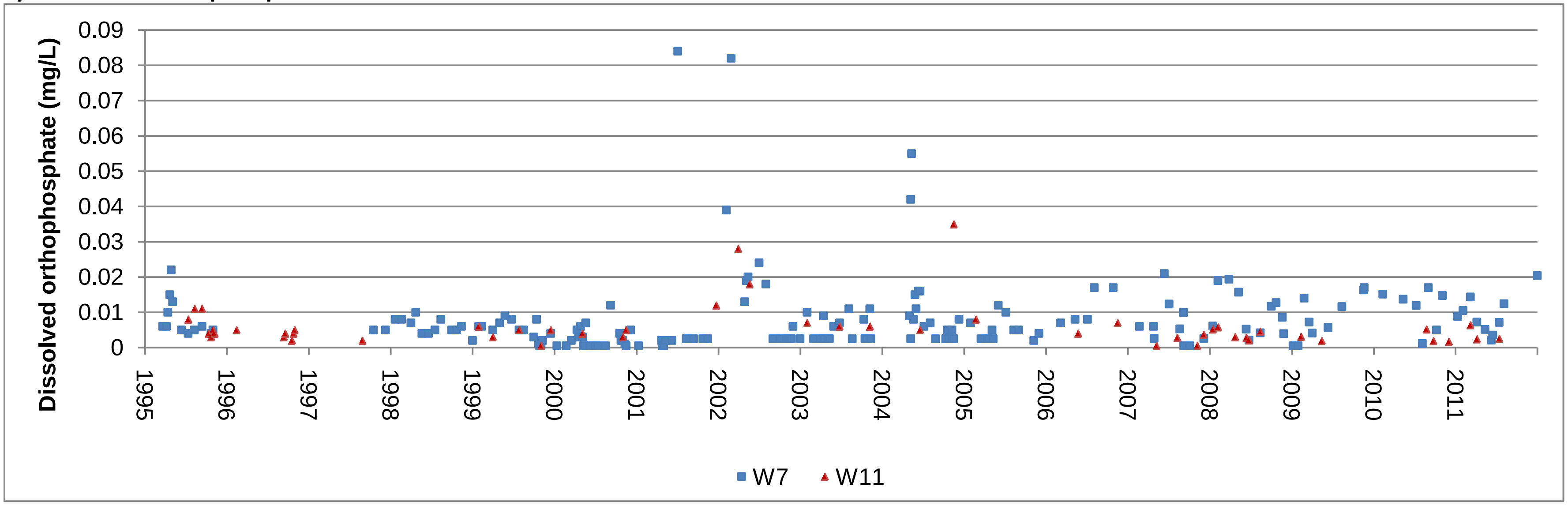


Figure 5.1: Temporal plots of routine water nutrient data from Mount Polley Mine at Hazeltine Creek stations W7 and W11, 1995 - 2011 (30-day average and maximum BCWQGs presented, as available).

6.0 SUPPLEMENTAL SELENIUM MONITORING

6.1 Selenium in Water

Selenium concentrations in water samples collected at stations W7 and W11 in August 2011 were below the BCWQG, and the concentration at Station W7 was greater than at Station W11 (Table 4.1; Figure 6.1; Appendix F). Comparison to data collected by the mine since 1995 indicated that August 2011 samples were generally within the range of historical values. Following a reduction in the method detection limit achieved in 2011, the mean and standard deviation of detectable results was 0.00067 ± 0.00006 mg/L, well below the WQG of 0.002 mg/L.

6.2 Selenium in Sediment

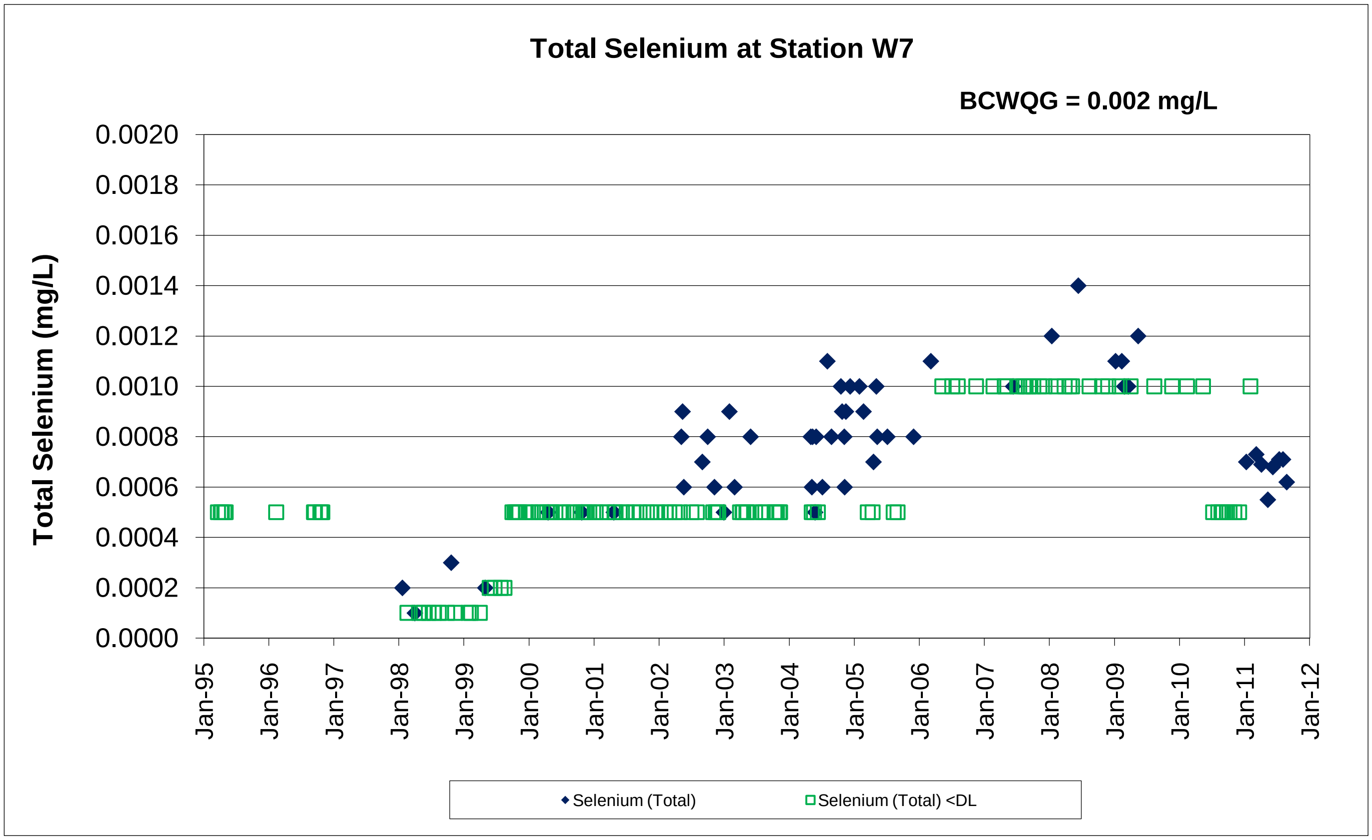
In sediment samples collected at Station W8 in Edney Creek, selenium was present at a mean concentration (3.2 ± 0.2 mg/kg dw); greater than the BCSQG of 2 mg/kg dw (Table 3.2; Appendix F). As previously discussed, this concentration was higher than previously observed (Figure 4.1) and the apparent temporal increase occurred in conjunction with total organic carbon, arsenic and manganese.

6.3 Aquatic Macrophyte Tissue Selenium

Selenium in macrophyte tissues will serve as a basis for comparison for future monitoring programs (Table 3.3; Appendix G). Of the species which were collected at intervals of distance downstream Hazeltine Creek, green algae samples appear to show a trend of decreasing selenium with increased distance downstream (Figure 6.2).

6.4 Periphyton Selenium

Selenium concentrations in periphyton tissue in August 2011 were almost identical to those documented in 2010 (Figure 6.3; Appendix G). Concentrations at Station W7 were approximately three times higher than at Station W11 in both 2010 and 2011 (Figure 6.3). This spatial pattern, also apparent in green algae (above), suggests a potential mine-related influence.



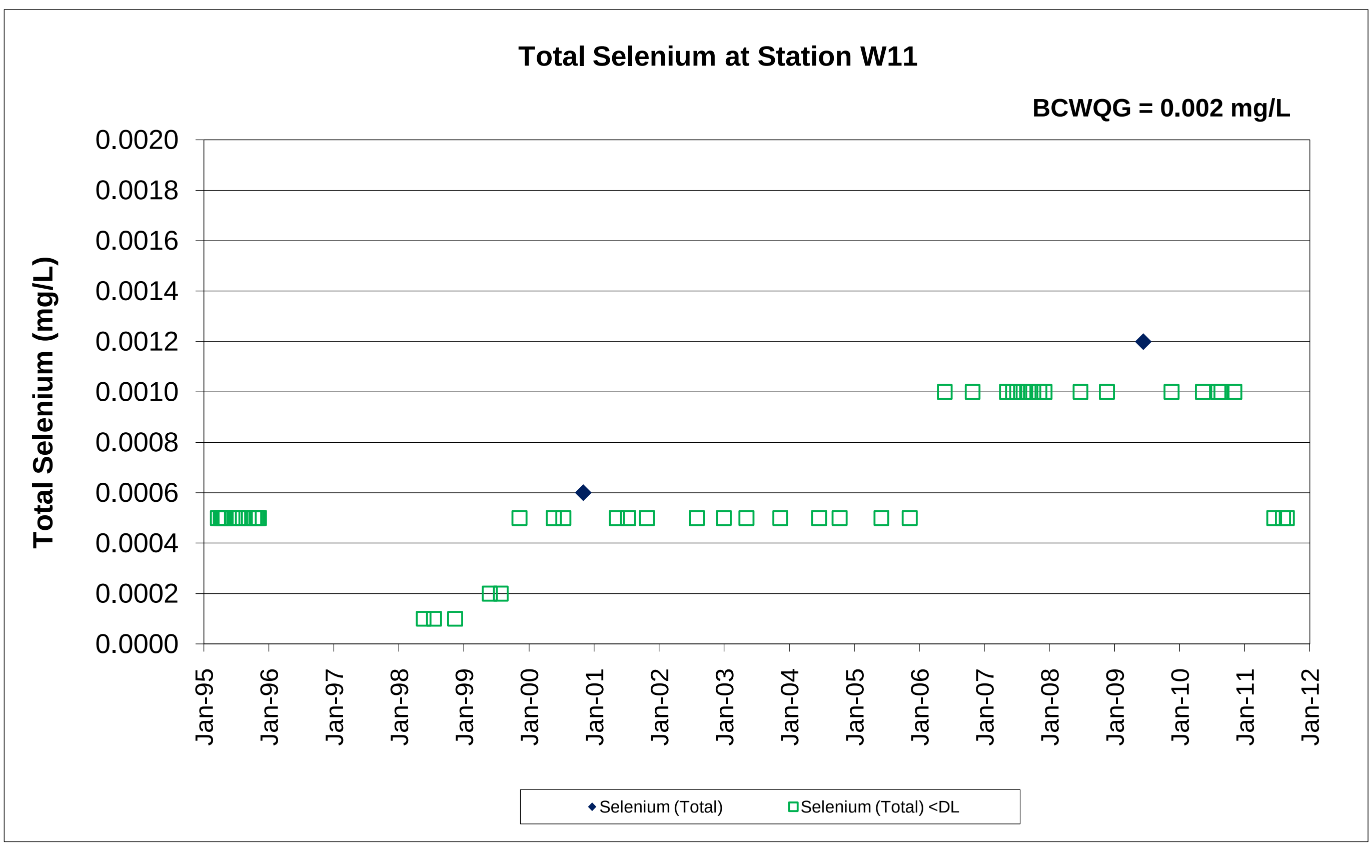


Figure 6.1: Aqueous selenium concentrations in Hazeltine Creek, 1995-2011.

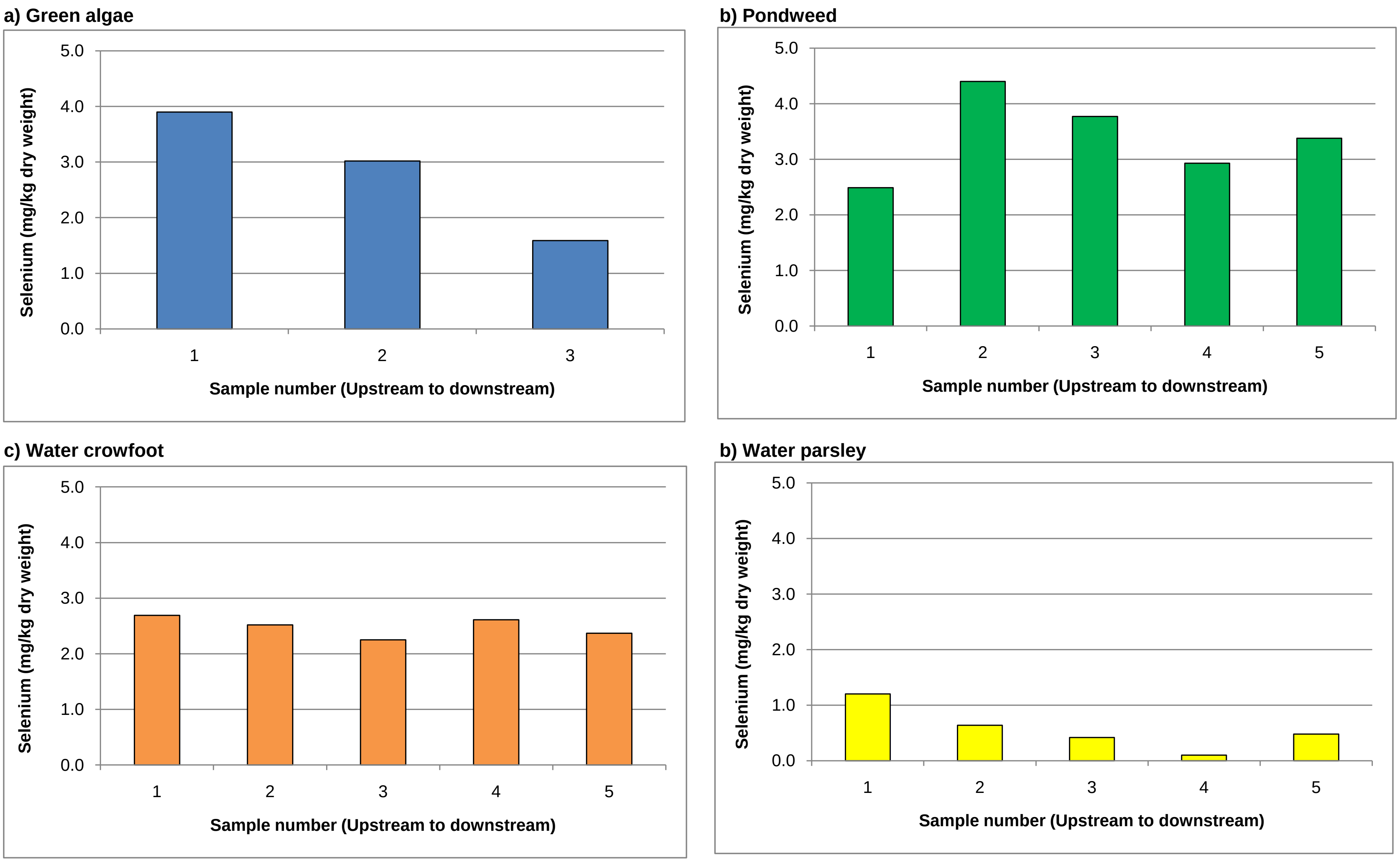


Figure 6.2: Plant tissue selenium concentrations plotted by sample location, Hazeltine Creek 2011.

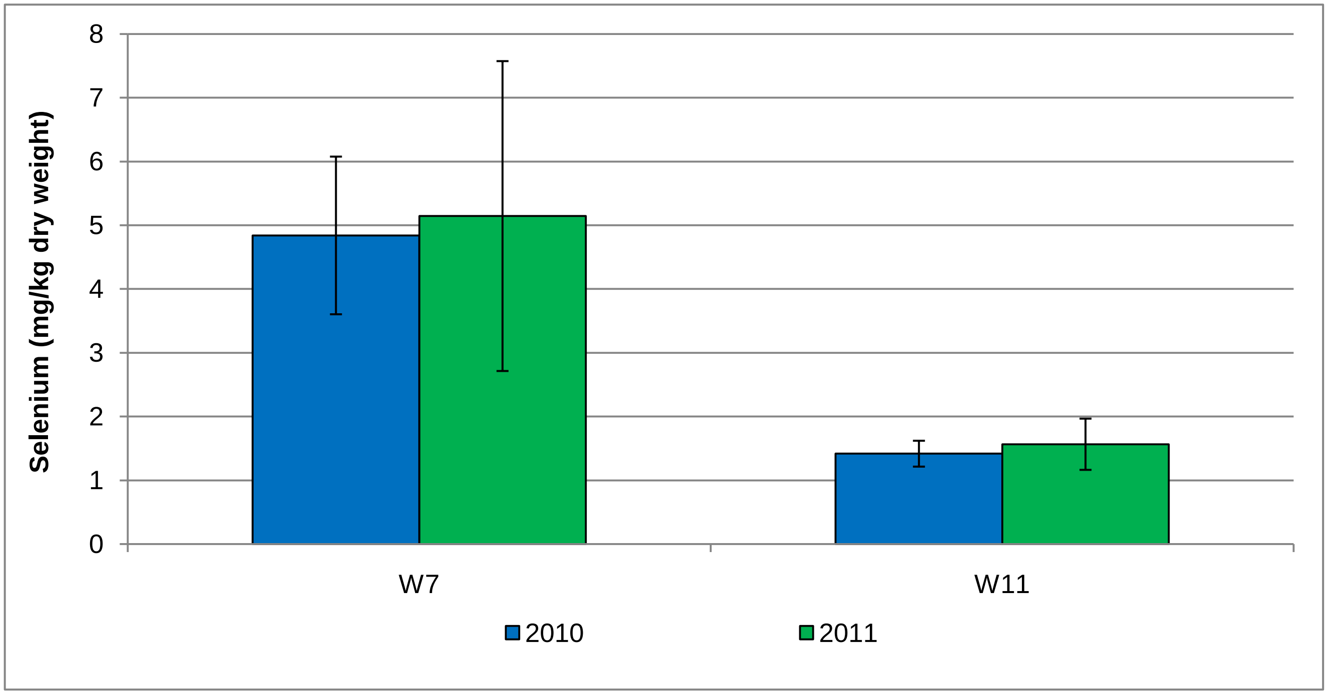


Figure 6.3: Selenium concentrations in periphyton from Hazeltine Creek, 2010[1] and 2011.

[1] Minnow 2011a

Data presented as mean ± standard deviation (n = 5)

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Based on the supplemental aquatic monitoring undertaken in 2011, the following conclusions are provided.

- The optimal location for the discharge of effluent to Hazeltine Creek is approximately 110 m upstream of the location initially proposed.
- Reconnaissance of Hazeltine Creek identified one depositional location approximately 200 m upstream of Station W7 and an ideal bank erosion monitoring location approximately 20 m downstream of Station W7. Two photo-documentation stations were established at the mouth of Hazeltine Creek to track primary productivity.
- Hazeltine Creek supports very limited macrophyte growth. Nonetheless, green algae and three macrophyte species (pondweed, water crowfoot and water parsley) were sufficiently abundant to allow their use in monitoring. At the mouth of Hazeltine Creek, another pondweed, tapegrass and creeping spearwort were sufficiently abundant to allow their use in monitoring. Metal concentrations in these plants were characterized.
- Periphyton communities at Hazeltine Creek stations W7 and W11 were characterized and differed from each other. Blue-green algae dominated the periphyton community of W7; whereas diatoms dominated the periphyton community at Station W11 and the baseline periphyton community at Station W7.
- Water quality in August 2011 was within range observed in routine monitoring. A number of analytes were present at higher concentrations at W7 than at W11, potentially indicative of mine and/or lake influence that is attenuated with distance downstream. Examination of nutrient concentrations in Hazeltine Creek suggested a slight influence of the mine on nitrate, but at concentrations well below water quality guidelines. Although phosphorus concentrations have been in the range of mesotrophic to eutrophic creeks, chlorophyll a concentrations on bottom substrate (i.e., periphyton) were well below the BC water quality guideline.
- Sediment collected at Edney Creek Station W8 had concentrations of arsenic, manganese and selenium that were greater than sediment quality guidelines and

greater than those documented in previous monitoring. Sediment organic carbon content was also higher in 2011 than in most previous years. Consequently, there is some uncertainty as to the influence of higher organic carbon versus a potential mine influence on the concentrations of arsenic, manganese and selenium.

- Concentrations of selenium in periphyton in 2011 were almost identical to those in 2010 and were approximately three times greater at Station W7 than at Station W11. This spatial pattern, also apparent in green algae, suggests a potential mine-related influence.

7.2 Recommendations

Based on the findings of supplemental aquatic monitoring undertaken in 2011, the following recommended are provided for consideration by the Mount Polley Mine.

- Move the point of proposed effluent discharge to Hazeltine Creek approximately 110 m upstream of the location initially proposed.
- Conduct sediment sampling of the depositional location of Hazeltine Creek (approximately 200 m upstream of Station W7) in 2012.
- At an annual frequency (August or September):
    - Monitor the Hazeltine Creek cross-section (to track potential bank erosion) at an established location approximately 20 m downstream of Station W7.
    - Repeat photo-documentation (to track primary productivity) at stations established at the mouth of Hazeltine Creek.
    - Continue to monitor periphyton chlorophyll a and selenium concentrations at Hazeltine Creek stations W7 and W11.
- At a frequency of every three years (August or September concurrent with Environmental Effects Monitoring under the Metal Mining Effluent Regulations):
    - Monitor metal concentration in aquatic plants.
    - Monitor sediment quality at the depositional location of Hazeltine Creek.

8.0 REFERENCES

BCMOE (British Columbia Ministry of Environment). 2006a. Water Quality Guidelines (Criteria).

BCMOE (Nagpal, N.K., L.W. Pommen, and L.G. Swain) 2006b. A Compendium of Working Water Quality Guidelines for British Columbia. Ministry of Environment Science and Information Branch. August 2006.

Beak (Beak International Incorporated). 2000. Mount Polley Biological Monitoring Program – 1999. Report prepared for the Mount Polley Mining Corporation. April 2000.

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines.

HKP (Hallam Knight Piésold Ltd.). 1997. Mount Polley Project – Environmental Baseline and Monitoring Report: 1996. June 1997.

HKP (Hallam Knight Piésold Ltd.).1996. Mount Polley Project – Environmental Baseline and Monitoring Report: 1995. March 1996.

KPL (Knight Piésold Limited). 2009. Mount Polley Closure Water Balance – Predicted Discharge to Hazeltine Creek and Southwest Edney (Tributary 1) Creek. Letter to Mr. Ron Martel, Mount Polley Mining Corporation from Alexis McPherson, Greg Smyth and Ken Brouwer. April 9, 2009.

KPL (Knight Piésold Limited). 2011. Fulcrum database: Mount Polley Project.

Minnow (Minnow Environmental Inc.). 2009. Mount Polley Aquatic Environmental Characterization – 2007. October 2009.

Minnow (Minnow Environmental Inc.). 2011a. Mount Polley Mine Selenium Monitoring 2009/2010. March 2011.

Minnow (Minnow Environmental Inc.). 2011b. Hazeltine Creek Discharge Location Characterization. Memorandum from Fred Burgess to Ron Martel. September 1st, 2011.

Minnow (Minnow Environmental Inc.). 2011c. Preliminary Physical Assessment to Support the Selection of a Location for Discharge to Hazeltine Creek. Memorandum from Fred Burgess to Ron Martel. December 7th, 2011.

Morrow (Morrow Environmental Consultants Inc.). 2003. Mount Polley Mining Corporation Biological Monitoring Program – 2002. April 2003.

MPMC (Mount Polley Mining Corporation). 2009. Mount Polley Mine Technical Assessment Report for a Proposed Discharge of Mine Effluent. Prepard in Support of an Application for the Discharge of Mine Effluent under the British Columbia *Environmental Management Act*. July 2009.

Olding (Brian Olding and Associates). 2011. Independent Review of the Mount Polley Mine Technical Assessment Report for a Proposed Discharge of Mine Effluent (2009). Prepared for T'exelc Williams Lake Indian Band, Xat'sull Soda Creek First Nations and Mount Polley Mining Corporation. June 2011

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

APPENDIX A

MOUNT POLLEY DISCHARGE PERMIT

PROVINCE OF
BRITISH COLUMBIA

Environmental Protection
Suite 400 - 640 Borland Street
Williams Lake
British Columbia V2G 4T1
Telephone: (250) 398-4530
Fax: (250) 398-4214

MINISTRY OF WATER,
LAND AND AIR PROTECTION

PERMIT

PE-11678

Under the Provisions of the *Environmental Management Act*

Mount Polley Mining Corporation

200-580 Hornby Street

Vancouver, British Columbia

V6C 3B6

is authorised to discharge effluent to the land and surface water from a copper-gold mine and mill located near Likely, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

This permit supersedes and amends all previous versions of Permit PE-11678, issued under Part 2 Section 10 of the *Environmental Management Act.*

1. AUTHORISED DISCHARGES

1.1 This section applies to the discharge of effluent from a **COPPER-GOLD MINE AND ORE CONCENTRATOR** to a tailings impoundment. The site reference number for this discharge is E225309.

1.1.1 The monthly average maximum authorised rate of discharge of slurry is 54, 500 m^3/d.

1.1.2 The characteristics of the discharge shall be typical concentrator tailings from the milling of ore or metal contaminated soil, mill site runoff, rock disposal site runoff, open pit water, and septic tank effluent from a copper-gold mine and mill complex.

Douglas Hill, P. Eng.
for Director
Environmental Management Act
Cariboo Region

Date Issued: May 30, 1997
Date Amended: (most recent) MAY 0 4 2005

1.1.3 The works authorised are a septic tank; tailings discharge line; open pits; tailings impoundment; seepage collection and recycle system; mine, mill, and rock disposal site runoff collection ditches and sumps; tailings supernatant and sediment pond supernatant recycle systems; and related appurtenances located approximately as shown on the attached Site Plans.

1.1.4 The authorised works must be complete and in operation when discharge commences.

1.1.5 The location of the facilities from which the discharge originates is within the entire facility (excluding the Tailings Storage Facility) on Mineral Leases No. 345731 and No. 410495 and Mineral Claim CB-20 and PM-11, Cariboo Mining Division, Cariboo Land District.

1.1.6 The location of the point of discharge (Tailings Storage Facility) is five kilometres southeast of Mount Polley, on Mineral Claim CB-20, Cariboo Mining Division, Cariboo Land District.

1.2 This section applies to the discharge of **TAILINGS IMPOUNDMENT SUPERNATANT** to the Cariboo Pit. The site reference number for this discharge is E247302.

1.2.1 The maximum authorised rate of discharge of supernatant and runoff water to the Cariboo Pit shall be 100, 000 m^3/year This discharge shall not occur while tailings slurry from the mill is being discharged to the tailings impoundment.

1.2.2 The characteristics of the supernatant shall be typical of mine tailings impoundment supernatant.

1.2.3 The works authorised include a supernatant reclaim system, pump(s), piping and related appurtenances located approximately as shown on the attached Site Plans.

1.2.4 The authorised works must be complete and in operation when discharge commences.

1.2.5 The location of the facilities from which the discharge originates is on Mineral Lease No. 345731, Cariboo Mining Division, Cariboo Land District and five kilometers southeast of Mount Polley, on Mineral Claim CB-20, Cariboo Mining Division, Cariboo Land District.

1.2.6 The location of the point of discharge (Cariboo Pit) is on Mineral Lease No. 345731, Cariboo Mining Division, Cariboo Land District.

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Cariboo Region

1.3 This section applies to the discharge of effluent from the **MAIN EMBANKMENT SEEPAGE POND** to an unnamed tributary of Edney Creek. The site reference number for this discharge is E224221.

1.3.1 The total maximum authorised rate of discharge of effluent from the main embankment seepage pond shall be 2000 m^3/d.

1.3.2 The characteristics of the discharges shall be equal to or better than:

Water Quality Characteristic:	Maximum Concentration:
non-filterable residue	25 mg/L
96 hour LC_{50} toxicity (rainbow trout)	not less than 100% V/V
48 hour LC_{50} toxicity (Daphnia Magna)	not less than 100% V/V
nitrate (as N)	10 mg/L
orthophosphorus (as P)	0.05 mg/L
dissolved sulphate	200 mg/L
total Copper	0.020 mg/L
total Iron	1.0 mg/L
total Selenium	0.01 mg/L

1.3.3 The works authorised are the main seepage collection and recycle systems; tailings impoundment foundation, toe and chimney drain system, outfall; and related appurtenances located approximately as shown on the attached Site Plans.

1.3.4 The authorised works must be complete and in operation when discharge commences.

1.3.5 The location of the facilities from which the discharge originates and the point of discharge (Tailings Storage Facility site) is five kilometers southeast of Mount Polley, on Mineral Claim CB-20, Cariboo Mining Division, Cariboo Land District.

1.4 This section applies to the discharge of miscellaneous groundwater sources from the **Wight Pit** dewatering system to Polley Lake. The site reference number for this discharge is E258923.

1.4.1 The maximum authorised rate of discharge is 75,000 cubic meters for the initial two weeks of operation and thereafter a continuous rate not to exceed 13,750 cubic meters per day (2,500 gallons per minute).

1.4.2 The authorised discharge period is continuous during operation of the Wight Pit.

Douglas Hill, P. Eng.
for Director
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1.4.3 The sources authorised are groundwater dewatering (monitoring), well(s) located within the interface of Polley Lake and Wight Pit.

1.4.4 The authorised works are wells, submersible pumps, common pipe manifold connecting the wells, discharge pipe and diffuser.

1.4.5 The authorised point of discharge is Polley Lake

2. GENERAL REQUIREMENTS

2.1 Maintenance of Works and Emergency Procedures

The Permittee shall inspect the pollution control works regularly and maintain them in good working order. In the event of an emergency or condition beyond the control of the Permittee which prevents continuing operation of the approved method of pollution control, the Permittee shall notify the Regional Manager, Environmental Protection:

a) by telephone (250-398-4530) if the condition occurs between the hours of 08:00 and 16:30, Monday to Friday on normal working days; and,

b) by facsimile transmission (250-398-4214) if the condition occurs at any other time.

All such reports must be received within 24 hours of detection of the occurrence.

In addition, emergencies involving spills to the environment (as defined in the Spill Reporting Regulation), or spills to the effluent treatment facilities that have the potential to impair the treatment process, shall be reported immediately to the Provincial Emergency Program (1-800-663-3456).

2.2 Bypasses

The discharge of effluent which has bypassed the designated treatment works is prohibited unless the approval of the Director is obtained and confirmed in writing.

2.3 Process Modifications

The Regional Manager, Environmental Protection, shall be notified prior to implementing changes to any process that may adversely affect the quality and/or quantity of the discharge.

2.4 Surface Runoff and Mine Drainage Control

2.4.1 To the maximum extent possible, seepage and runoff from the open pits, rock disposal sites, and from down gradient of the tailings impoundment shall, when the mine or mill is operating, be collected and conveyed to the tailings impoundment, mill or open pits. Recycling of on-site water shall be practised to the maximum extent practicable.

2.4.2 Surface runoff from undisturbed areas shall be diverted so that it does not flow to the tailings impoundment, or to the mine and mill area. Water quality shall be maintained during construction and operation from these areas when being diverted to natural watercourses.

2.4.3 Surface runoff control works shall be provided for all areas disturbed by roads, open pits, rock disposal sites, and the mill and ore storage area. The surface runoff control system shall convey all flows up to a 1 in 10 year 24-hour storm event, and shall withstand all flows up to a 1 in 100 year 24-hour storm event without significant damage.

2.4.4 The tailings impoundment shall provide 1.0 meter of freeboard plus storage for the Probable Maximum Precipitation (PMP), and all other effluent storage ponds, seepage ponds, and surface runoff ponds shall provide at least 0.5 metre of freeboard, up to a 1 in 100 year 24-hour storm event. If at any time the freeboard in the tailings impoundment is reduced to less than 1.0 metres plus the PMP, or less than 1.0 metre in any other pond, the Permittee shall notify the Regional Manager, Environmental Protection following procedures in Section 2.1 of this permit. After initially reporting such an occurrence, the Permittee shall report the freeboard weekly until such time as the required freeboard is re-established. Freeboard is defined as the difference in elevation between the contained liquid level and the top of the berm structure at its lowest point. The lowest point does not include spillways where a discharge is authorised or where the supernatant overflows to a downstream collection pond that is part of the authorized works.

2.4.5 Sedimentation of watercourses shall be prevented during construction and operation of any mine structures or facilities. The Director may specify and require implementation of measures to prevent sedimentation of watercourses caused by construction or operational activity at the site.

2.4.6 All ponds, ditching, and other runoff or seepage collection and diversion works shall be inspected at least twice per year, once in the spring after freshet and once in the fall before freeze-up.

2.5 Spill Contingency Plan

The Permittee shall maintain a "Spill Contingency Plan" for responding to environmental emergencies at the Mt. Polley Mine Project area. The Permittee shall keep this plan up-to-date and appropriate mine personnel shall be made aware of its contents. Any future updates to the plan shall be submitted to the Regional Manager, Environmental Protection within 30 days of adoption of the changes by the Permittee.

Douglas Hill, P. Eng.
for Director
Environmental Management Act
Cariboo Region

2.6 Security
The Permittee shall maintain security with the Minister of Finance and Corporate Relations, as a condition of the Permit Approving Work System and Reclamation Program issued by the Ministry of Energy and Mines pursuant to the *Mines Act*.

2.7 Metal Contaminated Soil Milling
Tailings from the mill processing of metal contaminated soil from off minesite sources may be discharged to the tailings impoundment provided the Permittee has obtained written approval from the Director prior to receiving at the minesite, any metal contaminated soils.

3. MONITORING AND REPORTING REQUIREMENTS

3.1 Water Sampling and Analysis
The Permittee shall collect grab samples from the locations and at the frequencies listed in Table 1 of this permit and have the samples analysed for the parameters listed in Table 2 of this permit. The minimum detection limit for analysis shall be as shown in Table 2 of this permit.

3.2 Biological Monitoring and Lake Sampling Program
The Permittee shall develop a biological monitoring program, in accordance with the Metal Mining Effluent Regulations (pursuant to Subsections 34(2), 36(5) and 38(9) of the *Fisheries Act*), to assess impacts on the receiving environment.

An annual lake sampling program for Polley and Bootjack Lakes shall include;

- Dissolved oxygen (MDL 0.1 mg/L), temperature and conductivity profile sampling in late winter (lake surface safely frozen) and at spring and fall overturn
- water chemistry sampling (lake surface and at 2.0 meters above lake bottom) during spring and fall overturn, and
- Secchi disk measurements two times a month, occurring between spring and fall overturn.

The lake sampling locations shall include sites known as P1 and P2 on Polley Lake and B1 and B2 on Bootjack Lake. Lake samples that are collected shall be analysed for the parameters listed in Table 2 of this permit. The lake sampling program shall be conducted in accordance with the lake sampling and biological monitoring protocols that shall be included in the approved Quality Assurance Manual required in Section 3.7 of this permit.

3.3 Flow Measurement
The Permittee shall provide and maintain suitable measuring devices and record staff gauge measurements, during the non-freezing period, at surface water stations W1a, W4, W5, W8, and W12, located approximately as shown on the site plan. These staff gauge readings shall be taken at the same time as water samples are collected at the same or associated sites.

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The Permittee shall provide and maintain a suitable flow measuring device and record continuously during the non-freezing period the flow at surface water station W7. The water elevation shall be measured in all groundwater wells each time they are sampled for water quality. The Permittee shall provide and maintain a suitable flow measuring device and record daily, the volume of tailings slurry discharged to the tailings impoundment. The Permittee shall provide and maintain suitable flow measuring devices and record once per week, the rate of flow discharging from the main embankment seepage pond to the environment. The Permittee shall provide and maintain suitable flow measuring devices and record once per week, during the non-freezing period, the rate of flow into the mill site sump and into the southeast sediment control pond. A stage discharge curve shall be developed for all staff gauges, and all staff gauges and flow measuring devices shall be checked and calibrated once per year, after spring freshet.

3.4 Climate Monitoring

The Permittee shall maintain a meteorological station and measure continuous daily precipitation; daily maximum, minimum and mean temperature; and daily open pan evaporation.

3.5 Sampling Procedure

At sites where sampling is required, the Permittee shall install a suitable sampling facility and obtain samples in accordance with procedures described in "British Columbia Field Sampling Manual for Continuous Monitoring Plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples 2003 Edition (Permittee)", or most recent edition, or by suitable alternative procedures as authorized by the Director. Proper care should be taken in sampling, storing and transporting the samples to adequately control temperature and avoid contamination, breakage, etc.

A copy of the above manual may be purchased from the Queen's Printer Publication Centre, P.O. Box 9452, Stn. Prov. Govt, Victoria, British Columbia, V8W 9V7 (1-800-663-6105 or (250) 387-6409), and also available for inspection at all Environmental Protection Program Offices.

3.6 Analytical Procedures

Analyses are to be carried out in accordance with procedures described in the "British Columbia Laboratory Methods Manual for the Analysis of Water, Wastewater, Sediment, Biological Materials and Discrete Ambient Air Samples (2003 Permittee Edition)", or the most recent edition, or by suitable alternative procedures as authorized by the Director.

Douglas Hill, P. Eng.
for Director
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A copy of the above manual may be purchased from Queen's Printer Publications Centre, P.O. Box 9452, Stn. Prov. Govt, Victoria, British Columbia, V8W 9V7 (1-800-663-6105 or (250) 387-6409). A copy of the manual is also available for inspection at all Environmental Protection Program Offices.

The 96 hour LC_{50} rainbow trout toxicity test shall be carried out in accordance with the procedures described in "Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout," Report EPS 1/RM/13 July 1990. The 48-hour LC_{50} Daphnia Magna toxicity test shall be conducted in accordance with the procedures described in "Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Daphnia Magna," (Reference method EPS 1/RM/14), July 1990.

3.7 Quality Assurance

The Permittee shall, to the satisfaction of the Director, maintain a "Quality Assurance Manual" consistent with "British Columbia Field Sampling Manual for Continuous Monitoring Plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples 2003 Edition (Permittee)", or most recent edition, or by suitable alternative procedures as authorized by the Director. The Permittee shall ensure that all data submitted as a requirement of this permit is produced in accordance with the Quality Assurance Manual approved by the Director. Any future updates to the manual shall be submitted to the Regional Manager, Environmental Protection within 30 days of adoption of the changes by the Permittee.

Analysis of samples for parameters designated under the Environmental Data Quality Assurance Regulation shall be at a laboratory registered for the designated parameter under the Regulation. In addition, the Permittee shall participate in quality assurance audits as required by the Regulation.

3.8 Reporting

Maintain water sample analysis and field measurement data for inspection and submit the data, suitably tabulated, to the Regional Manager, Environmental Protection once every three months. All reports shall be submitted within 45 days of the end of the three-month period during which the data was collected. The data shall be submitted in an electronic format suitable for entry into the provincial database system known as EMS (Environmental Monitoring System).

Douglas Hill, P. Eng.
for Director
Environmental Management Act
Cariboo Region

The Permittee shall submit a comprehensive annual report, in a format suitable for public release, to the Regional Manager, Environmental Protection and to the Likely Public Library, by April 30th of each year. The annual report shall include:

a) the flow measurement, quality assurance, and climate data;
b) an updated water balance spreadsheet for the minesite and tailings impoundment;
c) an annual report on the construction and performance of the tailings impoundment and dam, including a review of the results and analysis of hydrogeological data from the previous year;
d) a summary of all water quality data for the previous calendar year, employing tables and graphs, and including an assessment of relevant quality assurance data;
e) the results of ongoing mine drainage chemistry studies;
f) the results of the ongoing progress in developing site specific water quality objectives and discharge standards for the closure of the tailings impoundment and mine site;
g) an update on progress on reclamation and any updating of the reclamation plan; and,
h) an evaluation of the impacts of the mining and milling operation on the receiving environment from the previous year, including results of any lake and/or biological monitoring that may have been done.

The Director may require modifications to the monitoring program based on the evaluation of the annual report and on any other information collected by Environmental Protection in connection with this discharge.

Douglas Hill, P. Eng.
for Director
Environmental Management Act
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TABLE 1

Site Code	EMS Code	Site Name	Sample Frequency
E1	E225309	tailings impoundment supernatant	monthly
E4	E224221	main embankment seepage pond	monthly, except RBT and Daphnia bioassay shall be quarterly
E5	E232862	tailings impoundment main embankment drain composite	monthly
W1	E225084	lower Morehead Cr.	quarterly
W3a	E216893	Mine Drainage Cr. u/s Bootjack Lake	quarterly
W4	E225124	North Dump Cr. u/s Polley Lk FSR	monthly + 5 weekly in spring and fall
W5	E208039	Bootjack Cr. above Hazeltine Cr.	quarterly
W7	E208038	upper Hazeltine Cr.	quarterly
W8	E216743	NE Edney Cr. Trib.	monthly + 5 weekly in spring and fall
W8z	E223292	SW Edney Cr. Trib.	monthly + 5 weekly in spring and fall
W11	E224223	lower Edney Cr. u/s Quesnel Lk.	2 times/year (spring and fall)
W12	E216744	6K Creek at road	quarterly
W13	E247623	9.5 K Creek u/s Bootjack Lake	quarterly
GW96-1a	E229679	tailings impoundment north well (deep)	2 times/year (spring and fall)
GW96-1b	E229680	tailings impoundment north well (shallow)	2 times/year (spring and fall)
GW96-2a	E229681	tailings impoundment east well (deep)	2 times/year (spring and fall)
GW96-2b	E229682	tailings impoundment east well (shallow)	2 times/year (spring and fall)
GW96-3a	E229683	tailings impoundment SE well (deep)	2 times/year (spring and fall)
GW96-3b	E229684	tailings impoundment SE well (shallow)	2 times/year (spring and fall)
GW96-4a	E229685	tailings impoundment SW well (deep)	2 times/year (spring and fall)
GW96-4b	E229686	tailings impoundment SW well (shallow)	2 times/year (spring and fall)
GW96-5a	E229687	tailings impoundment background well (deep)	2 times/year (spring and fall)
GW96-5b	E229688	tailings impoundment background well (shallow)	2 times/year (spring and fall)
GW96-6	E229689	SE RDS well	Once a year (spring)
GW00-1b	E242384	tailings impoundment west well (shallow)	2 times/year (spring and fall)
GW00-1a	E242385	tailings impoundment west well (deep)	2 times/year (spring and fall)
GW00-2b	E242386	tailings impoundment west well (shallow)	2 times/year (spring and fall)
GW00-2a	E242387	tailings impoundment west well (deep)	2 times/year (spring and fall)
GW00-3b	E242388	tailings impoundment west well (shallow)	2 times/year (spring and fall)
GW00-3a	E242389	tailings impoundment west well (deep)	2 times/year (spring and fall)
GW96-7	E229690	south east sed pond well	Once a year (spring)
GW96-8a	E229691	Bootjack Lake FSR well @ 11 k (deep)	Once a year (spring)
GW96-8b	E229692	Bootjack Lake FSR well @ 11 k (shallow)	Once a year (spring)
GW96-9	E229693	tailings impoundment south well	Once a year (spring)
95-R-4	E229694	Springer pit well	Once a year (spring)
95-R-5	E229695	Lower SE RDS well	Once a year (spring)
GW05-1	E258923	Wight Pit/Polley Lake interface well(s)	quarterly

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for Director
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Date Issued: May 30, 1997
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PERMIT: PE-11678

TABLE 2

Parameter	Sites	MDL*
field pH	all sites	0.1 pH units
field temperature	all sites	0.1 °C
field specific conductivity	all sites	1 µS/cm
96 hour LC_{50} rainbow trout toxicity	E4, during mine operation	10% mortality
48 hour LC50 Daphnia Magna toxicity	E4, during mine operation	10 % mortality
alkalinity	all sites	1 mg/L
sulphate	all sites	1 mg/L
nitrate plus nitrite - N	all surface water and effluent sites, GW96-6,7,8a, 8b, 95-R-4, 5	0.005 mg/L
ammonia - N	all surface water and effluent sites, GW96-6,7,8a, 8b, 95-R-4, 5	0.005 mg/L
total nitrogen	all surface water sites	0.005 mg/L
ortho-phosphorus	all surface water and effluent sites	0.001 mg/L
total phosphorus	all surface water sites	0.001 mg/L
total dissolved phosphorus	all surface water and effluent sites	0.001 mg/L
non-filterable residue	W3a, W4, W5, W7, W8, W8z	10 mg/L
filterable residue	W3a, W4, W5, W7, W8, W8z	5 mg/L
turbidity	W3a, W4, W5, W7, W8, W8z	0.1 NTU
dissolved organic carbon	all surface water sites	0.5 mg/L
hardness	all sites	0.1 mg/L
aluminum	dissolved = all sites	0.001 mg/L
arsenic	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.0001 mg/L
barium	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.01 mg/L
calcium	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.05 mg/L
copper	dissolved = all sites; t&d = all surface water and effluent sites	0.0001 mg/L
iron	dissolved = all sites; t&d = all surface water and effluent sites	0.03 mg/L
lead	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.00005 mg/L
magnesium	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.05 mg/L
manganese	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.0005 mg/L
molybdenum	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.00005 mg/L
nickel	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.001 mg/L
potassium	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.1 mg/L
selenium	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.001 mg/L
silicon	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.5 mg/L
sodium	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.02 mg/L
strontium	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.0001 mg/L
zinc	dissolved = all groundwater wells; t&d = all surface water and effluent sites	0.001 mg/L

* may use higher MDL where results are 10 times MDL used

t&d = total and dissolved

Douglas Hill

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SITE PLAN

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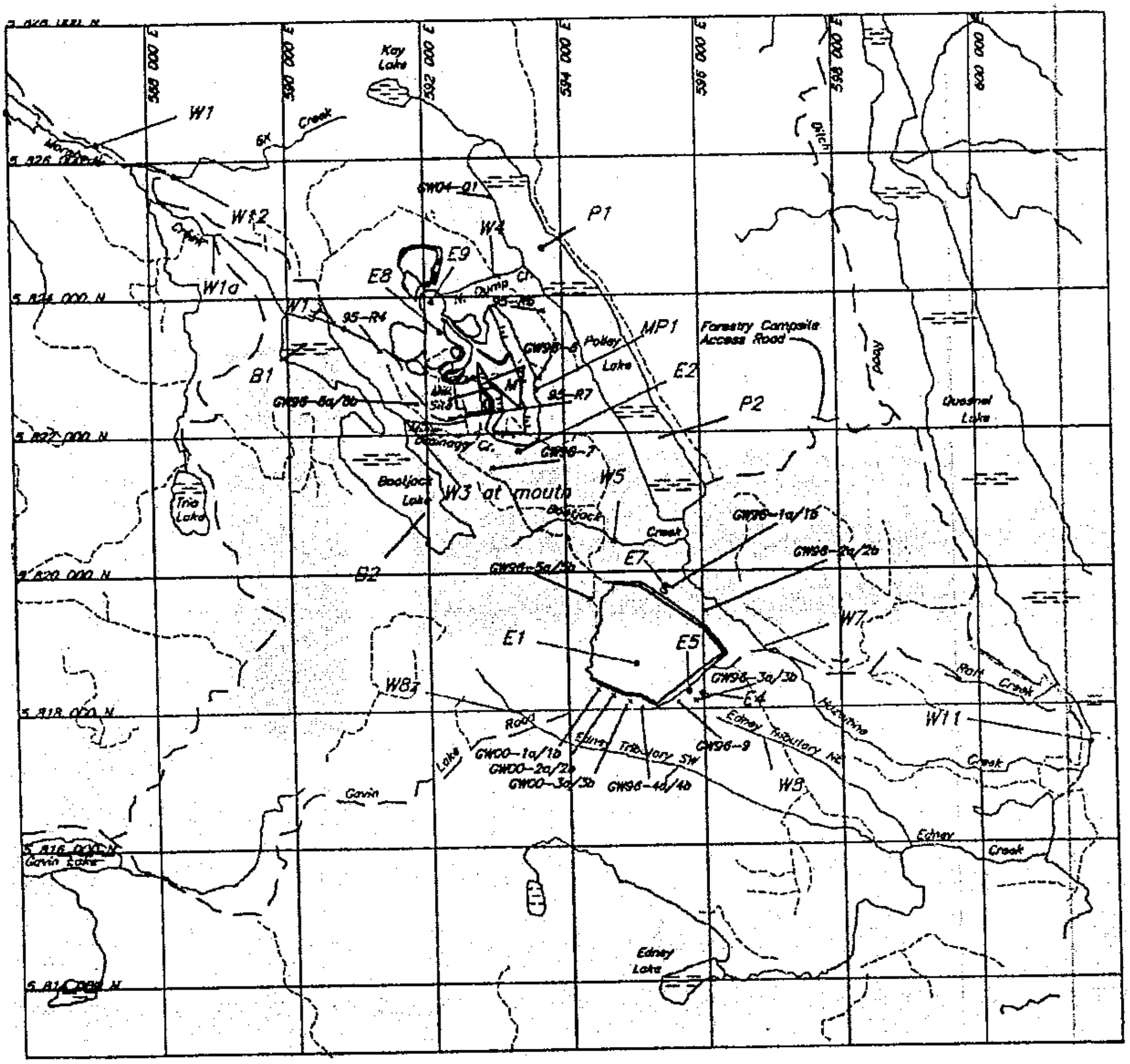

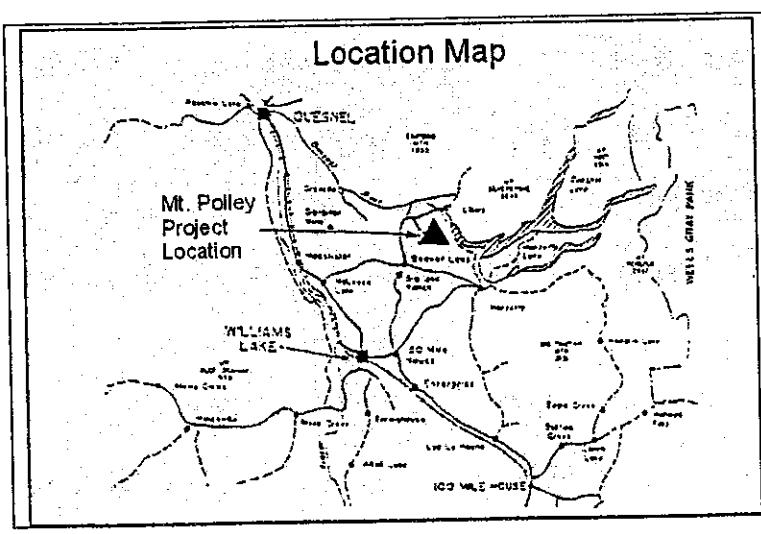

Permit: PE-11678

Date: MAY 0 4 2005

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for Director
Environmental Management Act
Cariboo Region

APPENDIX B

DATA QUALITY ASSESSMENT

APPENDIX B: DATA QUALITY ASSESSMENT

B1.0 INTRODUCTION

Data Quality Assessment (DQA) was conducted on data collected as part of the supplemental aquatic monitoring program for the Mount Polley mine. 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.

B1.1 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).

DQOs were established at the outset of the field program that reflect reasonable and achievable performance expectations (Table B.1). Programs involving a large amount of samples and analytes usually have 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 analytes 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 any questionable data received

Table B.1: Data quality objectives for environmental samples.

Quality Control Measure	Quality Control Sample Type	Study Component		
		Water Quality	Sediment Quality	Tissue Quality
Method Detection Limits (MDL)	Comparison actual MDL versus target MDL	MDL for each parameter should be at least as low as applicable guidelines, ideally ≤1/10th guideline value[a]	MDL for each parameter should be at least as low as applicable guidelines, ideally ≤1/10th guideline value[a]	MDL for each parameter should be at least as low as applicable guidelines, ideally ≤1/10th guideline value[a]
Blank Analysis	Field or Laboratory Blank	≤two-times the laboratory MDL	≤two-times the laboratory MDL	n/a
Field Precision	Field Duplicates	≤25% RPD[b]	≤40% RPD	≤25% RPD
Laboratory Precision	Laboratory Duplicates	≤25% RPD	≤35% RPD	≤30% RPD
Accuracy	Recovery of Blank Spikes	80-120%	75-125%	75-125%
	Recovery of Matrix Spikes	75-125%	75-125%	75-125%
	Recovery of Certified Reference Material, QC Standards	85-115%	70-130%	70-130%

[a] or below predictions, if applicable and no guideline exists for the substance.

[b] RPD - Relative Percent Difference

n/a - not applicable

more scrutiny to determine what effect, if any, this had on interpretation of results within the context of this project.

B1.2 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 of samples occurring in the laboratory. Concentrations of analytes should not be detectable, although a DQO of twice the method detection limit allows for slight "noise" around the detection limit.

- **Field Duplicates** are replicate samples collected from a randomly selected field station using identical collection and handling methods that are then analyzed separately in the laboratory. The data from field replicate 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 replicate sub-samples 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 (in this data set called laboratory control samples) 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.

B2.0 WATER SAMPLES

B2.1 Method Detection Limits

Target laboratory method detection limits (MDLs) for water sample analyses were established at levels below all potentially applicable water quality guidelines (Table B.2). A few of the reported MDLs were above the target concentrations of ≤ 1/10th of the BC guideline: total phosphorus, cadmium, chromium, copper, selenium, silver, vanadium and zinc. Analytical results for total phosphorus and copper reported detectable concentrations in all samples, therefore elevated MDLs would not affect interpretation of the results. The MDLs reported for cadmium, chromium, selenium, silver, vanadium, and zinc were greater than the target but lower than applicable water quality criteria, so interpretation of results for these analytes should not be affected. Water quality data for all analytes can be reliably interpreted relative to the guidelines.

B2.2 Laboratory Blank Sample Analysis

All laboratory blank samples analyzed reported detectable concentrations of the analyte below the data quality objective of two times the laboratory MDL, indicating no inadvertent contamination of samples during laboratory analysis (Table B.3).

B2.3 Travel Blank Sample Analysis

All travel blank samples analyzed reported detectable concentrations of the analyte below the data quality objective of two times the laboratory MDL, indicating no inadvertent contamination of samples during field preparation and transport (Table B.4).

B2.3 Data Precision

Field Duplicate Samples

One set of duplicate water samples was collected in the field, and showed excellent agreement in analyte concentrations between duplicates (Table B.5). Nearly all duplicates met the ≤ 25% relative percent difference (RPD), the only exception being total suspended solids. This is likely the result of the habitat being sampled (i.e., shallow lotic environment with varying amounts of in-stream particulate debris). Heterogeneous conditions would be expected in such a system of low volume, moving water. For instance, disturbances upstream could more readily affect concentrations temporally between a sample and a replicate collected at the same location. Overall, the results suggest that reported sample data were precise representations of conditions at the time of sampling.

Table B.2: Laboratory method detection limits (MDLs) for water quality.

Analyte		Units	BCWQG[1]		CCME WQG[2]	Method Detection Limit	
			30-d Chronic	Maximum		Target	Achieved
Physical	Conductivity	µS/cm	-	-		-	2
	Hardness (as $CaCO_3$)	mg/L	-	-		-	0.5
	pH	pH units	-	6.5 - 9.0	6.5 - 8.5		0.1
	Total Suspended Solids	mg/L	-	-		-	3
	Total Dissolved Solids	mg/L	-	-		-	10
	Turbidity	NTU	-	-		-	0.1
Nutrients, Anions and Organic Carbon	Alkalinity, Total (as $CaCO_3$)	mg/L	-	-		-	2.0
	Ammonia (as N)	mg/L	0.13[a]	0.97[a]	0.13/0.97**[a]	0.013	0.0050
	Chloride (Cl)	mg/L	100	150	100	10.0	0.50
	Nitrate and Nitrite (as N)	mg/L	-	10	100	1.0	0.0051
	Nitrate (as N)	mg/L	3	10	13	0.3	0.0050
	Nitrite (as N)	mg/L	0.02	0.06	0.06	0.002	0.0010
	Total Nitrogen		-	-	-	-	0.050
	Orthophosphate-Dissolved (as P)	mg/L	-	-	-	-	0.0010
	Phosphorus - Total dissolved	mg/L	-	-	-	-	0.0020
	Phosphorus (P)-Total	mg/L	-	0.005	0.004	0.0005	0.0020
	Sulfate (SO_4)	mg/L	-	100	1,000	10	0.50
	Dissolved Organic Carbon	mg/L	-	-	-	-	0.50
	Total Organic Carbon	mg/L	-	-	-	-	0.50
Total metals	Aluminum (Al)-Total	mg/L	5	5	0.05[b]	0.5	0.003
	Antimony (Sb)-Total	mg/L	-	0.014*	-	0.0014	0.0001
	Arsenic (As)-Total	mg/L	-	0.005	0.005	0.0005	0.0001
	Barium (Ba)-Total	mg/L	1	5	1	0.1	0.00005
	Beryllium (Be)-Total	mg/L	-	0.004*	0.1	0.0004	0.0001
	Bismuth (Bi)-Total	mg/L	-	-	-	-	0.0005
	Boron (B)-Total	mg/L	-	0.5	0.5	0.05	0.01
	Cadmium (Cd)-Total	mg/L	-	0.00002*[b]	0.00002[c]	0.000002	0.00001
	Calcium (Ca)-Total	mg/L	-	-	-	-	0.05
	Chromium (Cr)-Total	mg/L	-	0.001	0.001	0.0001	0.0005
	Cobalt (Co)-Total	mg/L	0.004	0.11	0.05	0.0004	0.0001
	Copper (Cu)-Total	mg/L	0.0019[b]	0.0070[b]	0.002[c]	0.0001900	0.0005
	Iron (Fe)-Total	mg/L	-	1	-	0.1	0.03
	Lead (Pb)-Total	mg/L	0.0046[b]	0.032[b]	0.001[c]	0.00046	0.00005
	Lithium (Li)-Total	mg/L	0.014*	-	2.5	0.0014	0.0005
	Magnesium (Mg)-Total	mg/L	-	-	-	-	0.1
	Manganese (Mn)-Total	mg/L	0.843	0.200*	0.2	0.02	0.00005
	Molybdenum (Mo)-Total	mg/L	0.01	0.05	0.01	0.001	0.00005
	Nickel (Ni)-Total	mg/L	-	0.025*[b]	0.025[c]	0.0025	0.0005
	Potassium (K)-Total	mg/L	-	373	-	37.3	0.05
	Selenium (Se)-Total	mg/L	-	0.002	0.001	0.0002	0.0005
	Silicon (Si)-Total	mg/L	-	-	-	-	0.05
	Silver (Ag)-Total	mg/L	0.00005[b]	0.00010[b]	-	0.000005	0.00001
	Sodium (Na)-Total	mg/L	-	-	-	-	0.05

Table B.2: Laboratory method detection limits (MDLs) for water quality.

Analyte		Units	BCWQG[1]		CCME WQG[2]	Method Detection Limit	
			30-d Chronic	Maximum		Target	Achieved
Total metals	Strontium (Sr)-Total	mg/L	-	-	-	-	0.0001
	Thallium (Tl)-Total	mg/L	0.0008*	0.0003*	0.8	0.00003	0.00001
	Tin (Sn)-Total	mg/L	-	-	-	-	0.0001
	Titanium (Ti)-Total	mg/L	-	2	-	0.2	0.01
	Uranium (U)-Total	mg/L	-	-	0.015	-	0.00001
	Vanadium (V)-Total	mg/L	-	0.006*	0.1	0.0006	0.001
	Zinc (Zn)-Total	mg/L	0.0075	0.033	0.03	0.00075	0.003
Dissolved metals	Aluminum (Al)-Dissolved	mg/L	0.050	0.100	-	0.005	0.003
	Antimony (Sb)-Dissolved	mg/L	-	-	-	-	0.0001
	Arsenic (As)-Dissolved	mg/L	-	-	-	-	0.0001
	Barium (Ba)-Dissolved	mg/L	-	-	-	-	0.00005
	Beryllium (Be)-Dissolved	mg/L	-	-	-	-	0.0001
	Bismuth (Bi)-Dissolved	mg/L	-	-	-	-	0.0005
	Boron (B)-Dissolved	mg/L	-	-	-	-	0.01
	Cadmium (Cd)-Dissolved	mg/L	-	-	-	-	0.00001
	Calcium (Ca)-Dissolved	mg/L	-	-	-	-	0.05
	Chromium (Cr)-Dissolved	mg/L	-	-	-	-	0.0005
	Cobalt (Co)-Dissolved	mg/L	-	-	-	-	0.0001
	Copper (Cu)-Dissolved	mg/L	-	-	-	-	0.0005
	Iron (Fe)-Dissolved	mg/L	-	0.35	0.30	0.035	0.03
	Lead (Pb)-Dissolved	mg/L	-	-	-	-	0.00005
	Lithium (Li)-Dissolved	mg/L	-	-	-	-	0.0005
	Magnesium (Mg)-Dissolved	mg/L	-	-	-	-	0.1
	Manganese (Mn)-Dissolved	mg/L	-	-	-	-	0.00005
	Molybdenum (Mo)-Dissolved	mg/L	-	-	-	-	0.00005
	Nickel (Ni)-Dissolved	mg/L	-	-	-	-	0.0005
	Potassium (K)-Dissolved	mg/L	-	-	-	-	0.05
	Selenium (Se)-Dissolved	mg/L	-	-	-	-	0.0005
	Silicon (Si)-Dissolved	mg/L	-	-	-	-	0.05
	Silver (Ag)-Dissolved	mg/L	-	-	-	-	0.00001
	Sodium (Na)-Dissolved	mg/L	-	-	-	-	0.05
	Strontium (Sr)-Dissolved	mg/L	-	-	-	-	0.0001
	Thallium (Tl)-Dissolved	mg/L	-	-	-	-	0.00001
	Tin (Sn)-Dissolved	mg/L	-	-	-	-	0.0001
	Titanium (Ti)-Dissolved	mg/L	-	-	-	-	0.01
	Uranium (U)-Dissolved	mg/L	-	-	-	-	0.00001
	Vanadium (V)-Dissolved	mg/L	-	-	-	-	0.001
	Zinc (Zn)-Dissolved	mg/L	-	-	-	-	0.003

[1] British Columbia Approved Water Quality Guidelines (BC MOE 2006) unless noted otherwise

[2] Canadian Council of Ministers of the Environment Water Quality Guidelines

[*] British Columbia Working Water Quality Guidelines (Nagpal et al. 2006)

[a] Lowest guideline based on highest possible temperature and pH

[b] Lowest guideline based lowest possible pH

[c] Lowest guideline based on lowest possible hardness

(grey box) achieved method detection limit greater than 0.1 x lowest guideline

Table B.3: Laboratory QAQC for water quality.

	Analyte	Units	Method Blank			Spiked Blank				Matrix Spike				Certified Reference Material			
			Target	Achieved	# Tests	Target	Achieved	# Tests	% Recovery	Target	Achieved	# Tests	% Recovery	Target	Achieved	# Tests	% Recovery
Physical	Conductivity	µS/cm	4	<2.0	7	-	-	-	-	-	-	-	-	147	146	1	100
	Hardness (as $CaCO_3$)	mg/L	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
	pH	pH units	0.2	-	0	-	-	-	-	-	-	-	-	7	7.02	1	100
	Total Suspended Solids	mg/L	6	<3.0	5	75	64 - 74	5	85 - 99	-	-	-	-	-	-	-	-
	Total Dissolved Solids	mg/L	20	<10	6	425	412 - 431	6	97 - 101	-	-	-	-	-	-	-	-
	Turbidity	NTU	0.2	<0.10	8	-	-	-	-	-	-	-	-	8.00	7.96 - 8.36	8	100 - 105
Nutrients, Anions and Organic Carbon	Alkalinity, Total (as $CaCO_3$)	mg/L	4	<1.0	4	-	-	-	-					50.0	52.0	1	104
	Ammonia (as N)	mg/L	0.01	<0.0050	5	-	-	-	-	0.206	0.199	1	96	0.12	0.114 - 0.119	5	95 - 99
										0.245	0.233	1	94				
	Chloride (Cl)	mg/L	1	<0.50	11	100	100.7 - 101.5	4	101	50.0	49.8 - 50.8	7	100 - 102	-	-	-	-
	Nitrate and Nitrite (as N)	mg/L	0.0102	-	0	-	-	-	-	-	-	-	-	-	-	-	-
	Nitrate (as N)	mg/L	0.01	<0.0050	11	2.50	2.54 - 2.58	4	102 - 103	1.25	1.26 - 1.28	5	101 - 103	-	-	-	-
										1.28	1.31	1	102				
										1.30	1.33	1	102				
	Nitrite (as N)	mg/L	0.002	<0.0010	11	0.500	0.510 - 0.518	4	102 - 104	-	-	-	-	-	-	-	-
	Total Nitrogen	mg/L	0.1	<0.05	4	-	-	-	-	-	-	-	-	5.00	5.14 - 5.77	4	103 - 115
	Orthophosphate-Dissolved (as P)	mg/L	0.002	<0.0010	1	-	-	-	-	-	-	-	-	0.0300	0.0287	1	96
	Phosphorus - Total Dissolved	mg/L	0.004	<0.0020	8	-	-	-	-	-	-	-	-	3.99	4.02 - 4.18	8	101 - 105
	Phosphorus (P) - Total	mg/L	0.004	<0.0020	8	-	-	-	-	-	-	-	-	3.99	3.93 - 4.33	8	99 - 108
	Sulfate (SO4)	mg/L	1	<0.50	11	100	103.3 - 104.2	4	103 - 104	50.0	51.4 - 52.5	2	103 - 105	-	-	-	-
			-	-	-	-	-	-	-	52.0	54.0	1	104	-	-	-	-
			-	-	-	-	-	-	-	64.7	65.1	1	101	-	-	-	-
			-	-	-	-	-	-	-	277	264.9	1	96	-	-	-	-
			-	-	-	-	-	-	-	57.7	59.4	1	103	-	-	-	-
			-	-	-	-	-	-	-	90.6	89.2	1	97	-	-	-	-
	Dissolved Organic Carbon	mg/L	1	<0.50	2	-	-	-	-	10.7	10.5	1	98	-	-	-	-
	Total Organic Carbon	mg/L	1	<0.50	2	-	-	-	-	-	-	-	-	8.57	8.26 - 8.57	4	96 - 100
Total metals	Aluminum (Al)-Total	mg/L	0.006	<0.0030	2	-	-	-	-	-	-	-	-	2.00	1.86 - 1.91	2	93 - 96
	Antimony (Sb)-Total	mg/L	0.0002	<0.00010	2	-	-	-	-	-	-	-	-	1.00	0.979 - 0.965	2	98 - 97
	Arsenic (As)-Total	mg/L	0.0002	<0.00010	2	-	-	-	-	-	-	-	-	1.00	0.965 - 0.969	2	97 - 97
	Barium (Ba)-Total	mg/L	0.0001	<0.000050	2	-	-	-	-	-	-	-	-	0.250	0.253 - 0.236	2	101 - 95
	Beryllium (Be)-Total	mg/L	0.0002	<0.00010	2	-	-	-	-	-	-	-	-	0.100	0.102 - 0.0995	2	102 - 99
	Bismuth (Bi)-Total	mg/L	0.001	<0.00050	2	-	-	-	-	-	-	-	-	1.00	1.00 - 0.963	2	100 - 96
	Boron (B)-Total	mg/L	0.02	<0.010	2	-	-	-	-	-	-	-	-	1.00	0.89 - 0.90	2	89 - 90
	Cadmium (Cd)-Total	mg/L	0.00002	<0.000010	2	-	-	-	-	-	-	-	-	0.100	0.101 - 0.0972	2	101 - 97
	Calcium (Ca)-Total	mg/L	0.1	<0.050	2	-	-	-	-	-	-	-	-	50.0	51.9 - 49.8	2	104 - 100
	Chromium (Cr)-Total	mg/L	0.001	<0.00010	2	-	-	-	-	-	-	-	-	0.250	0.245 - 0.237	2	98 - 95
	Cobalt (Co)-Total	mg/L	0.0002	<0.00010	2	-	-	-	-	-	-	-	-	0.250	0.243 - 0.237	2	97 - 95
	Copper (Cu)-Total	mg/L	0.001	<0.00050	2	-	-	-	-	-	-	-	-	0.250	0.235 - 0.235	2	94 - 94
	Iron (Fe)-Total	mg/L	0.06	<0.030	2	-	-	-	-	-	-	-	-	1.00	0.981 - 0.944	2	98 - 94
	Lead (Pb)-Total	mg/L	0.0001	<0.000050 - 0.00428	2	-	-	-	-	-	-	-	-	0.500	0.500 - 0.510	2	100 - 102

Table B.3: Laboratory QAQC for water quality.

Analyte		Units	Method Blank			Spiked Blank				Matrix Spike				Certified Reference Material			
			Target	Achieved	# Tests	Target	Achieved	# Tests	% Recovery	Target	Achieved	# Tests	% Recovery	Target	Achieved	# Tests	% Recovery
Total Metals	Lithium (Li)-Total	mg/L	0.001	<0.00050	2	-	-	-	-	-	-	-	-	0.250	0.247 - 0.228	2	99 - 91
	Magnesium (Mg)-Total	mg/L	0.2	<0.10	2	-	-	-	-	-	-	-	-	50.0	50.4 - 49.6	2	101 - 99
	Manganese (Mn)-Total	mg/L	0.0001	<0.000050	2	-	-	-	-	-	-	-	-	0.250	0.256 - 0.241	2	102 - 97
	Molybdenum (Mo)-Total	mg/L	0.0001	<0.000050	2	-	-	-	-	-	-	-	-	0.250	0.249 - 0.247	2	100 - 99
	Nickel (Ni)-Total	mg/L	0.001	<0.00050	2	-	-	-	-	-	-	-	-	0.500	0.503 - 0.492	2	101 - 98
	Potassium (K)-Total	mg/L	0.1	<0.050	2	-	-	-	-	-	-	-	-	50.0	48.8 - 46.6	2	98 - 93
	Selenium (Se)-Total	mg/L	0.001	<0.00010	2	-	-	-	-	-	-	-	-	1.00	0.965 - 0.989	2	97 - 99
	Silicon (Si)-Total	mg/L	0.1	<0.050	2	-	-	-	-	-	-	-	-	1.00	1.07 - 1.03	2	107 - 103
	Silver (Ag)-Total	mg/L	0.00002	<0.000010	2	-	-	-	-	-	-	-	-	0.100	0.0920 - 0.0902	2	92 - 90
	Sodium (Na)-Total	mg/L	0.1	<0.050	2	-	-	-	-	-	-	-	-	50.0	50.0 - 49.8	2	100 - 100
	Strontium (Sr)-Total	mg/L	0.0002	<0.00010	2	-	-	-	-	-	-	-	-	0.250	0.252 - 0.249	2	101 - 100
	Thallium (Tl)-Total	mg/L	0.00002	<0.000010	2	-	-	-	-	-	-	-	-	1.00	0.997 - 0.972	2	100 - 97
	Tin (Sn)-Total	mg/L	0.0002	<0.00010	2	-	-	-	-	-	-	-	-	0.500	0.507 - 0.486	2	101 - 97
	Titanium (Ti)-Total	mg/L	0.02	<0.010	2	-	-	-	-	-	-	-	-	0.250	0.251 - 0.238	2	100 - 95
	Uranium (U)-Total	mg/L	0.00002	<0.000010	2	-	-	-	-	-	-	-	-	0.00500	0.00497 - 0.00503	2	99 - 101
	Vanadium (V)-Total	mg/L	0.002	<0.0010	2	-	-	-	-	-	-	-	-	0.500	0.491 - 0.483	2	98 - 97
	Zinc (Zn)-Total	mg/L	0.006	<0.0030	2	-	-	-	-	-	-	-	-	0.500	0.460 - 0.455	2	92 - 91
Dissolved metals	Aluminum (Al)-Dissolved	mg/L	0.006	<0.0030	2	-	-	-	-	-	-	-	-	2.00	1.89	1	94
	Antimony (Sb)-Dissolved	mg/L	0.0002	<0.00010	2	-	-	-	-	-	-	-	-	1.00	0.997	1	100
	Arsenic (As)-Dissolved	mg/L	0.0002	<0.00010	2	-	-	-	-	-	-	-	-	1.00	1.00	1	100
	Barium (Ba)-Dissolved	mg/L	0.0001	<0.000050	2	-	-	-	-	-	-	-	-	0.250	0.243	1	97
	Beryllium (Be)-Dissolved	mg/L	0.0002	<0.00010	2	-	-	-	-	-	-	-	-	0.100	0.103	1	103
	Bismuth (Bi)-Dissolved	mg/L	0.001	<0.00050	2	-	-	-	-	-	-	-	-	1.00	0.969	1	97
	Boron (B)-Dissolved	mg/L	0.02	<0.010	2	-	-	-	-	-	-	-	-	1.00	0.93	1	93
	Cadmium (Cd)-Dissolved	mg/L	0.00002	<0.000010	2	-	-	-	-	-	-	-	-	0.100	0.0995	1	100
	Calcium (Ca)-Dissolved	mg/L	0.1	<0.050	2	-	-	-	-	-	-	-	-	50.0	51.3	1	103
	Chromium (Cr)-Dissolved	mg/L	0.001	<0.00010	2	-	-	-	-	-	-	-	-	0.250	0.243	1	97
	Cobalt (Co)-Dissolved	mg/L	0.0002	<0.00010	2	-	-	-	-	-	-	-	-	0.250	0.242	1	97
	Copper (Cu)-Dissolved	mg/L	0.001	<0.00050	2	-	-	-	-	-	-	-	-	0.250	0.240	1	96
	Iron (Fe)-Dissolved	mg/L	0.06	<0.030	2	-	-	-	-	-	-	-	-	1.00	0.977	1	98
	Lead (Pb)-Dissolved	mg/L	0.0001	<0.000050	2	-	-	-	-	-	-	-	-	0.500	0.516	1	103
	Lithium (Li)-Dissolved	mg/L	0.001	<0.00050	2	-	-	-	-	-	-	-	-	0.250	0.238	1	95
	Magnesium (Mg)-Dissolved	mg/L	0.2	<0.10	2	-	-	-	-	-	-	-	-	50.0	50.2	1	100
	Manganese (Mn)-Dissolved	mg/L	0.0001	<0.000050	2	-	-	-	-	-	-	-	-	0.250	0.247	1	99
	Molybdenum (Mo)-Dissolved	mg/L	0.0001	<0.000050	2	-	-	-	-	-	-	-	-	0.250	0.252	1	101
	Nickel (Ni)-Dissolved	mg/L	0.001	<0.00050	2	-	-	-	-	-	-	-	-	0.500	0.506	1	101
	Potassium (K)-Dissolved	mg/L	0.1	<0.050	2	-	-	-	-	-	-	-	-	50.0	47.4	1	95
	Selenium (Se)-Dissolved	mg/L	0.001	<0.00010	2	-	-	-	-	-	-	-	-	1.00	0.994	1	99
	Silicon (Si)-Dissolved	mg/L	0.1	<0.050	2	-	-	-	-	-	-	-	-	1.00	1.10	1	110
	Silver (Ag)-Dissolved	mg/L	0.00002	<0.000010	2	-	-	-	-	-	-	-	-	0.100	0.0925	1	92
	Sodium (Na)-Dissolved	mg/L	0.1	<0.050	2	-	-	-	-	-	-	-	-	50.0	51.4	1	103
	Strontium (Sr)-Dissolved	mg/L	0.0002	<0.00010	2	-	-	-	-	-	-	-	-	0.250	0.256	1	102
	Thallium (Tl)-Dissolved	mg/L	0.00002	<0.000010	2	-	-	-	-	-	-	-	-	1.00	0.969	1	97

Table B.3: Laboratory QAQC for water quality.

Analyte		Units	Method Blank			Spiked Blank				Matrix Spike				Certified Reference Material			
			Target	Achieved	# Tests	Target	Achieved	# Tests	% Recovery	Target	Achieved	# Tests	% Recovery	Target	Achieved	# Tests	% Recovery
Dissolved metals	Tin (Sn)-Dissolved	mg/L	0.0002	<0.00010 - 0.00038	2	-	-	-	-	-	-	-	-	0.500	0.499	1	100
	Titanium (Ti)-Dissolved	mg/L	0.02	<0.010	2	-	-	-	-	-	-	-	-	0.250	0.253	1	101
	Uranium (U)-Dissolved	mg/L	0.00002	<0.000010	2	-	-	-	-	-	-	-	-	0.00500	0.00514	1	103
	Vanadium (V)-Dissolved	mg/L	0.002	<0.0010	2	-	-	-	-	-	-	-	-	0.500	0.490	1	98
	Zinc (Zn)-Dissolved	mg/L	0.006	<0.0030	2	-	-	-	-	-	-	-	-	0.500	0.471	1	94

Table B.4: Travel blank analysis for water quality.

	Analyte	Units	MDL	Travel Blank
Physical	Conductivity	µS/cm	2	<2.0
	Hardness (as $CaCO_3$)	mg/L	0.5	<0.50
	pH	pH units	0.1	6.06
	Total Suspended Solids	mg/L	3	<3.0
	Total Dissolved Solids	mg/L	10	<10
	Turbidity	NTU	0.1	<0.10
Nutrients, Anions and Organic Carbon	Alkalinity, Total (as $CaCO_3$)	mg/L	2	<2.0
	Ammonia (as N)	mg/L	0.005	0.0157
	Chloride (Cl)	mg/L	0.5	<0.50
	Nitrate and Nitrite (as N)	mg/L	0.0051	<0.0051
	Nitrate (as N)	mg/L	0.005	<0.0050
	Nitrite (as N)	mg/L	0.001	<0.0010
	Total Nitrogen		0.05	<0.050
	Orthophosphate-Dissolved (as P)	mg/L	0.001	<0.0010
	Phosphorus - Total dissolved	mg/L	0.002	<0.0020
	Phosphorus (P)-Total	mg/L	0.002	<0.0020
	Sulfate (SO4)	mg/L	0.5	<0.50
	Dissolved Organic Carbon	mg/L	-	-
	Total Organic Carbon	mg/L	0.5	<0.50
Total metals	Aluminum (Al)-Total	mg/L	0.003	<0.0030
	Antimony (Sb)-Total	mg/L	0.0001	<0.00010
	Arsenic (As)-Total	mg/L	0.0001	<0.00010
	Barium (Ba)-Total	mg/L	0.00005	<0.000050
	Beryllium (Be)-Total	mg/L	0.0001	<0.00010
	Bismuth (Bi)-Total	mg/L	0.0005	<0.00050
	Boron (B)-Total	mg/L	0.01	<0.010
	Cadmium (Cd)-Total	mg/L	0.00001	<0.000010
	Calcium (Ca)-Total	mg/L	0.05	<0.050
	Chromium (Cr)-Total	mg/L	0.0005	<0.00050
	Cobalt (Co)-Total	mg/L	0.0001	<0.00010
	Copper (Cu)-Total	mg/L	0.0005	<0.00050
	Iron (Fe)-Total	mg/L	0.03	<0.030
	Lead (Pb)-Total	mg/L	0.00005	<0.000050
	Lithium (Li)-Total	mg/L	0.0005	<0.00050
	Magnesium (Mg)-Total	mg/L	0.1	<0.10
	Manganese (Mn)-Total	mg/L	0.00005	<0.000050
	Molybdenum (Mo)-Total	mg/L	0.00005	<0.000050
	Nickel (Ni)-Total	mg/L	0.0005	<0.00050
	Potassium (K)-Total	mg/L	0.05	<0.050
	Selenium (Se)-Total	mg/L	0.0005	<0.00050
	Silicon (Si)-Total	mg/L	0.05	<0.050
	Silver (Ag)-Total	mg/L	0.00001	<0.000010
	Sodium (Na)-Total	mg/L	0.05	<0.050
	Strontium (Sr)-Total	mg/L	0.0001	<0.00010
	Thallium (Tl)-Total	mg/L	0.00001	<0.000010
	Tin (Sn)-Total	mg/L	0.0001	<0.00010
	Titanium (Ti)-Total	mg/L	0.01	<0.010
	Uranium (U)-Total	mg/L	0.00001	<0.000010
	Vanadium (V)-Total	mg/L	0.001	<0.0010
	Zinc (Zn)-Total	mg/L	0.003	<0.0030

> 25% RPD

Table B.5: Field duplicate analysis for water quality.

Analyte		Units	Method Detection Limit		
			W7	WG	RPD[1]
Physical	Conductivity	µS/cm	207	208	0
	Hardness (as $CaCO_3$)	mg/L	105	107	2
	pH	pH units	8.04	8.02	0
	Total Suspended Solids	mg/L	3	4.3	36
	Total Dissolved Solids	mg/L	141	138	2
	Turbidity	NTU	1.33	1.24	7
Nutrients, Anions and Organic Carbon	Alkalinity, Total (as $CaCO_3$)	mg/L	82.6	82.7	0
	Ammonia (as N)	mg/L	0.0116	0.0117	1
	Chloride (Cl)	mg/L	<0.50	<0.50	0
	Nitrate and Nitrite (as N)	mg/L	0.0269	0.0	5
	Nitrate (as N)	mg/L	0.0269	0.0283	5
	Nitrite (as N)	mg/L	<0.0010	<0.0010	0
	Total Nitrogen		0.28	0.29	4
	Orthophosphate-Dissolved (as P)	mg/L	0.0051	0.0052	2
	Phosphorus - Total dissolved	mg/L	0.0102	0.0102	0
	Phosphorus (P)-Total	mg/L	0.0237	0.023	3
	Sulfate (SO4)	mg/L	27.2	27.2	0
	Dissolved Organic Carbon	mg/L	5.82	5.72	2
	Total Organic Carbon	mg/L	-	-	-
Total metals	Aluminum (Al)-Total	mg/L	0.043	0.0436	1
	Antimony (Sb)-Total	mg/L	<0.00010	<0.00010	0
	Arsenic (As)-Total	mg/L	0.00051	0.00053	4
	Barium (Ba)-Total	mg/L	0.00689	0.00714	4
	Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	0
	Bismuth (Bi)-Total	mg/L	<0.00050	<0.00050	0
	Boron (B)-Total	mg/L	0.023	0.024	4
	Cadmium (Cd)-Total	mg/L	<0.000010	<0.000010	0
	Calcium (Ca)-Total	mg/L	32.5	33.7	4
	Chromium (Cr)-Total	mg/L	<0.00050	<0.00050	0
	Cobalt (Co)-Total	mg/L	<0.00010	<0.00010	0
	Copper (Cu)-Total	mg/L	0.00162	0.0016400	1
	Iron (Fe)-Total	mg/L	0.07	0.07	0
	Lead (Pb)-Total	mg/L	<0.000050	<0.000050	0
	Lithium (Li)-Total	mg/L	<0.00050	<0.00050	0
	Magnesium (Mg)-Total	mg/L	5.22	5.36	3
	Manganese (Mn)-Total	mg/L	0.0233	0.024	3
	Molybdenum (Mo)-Total	mg/L	0.00218	0.002	2
	Nickel (Ni)-Total	mg/L	<0.00050	<0.00050	0
	Potassium (K)-Total	mg/L	0.386	0.395	2
	Selenium (Se)-Total	mg/L	0.00062	0.00066	6
	Silicon (Si)-Total	mg/L	3.45	3.55	3
	Silver (Ag)-Total	mg/L	<0.000010	<0.000010	0
	Sodium (Na)-Total	mg/L	4.74	4.93	4
	Strontium (Sr)-Total	mg/L	0.247	0.254	3
	Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	0
	Tin (Sn)-Total	mg/L	<0.00010	<0.00010	0
	Titanium (Ti)-Total	mg/L	<0.010	<0.010	0
	Uranium (U)-Total	mg/L	0.000118	0.000118	0
	Vanadium (V)-Total	mg/L	0.0011	0.0012	9
	Zinc (Zn)-Total	mg/L	<0.0030	<0.0030	0
Dissolved metals	Aluminum (Al)-Dissolved	mg/L	0.0098	0.0098	0
	Antimony (Sb)-Dissolved	mg/L	<0.00010	<0.00010	0
	Arsenic (As)-Dissolved	mg/L	0.00049	0.00050	2
	Barium (Ba)-Dissolved	mg/L	0.00676	0.00663	2
	Beryllium (Be)-Dissolved	mg/L	<0.00010	<0.00010	0
	Bismuth (Bi)-Dissolved	mg/L	<0.00050	<0.00050	0
	Boron (B)-Dissolved	mg/L	0.023	0.023	0
	Cadmium (Cd)-Dissolved	mg/L	<0.000010	<0.000010	0
	Calcium (Ca)-Dissolved	mg/L	33.2	34.0	2
	Chromium (Cr)-Dissolved	mg/L	<0.00050	<0.00050	0
	Cobalt (Co)-Dissolved	mg/L	<0.00010	<0.00010	0
	Copper (Cu)-Dissolved	mg/L	0.00136	0.00137	1
	Iron (Fe)-Dissolved	mg/L	<0.030	<0.030	0
	Lead (Pb)-Dissolved	mg/L	<0.000050	<0.000050	0
	Lithium (Li)-Dissolved	mg/L	<0.00050	<0.00050	0
	Magnesium (Mg)-Dissolved	mg/L	5.25	5.32	1
	Manganese (Mn)-Dissolved	mg/L	0.000337	0.000373	10
	Molybdenum (Mo)-Dissolved	mg/L	0.00218	0.00220	1
	Nickel (Ni)-Dissolved	mg/L	<0.00050	<0.00050	0
	Potassium (K)-Dissolved	mg/L	0.385	0.381	1
	Selenium (Se)-Dissolved	mg/L	0.00067	0.00070	4
	Silicon (Si)-Dissolved	mg/L	3.40	3.45	1
	Silver (Ag)-Dissolved	mg/L	<0.000010	<0.000010	0
	Sodium (Na)-Dissolved	mg/L	4.91	4.86	1
	Strontium (Sr)-Dissolved	mg/L	0.249	0.247	1
	Thallium (Tl)-Dissolved	mg/L	<0.000010	<0.000010	0
	Tin (Sn)-Dissolved	mg/L	<0.00010	<0.00010	0
	Titanium (Ti)-Dissolved	mg/L	<0.010	<0.010	0
	Uranium (U)-Dissolved	mg/L	0.000118	0.000116	2
	Vanadium (V)-Dissolved	mg/L	0.0011	0.0010	10
	Zinc (Zn)-Dissolved	mg/L	<0.0030	<0.0030	0

[1] RPD - Relative Percent Difference

(grey shading) > 25% RPD

Laboratory Duplicate Samples

The data quality objective of ≤ 25% RPD was achieved between all laboratory duplicate samples (Table B.6). Reported sample results were therefore associated with excellent analytical precision.

B2.4 Data Accuracy

Matrix Spike Recovery Samples

Analyte recoveries for spiked blank (laboratory control) samples and matrix spikes all met the data quality objective (Table B.3), indicating excellent analytical accuracy associated with the analysis of water samples.

Certified Reference Materials

Reference material recoveries were all reported within the target range (Table B.3). This further indicates sufficient analytical accuracy.

Table B.6: Laboratory duplicate analysis for water quality.

Analyte	Units	1	2	RPD[1]
Conductivity	mg/L	207	208	0%
pH	mg/L	8.04	8.00	0%
Alkalinity, Total (as CaCO3)	mg/L	82.6	82.7	0%
Orthophosphate-Dissolved (as P)	mg/L	0.0051	0.0052	2%
Phosphorus (P)-Total Dissolved	mg/L	0.0102	0.0107	5%
Phosphorus (P)-Total	mg/L	0.023	0.0225	2%
Ammonia (as N)	mg/L	0.0157	0.0155	1%

[1] RPD - Relative Percent Difference

> 25% RPD

B3.0 SEDIMENT SAMPLES

B3.1 Method Detection Limits

Target laboratory MDLs for sediment sample analyses were established at levels 0.1 times the lowest applicable sediment quality guidelines. The MDL for two analytes was reported to be above this target: cadmium and lead (Table B.7). The MDL for cadmium was reported above both the target MDL and the CCME guideline for sediment. This was problematic as concentrations of cadmium in all sediment samples were below the MDL. The MDL for lead, although above the target, was below the all guidelines and therefore was not an issue in interpretation of data relative to guidelines. All other analytes were reported by the laboratory to have been below the target concentration, indicating acceptable analytical resolution overall.

B3.2 Laboratory Blank Sample Analysis

All laboratory blank samples were reported to have concentrations below two times the laboratory MDL for all analytes, indicating no inadvertent contamination of samples within the laboratory during analysis (Table B.8).

B3.3 Data Precision

Laboratory Duplicate Samples

The laboratory reported duplicate sample results only for total organic carbon, and the results met the data quality objective (Table B.8). Using the total organic carbon as a general indication of precision quality would demonstrate that the laboratory achieved sufficient precision; however the lack of duplicate data for other analytes makes it difficult to comment on laboratory precision overall.

B3.4 Data Accuracy

Certified Reference Materials

Reference material recovery met the data quality objectives in all cases except lead (Table B.8). One of the two reference material tests for lead resulted in an extremely high recovery value, indicating potential accuracy issues for lead which should be considered in the interpretation of data. All other results indicated excellent analytical accuracy.

Table B.7: Laboratory method detection limits (MDLs) for sediment quality.

Analyte		Units	BC Sediment Quality Guidelines[1]	Target	Achieved
Carbon	Total Organic Carbon	%	-	-	0.10
Metals	Aluminum (Al)	mg/kg	-	-	50
	Antimony (Sb)	mg/kg	-	-	0.10
	Arsenic (As)	mg/kg	5.9/17[2]	0.59	0.050
	Barium (Ba)	mg/kg	-	-	0.50
	Beryllium (Be)	mg/kg	-	-	0.20
	Bismuth (Bi)	mg/kg	-	-	0.20
	Cadmium (Cd)	mg/kg	0.6/3.52[2]	0.06	**0.80**
	Calcium (Ca)	mg/kg	-	-	50
	Chromium (Cr)	mg/kg	37.3/90[2]	3.73	0.50
	Cobalt (Co)	mg/kg	-	-	0.10
	Copper (Cu)	mg/kg	35.7/197[2]	3.57	0.50
	Iron (Fe)	mg/kg	21,200/ 43,766[3]	-	50
	Lead (Pb)	mg/kg	35/91.3[2]	3.5	8.0 - 9.0
	Lithium (Li)	mg/kg	-	-	1.0
	Magnesium (Mg)	mg/kg	-	-	20
	Manganese (Mn)	mg/kg	460/1,100[3]	-	1.0
	Mercury (Hg)	mg/kg	0.17/0.486[2]	0.017	0.0050
	Molybdenum (Mo)	mg/kg	-	-	0.50
	Nickel (Ni)	mg/kg	16/75[3]	-	0.50
	Phosphorus (P)	mg/kg	-	-	50
	Potassium (K)	mg/kg	-	-	100
	Selenium (Se)	mg/kg	2	-	0.20
	Silver (Ag)	mg/kg	0.5	-	0.10
	Sodium (Na)	mg/kg	-	-	100
	Strontium (Sr)	mg/kg	-	-	0.50
	Thallium (Tl)	mg/kg	-	-	0.050
	Tin (Sn)	mg/kg	-	-	2.0
	Titanium (Ti)	mg/kg	-	-	1.0
	Uranium (U)	mg/kg	-	-	0.050
	Vanadium (V)	mg/kg	-	-	0.20
	Zinc (Zn)	mg/kg	123/315[2]	12.3	1.0

[1] Working guidelines (Nagpal et al. 2006)

[2] Interim sediment quality guideline (ISQG) / probable effect level (PEL)

[3] Lowest effect level (LEL) / severe effect level (SEL)

(grey box) Greater than guideline

bold Priority analyte from Mount Polley Mine Technical Assessment (2009) above guideline.

Table B.8: Laboratory QAQC for sediment quality.

Analyte		Units	Method Blank		Certified Reference Material			Replicates		
			Target	Achieved	Target	Achieved	% recovery	1	2	RPD
Carbon	Total Organic Carbon	%	0.02	<0.1	1.10	1.01	92	9.92	10.1	2
					1.10	1.02	93			
Metals	Aluminum (Al)	mg/kg	100	<50	18200	15400	85	-	-	-
					17500	14700	84	-	-	-
	Antimony (Sb)	mg/kg	0.2	<0.10	6.27	6.63	106	-	-	-
					11.3	9.72	86	-	-	-
	Arsenic (As)	mg/kg	0.1	<0.050	15.4	17.7	115	-	-	-
					23.3	24.6	106	-	-	-
	Barium (Ba)	mg/kg	1	<0.50	80.6	82.8	103	-	-	-
					294	270	92	-	-	-
	Beryllium (Be)	mg/kg	0.4	<0.20	0.39	0.40	103	-	-	-
	Bismuth (Bi)	mg/kg	0.4	<0.20	0.35	0.33	94	-	-	-
	Cadmium (Cd)	mg/kg	1.6	<0.050	1.98	2.15	109	-	-	-
	Calcium (Ca)	mg/kg	100	<50	3320	3300	99	-	-	-
					7790	7690	99	-	-	-
	Chromium (Cr)	mg/kg	1	<0.50	27.2	28.6	105	-	-	-
					48.1	48.9	102	-	-	-
	Cobalt (Co)	mg/kg	0.2	<0.10	12.5	12.7	102	-	-	-
					8.75	8.35	95	-	-	-
	Copper (Cu)	mg/kg	1	<0.50	44.9	44.1	98	-	-	-
					297	279	94	-	-	-
	Iron (Fe)	mg/kg	100	<50	33300	32000	96	-	-	-
					31200	29900	96	-	-	-
	Lead (Pb)	mg/kg	16 - 18	<0.50	14.4	52.7	366	-	-	-
					167	158	95	-	-	-
	Lithium (Li)	mg/kg	2	<1.0	11.5	9.4	82	-	-	-
					25.8	21.6	84	-	-	-
	Magnesium (Mg)	mg/kg	40	<20	5830	5480	94	-	-	-
					9900	8990	91	-	-	-

Table B.8: Laboratory QAQC for sediment quality.

	Analyte	Units	Method Blank		Certified Reference Material			Replicates		
			Target	Achieved	Target	Achieved	% recovery	1	2	RPD
Metals	Manganese (Mn)	mg/kg	2	<1.0	1100	1080	98	-	-	-
					253	243	96	-	-	-
	Mercury (Hg)	mg/kg	.0.1	<0.0050	0.098	0.106	108	-	-	-
					3.04	3.12	103	-	-	-
	Molybdenum (Mo)	mg/kg	1	<0.50	4.57	5.01	110	-	-	-
	Nickel (Ni)	mg/kg	1	<0.50	17.4	17.8	102	-	-	-
					31.6	30.8	97	-	-	-
	Phosphorus (P)	mg/kg	100	<50	796	829	104	-	-	-
					838	892	106	-	-	-
	Potassium (K)	mg/kg	200	<100	620	580	94	-	-	-
					3230	3060	95	-	-	-
	Selenium (Se)	mg/kg	0.4	<0.20	0.32	0.36	113	-	-	-
					0.92	0.91	99	-	-	-
	Silver (Ag)	mg/kg	0.2	<0.10	1.22	1.19	98	-	-	-
	Sodium (Na)	mg/kg	200	<100	340	340	100	-	-	-
					18600	18400	99	-	-	-
	Strontium (Sr)	mg/kg	1	<0.50	11.6	11.4	98	-	-	-
					68	68.6	101	-	-	-
	Thallium (Tl)	mg/kg	0.1	<0.050	0.125	0.138	110	-	-	-
					0.412	0.438	106	-	-	-
	Tin (Sn)	mg/kg	4	<2.0	19.1	20.5	107	-	-	-
	Titanium (Ti)	mg/kg	2	<1.0	764	744	97	-	-	-
					900	882	98	-	-	-
	Uranium (U)	mg/kg	0.1	<0.050	1.52	1.49	98	-	-	-
	Vanadium (V)	mg/kg	0.4	<0.20	54.9	57.9	105	-	-	-
					74.4	76.9	103	-	-	-
	Zinc (Zn)	mg/kg	2	<1.0	67.5	72.1	107	-	-	-
					337	310	92	-	-	-

DQO not achieved

B4.0 MACROPHYTE TISSUE SAMPLES

B4.1 Laboratory Blank Sample Analysis

Laboratory blank samples were reported to have concentrations of more than two times the laboratory MDL for barium, cadmium and manganese, indicating the potential of some contamination of samples within the laboratory during analysis (Table B.9). The reported values of laboratory blanks were below two times the MDL for all other analytes, therefore laboratory contamination of samples need only be considered in interpretation of the analytical results of barium, cadmium and manganese.

B4.2 Data Precision

Laboratory Duplicates

The RPDs reported for laboratory duplicates of macrophyte tissue were nearly all below the data quality objective of ≤ 25%. The exceptions to this were total arsenic and dissolved thorium (Table B.10). For both analytes, the reported concentrations in both duplicates were low, and very close to the method detection limit (less than ten times).

Table B.9: Laboratory QAQC for plant tissue.

Analyte	Method Blank			Certified Reference Material			
	Units	Target	Achieved	Units	Target	Achieved	% Recovery
Aluminum (Al)-Total	mg/kg wwt	0.4	<0.40	mg/kg	249	211	85
	mg/kg	2	<2.0	mg/kg	231	193	84
	mg/kg	2	<2.0	-	-	-	-
	mg/kg wwt	0.4	<0.40	-	-	-	-
Antimony (Sb)-Total	mg/kg	0.01	<0.010	-	-	-	-
	mg/kg wwt	0.002	<0.0020	-	-	-	-
	mg/kg wwt	0.002	<0.0020	-	-	-	-
	mg/kg	0.01	<0.010	-	-	-	-
Arsenic (As)-Total	mg/kg wwt	0.004	<0.0040	mg/kg	0.06	0.069	115
	mg/kg	0.02	<0.020	mg/kg wwt	0.06	0.0685	114
	mg/kg wwt	0.004	<0.0040	mg/kg wwt	0.038	0.0326	86
	mg/kg	0.02	<0.020	mg/kg	0.038	0.033	87
Barium (Ba)-Total	mg/kg wwt	0.01	0.018	mg/kg	124	131	106
	mg/kg	0.05	0.089	mg/kg wwt	124	131	106
	mg/kg	0.05	0.084	mg/kg	49	47	96
	mg/kg wwt	0.01	0.017	mg/kg wwt	49	47	96
Beryllium (Be)-Total	mg/kg wwt	0.002	<0.0020	-	-	-	-
	mg/kg	0.01	<0.010	-	-	-	-
	mg/kg wwt	0.002	<0.0020	-	-	-	-
	mg/kg	0.01	<0.010	-	-	-	-
Bismuth (Bi)-Total	mg/kg	0.01	<0.010	-	-	-	-
	mg/kg wwt	0.002	<0.0020	-	-	-	-
	mg/kg	0.01	<0.010	-	-	-	-
	mg/kg wwt	0.002	<0.0020	-	-	-	-
Boron (B)-Total	mg/kg wwt	0.2	<0.20	mg/kg wwt	29	27.3	94
	mg/kg	1	<1.0	mg/kg	29	27.3	94
	mg/kg	1	<1.0	mg/kg wwt	27	26.7	99
	mg/kg wwt	0.2	<0.20	mg/kg	27	26.7	99
Cadmium (Cd)-Total	mg/kg wwt	0.002	0.0052	mg/kg wwt	0.026	0.025	96
	mg/kg	0.01	0.026	mg/kg	0.026	0.025	96
	mg/kg wwt	0.002	0.0057	mg/kg	0.013	0.013	100
	mg/kg	0.01	0.029	-	-	-	-
Calcium (Ca)-Total	mg/kg	3	<3.0	mg/kg wwt	15600	15400	99
	mg/kg wwt	0.5	<0.50	mg/kg	15600	15400	99
	mg/kg	3	<3.0	mg/kg wwt	15300	14900	97
	mg/kg wwt	0.5	<0.50	mg/kg	15300	14900	97
Cesium (Cs)-Total	mg/kg	0.005	<0.0050	-	-	-	-
	mg/kg wwt	0.001	<0.0010	-	-	-	-
	mg/kg	0.005	<0.0050	-	-	-	-
	mg/kg wwt	0.001	<0.0010	-	-	-	-
Chromium (Cr)-Total	mg/kg	0.05	<0.050	-	-	-	-
	mg/kg wwt	0.01	<0.010	-	-	-	-
	mg/kg	0.05	<0.050	-	-	-	-
	mg/kg wwt	0.01	<0.010	-	-	-	-
Cobalt (Co)-Total	mg/kg wwt	0.004	<0.0040	mg/kg wwt	0.06	0.0613	102
	mg/kg	0.02	<0.020	mg/kg	0.06	0.061	102
	mg/kg	0.02	<0.020	mg/kg wwt	0.09	0.0906	101
	mg/kg wwt	0.004	<0.0040	mg/kg	0.09	0.091	101
Copper (Cu)-Total	mg/kg	0.05	<0.050	mg/kg wwt	3.7	3.97	107
	mg/kg wwt	0.01	<0.010	mg/kg	3.7	3.97	107
	mg/kg wwt	0.01	<0.010	mg/kg	5.64	5.82	103
	mg/kg	0.05	<0.050	mg/kg wwt	5.64	5.82	103
Gallium (Ga)-Total	mg/kg	0.02	<0.020	-	-	-	-
	mg/kg wwt	0.004	<0.0040	-	-	-	-
	mg/kg wwt	0.004	<0.0040	-	-	-	-
	mg/kg	0.02	<0.020	-	-	-	-
Iron (Fe)-Total	mg/kg wwt	0.2	<0.20	mg/kg wwt	218	213	98
	mg/kg	1	<1.0	mg/kg	218	213	98
	mg/kg	1	<1.0	mg/kg wwt	83	72.8	88
	mg/kg wwt	0.2	<0.20	mg/kg	83	72.8	88
Lead (Pb)-Total	mg/kg	0.02	<0.020	mg/kg wwt	0.87	0.876	101
	mg/kg wwt	0.004	<0.0040	mg/kg	0.87	0.876	101
	mg/kg wwt	0.004	<0.0040	mg/kg	0.47	0.405	86
	mg/kg	0.02	<0.020	mg/kg wwt	0.47	0.405	86
Lithium (Li)-Total	mg/kg wwt	0.02	<0.020	-	-	-	-
	mg/kg	0.1	<0.10	-	-	-	-
	mg/kg	0.1	<0.10	-	-	-	-
	mg/kg wwt	0.02	<0.020	-	-	-	-
Magnesium (Mg)-Total	mg/kg wwt	1	<1.0	mg/kg wwt	4320	4140	96
	mg/kg	5	<5.0	mg/kg	4320	4140	96
	mg/kg wwt	1	<1.0	mg/kg	2710	2590	96
	mg/kg	5	<5.0	mg/kg wwt	2710	2590	96
Manganese (Mn)-Total	mg/kg wwt	0.004	0.0113	mg/kg wwt	98	106	108
	mg/kg	0.02	0.057	mg/kg	98	106	108
	mg/kg	0.02	0.046	mg/kg	54	55.8	103
	mg/kg wwt	0.004	0.0093	mg/kg wwt	54	55.8	103
Mercury (Hg)-Total	mg/kg wwt	0.01	<0.010	mg/kg	0.031	<0.050	161
	mg/kg	0.05	<0.050	mg/kg wwt	0.031	0.03	97
	mg/kg wwt	0.01	<0.010	mg/kg	0.044	<0.050	114
	mg/kg	0.05	<0.050	mg/kg wwt	0.044	0.039	89
Molybdenum (Mo)-Total	mg/kg wwt	0.004	<0.0040	-	-	-	-
	mg/kg	0.02	<0.020	-	-	-	-
	mg/kg	0.02	<0.020	-	-	-	-
	mg/kg wwt	0.004	<0.0040	-	-	-	-

Table B.9: Laboratory QAQC for plant tissue.

Analyte	Method Blank			Certified Reference Material			
	Units	Target	Achieved	Units	Target	Achieved	% Recovery
Nickel (Ni)-Total	mg/kg wwt	0.01	<0.010	mg/kg	0.69	0.536	78
	mg/kg	0.05	<0.050	mg/kg wwt	0.91	0.891	98
	mg/kg	0.05	<0.050	mg/kg	0.91	0.891	98
	mg/kg wwt	0.01	<0.010	-	-	-	-
Phosphorus (P)-Total	mg/kg	20	<20	mg/kg	1370	1350	99
	mg/kg wwt	5	<5.0	mg/kg wwt	1370	1350	99
	mg/kg	20	<20	mg/kg wwt	1590	1530	96
	mg/kg wwt	5	<5.0	mg/kg	1590	1530	96
Potassium (K)-Total	mg/kg wwt	20	<20	mg/kg wwt	24300	25000	103
	mg/kg	100	<100	mg/kg	24300	25000	103
	mg/kg wwt	20	<20	mg/kg	16100	15800	98
	mg/kg	100	<100	mg/kg wwt	16100	15800	98
Rhenium (Re)-Total	mg/kg	0.01	<0.010	-	-	-	-
	mg/kg wwt	0.002	<0.0020	-	-	-	-
	mg/kg	0.01	<0.010	-	-	-	-
	mg/kg wwt	0.002	<0.0020	-	-	-	-
Rubidium (Rb)-Total	mg/kg	0.05	<0.050	mg/kg wwt	19.7	19.9	101
	mg/kg wwt	0.01	<0.010	mg/kg	19.7	19.9	101
	mg/kg	0.05	<0.050	mg/kg wwt	10.2	10	98
	mg/kg wwt	0.01	<0.010	mg/kg	10.2	10	98
Selenium (Se)-Total	mg/kg wwt	0.02	<0.020	mg/kg	0.12	0.15	125
	mg/kg	0.1	<0.10	mg/kg wwt	0.12	0.15	125
	mg/kg	0.1	<0.10	-	-	-	-
	mg/kg wwt	0.02	<0.020	-	-	-	-
Sodium (Na)-Total	mg/kg	100	<100	-	-	-	-
	mg/kg wwt	20	<20	-	-	-	-
	mg/kg wwt	20	<20	-	-	-	-
	mg/kg	100	<100	-	-	-	-
Strontium (Sr)-Total	mg/kg	0.05	<0.050	mg/kg wwt	53	55	104
	mg/kg wwt	0.01	<0.010	mg/kg	53	55	104
	mg/kg wwt	0.01	<0.010	mg/kg wwt	25	23.9	96
	mg/kg	0.05	<0.050	mg/kg	25	23.9	96
Tellurium (Te)-Total	mg/kg wwt	0.004	<0.0040	-	-	-	-
	mg/kg	0.02	<0.020	-	-	-	-
	mg/kg	0.02	<0.020	-	-	-	-
	mg/kg wwt	0.004	<0.0040	-	-	-	-
Thallium (Tl)-Total	mg/kg	0.002	<0.0020	-	-	-	-
	mg/kg wwt	0.0004	<0.00040	-	-	-	-
	mg/kg wwt	0.0004	<0.00040	-	-	-	-
	mg/kg	0.002	<0.0020	-	-	-	-
Thorium (Th)-Total	mg/kg wwt	0.002	<0.0020	mg/kg wwt	0.045	0.0403	90
	mg/kg	0.01	<0.010	mg/kg	0.045	0.04	89
	mg/kg	0.01	<0.010	-	-	-	-
	mg/kg wwt	0.002	<0.0020	-	-	-	-
Tin (Sn)-Total	mg/kg	0.02	<0.020	-	-	-	-
	mg/kg wwt	0.004	<0.0040	-	-	-	-
	mg/kg	0.02	<0.020	-	-	-	-
	mg/kg wwt	0.004	<0.0040	-	-	-	-
Titanium (Ti)-Total	mg/kg	0.05	<0.050	-	-	-	-
	mg/kg wwt	0.01	<0.010	-	-	-	-
	mg/kg	0.05	<0.050	-	-	-	-
	mg/kg wwt	0.01	<0.010	-	-	-	-
Uranium (U)-Total	mg/kg	0.002	<0.0020	-	-	-	-
	mg/kg wwt	0.0004	<0.00040	-	-	-	-
	mg/kg wwt	0.0004	<0.00040	-	-	-	-
	mg/kg	0.002	<0.0020	-	-	-	-
Vanadium (V)-Total	mg/kg	0.02	<0.020	mg/kg	0.37	0.324	88
	mg/kg wwt	0.004	<0.0040	-	-	-	-
	mg/kg wwt	0.004	<0.0040	-	-	-	-
	mg/kg	0.02	<0.020	-	-	-	-
Yttrium (Y)-Total	mg/kg wwt	0.002	<0.0020	-	-	-	-
	mg/kg	0.01	<0.010	-	-	-	-
	mg/kg wwt	0.002	<0.0020	-	-	-	-
	mg/kg	0.01	<0.010	-	-	-	-
Zinc (Zn)-Total	mg/kg wwt	0.1	<0.10	mg/kg	17.9	19.9	111
	mg/kg	0.5	<0.50	mg/kg wwt	17.9	19.9	111
	mg/kg	0.5	<0.50	mg/kg	12.5	12.6	101
	mg/kg wwt	0.1	<0.10	mg/kg wwt	12.5	12.6	101
Zirconium (Zr)-Total	mg/kg wwt	0.04	<0.040	-	-	-	-
	mg/kg	0.2	<0.20	-	-	-	-
	mg/kg	0.2	<0.20	-	-	-	-
	mg/kg wwt	0.04	<0.040	-	-	-	-

DQO not achieved

Table B.10: Laboratory duplicates for plant tissue.

Analyte	Units	MDL	1	2	RPD[1]
% Moisture	%	0.1	94.9	93.4	2
	%	2 - 4	87	87.8	1
Aluminum (Al)-Total	mg/kg wwt	0.4	8.24	8.44	2
	mg/kg	0.01 - 0.02	84.3	86.4	2
Antimony (Sb)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	0
	mg/kg	0.02 - 0.04	<0.020	<0.020	0
Arsenic (As)-Total	mg/kg wwt	0.004	0.0046	0.0066	36
	mg/kg	0.05 - 0.1	0.047	0.068	37
Barium (Ba)-Total	mg/kg wwt	0.01	0.489	0.489	0
	mg/kg	0.01 - 0.02	5.01	5.01	0
Beryllium (Be)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	0
	mg/kg	0.01 - 0.02	<0.020	<0.020	0
Bismuth (Bi)-Total	mg/kg wwt	0.002	<0.0020	<0.0020	0
	mg/kg	1 - 2	<0.020	<0.020	0
Boron (B)-Total	mg/kg wwt	0.2	4.99	5	0
	mg/kg	0.01 - 0.26	51.1	51.1	0
Cadmium (Cd)-Total	mg/kg wwt	0.002 - 0.025	<0.0060	<0.0060	0
	mg/kg	3 - 6	<0.060	<0.060	0
Calcium (Ca)-Total	mg/kg	0.5	13200	13600	3
	mg/kg wwt	0.005 - 0.01	1290	1330	3
Cesium (Cs)-Total	mg/kg wwt	0.001	0.0025	0.0025	0
	mg/kg	0.05 - 0.1	0.025	0.025	0
Chromium (Cr)-Total	mg/kg wwt	0.01	0.189	0.18	5
	mg/kg	0.02 - 0.04	1.93	1.84	5
Cobalt (Co)-Total	mg/kg wwt	0.004	0.01	0.0102	2
	mg/kg	0.05 - 0.1	0.102	0.104	2
Copper (Cu)-Total	mg/kg wwt	0.01	0.732	0.728	1
	mg/kg	0.02 - 0.04	7.49	7.45	1
Gallium (Ga)-Total	mg/kg wwt	0.004	<0.0040	<0.0040	0
	mg/kg	1 - 2	<0.040	<0.040	0
Iron (Fe)-Total	mg/kg wwt	0.2	17.1	17.1	0
	mg/kg	0.02 - 0.04	175	175	0
Lead (Pb)-Total	mg/kg wwt	0.004	0.007	0.0068	3
	mg/kg	0.1 - 0.2	0.072	0.07	3
Lithium (Li)-Total	mg/kg wwt	0.02	<0.020	<0.020	0
	mg/kg	5 - 10	<0.20	<0.20	0
Magnesium (Mg)-Total	mg/kg	1	2110	2170	3
	mg/kg wwt	0.02 - 0.04	206	212	3
Manganese (Mn)-Total	mg/kg wwt	0.004	20.5	21.2	3
	mg/kg	0.005 - 0.01	210	217	3
Mercury (Hg)-Total	mg/kg wwt	0.001 - 0.01	<0.0010	<0.0010	0
	mg/kg	0.02 - 0.04	0.008	0.0083	4
Molybdenum (Mo)-Total	mg/kg wwt	0.004	0.15	0.148	1
	mg/kg	0.05 - 0.1	1.53	1.51	1
Nickel (Ni)-Total	mg/kg wwt	0.01	0.119	0.121	2
	mg/kg	20 - 40	1.21	1.24	2

Table B.10: Laboratory duplicates for plant tissue.

Analyte	Units	MDL	1	2	RPD[1]
Phosphorus (P)-Total	mg/kg wwt	5	115	117	2
	mg/kg	100 - 200	1170	1200	3
Potassium (K)-Total	mg/kg	20	47200	48200	2
	mg/kg wwt	0.01 - 0.02	4610	4710	2
Rhenium (Re)-Total	mg/kg wwt	0.002	0.0038	0.0036	5
	mg/kg	0.05 - 0.1	0.039	0.037	5
Rubidium (Rb)-Total	mg/kg wwt	0.01	4.32	4.32	0
	mg/kg	0.1 - 0.2	44.2	44.2	0
Selenium (Se)-Total	mg/kg wwt	0.02	0.041	0.033	22
	mg/kg	100 - 200	0.42	0.34	21
Sodium (Na)-Total	mg/kg wwt	20	<20	<20	0
	mg/kg	0.05 - 0.1	<200	<200	0
Strontium (Sr)-Total	mg/kg wwt	0.01	7.77	7.88	1
	mg/kg	0.02 - 0.04	79.5	80.6	1
Tellurium (Te)-Total	mg/kg wwt	0.004	<0.0040	<0.0040	0
	mg/kg	0.002 - 0.004	<0.040	<0.040	0
Thallium (Tl)-Total	mg/kg wwt	0.0004	0.00113	0.00114	1
	mg/kg	0.01 - 0.02	0.0115	0.0116	1
Thorium (Th)-Total	mg/kg wwt	0.002	0.0034	0.0024	34
	mg/kg	0.02 - 0.04	0.035	0.025	33
Tin (Sn)-Total	mg/kg wwt	0.004	0.005	0.0056	11
	mg/kg	0.05 - 0.1	0.051	0.057	11
Titanium (Ti)-Total	mg/kg wwt	0.01	0.618	0.584	6
	mg/kg	0.002 - 0.004	6.32	5.98	6
Uranium (U)-Total	mg/kg wwt	0.0004	0.00056	0.00052	7
	mg/kg	0.02 - 0.04	0.0058	0.0053	9
Vanadium (V)-Total	mg/kg wwt	0.004	0.0404	0.0412	2
	mg/kg	0.01 - 0.02	0.414	0.422	2
Yttrium (Y)-Total	mg/kg wwt	0.002	0.0055	0.0054	2
	mg/kg	0.5 - 1	0.057	0.055	4
Zinc (Zn)-Total	mg/kg wwt	0.1	1.5	1.57	5
	mg/kg	0.2 - 0.4	15.3	16	4
Zirconium (Zr)-Total	mg/kg wwt	0.04	<0.040	<0.040	0
	mg/kg		<0.40	<0.40	0

[1] Relative percent difference

(grey shading) DQO not achieved

B4.0 PERIPHYTON SAMPLES

B4.1 Laboratory Blank Sample Analysis

Laboratory blank samples were reported for periphyton chlorophyll a analysis, and in all blanks the reported concentration was equal to the data quality objective of two times the laboratory method detection limit (Table B.11).

B4.2 Data Precision

Laboratory Duplicates

Duplicates of periphyton analysed for selenium were below the data quality objective of ≤ 25% (Table B.12), indicating sufficient analytical precision.

Table B.11: Laboratory method blanks for periphyton.

Analyte	Units	Target	# Tests	Achieved
Chlorophyll A	µg	<0.01	7	<0.010

DQO exceeded

Table B.12: Lab duplicate results for periphyton.

Analyte	Units	1	2	RPD[1]
Selenium	mg/kg	1.66	1.86	11

DQO exceeded

B5.0 DATA QUALITY STATEMENT

The quality of data for this project was adequate to serve the project objectives.

APPENDIX C

AUGUST 2011 DISCHARGE CHARACTERIZATION MEMORANDUM (MINNOW 2011A) & NOVEMBER 2011 FIELD PROGRAM MEMORANDUM (MINNOW 2011B)

MEMORANDUM

Re: Hazeltine Creek Discharge Location Characterization

Prepared for:
Mount Polley Mining Corporation
Box 12
Likely, British Columbia
V0L 1N0

Prepared by:
Minnow Environmental Inc.
101 - 1025 Hillside Avenue
Victoria, British Columbia
V8T 2A2

Memo

To: Ron Martel, Environmental Superintendent, Mount Polley Mining Corporation

From: Fred Burgess, Minnow Environmental

EC: Pierre Stecko, Minnow Environmental

Date: September 1st, 2011

Re: Hazeltine Creek Discharge Location Characterization

The proposed effluent discharge location for the Mount Polley mine into Hazeltine Creek was characterized by Minnow Environmental during a site visit the afternoon of August 22, 2011. Characterization was based on stream morphology, erosional/depositional properties and observable local flora and fauna.

The discharge location, shown in the attached photos, was a braided section of the creek which created a large island (approximately 50 m long). Approximately 30 m upgrade from the floodplain on the southwest side of the creek was the area of maximum slope along the flagged discharge path. Five transects were measured at ten metre intervals parallel to the discharge path. An average slope of 16% or 9° was determined (Table 1).

The streambed in this area was erosional; the substrate consisted of mostly large gravel. The creek was very overgrown (see photos, attached). Alder, fern, and sedge were the dominant plants. Many trout fry and some *Fontinalis antipyretica* moss were observed in the creek, but no macrophyte growth was seen in-stream.

Upstream of the braid, Hazeltine Creek flowed as a well defined channel with an average depth of 0.19 m and a width of 13 m. This appears to be a more ideal discharge location. GPS coordinates defining the braid extents and discharge location are listed in Table 2.

I hope that this memo provides the information you require. If you have any questions, please do not hesitate to contact me at (250) 595-1627.

Table 1: Slope measurements upgrade from floodplain.

Transect	Slope (°)	Slope (%)
1. 20m upstream from discharge	7	13
2. 10m upstream from discharge	7	13
3. Flagged discharge course	9	16
4. 10m downstream from discharge	10	17
5. 20m downstream from discharge	11	20
Average	9	16

Table 2: GPS points.

Location	Measurement (NAD83)	Measurement (UTM)
Upstream extent of braid	N52 31.219, W121 35.144	10U 595958, 5819851
Flagged discharge location	N52 31.208, W121 35.140	10U 595963, 5819832
Downstream extent of braid	N52 31.196, W121 35.114	10U 595993, 5819810

1) Thick brush near proposed discharge location.

2) Beginning of braid; large gravel substrate visible.

3) Creek overgrowth.

MEMORANDUM
Re: Preliminary Physical Assessment to Support the Selection of a Location for Discharge to Hazeltine Creek

Prepared for:
Mount Polley Mining Corporation
Box 12
Likely, British Columbia
V0L 1N0

Prepared by:
Minnow Environmental Inc.
101 - 1025 Hillside Avenue
Victoria, British Columbia
V8T 2A2

Memo

To: Ron Martel, Environmental Superintendent, Mount Polley Mining Corporation

From: Fred Burgess, Minnow Environmental

EC: Pierre Stecko, Minnow Environmental

Date: December 7th, 2011

Re: Preliminary Physical Assessment to Support the Selection of a Location for Discharge to Hazeltine Creek

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In November 2011, Minnow Environmental Inc. implemented a field program to collect data to support efforts by the Mount Polley mine to select the most appropriate location for the discharge of excess water into Hazeltine Creek. The mine had previously flagged a location on the creek as a candidate for discharge. However, this location was found to be at a braid in the creek where the flow of water splits around a large island. This location was therefore not considered ideal due to the smaller channel width and consequent greater physical sensitivity and lower water volume for initial mixing of the effluent. Accordingly, Hazeltine Creek was assessed upstream and downstream of the previously flagged location to identify a more suitable location, if available. A distance of approximately 100 m downstream was assessed, and it was discovered that for this distance the creek continues to flow as multiple, smaller channels. However, a well defined single channel was observed over a distance of approximately 90 m upstream from the above mentioned island. This would allow 90 m of mixing of the effluent in a single channel before the start of braiding. The stream bed material at the upstream extent of this well defined channel was observed to be a combination of approximately 40% sand, and 60% gravel and pebbles, with a few larger cobbles and no observable areas of fines such as silt and clay. Further information was gathered at this site to better document the nature of the underlying material and the stream morphology, and to effectively describe the area.

Two aspects of the underlying material were examined: stream bed material composition and bank material composition. The stream bed material was sampled from an area within 2 m up and downstream (to stay within the 5 m width of the proposed final outfall riprap structure) of a wooden stake on shore set to mark the farthest upstream the mine could potentially discharge into the length of well-defined, single channel flow. This was done using the CABIN protocol “100 pebble count” (Environment Canada, 2010) which essentially involves sorting a sample of 100 randomly selected rocks in the stream by “intermediate diameter,” which is the measurement perpendicular to the longest axis of the rock (Table 1; Figure 1). To sample the bank material, a test pit was excavated approximately 5 m back from the creek edge, which would represent the middle of the 10 m rip-rap installation that is to make up the final approach of the discharge to the stream. Approximately 10 kg of generally sandy bank material was sampled from this pit at a depth of 30 cm – 60 cm. The sample was sent to Knight Piesold for analysis. Also, a standard penetration test based on Knight Piesold's "blows per foot" density relationship of sands and gravels was performed with a length of threaded rod in the bank material of the discharge site (Table 2).

Stream morphology at the alternate discharge location was characterized by means of cross sections measured at the proposed location, as well at one section 3 stream widths upstream and one section 3 stream widths downstream (Table 3; Figure 2). The slope of the creek along this section was measured with an inclinometer to be 2%.

The coordinates of the alternate discharge location were measured using a total station from control points set by mine survey staff. The rest of the discharge path—as it would be should this site be chosen for the final design—was then determined and marked with wooden stakes to link this point back to the end of the straight section of the existing trench at the polishing pond. All relevant coordinates from this total station work, including additional points along the proposed discharge path and new measurements of the upstream extent of the island (which marks the beginning of stream braiding), are presented in Table 4 and Figure 3. These measurements were not taken by a licensed surveyor and are only to support the selection of the most appropriate discharge location; they should not be used for engineering purposes.

Finally, photographic record of the area was made (Figure 4).

I look forward to discussing these results with you soon. Please do not hesitate to contact me at 250-595-1627 if you have any questions or comments.

REFERENCES

Environment Canada. 2010. Canadian Aquatic Biomonitoring Network Wadeable Streams Field Manual. Dartmouth, NS. March 2010.

Table 1: Diameter (intermediate) of pebbles, Hazeltine Creek proposed discharge site

Intermediate diameter (cm)	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**	**6.5**	**7.0**	**7.5**	**8.0**	**8.5**	**9.0**
	HAC-1																
Frequency	5	19	21	20	16	8	4	3	2	1	1	0	0	0	0	0	0
Relative Frequency	5%	19%	21%	20%	16%	8%	4%	3%	2%	1%	1%	0%	0%	0%	0%	0%	0%
Cumulative %	5%	24%	45%	65%	81%	89%	93%	96%	98%	99%	100%	100%	100%	100%	100%	100%	100%
	HAC-2																
Frequency	9	27	25	17	12	5	2	0	1	1	0	0	0	0	0	1	0
Relative Frequency	9%	27%	25%	17%	12%	5%	2%	0%	1%	1%	0%	0%	0%	0%	0%	1%	0%
Cumulative %	9%	36%	61%	78%	90%	95%	97%	97%	98%	99%	99%	99%	99%	99%	99%	100%	100%
	HAC-3																
Frequency	9	30	36	18	4	2	1	0	0	0	0	0	0	0	0	0	0
Relative Frequency	9%	30%	36%	18%	4%	2%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cumulative %	9%	39%	75%	93%	97%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	HAC-4																
Frequency	16	40	16	15	9	2	0	0	1	0	1	0	0	0	0	0	0
Relative Frequency	16%	40%	16%	15%	9%	2%	0%	0%	1%	0%	1%	0%	0%	0%	0%	0%	0%
Cumulative %	16%	56%	72%	87%	96%	98%	98%	98%	99%	99%	100%	100%	100%	100%	100%	100%	100%
	HAC-5																
Frequency	23	26	22	15	8	4	2	0	0	0	0	0	0	0	0	0	0
Relative Frequency	23%	26%	22%	15%	8%	4%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cumulative %	23%	49%	71%	86%	94%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Average																
Frequency	12.4	28.4	24	17	9.8	4.2	1.8	0.6	0.8	0.4	0.4	0	0	0	0	0.2	0
Relative Frequency	12%	28%	24%	17%	10%	4%	2%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%
Cumulative %	12%	41%	65%	82%	92%	96%	98%	98%	99%	99%	100%	100%	100%	100%	100%	100%	100%

Table 2: Standard penetration test of soil at proposed discharge site at Hazeltine Creek

Site*	Description	Blows to 30 cm	Descriptive term	Blows to 30 - 60 cm	Descriptive term	Blows to 60 - 90 cm	Descriptive term	Impenetrable at	Depth to noticeable increase in stiffness
1	Discharge site	6	Loose	22	Medium dense	33	Dense	-	39
2	2 m upstream of 1	11	Medium dense	19	Medium dense	>50	Very dense	63	63
3	2 m downstream of 1	8	Loose	22	Medium dense	>50	Very dense	54	54
4	5 m west of 1, away from creek along proposed discharge path	9	Loose	21	Medium dense	>50	Very dense	41	41
5	2 m upstream of 5	6	Loose	18	Medium dense	>50	Very dense	45	45
6	2 m downstream of 5	6	Loose	16	Medium dense	>50	Very dense	55	55
	Average	**8**	**Loose**	**20**	**Medium dense**	**>50**	**Very dense**	**52**	**50**

Table 3: Cross section measurements relative to bankfull height of Hazeltine Creek near proposed discharge

Distance NE from shore (m)	Site 1 12.45 m @ 328° Upstream (cm)	Site 2 Discharge Location (cm)	Site 3 11.7 m @ 127° Downstream* (cm)
0.25	53.7	43.5	35.5
0.5	53.3	45.2	39.7
0.75	56.2	47.3	35.7
1	60.2	50.9	36.8
1.25	58	50.1	37.7
1.5	57.3	48.2	39.9
1.75	52.8	45.7	45.8
2	55.1	40.6	48.2
2.25	55.4	41.4	48
2.5	55.3	40.3	46.7
2.75	57.2	41.3	43.5
3	48.6	46	45.2
3.25	50.1	50.1	45.6
3.5	47.9	51.2	48.8
3.75	48.9	44.6	46.6
4	48.4	39.3	43.8
4.25	49.1		38.3
4.5	50.2		36.7
4.75	43.7		37.4
5	44.4		38.8
5.25	40.2		40.2
5.5	43.3		42
5.75	40.8		40.2
6	36.3		41.9
6.25			38.3
6.5			42.9
6.75			42.7
7			39.7
7.25			37.3
7.5			30.3
Stream width	6.15	4.15	7.6

* A log obstructed the profile site at 12.45 m.

Table 4: Coordinates of points from November 2011 total station work at Mount Polley near Hazeltine Creek

Name	Easting (m)	Northing (m)	Elevation (m)	Description	Notes
1	595438.580	5819860.627	931.694	CP	Initial backsight
2	595768.487	5819684.937	929.280	CP	Initial point occupied
8	595832.783	5819738.531	923.086	EL	Ditch invert
9	595856.343	5819769.364	924.445	TV	Traverse point
10	595762.044	5819688.370	926.650	EL	Ditch invert
11	595884.369	5819790.245	920.415	TV	Traverse point
12	595895.086	5819800.620	919.074	TV	Traverse point
13	595910.553	5819815.786	918.210	TV	Traverse point
14	595933.275	5819831.631	914.080	TV	Traverse point
15	595955.582	5819844.024	913.717	TV	Traverse point
16	595963.396	5819853.945	913.259	WE	Upstream extent of island
17	595966.085	5819858.503	913.365	WE	water's edge, opposite shore of discharge
18	595960.941	5819854.936	913.305	WE	water's edge same shore as discharge
19	595948.988	5819883.426	913.948	TV	Traverse point
20	595936.446	5819904.140	914.115	TV	Traverse point
21	595916.397	5819926.913	914.167	EL	Discharge point, stake on shore
22	595920.694	5819918.466	914.010	TV	Traverse point
G1	595865.111	5819840.119	918.995	TV	Midway between the ditch and the curve
G2	595877.688	5819898.260	918.656	TV	Start of curve
G3	595895.964	5819926.565	917.890	TV	End of curve

Figure 1: Diameter (intermediate) of pebbles, Hazeltine Creek proposed discharge site

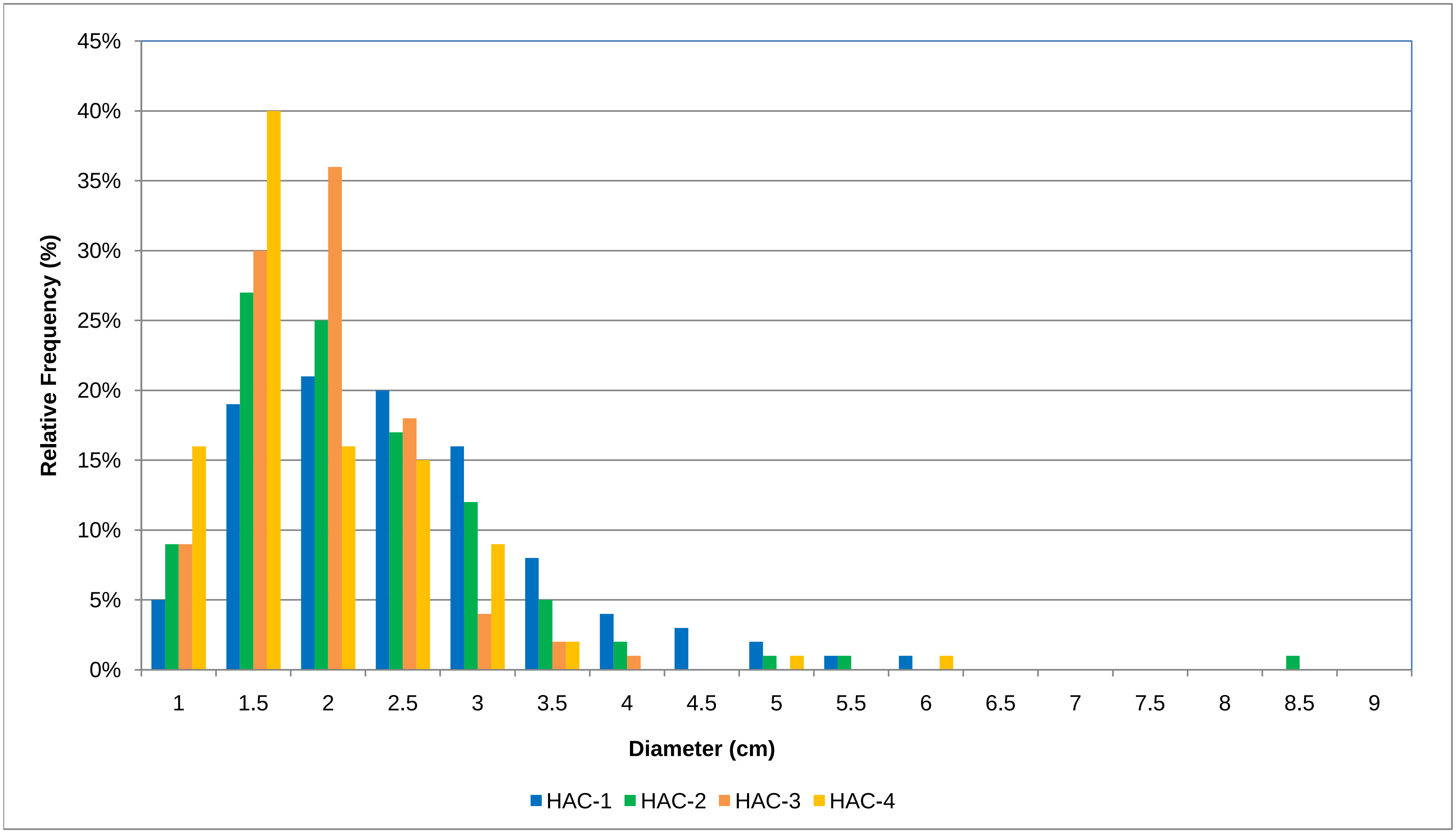
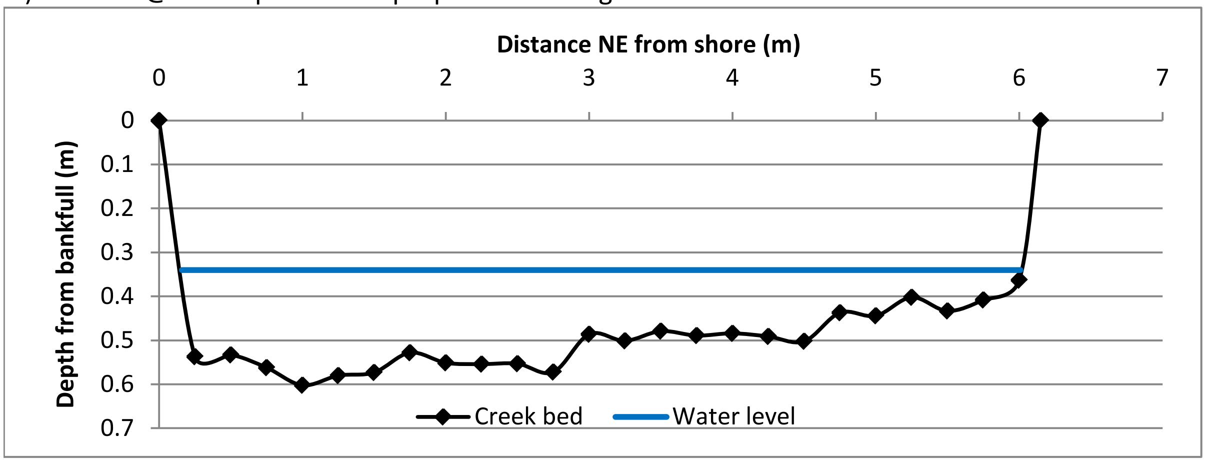
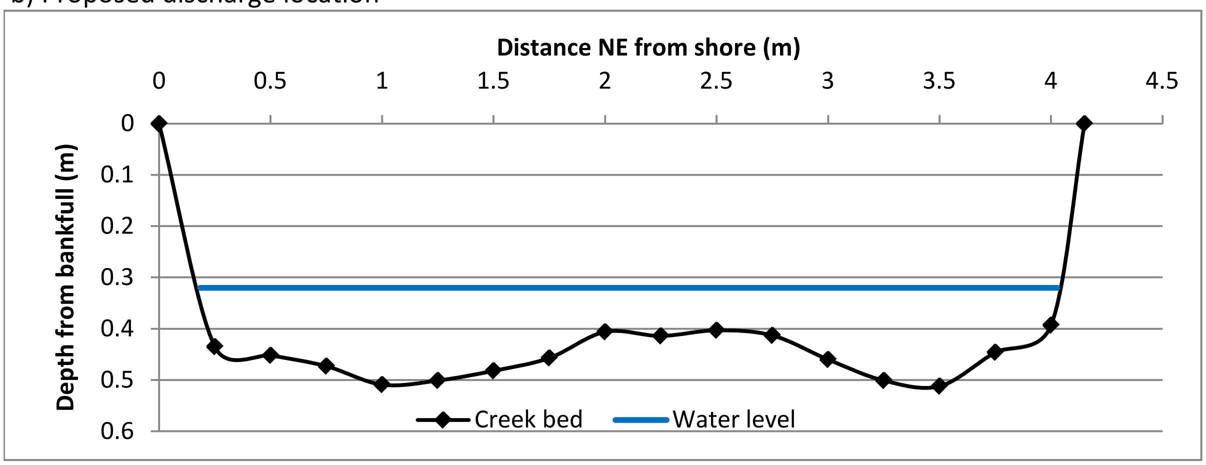


Figure 2: Cross section profiles near proposed discharge site at Hazeltine Creek

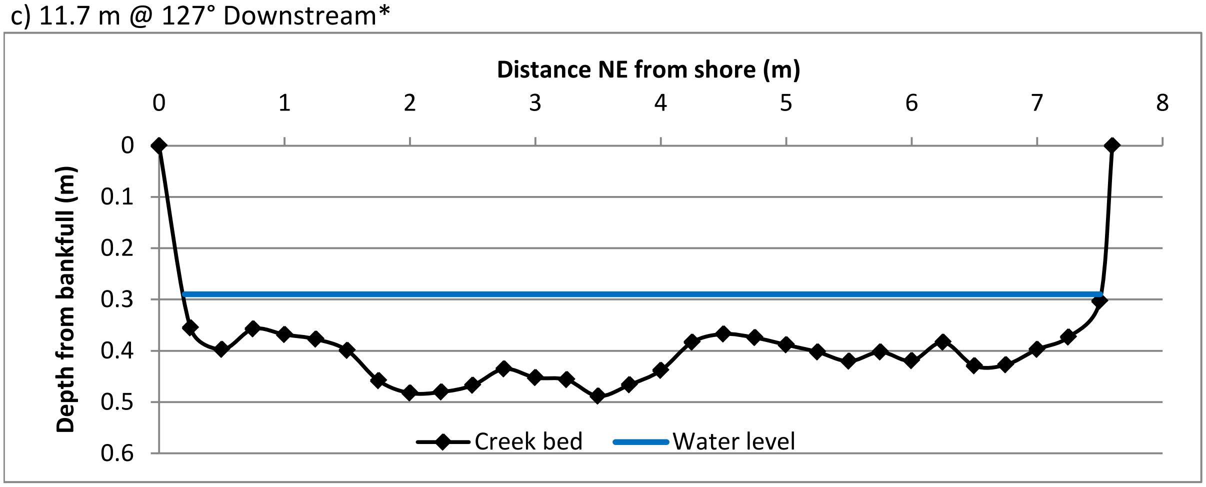
a) 12.45 m @ 328° upstream of proposed discharge



b) Proposed discharge location



c) 11.7 m @ 127° Downstream*



* A log obstructed the profile site at 12.45 m.

Figure 3: Plot of relevant total station measurements

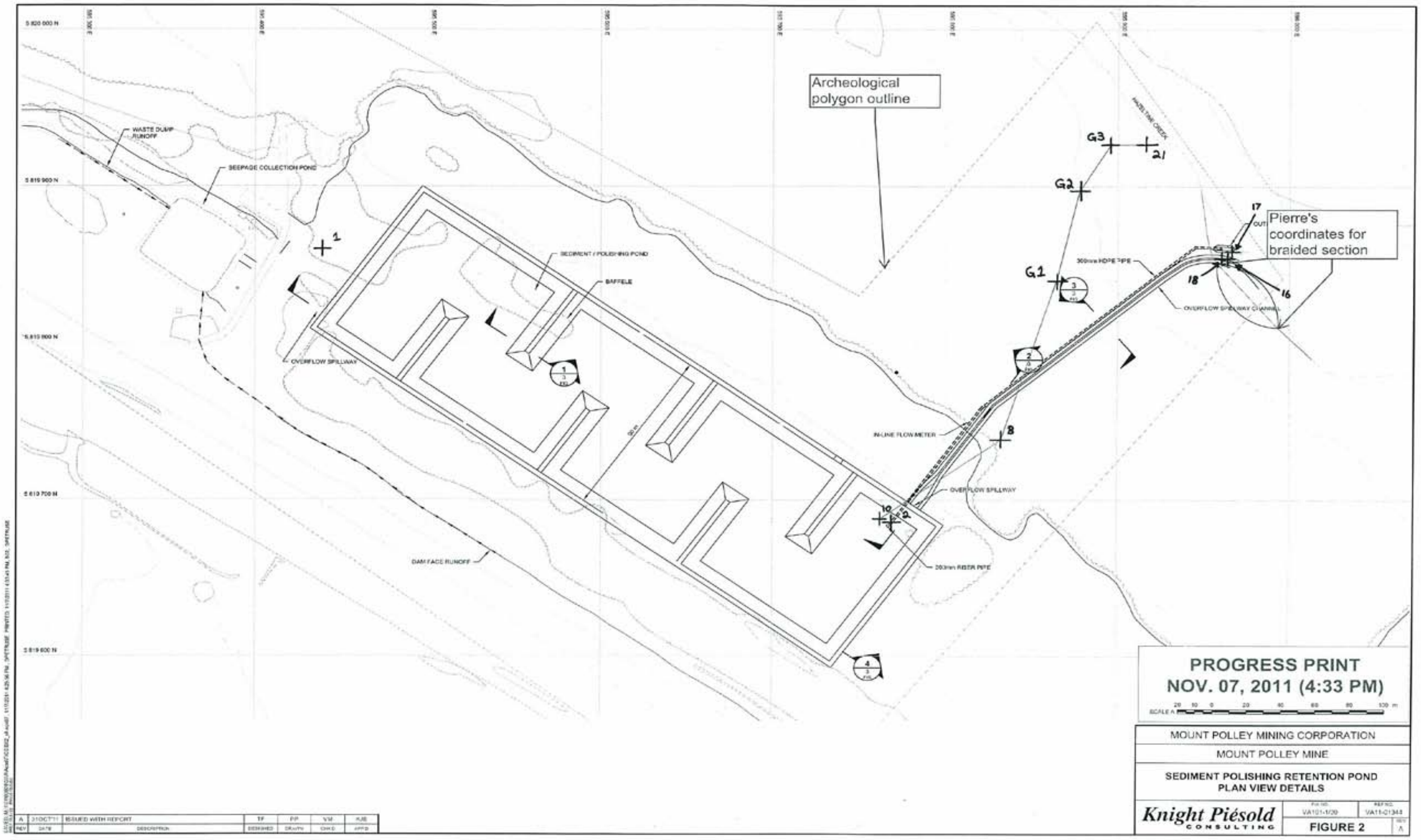


Figure 4: Photographs from November 2011 field work


a) Proposed discharge site from opposite shore


b) Looking downstream of discharge


c) Looking upstream of discharge


d) Looking up proposed discharge path from creek 1


e) Looking up proposed discharge path from creek 2


f) Looking up proposed discharge path from creek 3

Figure 4: Photographs from November 2011 field work


g) Looking up proposed discharge path from creek 4


h) Looking down proposed discharge path to creek 1


i) Looking down proposed discharge path to creek 2


j) Looking down proposed discharge path to creek 3


k) Looking down proposed discharge path to creek 4

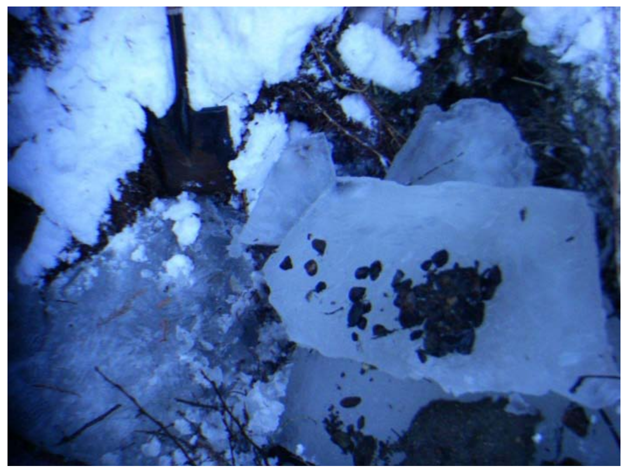

l) Looking down proposed discharge path 5

Figure 4: Photographs from November 2011 field work

m) Upstream cross section

n) Cross section at discharge

o) Cross section downstream



p) Substrate material adhered to ice cleared off creek

q) 0.5 m ruler in creek at proposed discharge site

APPENDIX D

PHYSICAL DATA

Table D.1 GPS coordinates for points of interest, Hazeltine Creek August 2011.

Point Name	Date	Easting (m)	Northing (m)	Elevation (m)	Description
DISCHARGE	22-AUG-11 1:54:10PM	5819832	595963	962	Upstream extent of braid around island at flagged discharge proposal site.
BRAIDUP	22-AUG-11 2:16:03PM	5819851	595958	939	Flagged discharge proposal site.
BRAIDDOWN	22-AUG-11 2:45:20PM	5819810	595993	922	Downstream extent of braid around island at flagged discharge proposal site.
SED1	22-AUG-11 2:59:46PM	5819782	596088	912	Location with some degree sediment deposition.
SED2	22-AUG-11 3:17:34PM	5819711	596164	913	Location with some degree sediment deposition.
SED3	22-AUG-11 3:35:34PM	5819616	596273	918	Location with some degree sediment deposition.
WATERCROW	22-AUG-11 4:14:13PM	5819395	596510	911	Water crowfoot identified here.
SEDGES1	22-AUG-11 4:25:29PM	5819360	596537	908	Sedges observed at this location.
PONDWEED1	22-AUG-11 4:32:16PM	5819342	596577	908	Pondweed observed here.
LEMNA1	22-AUG-11 4:37:39PM	5819349	596595	909	Duckweed observed here.
MEADOW1	22-AUG-11 4:39:27PM	5819350	596593	909	Meadow /w sedge & aquatic macrophyte growth
SED4	22-AUG-11 4:49:48PM	5819324	596617	910	Location with some degree sediment deposition.
SED5	22-AUG-11 5:04:50PM	5819213	596716	904	Location with some degree sediment deposition.
SED6	22-AUG-11 5:11:01PM	5819201	596750	905	Location with some degree sediment deposition.
DEPAREA1	22-AUG-11 5:14:17PM	5819179	596782	901	Large, deep sediment deposition.
Pond21	22-AUG-11 5:21:49PM	5819143	596788	897	Pond, part of DEPAREA1. Can be seen from satellite images.
W7	24-AUG-11 9:08:51AM	5819042	596941	905	Mine water quality monitoring station.
PICKUPSPEED	24-AUG-11 10:09:26AM	5818649	597376	892	Creel begins flowing more quickly.
PERI LOC1	24-AUG-11 10:39:50AM	5818280	597508	885	Observed significant periphyton growth here.
ALGAE1	24-AUG-11 11:16:47AM	5817952	597786	878	Observed algae growth here.
PICKUP2	24-AUG-11 1:00:39PM	5817268	598957	839	Creek once again picks up speed.
ALGAE2	24-AUG-11 1:10:34PM	5817268	599063	837	Observed algae growth here.
Upstream Barrier	24-AUG-11 1:14:12PM	5817304	599101	836	Possible fish barrier.
BARRIER2	24-AUG-11 1:53:48PM	5817258	599793	821	Possible fish barrier.
BARRIER3	24-AUG-11 2:00:01PM	5817214	599863	816	Possible fish barrier.
BARRIER4	24-AUG-11 2:15:52PM	5817096	600099	807	Possible fish barrier.
ALGAE3	24-AUG-11 2:24:48PM	5817145	600170	798	Observed algae growth here.

Table D.1 GPS coordinates for points of interest, Hazeltine Creek August 2011.

Point Name	Date	Easting (m)	Northing (m)	Elevation (m)	Description
Downstream Barrier	24-AUG-11 2:30:29PM	5817151	600243	792	Possible fish barrier.
FISH	24-AUG-11 2:37:42PM	5817182	600341	787	Fish observed in creek.
SLOWS	24-AUG-11 3:01:00PM	5817358	600578	773	Flow slows down.
CONFLUENCE	24-AUG-11 3:54:23PM	5817172	601396	732	Confuence of Edney Creek and Hazeltine Creek.
BDAM1	24-AUG-11 3:59:45PM	5817219	601423	729	Start of beaver dam.
SEDDS	24-AUG-11 4:19:41PM	5817640	601607	719	Sediment deposition observed near Quesnel Lake.
LAKE	24-AUG-11 4:35:34PM	5817735	601587	725	Mouth of Hazeltine Creek at Quesnel Lake.
PERI1	25-AUG-11 9:45:30AM	5817559	601558	732	Periphyton sampling location.
PERIW11-1	25-AUG-11 11:21:29AM	5817647	601623	728	Periphyton sampling location.
PERIW11-2	25-AUG-11 11:39:57AM	5817636	601571	723	Periphyton sampling location.
PERIW11-3	25-AUG-11 11:57:00AM	5817620	601559	724	Periphyton sampling location.
PERIW11-4	25-AUG-11 12:18:37PM	5817557	601565	730	Periphyton sampling location.
PERIW11-5	25-AUG-11 12:49:42PM	5817534	601557	726	Periphyton sampling location.
PERIW7-1	25-AUG-11 2:08:01PM	5819020	596955	900	Periphyton sampling location.
PERIW7-2	25-AUG-11 2:31:16PM	5819019	596966	909	Periphyton sampling location.
PERIW7-3	25-AUG-11 3:01:08PM	5818999	596980	911	Periphyton sampling location.
MOUTHPHOTO1	26-AUG-11 10:37:32AM	5817742	601606	726	Panoramic photo location #1.
MOUTHPHOTO2	26-AUG-11 10:45:05AM	5817738	601565	726	Panoramic photo location #2.

Table D.2: Stream morphological measurements downstream of W7, Hazeltine Creek August 2011.

Distance from shore (m)	Measurement from bankfull to stream bed (m)
0	0
0	0.7
0.5	0.81
1	0.84
1.5	0.86
2	0.78
2.5	0.82
3	0.79
3.5	0.67
4	0.57
4.5	0.5
5	0.44
5.5	0.48
6	0.45
6.5	0.45
7	0.47
7.5	0.46
8	0.47
8.5	0

APPENDIX E

PHOTOGRAPHS & FIELD NOTES

1) Upstream extent of the island

2) Creek overgrowth

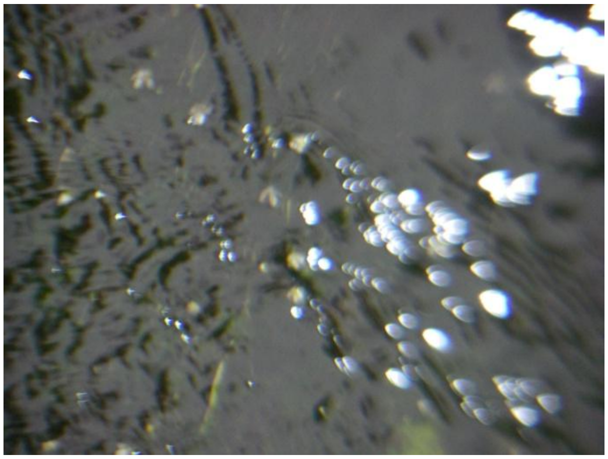
3) Gravel substrate

4) Sedge growing in stream

5) Water parsley

6) Well defined channel upstream of W7

Figure E.1: Photo documentation of Hazeltine Creek, August 2011.



7) Submerged water crowfoot

8) Pondweed-a

9) Lemna sp.

10) Depositional area 1

11) Velocity increase; moss on rock

12) Bedrock confined channel

Figure E.1: Photo documentation of Hazeltine Creek, August 2011.

13) Swift current in confined channel

14) One of several fish barriers

15) Larger rocks than upstream

16) Bedrock confined channel

17) Bedrock channel walls

18) Creek levels out and widens

Figure E.1: Photo documentation of Hazeltine Creek, August 2011.

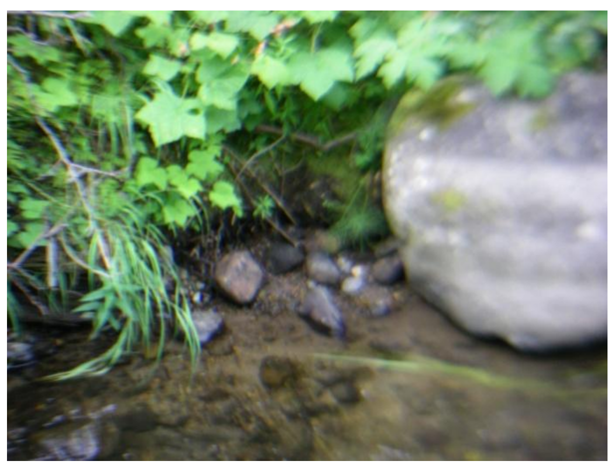
19) Near Quesnel lake outlet

20) Pondweed-b and tapegrass

21) W8 sediment sampling site

22) Sediment corer with sampled material

23) Erosion monitoring cross-section



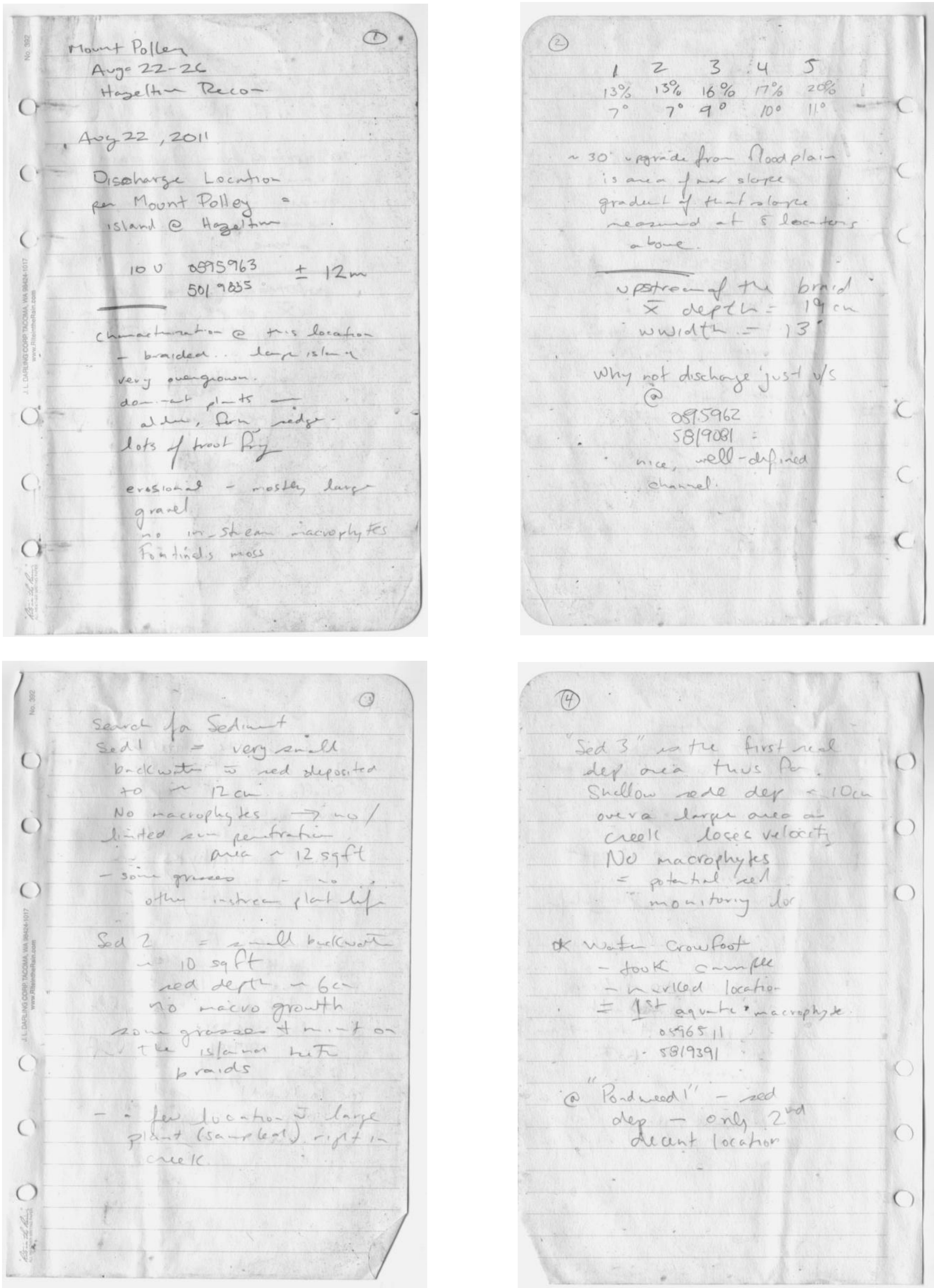
24) Erosion monitoring cross-section

Figure E.1: Photo documentation of Hazeltine Creek, August 2011.

a) From east bank at GPS point Mouth Photo 1

b) From west bank at GPS point Mouth Photo 2

Figure E.2: Panoramic photos taken at the mouth of Hazeltine Creek at Quesnel Lake, August 2011.


① Mount Polley
Aug 22-26
Hazelton Recon

Aug 22, 2011

Discharge Location
per Mount Polley
island @ Hazelton

10 U 0595963 ± 12m
5019855

characterization @ this location
- braided.. large island
very overgrown.
dominant plants —
alder, fern, sedge.
lots of trout fry

erosional - mostly large
gravel
no in-stream macrophytes
Fontinalis moss

②
1	2	3	4	5
13%	13%	16%	17%	20%
7°	7°	9°	10°	11°

~30' upgrade from floodplain
is area of max slope
gradient of that slope
measured at 5 locations
above.

upstream of the braid
x̄ depth = 19 cm
width = 13'

Why not discharge just u/s
@
0595962
5819081
nice, well-defined
channel.

③
Search for Sediment
Sed 1 = very small
backwater w/ sed deposited
to ~12 cm
No macrophytes → no /
limited sun penetration
area ~ 12 sqft
- some grasses - no
other instream plant life

Sed 2 = small backwater
~ 10 sqft
sed depth ~ 6cm
no macro growth
some grasses + moss on
the island b/t the
braids

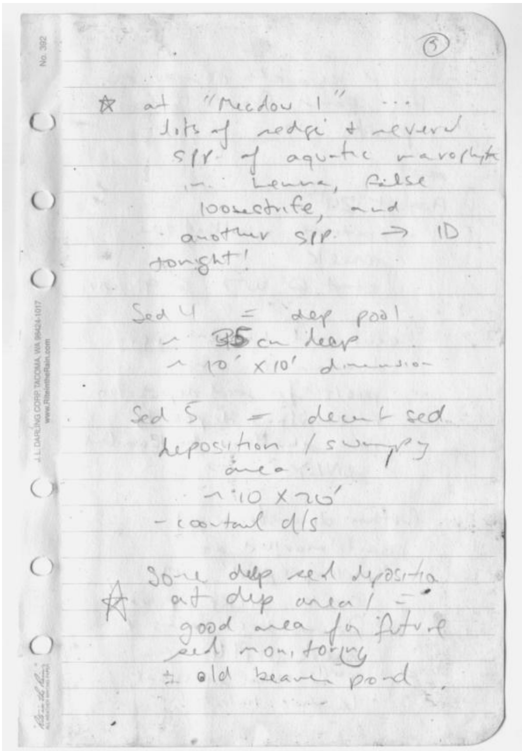
- few locations w/ large
plant (sampled) right in
creek

④
"Sed 3" is the first real
dep area thus far.
Shallow sed dep < 10cm
over a larger area as
creek loses velocity
No macrophytes
= potential sed
monitoring loc

Water Crowfoot
- took sample
- marked location
= 1st aquatic macrophyte
0596511
5819391

@ "Pondweed" - sed
dep - only 2nd
decent location

Figure E.3: August 2011 Minnow field notes.



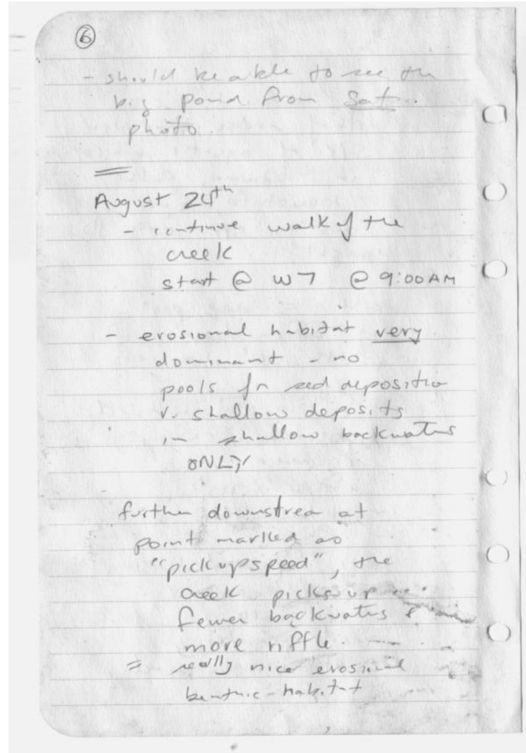
(5)

☆ at "Meadow 1" ...
lots of sedge & several
spp of aquatic macrophyte
i.e. Lemna, false
loosestrife, and
another spp → ID
tonight!

Sed 4 = deep pool
~ 35 cm deep
~ 10' x 10' dimension

Sed 5 = decent sed
deposition / swampy
area
~ 10 x 20'
- continued d/s

Some deep sed deposition
☆ at deep area! =
good area for future
sed monitoring
± old beaver pond



(6)

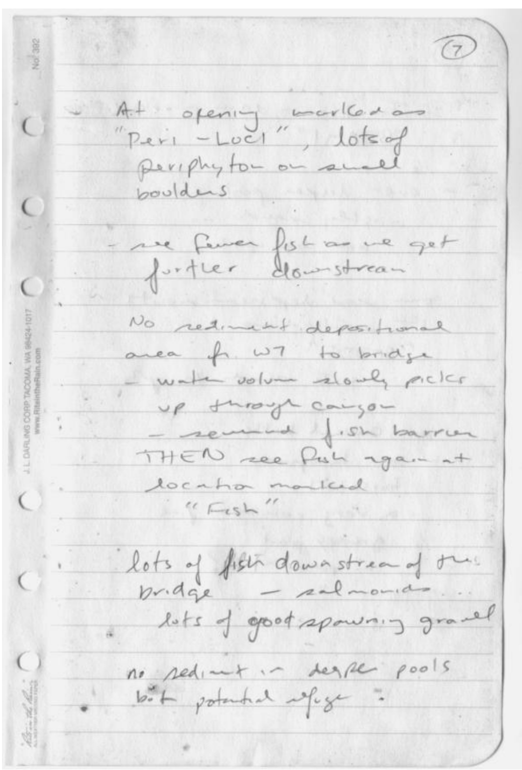
- should be able to see the
big pond from Sat.
photo

=

August 24th
- continue walk of the
creek
start @ W7 @ 9:00AM

- erosional habitat very
dominant - no
pools for sed deposition
v. shallow deposits
i.e. shallow backwaters
ONLY!

further downstream at
point marked as
"pickupspeed", the
creek picks up ...
fewer backwaters & more
more riffle. —
= really nice erosional
benthic-habitat



(7)

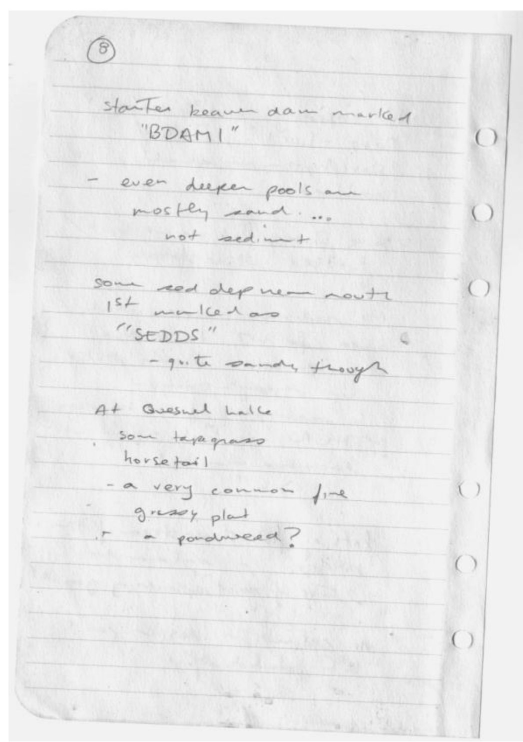
At opening marked as
"Peri-Loc1", lots of
periphyton on small
boulders

- see fewer fish as we get
further downstream

No sediment depositional
area fr W7 to bridge
- water volume slowly picks
up through canyon
- seasonal fish barrier
THEN see fish again at
location marked
"Fish"

lots of fish downstream of the
bridge - salmonids ..
lots of good spawning gravel

no sediment in deeper pools
but potential refuge :



(8)

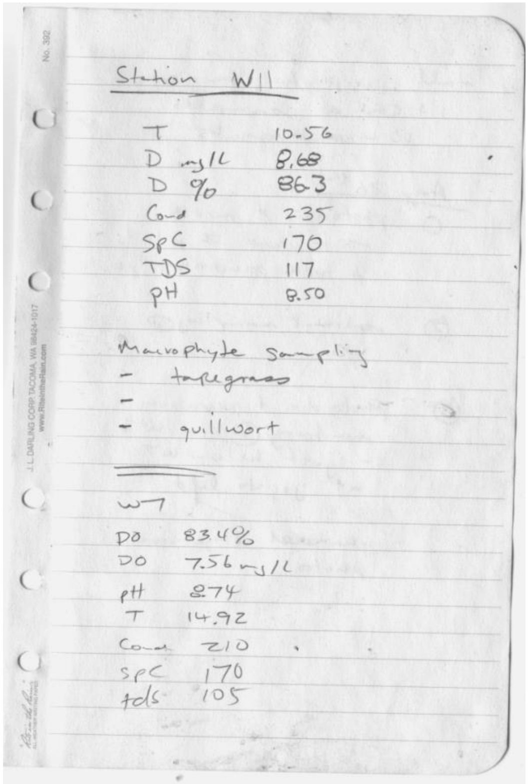
started beaver dam marked
"BDAM1"

- even deeper pools are
mostly sand ...
not sediment

some sed dep near mouth
1st marked as
"SEDDS"
- quite sandy though

At Quesnel Lake
some tape grass
horsetail
- a very common fine
grassy plant
i.e. a pondweed?

Figure E.3: August 2011 Minnow field notes.



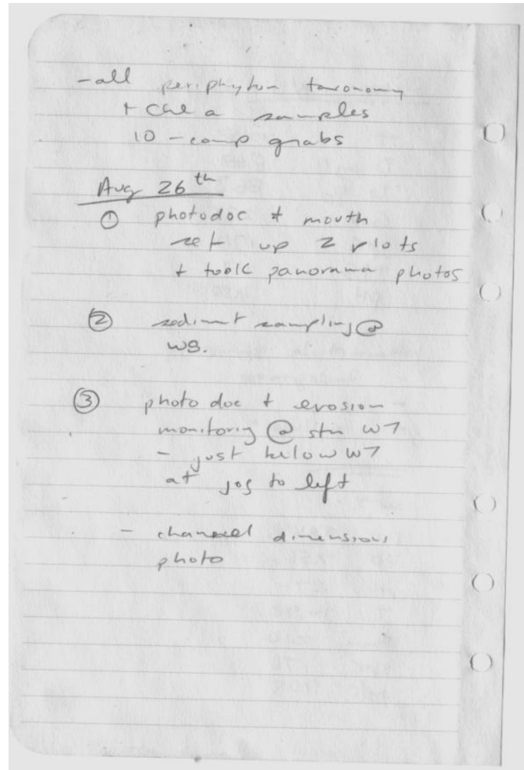
Station W11

T	10.56
D mg/L	8.68
D %	86.3
Cond	235
SpC	170
TDS	117
pH	8.50

Macrophyte Sampling
- tapegrass
-
- quillwort

W7

DO	83.4%
DO	7.56 mg/L
pH	8.74
T	14.92
Cond	210
SpC	170
tds	105



- all periphyton taxonomy
+ Chl a samples
10 - comp grabs

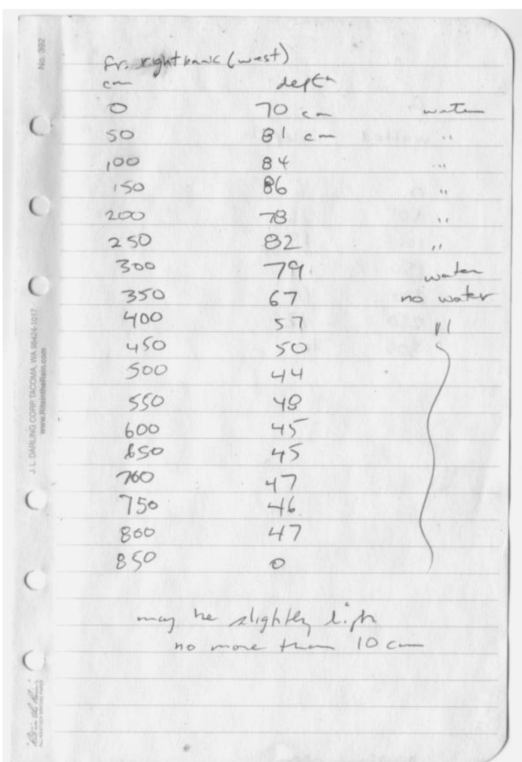
Aug 26th

① photodoc @ mouth
set up 2 plots
+ took panorama photos

② sediment sampling @ W8.

③ photo doc + erosion monitoring @ stn W7
- just below W7
at jog to left

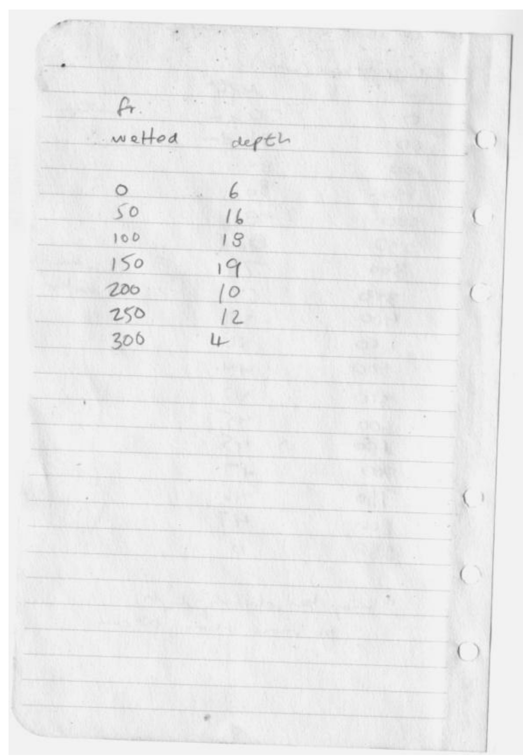
- channel dimension photo



fr. right bank (west)

cm	depth	
0	70 cm	water
50	81 cm	"
100	84	"
150	86	"
200	78	"
250	82	"
300	79	water
350	67	no water
400	57	"
450	50	
500	44	
550	48	
600	45	
650	45	
700	47	
750	46	
800	47	
850	0	

may be slightly high
no more than 10 cm



fr. wetted	depth
0	6
50	16
100	18
150	19
200	10
250	12
300	4

Figure E.3: August 2011 Minnow field notes.

APPENDIX F

WATER AND SEDIMENT QUALITY DATA

Table F.1: Water quality raw data.

Analyte		Units	W11	W7	Travel Blank
Physical Tests	Conductivity	uS/cm	232	207	<2.0
	Hardness (as CaCO3)	mg/L	121	105	<0.50
	pH	pH	7.94	8.04	6.06
	Total Suspended Solids	mg/L	3.3	3.0	<3.0
	Total Dissolved Solids	mg/L	154	141	<10
	Turbidity	NTU	0.45	1.33	<0.10
Anions, Nutrients and Organic Carbon	Alkalinity, Total (as CaCO3)	mg/L	105	82.6	<2.0
	Ammonia (as N)	mg/L	0.0068	0.0116	0.0157
	Chloride (Cl)	mg/L	<0.50	<0.50	<0.50
	Nitrate and Nitrite (as N)	mg/L	0.0469	0.0269	<0.0051
	Nitrate (as N)	mg/L	0.0469	0.0269	<0.0050
	Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010
	Total Nitrogen	mg/L	0.280	0.280	<0.050
	Orthophosphate-Dissolved (as P)	mg/L	0.0064	0.0051	<0.0010
	Phosphorus (P)-Total Dissolved	mg/L	0.0108	0.0102	<0.0020
	Phosphorus (P)-Total	mg/L	0.0129	0.0237	<0.0020
	Sulfate (SO4)	mg/L	19.7	27.2	<0.50
	Dissolved Organic Carbon	mg/L	6.43	5.82	-
	Total Organic Carbon	-	-	-	<0.50
Total Metals	Aluminum (Al)-Total	mg/L	0.0224	0.0430	<0.0030
	Antimony (Sb)-Total	mg/L	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total	mg/L	0.00073	0.00051	<0.00010
	Barium (Ba)-Total	mg/L	0.0166	0.00689	<0.000050
	Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total	mg/L	<0.00050	<0.00050	<0.00050
	Boron (B)-Total	mg/L	0.023	0.023	<0.010
	Cadmium (Cd)-Total	mg/L	<0.000010	<0.000010	<0.000010
	Calcium (Ca)-Total	mg/L	37.0	32.5	<0.050
	Chromium (Cr)-Total	mg/L	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Total	mg/L	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total	mg/L	0.00165	0.00162	<0.00050
	Iron (Fe)-Total	mg/L	0.056	0.070	<0.030
	Lead (Pb)-Total	mg/L	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total	mg/L	0.00074	<0.00050	<0.00050
	Magnesium (Mg)-Total	mg/L	7.68	5.22	<0.10
	Manganese (Mn)-Total	mg/L	0.0265	0.0233	<0.000050
	Molybdenum (Mo)-Total	mg/L	0.00177	0.00218	<0.000050
	Nickel (Ni)-Total	mg/L	0.00051	<0.00050	<0.00050
	Potassium (K)-Total	mg/L	0.665	0.386	<0.050
	Selenium (Se)-Total	mg/L	<0.00050	0.00062	<0.00050
	Silicon (Si)-Total	mg/L	4.29	3.45	<0.050
	Silver (Ag)-Total	mg/L	<0.000010	<0.000010	<0.000010

Table F.1: Water quality raw data.

Analyte		Units	W11	W7	Travel Blank
Total Metals	Sodium (Na)-Total	mg/L	6.11	4.74	<0.050
	Strontium (Sr)-Total	mg/L	0.268	0.247	<0.00010
	Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total	mg/L	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total	mg/L	<0.010	<0.010	<0.010
	Uranium (U)-Total	mg/L	0.000153	0.000118	<0.000010
	Vanadium (V)-Total	mg/L	<0.0010	0.0011	<0.0010
	Zinc (Zn)-Total	mg/L	<0.0030	<0.0030	<0.0030
Dissolved Metals	Aluminum (Al)-Dissolved	mg/L	0.0074	0.0098	-
	Antimony (Sb)-Dissolved	mg/L	<0.00010	<0.00010	-
	Arsenic (As)-Dissolved	mg/L	0.00070	0.00049	-
	Barium (Ba)-Dissolved	mg/L	0.0160	0.00676	-
	Beryllium (Be)-Dissolved	mg/L	<0.00010	<0.00010	-
	Bismuth (Bi)-Dissolved	mg/L	<0.00050	<0.00050	-
	Boron (B)-Dissolved	mg/L	0.022	0.023	-
	Cadmium (Cd)-Dissolved	mg/L	<0.000010	<0.000010	-
	Calcium (Ca)-Dissolved	mg/L	36.2	33.2	-
	Chromium (Cr)-Dissolved	mg/L	<0.00050	<0.00050	-
	Cobalt (Co)-Dissolved	mg/L	<0.00010	<0.00010	-
	Copper (Cu)-Dissolved	mg/L	0.00139	0.00136	-
	Iron (Fe)-Dissolved	mg/L	<0.030	<0.030	-
	Lead (Pb)-Dissolved	mg/L	<0.000050	<0.000050	-
	Lithium (Li)-Dissolved	mg/L	0.00066	<0.00050	-
	Magnesium (Mg)-Dissolved	mg/L	7.35	5.25	-
	Manganese (Mn)-Dissolved	mg/L	0.0163	0.000337	-
	Molybdenum (Mo)-Dissolved	mg/L	0.00170	0.00218	-
	Nickel (Ni)-Dissolved	mg/L	<0.00050	<0.00050	-
	Potassium (K)-Dissolved	mg/L	0.628	0.385	-
	Selenium (Se)-Dissolved	mg/L	<0.00050	0.00067	-
	Silicon (Si)-Dissolved	mg/L	4.10	3.40	-
	Silver (Ag)-Dissolved	mg/L	<0.000010	<0.000010	-
	Sodium (Na)-Dissolved	mg/L	5.81	4.91	-
	Strontium (Sr)-Dissolved	mg/L	0.254	0.249	-
	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	0.000152	0.000118	-
	Vanadium (V)-Dissolved	mg/L	<0.0010	0.0011	-
	Zinc (Zn)-Dissolved	mg/L	<0.0030	<0.0030	-

Table F.2: Sediment quality raw data.

Analyte	Units	W8-1	W8-2	W8-3	W8-4	W8-5
Total Organic Carbon	%	9.92	10.8	9.51	9.79	11.0
Aluminum (Al)	mg/kg	17900	18600	19500	18500	17900
Antimony (Sb)	mg/kg	0.36	0.39	0.39	0.38	0.36
Arsenic (As)	mg/kg	15.6	15.3	17.1	17.0	16.9
Barium (Ba)	mg/kg	174	179	193	185	188
Beryllium (Be)	mg/kg	0.44	0.47	0.51	0.46	0.47
Bismuth (Bi)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	<0.80	<0.80	<0.80	<0.80	<0.80
Calcium (Ca)	mg/kg	9820	11200	12400	12400	11000
Chromium (Cr)	mg/kg	50.6	55.1	55.6	53.3	51.7
Cobalt (Co)	mg/kg	15.3	14.9	16.1	15.3	15.6
Copper (Cu)	mg/kg	52.4	59.1	60.5	56.5	56.5
Iron (Fe)	mg/kg	35300	37200	37500	36500	35500
Lead (Pb)	mg/kg	<8.00	<8.00	<9.00	<8.00	<8.00
Lithium (Li)	mg/kg	19.8	20.9	23.0	23.9	21.1
Magnesium (Mg)	mg/kg	7370	7830	8070	8030	7250
Manganese (Mn)	mg/kg	2850	2760	3410	3030	3590
Mercury (Hg)	mg/kg	0.0964	0.110	0.105	0.101	0.111
Molybdenum (Mo)	mg/kg	1.11	1.28	1.22	1.25	1.25
Nickel (Ni)	mg/kg	37.2	38.5	40.6	38.5	38.0
Phosphorus (P)	mg/kg	1190	1320	1270	1240	1230
Potassium (K)	mg/kg	1420	1570	1560	1440	1350
Selenium (Se)	mg/kg	2.82	3.34	3.28	3.22	3.27
Silver (Ag)	mg/kg	0.22	0.23	0.23	0.22	0.23
Sodium (Na)	mg/kg	240	220	210	200	180
Strontium (Sr)	mg/kg	98.3	113	114	106	110
Thallium (Tl)	mg/kg	0.129	0.138	0.139	0.137	0.130
Tin (Sn)	mg/kg	<2.00	<2.00	<2.00	<2.00	<2.00
Titanium (Ti)	mg/kg	562	568	556	475	425
Uranium (U)	mg/kg	1.40	1.57	1.50	1.56	1.53
Vanadium (V)	mg/kg	57.4	57.7	58.9	56.3	53.2
Zinc (Zn)	mg/kg	92.3	96.4	99.0	95.5	93.1

APPENDIX G

MACROPHYTE TISSUE AND PERIPHYTON QUALITY DATA

Table G.1: Macrophyte tissue quality raw data, August 2011.

Analyte	Units	Creeping Spearwort (*Ranunculus flammula*)					Green Algae		
		LHC-M2-1	**LHC-M2-2**	**LHC-M2-3**	**LHC-M2-4**	**LHC-M2-5**	**HC-A-1**	**HC-A-2**	**HC-A-3**
% Moisture	%	87.6	87.5	87.7	87.4	87.7	73.8	76.9	86.9
Aluminum (Al)-Total	mg/kg	3350	1670	3320	3420	2800	7950	5350	6580
Aluminum (Al)-Total	mg/kg wwt	415	208	406	431	346	2090	1230	862
Antimony (Sb)-Total	mg/kg	0.069	0.054	0.054	0.056	0.074	0.045	0.052	0.056
Antimony (Sb)-Total	mg/kg wwt	0.0085	0.0067	0.0066	0.0071	0.0092	0.0118	0.0120	0.0074
Arsenic (As)-Total	mg/kg	5.40	3.93	5.41	3.91	3.84	7.21	4.77	4.64
Arsenic (As)-Total	mg/kg wwt	0.668	0.489	0.663	0.492	0.473	1.89	1.10	0.608
Barium (Ba)-Total	mg/kg	120	116	121	97.5	99.3	104	71.9	69.9
Barium (Ba)-Total	mg/kg wwt	14.8	14.4	14.8	12.3	12.3	27.2	16.6	9.15
Beryllium (Be)-Total	mg/kg	0.117	0.061	0.115	0.110	0.091	0.247	0.160	0.212
Beryllium (Be)-Total	mg/kg wwt	0.0145	0.0076	0.0141	0.0139	0.0112	0.0648	0.0370	0.0278
Bismuth (Bi)-Total	mg/kg	0.036	0.039	0.034	0.032	0.029	0.057	0.036	0.035
Bismuth (Bi)-Total	mg/kg wwt	0.0044	0.0049	0.0041	0.0041	0.0036	0.0150	0.0083	0.0046
Boron (B)-Total	mg/kg	44.5	65.1	69.1	42.9	48.8	35.6	70.0	44.6
Boron (B)-Total	mg/kg wwt	5.51	8.11	8.47	5.41	6.02	9.35	16.1	5.84
Cadmium (Cd)-Total	mg/kg	0.423	0.354	0.369	0.316	0.372	0.281	0.240	0.177
Cadmium (Cd)-Total	mg/kg wwt	0.0524	0.0441	0.0452	0.0397	0.0459	0.0737	0.0553	0.0232
Calcium (Ca)-Total	mg/kg	11300	10400	10700	11800	12100	12100	10700	9330
Calcium (Ca)-Total	mg/kg wwt	1400	1300	1310	1490	1490	3190	2480	1220
Cesium (Cs)-Total	mg/kg	0.378	0.197	0.377	0.377	0.310	0.925	0.532	0.519
Cesium (Cs)-Total	mg/kg wwt	0.0468	0.0245	0.0461	0.0475	0.0382	0.243	0.123	0.0680
Chromium (Cr)-Total	mg/kg	14.5	8.49	39.5	17.9	16.2	30.2	21.6	532
Chromium (Cr)-Total	mg/kg wwt	1.80	1.06	4.84	2.26	2.00	7.92	4.98	69.7
Cobalt (Co)-Total	mg/kg	7.80	6.56	7.59	5.56	5.91	5.53	4.07	9.43
Cobalt (Co)-Total	mg/kg wwt	0.966	0.818	0.930	0.701	0.729	1.45	0.938	1.23
Copper (Cu)-Total	mg/kg	30.8	24.0	22.7	24.3	32.4	38.5	28.7	27.9
Copper (Cu)-Total	mg/kg wwt	3.81	2.99	2.78	3.07	4.00	10.1	6.62	3.66
Gallium (Ga)-Total	mg/kg	0.951	0.451	0.951	0.980	0.766	2.11	1.36	2.18
Gallium (Ga)-Total	mg/kg wwt	0.118	0.0563	0.116	0.123	0.0945	0.555	0.313	0.285
Iron (Fe)-Total	mg/kg	7050	3930	6920	6730	5480	10800	7970	13700
Iron (Fe)-Total	mg/kg wwt	874	490	848	848	676	2840	1840	1790
Lead (Pb)-Total	mg/kg	2.04	1.18	1.93	1.88	1.65	3.62	2.25	2.59
Lead (Pb)-Total	mg/kg wwt	0.252	0.148	0.236	0.237	0.204	0.950	0.518	0.339
Lithium (Li)-Total	mg/kg	2.94	1.39	2.94	3.02	2.37	7.62	4.39	5.59
Lithium (Li)-Total	mg/kg wwt	0.364	0.174	0.361	0.380	0.293	2.00	1.01	0.733
Magnesium (Mg)-Total	mg/kg	3760	3250	3590	3780	4040	4300	3160	3990
Magnesium (Mg)-Total	mg/kg wwt	466	405	440	475	499	1130	728	523
Manganese (Mn)-Total	mg/kg	4620	5040	4850	2700	3580	2950	2250	1090
Manganese (Mn)-Total	mg/kg wwt	572	628	594	340	441	775	520	143
Mercury (Hg)-Total	mg/kg	0.0376	0.0248	0.0345	0.0328	0.027	0.125	0.0974	0.0531
Mercury (Hg)-Total	mg/kg wwt	0.0047	0.0031	0.0042	0.0041	0.0034	0.0329	0.0225	0.0070
Molybdenum (Mo)-Total	mg/kg	1.17	0.990	0.957	0.953	1.16	1.20	0.850	3.43
Molybdenum (Mo)-Total	mg/kg wwt	0.145	0.123	0.117	0.120	0.143	0.315	0.196	0.449
Nickel (Ni)-Total	mg/kg	12.9	8.83	22.2	12.2	11.5	16.2	12.3	214
Nickel (Ni)-Total	mg/kg wwt	1.59	1.10	2.72	1.53	1.41	4.24	2.83	28.0
Phosphorus (P)-Total	mg/kg	2600	3190	2830	2360	3320	4050	3870	2400
Phosphorus (P)-Total	mg/kg wwt	322	398	347	297	409	1060	892	315
Potassium (K)-Total	mg/kg	24200	25600	20000	20500	23100	13000	11700	15000
Potassium (K)-Total	mg/kg wwt	3000	3190	2450	2580	2850	3400	2700	1960
Rhenium (Re)-Total	mg/kg	<0.020	<0.020	<0.020	0.020	<0.020	<0.010	<0.010	<0.010
Rhenium (Re)-Total	mg/kg wwt	<0.0020	<0.0020	<0.0020	0.0025	0.0023	0.0023	<0.0020	<0.0020
Rubidium (Rb)-Total	mg/kg	27.2	27.8	21.3	21.8	25.4	19.5	16.8	15.8
Rubidium (Rb)-Total	mg/kg wwt	3.37	3.46	2.61	2.75	3.13	5.13	3.88	2.07
Selenium (Se)-Total	mg/kg	1.22	0.99	1.07	0.85	0.83	3.90	3.02	1.59
Selenium (Se)-Total	mg/kg wwt	0.151	0.123	0.131	0.107	0.102	1.02	0.697	0.209
Sodium (Na)-Total	mg/kg	4530	4850	3460	2520	4920	250	410	590
Sodium (Na)-Total	mg/kg wwt	561	605	424	317	607	65	93	77
Strontium (Sr)-Total	mg/kg	107	100	91.6	104	110	113	97.9	87.7
Strontium (Sr)-Total	mg/kg wwt	13.2	12.5	11.2	13.1	13.6	29.6	22.6	11.5
Tellurium (Te)-Total	mg/kg	<0.040	<0.040	<0.040	<0.020	<0.040	<0.020	<0.020	<0.020
Tellurium (Te)-Total	mg/kg wwt	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	mg/kg	0.0819	0.0861	0.0815	0.0617	0.0870	0.0810	0.0503	0.0488
Thallium (Tl)-Total	mg/kg wwt	0.0101	0.0107	0.00999	0.00777	0.0107	0.0213	0.0116	0.00640
Thorium (Th)-Total	mg/kg	0.969	0.494	1.03	1.06	0.821	1.58	0.716	1.59
Thorium (Th)-Total	mg/kg wwt	0.120	0.0616	0.126	0.133	0.101	0.414	0.165	0.208
Tin (Sn)-Total	mg/kg	0.117	0.114	0.090	0.086	0.094	0.138	0.022	0.108
Tin (Sn)-Total	mg/kg wwt	0.0145	0.0142	0.0110	0.0109	0.0116	0.0363	0.0052	0.0141
Titanium (Ti)-Total	mg/kg	166	81.0	166	173	130	286	179	400
Titanium (Ti)-Total	mg/kg wwt	20.6	10.1	20.4	21.8	16.1	74.9	41.3	52.4
Uranium (U)-Total	mg/kg	0.355	0.176	0.324	0.297	0.247	0.624	0.426	0.445
Uranium (U)-Total	mg/kg wwt	0.0439	0.0219	0.0397	0.0375	0.0304	0.164	0.0982	0.0582
Vanadium (V)-Total	mg/kg	16.5	9.19	16.5	15.2	12.5	26.8	19.8	38.6
Vanadium (V)-Total	mg/kg wwt	2.04	1.15	2.02	1.92	1.54	7.03	4.56	5.05
Yttrium (Y)-Total	mg/kg	3.97	2.37	3.84	3.49	3.07	8.14	5.91	6.35
Yttrium (Y)-Total	mg/kg wwt	0.492	0.295	0.471	0.440	0.379	2.14	1.36	0.832
Zinc (Zn)-Total	mg/kg	54.1	49.9	44.1	50.2	56.5	36.2	30.4	31.0
Zinc (Zn)-Total	mg/kg wwt	6.70	6.22	5.41	6.33	6.98	9.51	7.02	4.06
Zirconium (Zr)-Total	mg/kg	0.72	<0.40	0.55	0.59	<0.40	2.29	0.43	1.02
Zirconium (Zr)-Total	mg/kg wwt	0.089	<0.040	0.067	0.074	0.047	0.601	0.098	0.134

Table G.1: Macrophyte tissue quality raw data, August 2011.

Analyte	Units	Pondweed (*Potamogeton* sp. 1)					Pondweed (*Potamogeton* sp. 2)				
		LHC-M3-1	LHC-M3-2	LHC-M3-3	LHC-M3-4	LHC-M3-5	HC-M2-1	HC-M2-2	HC-M2-3	HC-M2-4	HC-M2-5
% Moisture	%	87.3	87.2	88.3	86.1	88.7	87.7	85.2	86.4	84.0	81.6
Aluminum (Al)-Total	mg/kg	3430	2600	2250	3570	2900	3540	3500	8190	4080	2680
Aluminum (Al)-Total	mg/kg wwt	434	332	264	495	328	436	519	1110	651	493
Antimony (Sb)-Total	mg/kg	0.054	0.074	0.060	0.064	0.059	0.052	0.052	0.044	0.071	0.040
Antimony (Sb)-Total	mg/kg wwt	0.0068	0.0094	0.0071	0.0089	0.0066	0.0064	0.0077	0.0059	0.0113	0.0073
Arsenic (As)-Total	mg/kg	4.61	4.86	4.51	6.33	4.54	1.98	2.00	2.78	2.23	2.39
Arsenic (As)-Total	mg/kg wwt	0.584	0.620	0.528	0.879	0.514	0.245	0.297	0.377	0.356	0.441
Barium (Ba)-Total	mg/kg	142	157	150	136	148	54.3	56.1	88.5	64.0	75.8
Barium (Ba)-Total	mg/kg wwt	17.9	20.0	17.6	18.9	16.8	6.69	8.32	12.0	10.2	14.0
Beryllium (Be)-Total	mg/kg	0.114	0.097	0.080	0.119	0.099	0.109	0.092	0.253	0.137	0.069
Beryllium (Be)-Total	mg/kg wwt	0.0145	0.0124	0.0094	0.0166	0.0112	0.0135	0.0137	0.0344	0.0218	0.0127
Bismuth (Bi)-Total	mg/kg	0.032	0.028	0.027	0.032	0.028	0.023	<0.020	0.048	0.026	<0.020
Bismuth (Bi)-Total	mg/kg wwt	0.0040	0.0036	0.0032	0.0045	0.0032	0.0028	0.0027	0.0066	0.0041	0.0027
Boron (B)-Total	mg/kg	55.5	60.5	87.9	67.4	44.7	20.1	36.1	19.8	30.5	34.3
Boron (B)-Total	mg/kg wwt	7.03	7.72	10.3	9.34	5.06	2.48	5.35	2.69	4.87	6.32
Cadmium (Cd)-Total	mg/kg	0.416	0.461	0.406	0.439	0.482	<0.20	0.225	0.269	0.246	0.231
Cadmium (Cd)-Total	mg/kg wwt	0.0526	0.0588	0.0476	0.0609	0.0546	<0.025	0.0334	0.0364	0.0392	0.0425
Calcium (Ca)-Total	mg/kg	13600	11100	11600	11100	11500	20800	13700	13300	28300	19800
Calcium (Ca)-Total	mg/kg wwt	1720	1420	1360	1540	1300	2560	2020	1810	4510	3650
Cesium (Cs)-Total	mg/kg	0.391	0.262	0.248	0.386	0.316	0.328	0.310	0.829	0.379	0.242
Cesium (Cs)-Total	mg/kg wwt	0.0495	0.0334	0.0291	0.0536	0.0358	0.0404	0.0460	0.113	0.0605	0.0446
Chromium (Cr)-Total	mg/kg	15.1	14.8	12.0	20.6	11.0	11.8	13.1	96.4	25.8	17.7
Chromium (Cr)-Total	mg/kg wwt	1.91	1.89	1.41	2.85	1.25	1.46	1.95	13.1	4.11	3.26
Cobalt (Co)-Total	mg/kg	6.94	7.35	6.48	7.60	7.26	3.46	4.03	5.92	3.66	4.46
Cobalt (Co)-Total	mg/kg wwt	0.879	0.937	0.760	1.05	0.823	0.426	0.597	0.804	0.584	0.822
Copper (Cu)-Total	mg/kg	25.1	30.6	27.5	29.4	27.1	30.7	25.4	46.4	31.5	26.6
Copper (Cu)-Total	mg/kg wwt	3.18	3.91	3.22	4.07	3.07	3.78	3.77	6.30	5.03	4.90
Gallium (Ga)-Total	mg/kg	0.967	0.730	0.628	0.966	0.776	0.961	1.04	2.22	1.10	0.726
Gallium (Ga)-Total	mg/kg wwt	0.122	0.0931	0.0736	0.134	0.0879	0.118	0.154	0.301	0.176	0.134
Iron (Fe)-Total	mg/kg	6600	5440	5040	6860	5880	5600	5160	11300	6590	4750
Iron (Fe)-Total	mg/kg wwt	835	693	591	952	667	690	765	1540	1050	874
Lead (Pb)-Total	mg/kg	1.74	1.46	1.35	1.74	1.45	1.55	1.25	3.51	1.77	1.01
Lead (Pb)-Total	mg/kg wwt	0.220	0.187	0.158	0.241	0.164	0.191	0.186	0.477	0.282	0.185
Lithium (Li)-Total	mg/kg	2.99	2.10	1.88	3.05	2.49	2.50	2.64	6.71	3.11	1.84
Lithium (Li)-Total	mg/kg wwt	0.379	0.268	0.220	0.424	0.282	0.308	0.391	0.911	0.496	0.339
Magnesium (Mg)-Total	mg/kg	2650	2290	2410	2620	2380	1890	2620	3560	2570	2370
Magnesium (Mg)-Total	mg/kg wwt	335	292	282	363	270	233	388	483	410	436
Manganese (Mn)-Total	mg/kg	5880	7300	7350	6170	6570	2440	2420	1890	2210	4920
Manganese (Mn)-Total	mg/kg wwt	744	931	861	856	745	300	359	257	352	905
Mercury (Hg)-Total	mg/kg	0.0463	0.040	0.088	0.0488	0.0625	0.0458	0.0434	0.0847	0.0555	0.0402
Mercury (Hg)-Total	mg/kg wwt	0.0059	0.0052	0.0103	0.0068	0.0071	0.0056	0.0064	0.0115	0.0089	0.0074
Molybdenum (Mo)-Total	mg/kg	0.876	1.39	0.847	1.08	0.799	1.59	2.28	1.55	2.07	3.23
Molybdenum (Mo)-Total	mg/kg wwt	0.111	0.177	0.0992	0.149	0.0905	0.196	0.338	0.210	0.330	0.595
Nickel (Ni)-Total	mg/kg	12.2	12.3	10.4	14.5	11.6	6.81	7.52	41.6	12.1	9.75
Nickel (Ni)-Total	mg/kg wwt	1.54	1.58	1.22	2.02	1.32	0.839	1.12	5.65	1.93	1.79
Phosphorus (P)-Total	mg/kg	2400	2140	2280	2220	2350	2310	3100	1500	2530	3440
Phosphorus (P)-Total	mg/kg wwt	304	272	267	308	266	284	459	203	404	634
Potassium (K)-Total	mg/kg	23000	18800	19300	24600	23500	9440	17100	4970	8660	15700
Potassium (K)-Total	mg/kg wwt	2910	2400	2260	3420	2670	1160	2540	675	1380	2880
Rhenium (Re)-Total	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.012	<0.010	<0.020
Rhenium (Re)-Total	mg/kg wwt	<0.0020	<0.0020	<0.0020	0.0023	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	mg/kg	17.4	15.4	14.1	16.2	15.5	5.56	7.65	7.16	5.66	7.07
Rubidium (Rb)-Total	mg/kg wwt	2.21	1.96	1.65	2.25	1.76	0.685	1.13	0.971	0.903	1.30
Selenium (Se)-Total	mg/kg	1.70	1.69	1.53	1.75	2.10	2.49	4.40	3.77	2.93	3.38
Selenium (Se)-Total	mg/kg wwt	0.215	0.215	0.180	0.242	0.238	0.307	0.652	0.511	0.467	0.623
Sodium (Na)-Total	mg/kg	5480	5900	4650	6870	5790	4360	6680	2170	3420	6530
Sodium (Na)-Total	mg/kg wwt	693	753	545	953	655	538	991	294	546	1200
Strontium (Sr)-Total	mg/kg	112	114	106	104	112	119	111	116	160	128
Strontium (Sr)-Total	mg/kg wwt	14.2	14.6	12.4	14.4	12.7	14.7	16.5	15.7	25.6	23.6
Tellurium (Te)-Total	mg/kg	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.020	<0.020	<0.040
Tellurium (Te)-Total	mg/kg wwt	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	mg/kg	0.0522	0.0264	0.0246	0.0336	0.0296	0.0330	0.0374	0.0612	0.0409	0.0368
Thallium (Tl)-Total	mg/kg wwt	0.00660	0.00336	0.00288	0.00467	0.00336	0.00407	0.00554	0.00831	0.00653	0.00677
Thorium (Th)-Total	mg/kg	0.931	0.675	0.599	1.02	0.826	0.672	0.598	2.02	0.936	0.438
Thorium (Th)-Total	mg/kg wwt	0.118	0.0862	0.0702	0.142	0.0935	0.0829	0.0886	0.274	0.149	0.0806
Tin (Sn)-Total	mg/kg	0.225	0.242	0.170	0.226	0.090	0.076	0.090	0.233	0.088	0.052
Tin (Sn)-Total	mg/kg wwt	0.0284	0.0309	0.0199	0.0313	0.0101	0.0093	0.0133	0.0317	0.0140	0.0096
Titanium (Ti)-Total	mg/kg	156	131	94.7	171	130	162	214	411	207	115
Titanium (Ti)-Total	mg/kg wwt	19.7	16.7	11.1	23.7	14.7	20.0	31.8	55.8	33.0	21.2
Uranium (U)-Total	mg/kg	0.292	0.267	0.227	0.293	0.264	0.375	0.262	0.750	0.480	0.213
Uranium (U)-Total	mg/kg wwt	0.0369	0.0340	0.0266	0.0406	0.0299	0.0462	0.0388	0.102	0.0766	0.0393
Vanadium (V)-Total	mg/kg	15.5	13.6	10.8	16.3	13.4	14.2	15.3	30.5	17.3	12.2
Vanadium (V)-Total	mg/kg wwt	1.96	1.73	1.26	2.26	1.51	1.74	2.26	4.14	2.76	2.25
Yttrium (Y)-Total	mg/kg	4.15	4.09	3.44	4.57	4.37	3.53	2.98	8.59	4.85	2.25
Yttrium (Y)-Total	mg/kg wwt	0.525	0.522	0.403	0.634	0.495	0.436	0.442	1.17	0.774	0.415
Zinc (Zn)-Total	mg/kg	44.8	44.5	39.1	45.8	44.8	25.6	29.3	35.6	26.5	27.5
Zinc (Zn)-Total	mg/kg wwt	5.68	5.68	4.58	6.35	5.07	3.15	4.35	4.84	4.23	5.07
Zirconium (Zr)-Total	mg/kg	1.36	1.19	0.86	0.80	0.66	0.78	0.62	3.38	0.76	<0.40
Zirconium (Zr)-Total	mg/kg wwt	0.173	0.151	0.101	0.112	0.075	0.096	0.092	0.458	0.121	0.051

Table G.1: Macrophyte tissue quality raw data, August 2011.

Analyte	Units	Tapegrass (*Vallisneria americana*)					Water Crowfoot (*Ranunculus aquatilis*)				
		LHC-M1-1	LHC-M1-2	LHC-M1-3	LHC-M1-4	LHC-M1-5	HC-M1-1	HC-M1-2	HC-M1-3	HC-M1-4	HC-M1-5
% Moisture	%	92.3	94.9	91.9	91.8	91.3	84.0	86.4	84.6	86.2	87.0
Aluminum (Al)-Total	mg/kg	1090	430	353	2290	463	2870	1760	2020	1650	1320
Aluminum (Al)-Total	mg/kg wwt	83.4	22.1	28.6	189	40.5	459	238	310	228	172
Antimony (Sb)-Total	mg/kg	0.036	0.024	0.024	0.053	0.021	0.066	0.063	0.060	0.030	0.028
Antimony (Sb)-Total	mg/kg wwt	0.0028	<0.0020	<0.0020	0.0043	<0.0020	0.0105	0.0085	0.0093	0.0041	0.0036
Arsenic (As)-Total	mg/kg	1.87	2.32	0.864	3.19	1.33	3.14	1.53	1.44	0.998	1.20
Arsenic (As)-Total	mg/kg wwt	0.143	0.119	0.0699	0.262	0.116	0.501	0.207	0.221	0.138	0.156
Barium (Ba)-Total	mg/kg	52.5	67.3	28.4	65.6	48.5	60.2	42.2	40.0	38.3	30.4
Barium (Ba)-Total	mg/kg wwt	4.03	3.46	2.30	5.40	4.24	9.60	5.73	6.15	5.30	3.97
Beryllium (Be)-Total	mg/kg	0.036	0.020	<0.020	0.072	<0.020	0.099	0.068	0.074	0.046	0.040
Beryllium (Be)-Total	mg/kg wwt	0.0028	<0.0020	<0.0020	0.0059	<0.0020	0.0158	0.0092	0.0113	0.0063	0.0052
Bismuth (Bi)-Total	mg/kg	<0.020	<0.020	<0.020	0.027	<0.020	0.018	<0.020	0.013	0.011	<0.010
Bismuth (Bi)-Total	mg/kg wwt	<0.0020	<0.0020	<0.0020	0.0022	<0.0020	0.0029	<0.0020	0.0021	<0.0020	<0.0020
Boron (B)-Total	mg/kg	61.2	55.1	70.2	116	70.4	52.9	46.8	38.6	36.4	49.7
Boron (B)-Total	mg/kg wwt	4.70	2.83	5.68	9.59	6.15	8.45	6.35	5.94	5.04	6.49
Cadmium (Cd)-Total	mg/kg	<0.16	<0.15	<0.090	<0.26	<0.13	0.422	0.436	0.321	0.643	0.665
Cadmium (Cd)-Total	mg/kg wwt	<0.012	<0.0080	<0.0070	<0.022	<0.011	0.0673	0.0591	0.0493	0.0889	0.0868
Calcium (Ca)-Total	mg/kg	12100	16500	13200	10800	12100	12400	10900	10100	8810	8640
Calcium (Ca)-Total	mg/kg wwt	927	846	1070	891	1060	1980	1480	1550	1220	1130
Cesium (Cs)-Total	mg/kg	0.113	0.043	0.038	0.262	0.048	0.247	0.166	0.194	0.183	0.141
Cesium (Cs)-Total	mg/kg wwt	0.0087	0.0022	0.0030	0.0216	0.0042	0.0394	0.0226	0.0299	0.0253	0.0184
Chromium (Cr)-Total	mg/kg	4.11	2.81	3.57	12.1	2.73	17.3	11.6	13.4	6.79	10.9
Chromium (Cr)-Total	mg/kg wwt	0.315	0.144	0.289	1.00	0.239	2.76	1.57	2.06	0.940	1.42
Cobalt (Co)-Total	mg/kg	2.71	3.52	1.28	4.01	2.16	4.27	3.41	2.88	3.42	3.58
Cobalt (Co)-Total	mg/kg wwt	0.208	0.181	0.103	0.330	0.189	0.681	0.462	0.443	0.473	0.467
Copper (Cu)-Total	mg/kg	14.3	12.5	11.3	26.7	10.6	31.0	26.1	22.7	21.9	26.7
Copper (Cu)-Total	mg/kg wwt	1.10	0.642	0.910	2.20	0.929	4.94	3.54	3.49	3.03	3.49
Gallium (Ga)-Total	mg/kg	0.318	0.097	0.093	0.661	0.121	0.825	0.455	0.535	0.436	0.365
Gallium (Ga)-Total	mg/kg wwt	0.0244	0.0050	0.0075	0.0544	0.0106	0.132	0.0617	0.0821	0.0604	0.0476
Iron (Fe)-Total	mg/kg	2250	1420	878	4370	1390	6330	3780	3560	2570	2190
Iron (Fe)-Total	mg/kg wwt	173	72.8	71.0	360	121	1010	512	548	356	286
Lead (Pb)-Total	mg/kg	0.579	0.260	0.245	1.23	0.281	1.21	0.857	0.884	0.755	0.553
Lead (Pb)-Total	mg/kg wwt	0.0444	0.0134	0.0198	0.101	0.0246	0.192	0.116	0.136	0.104	0.0721
Lithium (Li)-Total	mg/kg	0.90	0.31	0.26	1.88	0.26	1.87	1.01	1.30	1.09	0.79
Lithium (Li)-Total	mg/kg wwt	0.069	<0.020	0.021	0.155	0.023	0.299	0.137	0.199	0.150	0.104
Magnesium (Mg)-Total	mg/kg	3300	5160	3580	3480	3420	2680	2630	2550	2910	2730
Magnesium (Mg)-Total	mg/kg wwt	253	265	290	286	299	429	357	392	403	357
Manganese (Mn)-Total	mg/kg	2670	3780	1830	3530	2870	5900	6760	5420	7040	6790
Manganese (Mn)-Total	mg/kg wwt	205	194	148	291	251	941	916	833	975	886
Mercury (Hg)-Total	mg/kg	0.0219	0.024	0.019	0.032	0.018	0.0511	0.0460	0.0451	0.0450	0.0454
Mercury (Hg)-Total	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	0.0082	0.0062	0.0069	0.0062	0.0059
Molybdenum (Mo)-Total	mg/kg	2.50	1.48	4.03	4.87	3.23	2.50	2.14	2.39	2.34	2.10
Molybdenum (Mo)-Total	mg/kg wwt	0.192	0.0762	0.326	0.401	0.282	0.399	0.290	0.368	0.324	0.274
Nickel (Ni)-Total	mg/kg	3.95	3.18	2.60	8.81	2.66	9.60	6.52	7.37	4.24	5.79
Nickel (Ni)-Total	mg/kg wwt	0.303	0.164	0.210	0.726	0.233	1.53	0.884	1.13	0.587	0.756
Phosphorus (P)-Total	mg/kg	3690	4400	4970	3750	3190	2860	2890	2730	3250	3630
Phosphorus (P)-Total	mg/kg wwt	283	226	403	309	279	456	392	420	450	473
Potassium (K)-Total	mg/kg	24600	29900	28200	35400	25300	14300	18000	15200	23200	22500
Potassium (K)-Total	mg/kg wwt	1880	1540	2280	2910	2210	2280	2440	2340	3220	2940
Rhenium (Re)-Total	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.010	<0.020	<0.010	<0.010	<0.010
Rhenium (Re)-Total	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Rubidium (Rb)-Total	mg/kg	2.52	2.16	1.58	11.8	1.93	17.4	20.2	16.5	24.1	24.1
Rubidium (Rb)-Total	mg/kg wwt	0.194	0.111	0.128	0.969	0.169	2.77	2.74	2.53	3.34	3.15
Selenium (Se)-Total	mg/kg	0.82	0.78	0.52	1.14	0.64	2.69	2.52	2.25	2.61	2.37
Selenium (Se)-Total	mg/kg wwt	0.063	0.040	0.042	0.094	0.056	0.429	0.341	0.346	0.362	0.309
Sodium (Na)-Total	mg/kg	5210	8280	4640	5640	4660	1940	1900	1280	2070	2050
Sodium (Na)-Total	mg/kg wwt	400	425	375	464	407	310	258	196	287	268
Strontium (Sr)-Total	mg/kg	82.9	90.8	73.1	74.0	78.6	111	97.3	92.3	88.0	82.2
Strontium (Sr)-Total	mg/kg wwt	6.36	4.67	5.91	6.09	6.87	17.7	13.2	14.2	12.2	10.7
Tellurium (Te)-Total	mg/kg	<0.040	<0.040	<0.040	<0.040	<0.040	<0.020	<0.040	<0.020	<0.020	<0.020
Tellurium (Te)-Total	mg/kg wwt	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	mg/kg	0.0307	0.0387	0.0175	0.0364	0.0267	0.0458	0.0486	0.0420	0.0526	0.0536
Thallium (Tl)-Total	mg/kg wwt	0.00236	0.00199	0.00142	0.00300	0.00234	0.00730	0.00660	0.00645	0.00728	0.00700
Thorium (Th)-Total	mg/kg	0.101	0.054	0.063	0.362	0.106	0.390	0.227	0.163	0.120	0.069
Thorium (Th)-Total	mg/kg wwt	0.0077	0.0028	0.0051	0.0298	0.0093	0.0623	0.0307	0.0251	0.0167	0.0090
Tin (Sn)-Total	mg/kg	0.049	0.076	0.062	0.165	0.054	0.031	<0.040	<0.020	<0.020	<0.020
Tin (Sn)-Total	mg/kg wwt	<0.0040	<0.0040	0.0050	0.0136	0.0048	0.0049	<0.0040	<0.0040	<0.0040	<0.0040
Titanium (Ti)-Total	mg/kg	38.4	11.3	14.5	107	19.8	113	60.6	62.4	48.3	34.0
Titanium (Ti)-Total	mg/kg wwt	2.95	0.581	1.17	8.79	1.73	18.0	8.21	9.59	6.69	4.44
Uranium (U)-Total	mg/kg	0.103	0.0803	0.0425	0.174	0.0518	0.421	0.360	0.277	0.168	0.167
Uranium (U)-Total	mg/kg wwt	0.00791	0.00413	0.00344	0.0143	0.00452	0.0671	0.0488	0.0425	0.0232	0.0218
Vanadium (V)-Total	mg/kg	5.20	3.56	1.95	10.1	3.13	14.7	8.85	9.90	6.54	5.81
Vanadium (V)-Total	mg/kg wwt	0.399	0.183	0.158	0.831	0.274	2.35	1.20	1.52	0.905	0.758
Yttrium (Y)-Total	mg/kg	1.13	0.738	0.406	2.13	0.597	3.02	2.36	2.23	1.37	1.22
Yttrium (Y)-Total	mg/kg wwt	0.0868	0.0379	0.0329	0.175	0.0522	0.482	0.320	0.343	0.190	0.159
Zinc (Zn)-Total	mg/kg	27.7	28.8	31.1	49.0	27.8	40.2	31.0	31.1	38.5	42.9
Zinc (Zn)-Total	mg/kg wwt	2.12	1.48	2.51	4.04	2.43	6.42	4.20	4.79	5.33	5.59
Zirconium (Zr)-Total	mg/kg	<0.40	<0.40	<0.40	0.77	<0.40	<0.20	<0.40	<0.20	<0.20	<0.20
Zirconium (Zr)-Total	mg/kg wwt	<0.040	<0.040	<0.040	0.063	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040

Table G.1: Macrophyte tissue quality raw data, August 2011.

Analyte	Units	Water Parsley (*Sparganium emersum*)				
		HC-M3-1	HC-M3-2	HC-M3-3	HC-M3-4	HC-M3-5
% Moisture	%	88.3	90.6	90.2	89.4	89.9
Aluminum (Al)-Total	mg/kg	255	506	84.3	109	127
Aluminum (Al)-Total	mg/kg wwt	29.8	47.4	8.24	11.6	12.8
Antimony (Sb)-Total	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020
Antimony (Sb)-Total	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total	mg/kg	0.159	0.179	0.047	0.075	0.077
Arsenic (As)-Total	mg/kg wwt	0.0186	0.0167	0.0046	0.0079	0.0078
Barium (Ba)-Total	mg/kg	11.8	8.80	5.01	5.16	5.26
Barium (Ba)-Total	mg/kg wwt	1.38	0.824	0.489	0.547	0.533
Beryllium (Be)-Total	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium (Be)-Total	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020
Bismuth (Bi)-Total	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total	mg/kg	44.0	46.0	51.1	41.9	36.6
Boron (B)-Total	mg/kg wwt	5.13	4.30	4.99	4.44	3.71
Cadmium (Cd)-Total	mg/kg	<0.070	<0.050	<0.060	<0.060	<0.040
Cadmium (Cd)-Total	mg/kg wwt	<0.0080	<0.0050	<0.0060	<0.0070	<0.0040
Calcium (Ca)-Total	mg/kg	21600	16400	13200	16800	16300
Calcium (Ca)-Total	mg/kg wwt	2520	1540	1290	1780	1650
Cesium (Cs)-Total	mg/kg	0.083	0.071	0.025	0.053	0.078
Cesium (Cs)-Total	mg/kg wwt	0.0097	0.0066	0.0025	0.0056	0.0079
Chromium (Cr)-Total	mg/kg	3.66	19.5	1.93	2.35	2.59
Chromium (Cr)-Total	mg/kg wwt	0.427	1.82	0.189	0.249	0.262
Cobalt (Co)-Total	mg/kg	0.375	0.577	0.102	0.127	0.162
Cobalt (Co)-Total	mg/kg wwt	0.0438	0.0540	0.0100	0.0135	0.0164
Copper (Cu)-Total	mg/kg	7.87	8.72	7.49	6.56	8.48
Copper (Cu)-Total	mg/kg wwt	0.918	0.816	0.732	0.695	0.859
Gallium (Ga)-Total	mg/kg	0.074	0.156	<0.040	<0.040	0.040
Gallium (Ga)-Total	mg/kg wwt	0.0086	0.0146	<0.0040	0.0042	0.0041
Iron (Fe)-Total	mg/kg	463	845	175	198	260
Iron (Fe)-Total	mg/kg wwt	53.9	79.0	17.1	20.9	26.4
Lead (Pb)-Total	mg/kg	0.154	0.216	0.072	0.071	0.079
Lead (Pb)-Total	mg/kg wwt	0.0180	0.0202	0.0070	0.0075	0.0080
Lithium (Li)-Total	mg/kg	<0.20	0.24	<0.20	<0.20	<0.20
Lithium (Li)-Total	mg/kg wwt	<0.020	0.023	<0.020	<0.020	<0.020
Magnesium (Mg)-Total	mg/kg	3670	3660	2110	2480	3300
Magnesium (Mg)-Total	mg/kg wwt	427	343	206	263	334
Manganese (Mn)-Total	mg/kg	430	260	210	319	329
Manganese (Mn)-Total	mg/kg wwt	50.1	24.4	20.5	33.8	33.3
Mercury (Hg)-Total	mg/kg	0.0129	0.017	0.0080	<0.010	0.0098
Mercury (Hg)-Total	mg/kg wwt	0.0015	0.0016	<0.0010	<0.0010	<0.0010
Molybdenum (Mo)-Total	mg/kg	0.737	0.684	1.53	1.26	1.21
Molybdenum (Mo)-Total	mg/kg wwt	0.0859	0.0640	0.150	0.133	0.122
Nickel (Ni)-Total	mg/kg	1.98	8.23	1.21	1.62	1.44
Nickel (Ni)-Total	mg/kg wwt	0.231	0.770	0.119	0.172	0.146
Phosphorus (P)-Total	mg/kg	2130	1430	1170	1980	2480
Phosphorus (P)-Total	mg/kg wwt	249	134	115	210	252
Potassium (K)-Total	mg/kg	24000	40700	47200	43400	52400
Potassium (K)-Total	mg/kg wwt	2800	3810	4610	4590	5310
Rhenium (Re)-Total	mg/kg	0.047	0.032	0.039	0.032	0.031
Rhenium (Re)-Total	mg/kg wwt	0.0055	0.0030	0.0038	0.0034	0.0031
Rubidium (Rb)-Total	mg/kg	27.6	42.8	44.2	50.7	69.8
Rubidium (Rb)-Total	mg/kg wwt	3.22	4.00	4.32	5.37	7.07
Selenium (Se)-Total	mg/kg	1.20	0.64	0.42	<0.20	0.48
Selenium (Se)-Total	mg/kg wwt	0.140	0.060	0.041	<0.020	0.048
Sodium (Na)-Total	mg/kg	2550	1240	<200	<200	1110
Sodium (Na)-Total	mg/kg wwt	297	116	<20	<20	113
Strontium (Sr)-Total	mg/kg	137	103	79.5	76.3	86.2
Strontium (Sr)-Total	mg/kg wwt	16.0	9.61	7.77	8.08	8.74
Tellurium (Te)-Total	mg/kg	<0.040	<0.040	<0.040	<0.040	<0.040
Tellurium (Te)-Total	mg/kg wwt	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	mg/kg	0.0237	0.0094	0.0115	0.0046	0.0059
Thallium (Tl)-Total	mg/kg wwt	0.00277	0.00088	0.00113	0.00049	0.00060
Thorium (Th)-Total	mg/kg	0.089	0.121	0.035	0.024	0.032
Thorium (Th)-Total	mg/kg wwt	0.0104	0.0113	0.0034	0.0025	0.0032
Tin (Sn)-Total	mg/kg	0.065	0.049	0.051	<0.040	0.051
Tin (Sn)-Total	mg/kg wwt	0.0076	0.0046	0.0050	<0.0040	0.0052
Titanium (Ti)-Total	mg/kg	12.8	34.6	6.32	6.78	8.70
Titanium (Ti)-Total	mg/kg wwt	1.49	3.23	0.618	0.719	0.882
Uranium (U)-Total	mg/kg	0.0151	0.0404	0.0058	0.0060	0.0068
Uranium (U)-Total	mg/kg wwt	0.00175	0.00378	0.00056	0.00064	0.00069
Vanadium (V)-Total	mg/kg	0.970	2.54	0.414	0.486	0.625
Vanadium (V)-Total	mg/kg wwt	0.113	0.238	0.0404	0.0515	0.0634
Yttrium (Y)-Total	mg/kg	0.172	0.324	0.057	0.067	0.081
Yttrium (Y)-Total	mg/kg wwt	0.0200	0.0304	0.0055	0.0071	0.0082
Zinc (Zn)-Total	mg/kg	22.7	18.2	15.3	23.6	19.4
Zinc (Zn)-Total	mg/kg wwt	2.65	1.70	1.50	2.51	1.96
Zirconium (Zr)-Total	mg/kg	<0.40	<0.40	<0.40	<0.40	<0.40
Zirconium (Zr)-Total	mg/kg wwt	<0.040	<0.040	<0.040	<0.040	<0.040

Table G.2.1: Summary of creeping spearwort tissue quality from Hazeltine Creek, August 2011.

Analyte	Units	LHC-M2 Creeping Spearwort (*Ranunculus flammula*)				
		MDL[1]	n	# ND	Mean[2]	SD[2,3]
% Moisture	%	0.1	5	0	88	0.1
Aluminum (Al)-Total	**mg/kg**	**2 - 4**	**5**	**0**	**2,912**	**737**
	mg/kg wwt	**0.4**	**5**	**0**	**361**	**91**
Antimony (Sb)-Total	mg/kg	0.01 - 0.02	5	0	0.06	0.01
	mg/kg wwt	0.002	5	0	0.008	0.001
Arsenic (As)-Total	mg/kg	0.02 - 0.04	5	0	4.5	0.83
	mg/kg wwt	0.004	5	0	0.56	0.099
Barium (Ba)-Total	mg/kg	0.05 - 0.1	5	0	111	11
	mg/kg wwt	0.01	5	0	13.7	1.3
Beryllium (Be)-Total	mg/kg	0.01 - 0.02	5	0	0.10	0.02
	mg/kg wwt	0.002	5	0	0.0123	0.0029
Bismuth (Bi)-Total	mg/kg	0.01 - 0.02	5	0	0.034	0.0038
	mg/kg wwt	0.002	5	0	0.0042	0.00048
Boron (B)-Total	mg/kg	1 - 2	5	0	54	12
	mg/kg wwt	0.2	5	0	6.7	1.5
Cadmium (Cd)-Total	**mg/kg**	**0.01 - 0.02**	**5**	**0**	**0.37**	**0.039**
	mg/kg wwt	**0.002**	**5**	**0**	**0.045**	**0.0046**
Calcium (Ca)-Total	mg/kg	3 - 6	5	0	11,260	716
	mg/kg wwt	0.5	5	0	1,398	93
Cesium (Cs)-Total	mg/kg	0.005 - 0.01	5	0	0.33	0.08
	mg/kg wwt	0.001	5	0	0.041	0.0098
Chromium (Cr)-Total	mg/kg	0.05 - 0.1	5	0	19	11.8
	mg/kg wwt	0.01	5	0	2.39	1.44
Cobalt (Co)-Total	mg/kg	0.02 - 0.04	5	0	6.7	1.0
	mg/kg wwt	0.004	5	0	0.83	0.118
Copper (Cu)-Total	**mg/kg**	**0.05 - 0.1**	**5**	**0**	**27**	**4.4**
	mg/kg wwt	**0.01**	**5**	**0**	**3.3**	**0.54**
Gallium (Ga)-Total	mg/kg	0.02 - 0.04	5	0	0.82	0.22
	mg/kg wwt	0.004	5	0	0.10	0.03
Iron (Fe)-Total	**mg/kg**	**1 - 2**	**5**	**0**	**6,022**	**1,326**
	mg/kg wwt	**0.2**	**5**	**0**	**747**	**164**
Lead (Pb)-Total	mg/kg	0.02 - 0.04	5	0	1.7	0.34
	mg/kg wwt	0.004	5	0	0.22	0.042
Lithium (Li)-Total	mg/kg	0.1 - 0.2	5	0	2.5	0.69
	mg/kg wwt	0.02	5	0	0.31	0.085
Magnesium (Mg)-Total	mg/kg	5 - 10	5	0	3,684	291
	mg/kg wwt	1	5	0	457	36
Manganese (Mn)-Total	mg/kg	0.02 - 0.04	5	0	4,158	991
	mg/kg wwt	0.004	5	0	515	121
Mercury (Hg)-Total	mg/kg	0.005 - 0.01	5	0	0.031	0.0053
	mg/kg wwt	0.001	5	0	0.0039	0
Molybdenum (Mo)-Total	**mg/kg**	**0.02 - 0.04**	**5**	**0**	**1.0**	**0.1**
	mg/kg wwt	**0.004**	**5**	**0**	**0.13**	**0.01**
Nickel (Ni)-Total	mg/kg	0.05 - 0.1	5	0	13.5	5.1
	mg/kg wwt	0.01	5	0	1.7	0.62
Phosphorus (P)-Total	**mg/kg**	**20 - 40**	**5**	**0**	**2,860**	**400**
	mg/kg wwt	**5**	**5**	**0**	**355**	**48**
Potassium (K)-Total	mg/kg	100 - 200	5	0	22,680	2,395
	mg/kg wwt	20	5	0	2,814	302
Rhenium (Re)-Total	mg/kg	0.01 - 0.02	5	4	0.012	0.0045
	mg/kg wwt	0.002	5	3	0.0016	0.00077
Rubidium (Rb)-Total	mg/kg	0.05 - 0.1	5	0	25	3.0
	mg/kg wwt	0.01	5	0	3.1	0.37
Selenium (Se)-Total	**mg/kg**	**0.1 - 0.2**	**5**	**0**	**0.99**	**0.16**
	mg/kg wwt	**0.02**	**5**	**0**	**0.12**	**0.020**
Sodium (Na)-Total	mg/kg	100 - 200	5	0	4,056	1,039
	mg/kg wwt	20	5	0	503	128
Strontium (Sr)-Total	mg/kg	0.05 - 0.1	5	0	103	7
	mg/kg wwt	0.01	5	0	13	0.94
Tellurium (Te)-Total	mg/kg	0.02 - 0.04	5	5	0.018	0
	mg/kg wwt	0.004	5	5	0.0020	0
Thallium (Tl)-Total	mg/kg	0.002 - 0.004	5	0	0.080	0.0103
	mg/kg wwt	0.0004	5	0	0.0099	0.0012
Thorium (Th)-Total	mg/kg	0.01 - 0.02	5	0	0.87	0.23
	mg/kg wwt	0.002	5	0	0.11	0.029
Tin (Sn)-Total	mg/kg	0.02 - 0.04	5	0	0.10	0.014
	mg/kg wwt	0.004	5	0	0.0124	0.0018
Titanium (Ti)-Total	mg/kg	0.05 - 0.1	5	0	143	39
	mg/kg wwt	0.01	5	0	18	4.8
Uranium (U)-Total	mg/kg	0.002 - 0.004	5	0	0.280	0.070
	mg/kg wwt	0.0004	5	0	0.035	0.0087
Vanadium (V)-Total	mg/kg	0.02 - 0.04	5	0	14	3.1
	mg/kg wwt	0.004	5	0	1.7	0.38
Yttrium (Y)-Total	mg/kg	0.01 - 0.02	5	0	3.3	0.65
	mg/kg wwt	0.002	5	0	0.42	0.080
Zinc (Zn)-Total	mg/kg	0.5 - 1	5	0	51	4.7
	mg/kg wwt	0.1	5	0	6.3	0.60
Zirconium (Zr)-Total	mg/kg	0.2 - 0.4	5	2	0.45	0.24
	mg/kg wwt	0.04	5	1	0.059	0.027

[1] Method detection limit

[2] Calculated using 0.5 x MDL where values <MDL were reported

[3] Standard deviation

Table G.2.2: Summary of green algae tissue quality from Hazeltine Creek, August 2011.

Analyte	Units	HC-A Green Algae				
		MDL[1]	n	# ND	Mean[2]	SD[2,3]
% Moisture	%	0.1	3	0	66	37
Aluminum (Al)-Total	**mg/kg**	**2**	**3**	**0**	**4,054**	**3,641**
	mg/kg wwt	**0.4**	**3**	**0**	**844**	**875**
Antimony (Sb)-Total	mg/kg	0.01	3	0	0.033	0.026
	mg/kg wwt	0.002	3	0	0.0064	0.0057
Arsenic (As)-Total	mg/kg	0.02	3	0	3.4	3.2
	mg/kg wwt	0.004	3	0	0.72	0.80
Barium (Ba)-Total	mg/kg	0.05	3	0	51	44
	mg/kg wwt	0.01	3	0	11	11
Beryllium (Be)-Total	mg/kg	0.01	3	0	0.13	0.11
	mg/kg wwt	0.002	3	0	0.026	0.027
Bismuth (Bi)-Total	mg/kg	0.01	3	0	0.028	0.023
	mg/kg wwt	0.002	3	0	0.0058	0.0061
Boron (B)-Total	mg/kg	1	3	0	40	23
	mg/kg wwt	0.2	3	0	7.3	5.8
Cadmium (Cd)-Total	**mg/kg**	**0.01**	**3**	**0**	**0.15**	**0.12**
	mg/kg wwt	**0.002**	**3**	**0**	**0.031**	**0.032**
Calcium (Ca)-Total	mg/kg	3	3	0	10,401	5,009
	mg/kg wwt	0.5	3	0	1,822	1,063
Cesium (Cs)-Total	mg/kg	0.005	3	0	0.41	0.37
	mg/kg wwt	0.001	3	0	0.089	0.099
Chromium (Cr)-Total	mg/kg	0.05	3	0	119	231
	mg/kg wwt	0.01	3	0	17	30
Cobalt (Co)-Total	mg/kg	0.02	3	0	3.9	3.9
	mg/kg wwt	0.004	3	0	0.73	0.67
Copper (Cu)-Total	**mg/kg**	**0.05**	**3**	**0**	**21**	**16**
	mg/kg wwt	**0.01**	**3**	**0**	**4.3**	**4.2**
Gallium (Ga)-Total	mg/kg	0.02	3	0	1.2	1.0
	mg/kg wwt	0.004	3	0	0.23	0.23
Iron (Fe)-Total	**mg/kg**	**1**	**3**	**0**	**6,628**	**6,092**
	mg/kg wwt	**0.2**	**3**	**0**	**1,307**	**1,236**
Lead (Pb)-Total	mg/kg	0.02	3	0	1.7	1.6
	mg/kg wwt	0.004	3	0	0.37	0.39
Lithium (Li)-Total	mg/kg	0.1	3	0	3.6	3.4
	mg/kg wwt	0.02	3	0	0.75	0.83
Magnesium (Mg)-Total	mg/kg	5	3	0	3,041	1,408
	mg/kg wwt	1	3	0	556	400
Manganese (Mn)-Total	mg/kg	0.02	3	0	1,336	1,237
	mg/kg wwt	0.004	3	0	296	337
Mercury (Hg)-Total	mg/kg	0.005	3	0	0.058	0.053
	mg/kg wwt	0.001	3	0	0.013	0.014
Molybdenum (Mo)-Total	**mg/kg**	**0.02**	**3**	**0**	**1.4**	**1.2**
	mg/kg wwt	**0.004**	**3**	**0**	**0.22**	**0.16**
Nickel (Ni)-Total	mg/kg	0.05	3	0	50	92
	mg/kg wwt	0.01	3	0	7.1	12
Phosphorus (P)-Total	**mg/kg**	**20**	**3**	**0**	**2,538**	**1,466**
	mg/kg wwt	**5**	**3**	**0**	**505**	**443**
Potassium (K)-Total	mg/kg	100	3	0	18,397	13,035
	mg/kg wwt	20	3	0	2,648	1,263
Rhenium (Re)-Total	mg/kg	0.01	3	3	0.012	0.014
	mg/kg wwt	0.002	3	2	0.0018	0.0012
Rubidium (Rb)-Total	mg/kg	0.05	3	0	23	14
	mg/kg wwt	0.01	3	0	3.5	1.6
Selenium (Se)-Total	**mg/kg**	**0.1**	**3**	**0**	**1.9**	**1.5**
	mg/kg wwt	**0.02**	**3**	**0**	**0.41**	**0.43**
Sodium (Na)-Total	mg/kg	100	3	0	656	349
	mg/kg wwt	20	3	0	92	22
Strontium (Sr)-Total	mg/kg	0.05	3	0	84	34
	mg/kg wwt	0.01	3	0	15	11
Tellurium (Te)-Total	mg/kg	0.02	3	3	0.010	0.0071
	mg/kg wwt	0.004	3	3	0.0016	0.00089
Thallium (Tl)-Total	mg/kg	0.002	3	0	0.040	0.031
	mg/kg wwt	0.0004	3	0	0.0083	0.0085
Thorium (Th)-Total	mg/kg	0.01	3	0	0.80	0.77
	mg/kg wwt	0.002	3	0	0.16	0.17
Tin (Sn)-Total	mg/kg	0.02	3	0	0.066	0.054
	mg/kg wwt	0.004	3	0	0.012	0.014
Titanium (Ti)-Total	mg/kg	0.05	3	0	178	170
	mg/kg wwt	0.01	3	0	34	32
Uranium (U)-Total	mg/kg	0.002	3	0	0.30	0.28
	mg/kg wwt	0.0004	3	0	0.065	0.069
Vanadium (V)-Total	mg/kg	0.02	3	0	17	16
	mg/kg wwt	0.004	3	0	3.4	3.1
Yttrium (Y)-Total	mg/kg	0.01	3	0	4.1	3.7
	mg/kg wwt	0.002	3	0	0.87	0.91
Zinc (Zn)-Total	mg/kg	0.5	3	0	24	13
	mg/kg wwt	0.1	3	0	4.6	3.7
Zirconium (Zr)-Total	mg/kg	0.2	3	0	0.79	0.92
	mg/kg wwt	0.04	3	0	0.17	0.25

[1] Method detection limit

[2] Calculated using 0.5 x MDL where values <MDL were reported

[3] Standard deviation

Table G.2.3: Summary of pondweed (species 1) tissue quality from Hazeltine Creek, August 2011.

Analyte	Units	LHC-M3 Pondweed (*Potamogeton* sp. 1)				
		MDL[1]	n	# ND	Mean[2]	SD[2,3]
% Moisture	%	0.1	5	0	88	1.0
Aluminum (Al)-Total	**mg/kg**	**4**	**5**	**0**	**2,950**	**554**
	mg/kg wwt	**0.4**	**5**	**0**	**371**	**92**
Antimony (Sb)-Total	mg/kg	0.02	5	0	0.062	0.0075
	mg/kg wwt	0.002	5	0	0.0078	0.0013
Arsenic (As)-Total	mg/kg	0.04	5	0	5.0	0.77
	mg/kg wwt	0.004	5	0	0.63	0.15
Barium (Ba)-Total	mg/kg	0.1	5	0	147	8
	mg/kg wwt	0.01	5	0	18	1.2
Beryllium (Be)-Total	mg/kg	0.02	5	0	0.10	0.015
	mg/kg wwt	0.002	5	0	0.013	0.0028
Bismuth (Bi)-Total	mg/kg	0.02	5	0	0.029	0.0024
	mg/kg wwt	0.002	5	0	0.0037	0.00056
Boron (B)-Total	mg/kg	2	5	0	63	16
	mg/kg wwt	0.2	5	0	7.9	2.0
Cadmium (Cd)-Total	**mg/kg**	**0.02**	**5**	**0**	**0.44**	**0.031**
	mg/kg wwt	**0.002**	**5**	**0**	**0.055**	**0.0052**
Calcium (Ca)-Total	mg/kg	3 - 6	5	0	11,780	1,043
	mg/kg wwt	0.5	5	0	1,468	166
Cesium (Cs)-Total	mg/kg	0.01	5	0	0.32	0.07
	mg/kg wwt	0.001	5	0	0.040	0.011
Chromium (Cr)-Total	mg/kg	0.1	5	0	15	3.7
	mg/kg wwt	0.01	5	0	1.9	0.62
Cobalt (Co)-Total	mg/kg	0.04	5	0	7.1	0.4
	mg/kg wwt	0.004	5	0	0.89	0.11
Copper (Cu)-Total	**mg/kg**	**0.1**	**5**	**0**	**28**	**2.1**
	mg/kg wwt	**0.01**	**5**	**0**	**3.5**	**0.46**
Gallium (Ga)-Total	mg/kg	0.04	5	0	0.81	0.15
	mg/kg wwt	0.004	5	0	0.10	0.03
Iron (Fe)-Total	**mg/kg**	**2**	**5**	**0**	**5,964**	**765**
	mg/kg wwt	**0.2**	**5**	**0**	**748**	**144**
Lead (Pb)-Total	mg/kg	0.04	5	0	1.5	0.18
	mg/kg wwt	0.004	5	0	0.19	0.036
Lithium (Li)-Total	mg/kg	0.2	5	0	2.5	0.52
	mg/kg wwt	0.02	5	0	0.31	0.084
Magnesium (Mg)-Total	mg/kg	5 - 10	5	0	2,470	157
	mg/kg wwt	1	5	0	308	39
Manganese (Mn)-Total	mg/kg	0.04	5	0	6,654	660
	mg/kg wwt	0.004	5	0	827	81
Mercury (Hg)-Total	mg/kg	0.005 - 0.01	5	0	0.057	0.019
	mg/kg wwt	0.001	5	0	0.0071	0
Molybdenum (Mo)-Total	**mg/kg**	**0.04**	**5**	**0**	**1.0**	**0.2**
	mg/kg wwt	**0.004**	**5**	**0**	**0.13**	**0.04**
Nickel (Ni)-Total	mg/kg	0.1	5	0	12	1.5
	mg/kg wwt	0.01	5	0	1.5	0.31
Phosphorus (P)-Total	**mg/kg**	**20 - 40**	**5**	**0**	**2,278**	**103**
	mg/kg wwt	**5**	**5**	**0**	**283**	**21**
Potassium (K)-Total	mg/kg	100 - 200	5	0	21,840	2,618
	mg/kg wwt	20	5	0	2,732	459
Rhenium (Re)-Total	mg/kg	0.02	5	5	0.010	0
	mg/kg wwt	0.002	5	4	0.0013	0
Rubidium (Rb)-Total	mg/kg	0.1	5	0	16	1.2
	mg/kg wwt	0.01	5	0	2.0	0.27
Selenium (Se)-Total	**mg/kg**	**0.2**	**5**	**0**	**1.8**	**0.21**
	mg/kg wwt	**0.02**	**5**	**0**	**0.22**	**0.025**
Sodium (Na)-Total	mg/kg	100 - 200	5	0	5,738	800
	mg/kg wwt	20	5	0	720	151
Strontium (Sr)-Total	mg/kg	0.1	5	0	110	4
	mg/kg wwt	0.01	5	0	14	1.0
Tellurium (Te)-Total	mg/kg	0.04	5	5	0.020	0
	mg/kg wwt	0.004	5	5	0.0020	0
Thallium (Tl)-Total	mg/kg	0.004	5	0	0.033	0.011
	mg/kg wwt	0.0004	5	0	0.0042	0.0015
Thorium (Th)-Total	mg/kg	0.02	5	0	0.81	0.17
	mg/kg wwt	0.002	5	0	0.10	0.028
Tin (Sn)-Total	mg/kg	0.04	5	0	0.191	0.062
	mg/kg wwt	0.004	5	0	0.024	0.0091
Titanium (Ti)-Total	mg/kg	0.1	5	0	137	29
	mg/kg wwt	0.01	5	0	17	4.8
Uranium (U)-Total	mg/kg	0.004	5	0	0.27	0.027
	mg/kg wwt	0.0004	5	0	0.034	0.0055
Vanadium (V)-Total	mg/kg	0.04	5	0	14	2.1
	mg/kg wwt	0.004	5	0	1.7	0.39
Yttrium (Y)-Total	mg/kg	0.02	5	0	4.1	0.43
	mg/kg wwt	0.002	5	0	0.52	0.083
Zinc (Zn)-Total	mg/kg	1	5	0	44	2.7
	mg/kg wwt	0.1	5	0	5.5	0.67
Zirconium (Zr)-Total	mg/kg	0.4	5	0	0.97	0.29
	mg/kg wwt	0.04	5	0	0.12	0.039

[1] Method detection limit
[2] Calculated using 0.5 x MDL where values <MDL were reported
[3] Standard deviation

Table G.2.4: Summary of pondweed (species 2) tissue quality from Hazeltine Creek, August 2011.

Analyte	Units	HC-M2 Pondweed (*Potamogeton* sp. 2)				
		MDL[1]	n	# ND	Mean[2]	SD[2,3]
% Moisture	%	0.1	5	0	85	2.3
Aluminum (Al)-Total	**mg/kg**	**2 - 4**	**5**	**0**	**4,398**	**2178**
	mg/kg wwt	**0**	**5**	**0**	**642**	**273**
Antimony (Sb)-Total	mg/kg	0.01 - 0.02	5	0	0.052	0.012
	mg/kg wwt	0.002	5	0	0.0077	0.0021
Arsenic (As)-Total	mg/kg	0.02 - 0.04	5	0	2.3	0.33
	mg/kg wwt	0.004	5	0	0.34	0.075
Barium (Ba)-Total	mg/kg	0.05 - 0.1	5	0	68	14
	mg/kg wwt	0.0	5	0	10	2.9
Beryllium (Be)-Total	mg/kg	0.01 - 0.02	5	0	0.13	0.072
	mg/kg wwt	0.0020	5	0	0.019	0.0093
Bismuth (Bi)-Total	mg/kg	0.01 - 0.02	5	2	0.023	0.016
	mg/kg wwt	0.00200	5	0	0.0038	0.0017
Boron (B)-Total	mg/kg	1 - 2	5	0	28	8
	mg/kg wwt	0.2	5	0	4.3	1.7
Cadmium (Cd)-Total	**mg/kg**	**0.01 - 0.2**	**5**	**1**	**0.21**	**0.066**
	mg/kg wwt	**0.002 - 0.025**	**5**	**1**	**0.033**	**0.012**
Calcium (Ca)-Total	mg/kg	3	5	0	19,180	6,140
	mg/kg wwt	1	5	0	2,910	1,144
Cesium (Cs)-Total	mg/kg	0.005 - 0.01	5	0	0.42	0.24
	mg/kg wwt	0.0010	5	0	0.061	0.030
Chromium (Cr)-Total	mg/kg	0.05 - 0.1	5	0	33	36
	mg/kg wwt	0.01	5	0	4.8	4.8
Cobalt (Co)-Total	mg/kg	0.02 - 0.04	5	0	4.3	1.0
	mg/kg wwt	0.004	5	0	0.65	0.17
Copper (Cu)-Total	**mg/kg**	**0.05 - 0.1**	**5**	**0**	**32**	**8.4**
	mg/kg wwt	**0.01**	**5**	**0**	**4.8**	**1.0**
Gallium (Ga)-Total	mg/kg	0.02 - 0.04	5	0	1.2	0.58
	mg/kg wwt	0.00	5	0	0.18	0.073
Iron (Fe)-Total	**mg/kg**	**1 - 2**	**5**	**0**	**6,680**	**2,672**
	mg/kg wwt	**0**	**5**	**0**	**984**	**339**
Lead (Pb)-Total	mg/kg	0.02 - 0.04	5	0	1.8	0.99
	mg/kg wwt	0.004	5	0	0.26	0.13
Lithium (Li)-Total	mg/kg	0.1 - 0.2	5	0	3.4	1.9
	mg/kg wwt	0.020	5	0	0.49	0.25
Magnesium (Mg)-Total	mg/kg	5	5	0	2,602	608
	mg/kg wwt	1	5	0	390	95
Manganese (Mn)-Total	mg/kg	0.02 - 0.04	5	0	2,776	1,219
	mg/kg wwt	0	5	0	435	266
Mercury (Hg)-Total	mg/kg	0.0050	5	0	0.054	0.0181
	mg/kg wwt	0	5	0	0.0080	0.0023
Molybdenum (Mo)-Total	**mg/kg**	**0.02 - 0.04**	**5**	**0**	**2.1**	**0.7**
	mg/kg wwt	**0.00**	**5**	**0**	**0.33**	**0.16**
Nickel (Ni)-Total	mg/kg	0.05 - 0.1	5	0	16	15
	mg/kg wwt	0.01	5	0	2.3	1.9
Phosphorus (P)-Total	**mg/kg**	**20**	**5**	**0**	**2,576**	**750**
	mg/kg wwt	**5**	**5**	**0**	**397**	**166**
Potassium (K)-Total	mg/kg	100	5	0	11,174	5,085
	mg/kg wwt	20	5	0	1,727	941
Rhenium (Re)-Total	mg/kg	0.01 - 0.02	5	4	0.0094	0.0026
	mg/kg wwt	0	5	5	0.0010	0
Rubidium (Rb)-Total	mg/kg	0.05 - 0.1	5	0	6.6	0.9
	mg/kg wwt	0.01	5	0	1.0	0.23
Selenium (Se)-Total	**mg/kg**	**0.1 - 0.2**	**5**	**0**	**3.4**	**0.74**
	mg/kg wwt	**0.020**	**5**	**0**	**0.51**	**0.14**
Sodium (Na)-Total	mg/kg	100	5	0	4,632	1,962
	mg/kg wwt	20	5	0	714	370
Strontium (Sr)-Total	mg/kg	0.05 - 0.1	5	0	127	20
	mg/kg wwt	0.01	5	0	19	5.0
Tellurium (Te)-Total	mg/kg	0.02 - 0.04	5	5	0.016	0.0055
	mg/kg wwt	0	5	5	0.0020	0
Thallium (Tl)-Total	mg/kg	0.002 - 0.004	5	0	0.042	0.011
	mg/kg wwt	0.00040	5	0	0.0062	0.0016
Thorium (Th)-Total	mg/kg	0.01 - 0.02	5	0	0.93	0.63
	mg/kg wwt	0.002	5	0	0.14	0.083
Tin (Sn)-Total	mg/kg	0.02 - 0.04	5	0	0.11	0.072
	mg/kg wwt	0.0040	5	0	0.016	0.0093
Titanium (Ti)-Total	mg/kg	0.05 - 0.1	5	0	222	113
	mg/kg wwt	0.0	5	0	32	14
Uranium (U)-Total	mg/kg	0.002 - 0.004	5	0	0.42	0.21
	mg/kg wwt	0.0004	5	0	0.061	0.028
Vanadium (V)-Total	mg/kg	0.02 - 0.04	5	0	18	7.3
	mg/kg wwt	0.00	5	0	2.6	0.92
Yttrium (Y)-Total	mg/kg	0.01 - 0.02	5	0	4.4	2.5
	mg/kg wwt	0.002	5	0	0.65	0.33
Zinc (Zn)-Total	mg/kg	0.5 - 1	5	0	29	4.0
	mg/kg wwt	0.10	5	0	4.3	0.74
Zirconium (Zr)-Total	mg/kg	0.2 - 0.4	5	1	1.1	1.3
	mg/kg wwt	0.040	5	0	0.16	0.17

[1] Method detection limit
[2] Calculated using 0.5 x MDL where values <MDL were reported
[3] Standard deviation

Table G.2.5: Summary of tapegrass tissue quality from Hazeltine Creek, August 2011.

Analyte	Units	LHC-M1 Tapegrass (*Vallisneria americana*)				
		MDL[1]	n	# ND	Mean[2]	SD[2,3]
% Moisture	%	0.1	5	0	92	1.4
Aluminum (Al)-Total	**mg/kg**	**4**	**5**	**0**	**925**	**818**
	mg/kg wwt	**0.4**	**5**	**0**	**72.7**	**69**
Antimony (Sb)-Total	mg/kg	0.02	5	0	0.03	0.01
	mg/kg wwt	0.002	5	3	0.002	0.001
Arsenic (As)-Total	mg/kg	0.04	5	0	1.9	0.90
	mg/kg wwt	0.004	5	0	0.14	0.072
Barium (Ba)-Total	mg/kg	0.1	5	0	52	16
	mg/kg wwt	0.01	5	0	3.9	1.1
Beryllium (Be)-Total	mg/kg	0.02	5	2	0.030	0.026
	mg/kg wwt	0.002	5	3	0.0023	0.0021
Bismuth (Bi)-Total	mg/kg	0.02	5	4	0.013	0.0076
	mg/kg wwt	0.002	5	4	0.0012	0.00054
Boron (B)-Total	mg/kg	2	5	0	75	24
	mg/kg wwt	0.2	5	0	5.8	2.5
Cadmium (Cd)-Total	**mg/kg**	**0.09 - 0.26**	**5**	**5**	**0.079**	**0.032**
	mg/kg wwt	**0.007 - 0.022**	**5**	**5**	**0.0060**	**0.0030**
Calcium (Ca)-Total	mg/kg	3 - 6	5	0	12,940	2164
	mg/kg wwt	0.5	5	0	959	101
Cesium (Cs)-Total	mg/kg	0.01	5	0	0.10	0.10
	mg/kg wwt	0.001	5	0	0.0079	0.0080
Chromium (Cr)-Total	mg/kg	0.1	5	0	5.1	4.0
	mg/kg wwt	0.01	5	0	0.40	0.34
Cobalt (Co)-Total	mg/kg	0.04	5	0	2.7	1.1
	mg/kg wwt	0.004	5	0	0.20	0.082
Copper (Cu)-Total	**mg/kg**	**0.1**	**5**	**0**	**15**	**6.6**
	mg/kg wwt	**0.01**	**5**	**0**	**1.2**	**0.61**
Gallium (Ga)-Total	mg/kg	0.04	5	0	0.26	0.24
	mg/kg wwt	0.004	5	0	0.02	0.02
Iron (Fe)-Total	**mg/kg**	**2**	**5**	**0**	**2,062**	**1,381**
	mg/kg wwt	**0.2**	**5**	**0**	**160**	**120**
Lead (Pb)-Total	mg/kg	0.04	5	0	0.52	0.42
	mg/kg wwt	0.004	5	0	0.041	0.036
Lithium (Li)-Total	mg/kg	0.2	5	0	0.72	0.70
	mg/kg wwt	0.02	5	1	0.056	0.060
Magnesium (Mg)-Total	mg/kg	5 - 10	5	0	3,788	774
	mg/kg wwt	1	5	0	279	19
Manganese (Mn)-Total	mg/kg	0.04	5	0	2,936	769
	mg/kg wwt	0.004	5	0	218	55
Mercury (Hg)-Total	mg/kg	0.005 - 0.01	5	0	0.023	0.0056
	mg/kg wwt	0.01	5	5	0.0050	0
Molybdenum (Mo)-Total	**mg/kg**	**0.04**	**5**	**0**	**3.2**	**1.3**
	mg/kg wwt	**0.004**	**5**	**0**	**0.26**	**0.13**
Nickel (Ni)-Total	mg/kg	0.1	5	0	4.2	2.6
	mg/kg wwt	0.01	5	0	0.33	0.23
Phosphorus (P)-Total	**mg/kg**	**20 - 40**	**5**	**0**	**4,000**	**692**
	mg/kg wwt	**5**	**5**	**0**	**300**	**65**
Potassium (K)-Total	mg/kg	100 - 200	5	0	28,680	4,329
	mg/kg wwt	20	5	0	2,164	510
Rhenium (Re)-Total	mg/kg	0.02	5	5	0.010	0
	mg/kg wwt	0.002	5	5	0.0010	0
Rubidium (Rb)-Total	mg/kg	0.1	5	0	4.0	4.4
	mg/kg wwt	0.01	5	0	0.31	0.37
Selenium (Se)-Total	**mg/kg**	**0.2**	**5**	**0**	**0.78**	**0.23**
	mg/kg wwt	**0.02**	**5**	**0**	**0.059**	**0.022**
Sodium (Na)-Total	mg/kg	100 - 200	5	0	5,686	1,509
	mg/kg wwt	20	5	0	414	33
Strontium (Sr)-Total	mg/kg	0.1	5	0	80	7
	mg/kg wwt	0.01	5	0	6.0	0.82
Tellurium (Te)-Total	mg/kg	0.04	5	5	0.020	0
	mg/kg wwt	0.004	5	5	0.0020	0
Thallium (Tl)-Total	mg/kg	0.004	5	0	0.030	0.0084
	mg/kg wwt	0.0004	5	0	0.0022	0.00058
Thorium (Th)-Total	mg/kg	0.02	5	0	0.14	0.13
	mg/kg wwt	0.002	5	0	0.011	0.011
Tin (Sn)-Total	mg/kg	0.04	5	0	0.081	0.048
	mg/kg wwt	0.004	5	2	0.0055	0.0048
Titanium (Ti)-Total	mg/kg	0.1	5	0	38	40
	mg/kg wwt	0.01	5	0	3.0	3.3
Uranium (U)-Total	mg/kg	0.004	5	0	0.090	0.053
	mg/kg wwt	0.0004	5	0	0.007	0.0045
Vanadium (V)-Total	mg/kg	0.04	5	0	4.8	3.2
	mg/kg wwt	0.004	5	0	0.37	0.27
Yttrium (Y)-Total	mg/kg	0.02	5	0	1.0	0.69
	mg/kg wwt	0.002	5	0	0.077	0.059
Zinc (Zn)-Total	mg/kg	1	5	0	33	9.1
	mg/kg wwt	0.1	5	0	2.5	0.94
Zirconium (Zr)-Total	mg/kg	0.4	5	4	0.31	0.25
	mg/kg wwt	0.04	5	4	0.029	0.019

[1] Method detection limit

[2] Calculated using 0.5 x MDL where values <MDL were reported

[3] Standard deviation

Table G.2.6: Summary of water crowfoot tissue quality from Hazeltine Creek, August 2011.

Analyte	Units	HC-M1 Water Crowfoot (*Ranunculus aquatilis*)				
		MDL[1]	n	# ND	Mean[2]	SD[2,3]
% Moisture	%	0.1	5	0	86	1.3
Aluminum (Al)-Total	**mg/kg**	**2 - 4**	**5**	**0**	**1,924**	**585**
	mg/kg wwt	**0.4**	**5**	**0**	**281**	**111**
Antimony (Sb)-Total	mg/kg	0.01 - 0.02	5	0	0.049	0.019
	mg/kg wwt	0.002	5	0	0.0072	0.0031
Arsenic (As)-Total	mg/kg	0.02 - 0.04	5	0	1.7	0.85
	mg/kg wwt	0.004	5	0	0.24	0.15
Barium (Ba)-Total	mg/kg	0.05 - 0.1	5	0	42	11
	mg/kg wwt	0.01	5	0	6.2	2.1
Beryllium (Be)-Total	mg/kg	0.01 - 0.02	5	0	0.07	0.02
	mg/kg wwt	0.002	5	0	0.0096	0.0042
Bismuth (Bi)-Total	mg/kg	0.01 - 0.02	5	2	0.011	0.0047
	mg/kg wwt	0.002	5	3	0.0016	0.00087
Boron (B)-Total	mg/kg	1 - 2	5	0	45	7
	mg/kg wwt	0.2	5	0	6.5	1.3
Cadmium (Cd)-Total	**mg/kg**	**0.01 - 0.02**	**5**	**0**	**0.50**	**0.15**
	mg/kg wwt	**0.002**	**5**	**0**	**0.070**	**0.017**
Calcium (Ca)-Total	mg/kg	3	5	0	10,170	1,557
	mg/kg wwt	0.5	5	0	1,472	333
Cesium (Cs)-Total	mg/kg	0.005 - 0.01	5	0	0.19	0.04
	mg/kg wwt	0.001	5	0	0.027	0.0080
Chromium (Cr)-Total	mg/kg	0.05 - 0.1	5	0	12	3.8
	mg/kg wwt	0.01	5	0	1.8	0.69
Cobalt (Co)-Total	mg/kg	0.02 - 0.04	5	0	3.5	0.5
	mg/kg wwt	0.004	5	0	0.51	0.099
Copper (Cu)-Total	**mg/kg**	**0.05 - 0.1**	**5**	**0**	**26**	**3.6**
	mg/kg wwt	**0.01**	**5**	**0**	**3.7**	**0.72**
Gallium (Ga)-Total	mg/kg	0.02 - 0.04	5	0	0.52	0.18
	mg/kg wwt	0.004	5	0	0.08	0.03
Iron (Fe)-Total	**mg/kg**	**1 - 2**	**5**	**0**	**3,686**	**1,620**
	mg/kg wwt	**0.2**	**5**	**0**	**542**	**283**
Lead (Pb)-Total	mg/kg	0.02 - 0.04	5	0	0.85	0.24
	mg/kg wwt	0.004	5	0	0.12	0.045
Lithium (Li)-Total	mg/kg	0.1 - 0.2	5	0	1.2	0.41
	mg/kg wwt	0.02	5	0	0.18	0.076
Magnesium (Mg)-Total	mg/kg	5	5	0	2,700	135
	mg/kg wwt	1	5	0	388	31
Manganese (Mn)-Total	mg/kg	0.02 - 0.04	5	0	6,382	689
	mg/kg wwt	0.004	5	0	910	54
Mercury (Hg)-Total	mg/kg	0.005	5	0	0.047	0.0026
	mg/kg wwt	0.001	5	0	0.0067	0.00093
Molybdenum (Mo)-Total	**mg/kg**	**0.02 - 0.04**	**5**	**0**	**2.3**	**0.17**
	mg/kg wwt	**0.004**	**5**	**0**	**0.33**	**0.052**
Nickel (Ni)-Total	mg/kg	0.05 - 0.1	5	0	6.7	2.0
	mg/kg wwt	0.01	5	0	0.98	0.37
Phosphorus (P)-Total	**mg/kg**	**20**	**5**	**0**	**3,072**	**367**
	mg/kg wwt	**5**	**5**	**0**	**438**	**32**
Potassium (K)-Total	mg/kg	100	5	0	18,640	4086
	mg/kg wwt	20	5	0	2,644	414
Rhenium (Re)-Total	mg/kg	0.01 - 0.02	5	5	0.0060	0.0022
	mg/kg wwt	0.002	5	5	0.0010	0
Rubidium (Rb)-Total	mg/kg	0.05 - 0.1	5	0	20	3.6
	mg/kg wwt	0.01	5	0	2.9	0.33
Selenium (se)- Total	**mg/kg**	**0.1 - 0.2**	**5**	**0**	**2.488**	**0.1783816**
	mg/kg wwt	**0.02**	**5**	**0**	**0.3574**	**0.0444106**
Sodium (Na)-Total	mg/kg	100	5	0	1,848	326
	mg/kg wwt	20	5	0	264	43
Strontium (Sr)-Total	mg/kg	0.05 - 0.1	5	0	94	11
	mg/kg wwt	0.01	5	0	13.6	2.63
Tellurium (Te)-Total	mg/kg	0.02 - 0.04	5	5	0.012	0
	mg/kg wwt	0.004	5	5	0.0020	0
Thallium (Tl)-Total	mg/kg	0.002 - 0.004	5	0	0.049	0.0048
	mg/kg wwt	0.0004	5	0	0.0069	0.00039
Thorium (Th)-Total	mg/kg	0.01 - 0.02	5	0	0.19	0.12
	mg/kg wwt	0.002	5	0	0.029	0.020
Tin (Sn)-Total	mg/kg	0.02 - 0.04	5	4	0.016	0.009
	mg/kg wwt	0.004	5	4	0.0026	0.0013
Titanium (Ti)-Total	mg/kg	0.05 - 0.1	5	0	64	30
	mg/kg wwt	0.01	5	0	9.4	5.2
Uranium (U)-Total	mg/kg	0.002 - 0.004	5	0	0.28	0.11
	mg/kg wwt	0.0004	5	0	0.041	0.019
Vanadium (V)-Total	mg/kg	0.02 - 0.04	5	0	9.2	3.5
	mg/kg wwt	0.004	5	0	1.3	0.63
Yttrium (Y)-Total	mg/kg	0.01 - 0.02	5	0	2.0	0.75
	mg/kg wwt	0.002	5	0	0.30	0.13
Zinc (Zn)-Total	mg/kg	0.5 - 1	5	0	37	5.4
	mg/kg wwt	0.1	5	0	5.3	0.84
Zirconium (Zr)-Total	mg/kg	0.2 - 0.4	5	5	0.12	0.04
	mg/kg wwt	0.04	5	5	0.020	0

[1] Method detection limit

[2] Calculated using 0.5 x MDL where values <MDL were reported

[3] Standard deviation

Table G.2.7: Summary of water parsley tissue quality from Hazeltine Creek, August 2011.

Analyte	Units	HC-M3 Water Parsley (*Sparganium emersum)*				
		MDL[1]	n	# ND	Mean[2]	SD[2,3]
% Moisture	%	0.1	5	0	90	0.89
Aluminum (Al)-Total	**mg/kg**	**4**	**5**	**0**	**216**	**175**
	mg/kg wwt	**0**	**5**	**0**	**22**	**16**
Antimony (Sb)-Total	mg/kg	0.02	5	5	0.010	0
	mg/kg wwt	0.002	5	5	0.0010	0
Arsenic (As)-Total	mg/kg	0.04	5	0	0.11	0.058
	mg/kg wwt	0.004	5	0	0.011	0.0061
Barium (Ba)-Total	mg/kg	0	5	0	7	3
	mg/kg wwt	0.0	5	0	0.75	0.37
Beryllium (Be)-Total	mg/kg	0.02	5	5	0.010	0
	mg/kg wwt	0.0020	5	5	0.0010	0
Bismuth (Bi)-Total	mg/kg	0.020	5	5	0.010	0
	mg/kg wwt	0.0020	5	5	0.0010	0
Boron (B)-Total	mg/kg	2	5	0	44	5.3
	mg/kg wwt	0.2	5	0	4.5	0.6
Cadmium (Cd)-Total	**mg/kg**	**0.04 - 0.07**	**5**	**5**	**0.028**	**0.0057**
	mg/kg wwt	**0.004 - 0.008**	**5**	**5**	**0.0030**	**0.00079**
Calcium (Ca)-Total	mg/kg	3 - 6	5	0	16,860	3,016
	mg/kg wwt	1	5	0	1,756	463
Cesium (Cs)-Total	mg/kg	0.01	5	0	0.062	0.024
	mg/kg wwt	0.0010	5	0	0.0065	0.0027
Chromium (Cr)-Total	mg/kg	0.1	5	0	6.0	7.6
	mg/kg wwt	0.01	5	0	0.59	0.69
Cobalt (Co)-Total	mg/kg	0.0	5	0	0.27	0.20
	mg/kg wwt	0.004	5	0	0.028	0.020
Copper (Cu)-Total	**mg/kg**	**0.1**	**5**	**0**	**7.8**	**0.86**
	mg/kg wwt	**0.01**	**5**	**0**	**0.80**	**0.091**
Gallium (Ga)-Total	mg/kg	0.04	5	2	0.062	0.057
	mg/kg wwt	0.00	5	1	0.0067	0.0050
Iron (Fe)-Total	**mg/kg**	**2**	**5**	**0**	**388**	**279**
	mg/kg wwt	**0**	**5**	**0**	**39**	**26**
Lead (Pb)-Total	mg/kg	0.04	5	0	0.12	0.065
	mg/kg wwt	0.004	5	0	0.012	0.0064
Lithium (Li)-Total	mg/kg	0.20	5	4	0.13	0.063
	mg/kg wwt	0.020	5	4	0.013	0.0058
Magnesium (Mg)-Total	mg/kg	5 - 10	5	0	3,044	712
	mg/kg wwt	1	5	0	315	84
Manganese (Mn)-Total	mg/kg	0	5	0	310	83
	mg/kg wwt	0	5	0	32	11
Mercury (Hg)-Total	mg/kg	0.005 - 0.01	5	1	0.011	0.0046
	mg/kg wwt	0	5	3	0.00092	0.00058
Molybdenum (Mo)-Total	**mg/kg**	**0.0**	**5**	**0**	**1.1**	**0.36**
	mg/kg wwt	**0.00**	**5**	**0**	**0.11**	**0.035**
Nickel (Ni)-Total	mg/kg	0.1	5	0	2.9	3.0
	mg/kg wwt	0.01	5	0	0.29	0.27
Phosphorus (P)-Total	**mg/kg**	**20 - 40**	**5**	**0**	**1,838**	**532**
	mg/kg wwt	**5**	**5**	**0**	**192**	**64**
Potassium (K)-Total	mg/kg	100 - 200	5	0	41,540	10,745
	mg/kg wwt	20	5	0	4,224	957
Rhenium (Re)-Total	mg/kg	0	5	0	0.036	0.0068
	mg/kg wwt	0	5	0	0.0038	0.0010
Rubidium (Rb)-Total	mg/kg	0.1	5	0	47	15
	mg/kg wwt	0.01	5	0	4.8	1.5
Selenium (Se)-Total	**mg/kg**	**0.20**	**5**	**1**	**0.57**	**0.40**
	mg/kg wwt	**0.020**	**5**	**1**	**0.060**	**0.048**
Sodium (Na)-Total	mg/kg	100 - 200	5	2	1020	1011
	mg/kg wwt	20	5	2	109	117
Strontium (Sr)-Total	mg/kg	0	5	0	96	25
	mg/kg wwt	0.01	5	0	10	3.4
Tellurium (Te)-Total	mg/kg	0	5	5	0.020	0
	mg/kg wwt	0	5	5	0.0020	0
Thallium (Tl)-Total	mg/kg	0.0040	5	0	0.011	0.0076
	mg/kg wwt	0.00040	5	0	0.0012	0.00093
Thorium (Th)-Total	mg/kg	0.02	5	0	0.060	0.043
	mg/kg wwt	0.002	5	0	0.0062	0.0043
Tin (Sn)-Total	mg/kg	0.040	5	1	0.047	0.016
	mg/kg wwt	0.0040	5	1	0.0049	0.0020
Titanium (Ti)-Total	mg/kg	0	5	0	14	12
	mg/kg wwt	0.0	5	0	1.4	1.1
Uranium (U)-Total	mg/kg	0.004	5	0	0.015	0.015
	mg/kg wwt	0.0004	5	0	0.0015	0.0014
Vanadium (V)-Total	mg/kg	0.0	5	0	1.0	0.88
	mg/kg wwt	0.00	5	0	0.10	0.081
Yttrium (Y)-Total	mg/kg	0.02	5	0	0.14	0.11
	mg/kg wwt	0.002	5	0	0.014	0.011
Zinc (Zn)-Total	mg/kg	1.0	5	0	20	3.4
	mg/kg wwt	0.10	5	0	2.1	0.50
Zirconium (Zr)-Total	mg/kg	0.40	5	5	0.20	0
	mg/kg wwt	0.040	5	5	0.020	0

[1] Method detection limit

[2] Calculated using 0.5 x MDL where values <MDL were reported

[3] Standard deviation

Table G.3: Periphyton chemistry raw data, Hazeltine Creek August 2011.

Station	Selenium (Se)-Total (mg/kg)		Chlorophyll a (mg/kg)
W7	Replicate #1	6.46	101
	Replicate #2	3.11	
	Replicate #3	6.57	
	Replicate #4	7.57	
	Replicate #5	2.01	
W11	Replicate #1	1.01	48.2
	Replicate #2	1.97	
	Replicate #3	1.88	
	Replicate #4	1.31	
	Replicate #5	1.66	

Table G.4 Periphyton taxonomy raw data, Hazeltine Creek August 2011.

Phylum	Order	Genera and Species	Stn W7 (cells/cm^2)	Stn W11 (cells/cm^2)
Bacillariophycae	Centrales	*Cyclotella bondanica*		123.5
		Cyclotella spp.	<62.5	1,914.0
		Melosira varians	<62.5	279,885.2
		Melosira sp	<62.5	<123.5
		Stephanodiscus sp.	<62.5	<123.5
	Pennales	*Achnanthes lanceolata*	125.0	73,654.0
		Achnanthes minutissima	3,392.9	198,865.8
		Achnanthes spp.	2,423.5	125,211.8
		Amphipleura pellucida	<62.5	1,482.0
		Amphora spp.	<62.5	3,828.0
		Caloneis spp.		<123.5
		Cocconeis pediculus		2,871.0
		Cocconeis placentula	10,663.4	287,250.6
		Cymatopleura elliptica		<123.5
		Cymatopleura solea		123.5
		Cymbella affinis	5,816.4	247.0
		Cymbella cistula		<123.5
		Cymbella lanceolata	<62.5	<123.5
		Cymbella mexicana		3,705.0
		Cymbella minuta	250.0	69,971.3
		Cymbella prostrata		44,192.4
		Cymbella sinuata	125.0	14,730.8
		Cymbella tumida		<123.5
		Cymbella spp.	<62.5	<123.5
		Diatoma moniliformis	62.5	309,346.8
		Diploneis sp.		<123.5
		Epithemia sorex	125.0	247.0
		Epithemia turgida	<62.5	1,729.0
		Epithemia sp.	<62.5	<123.5
		Fragilaria capucina	62.5	<123.5
		Fragilaria construens	2,423.5	30,624.0
		Fragilaria crotonensis	<62.5	<123.5
		Fragilaria leptostauron		123.5
		Fragilaria pinnata	<62.5	494.0
		Fragilaria vaucheriae	125.0	114,163.7
		Fragilaria spp.	<62.5	66,288.6
		Frustulia sp.		<123.5
		Gomphoneis sp.		3,211.0
		Gomphonema olivaceum		29,461.6
		Gomphonema ventricosum	125.0	4,785.0
		Gomphonema spp.	10,178.7	62,605.9
		Gyrosigna / Pleurosigma sp.		<123.5
		Meridion circulare	125.0	77,336.7
		Navicula cuspidata		<123.5
		Navicula radiosa	<62.5	123.5
		Navicula cf. tripunctata	3,392.0	40,509.7
		Navicula viridula	<62.5	123.5
		Navicula spp.	3,877.6	191,500.4
		Neidium sp.		<123.5
		Nitzschia acicularis		247.0
		Nitzschia dissipata		139,942.6
		Nitzschia spp.	1,938.0	419,827.8
		Pinnularia spp.	<62.5	<123.5
		Rhoicosphenia curvata	6,785.8	1,914.0
		Rhopalodia gibba		123.5
		Rhopalodia sp.?	<62.5	
		Stauroneis sp.		<123.5
		Surirella angusta	<62.5	3,828.0
		Surirella spp.		2,223.0
		Synedra ulna	62.5	16,269.0
		Synedra spp.		22,096.2
Chlorophyta	Chaetophorales	*Stigeoclonium sp.*	4,875.0	8,645.0
		Gongrosira sp. ?	5,816.4	
	Chlorococcales	*Ankistrodesmus sp.*		4,785.0
		Crucigenia sp.	<62.5	<123.5
		Oocystis sp.	<62.5	247.0
		Scenedesmus spp.		988.0
	Oedogoniales	*Oedogonium sp.*		<123.5
	Ulothricales	*Ulothrix zonata*		17,043.0
	Zygnematales	*Closterium spp.*		123.5
		Cosmarium spp.		123.5
		Mougeotia sp.	<62.5	
		Staurastrum spp.		123.5
Chlorophyta		UID Chlorophyta colonial		1,482.0
		UID Chlorophyta flagellate		<123.5
		UID Chlorophyta unicellular	<62.5	247.0
Chrysophyta		UID Chrysophyta colonial	750.0	<123.5
		UID Chrysophyta cyst	125.0	
		UID Chrysophyta flagellate	<62.5	
		UID Chrysophyta unicellular	125.0	
Cyanophyta	Chamaesiphonales	*Chamaesiphon spp.*	376,790.6	95,750.2
	Chroococcales	*Aphanothece sp.*		<123.5
		Chroococcopsis sp.?	78,342.6	
		Chroococcus sp.		<123.5
		Gloeocapsa sp.?	48,497.8	<123.5
		Gomphosphaeria spp.	<62.5	<123.5
		Merismopedia spp.		1,976.0
		UID Chroococcales	18,653.0	
	Nostocales	*Anabaena sp.*		<123.5
		Calothrix spp.	71,250.9	
		Calothrix / Rivularia sp.	73,674.4	<123.5
	Oscillatoriales	*Homoeothrix varians*	20,353,747.5	26,796.0
		Lyngbya spp.	3,250.0	
		Oscillatoria spp.	84,337.8	11,609.0
		Pseudanabaena sp.		64,119.0
		UID Oscillatoriales		<123.5
Rhodophyta	Nemalionales	*Audouinella sp.*	26,173.8	3,952.0
UID		UID flagellate	<62.5	
		UID unicellular	1,938.8	957.0

UID = unidentified

Table G.5: Supporting field measurements at periphyton sampling sites, Hazeltine Creek August 2011.

Analyte	W7	W11
Temperature (°C)	14.92	10.56
Dissolved Oxygen (mg/L)	7.56	8.68
Dissolved Oxygen (%)	83.4	86.3
Conductivity (µS/cm)	210	235
Specific Conductance (µS/cm)	170	170
Total Dissolved Solids (mg/L)	105	117
pH (pH units)	8.74	8.50
Flow (m^3/s)		
Reading 1	0.113	0.233
Reading 2	0.150	0.201
Reading 3	0.210	0.205
Reading 4	0.113	0.396
Reading 5	0.113	0.362
Average	0.140	0.279