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Appendix A3

Report: *Aquatic Effects Monitoring Program – Targeted Study: Dike Construction TSS Effects Assessment Study 2010*

FINAL

Aquatic Effects Monitoring Program – Targeted Study: Dike Construction TSS Effects Assessment Study 2010

Meadowbank Mine, Nunavut

Prepared for:

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Gary Mann (Azimuth) – Gary provided overall management for this project. Gary was co-author of this report and conducted the statistical analyses for benthic invertebrates and periphyton.

Laura Nendick and Maggie McConnell (Azimuth) – Laura and Maggie conducted data compilation, analysis, interpretation, and report writing. Maggie also provided technical support in the field.

Randy Baker (Azimuth) - Randy reviewed the report.

Ryan Hill (Azimuth) – Ryan reviewed the statistical analysis appendix.

Morgan Finley (Azimuth) – Morgan was monitoring crew leader in the field.

Ryan Vanengen (AEM) – Ryan participated in this project on many levels, from helping with the study design, to collecting benthic invertebrate samples, to providing background literature, to reviewing the report for AEM. Ryan is also conducting his M.Sc. research on the effects of sedimentation on benthic invertebrate communities at Meadowbank.

Tom Thompson, Patrick Angoyuaq, and Jessica Fang (AEM) – Tom, Patrick and Jessica were involved with field sampling at Meadowbank.

PROFESSIONAL LIABILITY STATEMENT

This report has been prepared by Azimuth Consulting Group Inc. (Azimuth), for the use of Agnico-Eagle Mines Ltd. (AEM), who has been party to the development of the scope of work for this project and understands its limitations. The extent to which previous investigations were relied on is detailed in the report.

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ACRONYMS

AEM – Agnico-Eagle Mines Ltd.

AEMP – Aquatic Effects Monitoring Program

ANOVA – Analysis of Variance

BACI – Before/After Control/Impact

CCME – Canadian Council of Ministers of the Environment

DQO – Data Quality Objective

EAS – Effects Assessment Study

ED – East Dike

GPS – Global Positioning System

HVH – High value habitat

INUG – Inuggugayualik Lake

ISQG – Interim Sediment Quality Guidelines

MDL – Method Detection Limit

MMER – Metal Mining Effluent Regulations

PDL – Pipedream Lake

PEL – Probable Effect Level

QA/QC – Quality Assurance / Quality Control

RPD – Relative Percent Difference

SEP – Sequential Extraction Procedure

SIA – Stable isotopes analysis

SIE – Severity of Ill Effects

SOP – Standard Operating Procedure

SP – Second Portage Lake

SQG – Sediment Quality Guidelines

TE – Tehek Lake

TEFF – Tehek Lake Far Field

TKN – Total Kjeldahl Nitrogen

TPE – Third Portage Lake – East Basin

TPN – Third Portage Lake – North Basin

TPS – Third Portage Lake – South Basin

TSS – Total suspended solids

UTM – Universal Transverse Mercator

WAL – Wally Lake

WOE – Weight of Evidence

EXECUTIVE SUMMARY

AEM commissioned studies in each of the last three years (2008 - 2010) to address concerns regarding the potential impacts of elevated TSS concentrations on the local receiving environment from dike construction. Based on the literature, elevated TSS concentrations can directly or indirectly affect the entire range of organisms in the aquatic environment, so these studies have addressed a broad array of ecosystem elements.

The East Dike TSS EAS was initiated in 2008 and targets the effects of TSS from East Dike construction, primarily on Second Portage Lake, but also extending into Tehek Lake (Azimuth, 2009b). As planned, this study continued in 2009 (Azimuth, 2010b) and 2010 (this report), focusing more on characterizing potential deposition-related impacts, largely to periphyton and benthic invertebrate communities.

The Bay-Goose TSS EAS was initiated in 2009 and targets the effects of TSS from Bay-Goose construction, primarily on the east basin of Third Portage Lake, but also downstream into Second Portage Lake and Tehek Lake. Due to the phased nature of construction of the Bay-Goose Dike (i.e., Phase 1 in 2009; Phase 2 in 2010), the timing of study components is variable, with some conducted in 2009 (Azimuth, 2009b) and others slated for either 2010 (this report) or possibly later.

Collectively, the results of these studies have improved our understanding of the potential short-term (i.e., on the order of a year) and long-term (i.e., multiple years) effects of elevated TSS on a broad range of ecosystem elements in local receiving environments. Results to date for each major study component have been summarized in **Table ES-1** (2010 results highlighted in **bold**) for both TSS EAS studies to provide a more holistic perspective.

TSS EAS studies have targeted both the pelagic zone (i.e., water column) and benthic zone (i.e., lake bottom) of receiving environments. Elevated TSS concentrations over basin-wide spatial scales were well documented for both studies, lasting on the scale of weeks-to-months. While the TSS had obvious consequences for water clarity (and thus light penetration), no other substantial changes to local limnology were identified. From a water chemistry perspective, elevated metals and nutrients were largely associated with particulates rather than found in the dissolved phase (and more bioavailable). From a water column (pelagic zone) perspective, both TSS EAS studies identified some short-term effects to primary productivity (e.g., phytoplankton biomass). However, these did not appear to cascade up the food chain to zooplankton. Consequently, based on available data, indirect effects to higher-level organisms through reduced prey biomass are considered unlikely. This was also corroborated in the laboratory with a larval trout test using live zooplankton as a food resource. With respect to potential direct effects in the water column, no adverse effects to zooplankton or fish were seen in toxicity tests. Thus, the body of evidence collected to date suggests that while some effects have been seen in the water column, they are likely limited in time and have not been shown to propagate up the food chain.

In contrast to the pelagic zone, where potential effects would be linked to suspended sediments in the water column and thus less likely to have prolonged consequences, the benthic zone is susceptible to the potential effects of sedimentation. Sediment traps have been used to document sedimentation rates, deposition thickness and chemistry of settled matter over the last three years, both during the open water season and under ice cover. The 2008 results suggested that between 1 to 2 mm of construction-related deposition occurred in Second Portage Lake and identified possible changes to surface sediment chemistry (i.e., settled material in the traps contained elevated concentrations of several metals). Surface sediment chemistry results for 2009 did confirm that certain metals had increased in concentration in Second Portage Lake and in Tehek Lake relative to baseline. Thus, concerns in this zone relate primarily to physical smothering and to metals toxicity.

The concerns regarding metals toxicity were directly tested in 2010 using sediment toxicity tests and sequential extraction analysis. Results of amphipod (*Hyalella azteca*) and midge (*Chironomus tentans*) survival and growth endpoints in bioassays showed that surface sediments collected from within or adjacent to the East Dike construction zone (i.e., the zone delineated by the turbidity barriers) were not toxic relative to local reference sediment. The sequential extraction results showed that most of the metals in the sediment are associated with the residual matrix fraction, which is not considered bioavailable. Consequently, metals toxicity is not likely an issue in Second Portage Lake.

From an physical effects perspective, initial studies on periphyton biomass and community structure in Second Portage Lake conducted in 2009 identified reduced biomass and altered community composition in close proximity to the East Dike (i.e., in an area that would have been exposed to high TSS concentrations in 2008); these differences were not observed in an area exposed to lower TSS concentrations in 2008 (Azimuth, 2010b). Follow-up studies conducted in 2010 provided greater spatial resolution, confirming that effects were limited to the area closest to the East Dike.

For benthic invertebrates, the 2008 CREMP data indicated reduced benthic invertebrate abundances (a marginal trend) in Second Portage Lake (that did not extend to Tehek Lake); this was no longer observed in 2009 (i.e., abundance was similar to baseline), suggesting a short-term physical effect and subsequent recovery. The higher resolution EAS results in 2009 highlighted natural differences between Second Portage Lake (and Tehek) and the control areas (i.e., inherent inter-lake differences). Unfortunately, the 2010 results were contradictory, with the CREMP showing an even bigger drop in 2010 than that observed in 2008 (despite very low TSS exposure in 2010) and the EAS data suggesting further recovery relative to control areas. When considered together, the 2010 CREMP results are likely highly localized and unrelated to TSS.

Available data for potential effects to benthic invertebrate communities in the east basin of Third Portage Lake are also inconclusive. While most results point to the lack of any TSS-related impacts to the community, there have been two successive drops in abundance that coincide with dike construction. However, these "drops" were likely due to natural variability (2009) or a regional trend of decreased abundance and richness (2010).

As for fish and fish habitat, the 2008 results raised concerns regarding physical effects due to sedimentation on high-value habitats. These concerns were raised based on the sediment trap results (discussed above) and on the trout embryo development toxicity (no renewal) test, which suggested that physical settling of particles onto embryos could impair development. Underwater video was used in 2009 to examine high-value fish habitat for evidence of increased sediment deposition; areas close to the East Dike were found to contain more obvious signs of sediment accumulation than areas further away.

TSS EAS studies are scheduled to continue in 2011 with a focus on evaluating the potential effects on periphyton and fish habitat related to the Bay-Goose Dike EAS; the evaluation of benthic invertebrate community will continue at the TPE CREMP station. **Table ES-1** highlights (in **BOLD CAPS**) the activities currently scheduled for 2011, which are summarized below:

- *Periphyton Community* – The 2010 results for Second Portage Lake provided some spatial bounds to the observed depression in periphyton biomass. Given the correlation between mat sediment load and biomass, we recommend that a mat sediment survey be conducted in Third Portage Lake. This will be complemented with underwater video footage collected as part of the fish habitat assessment (below).
- *Benthic Invertebrate Community* – East Dike EAS results largely point to an impact in 2008 and subsequent recovery in 2009, but there is some uncertainty. For the Bay-Goose Dike EAS, there is some uncertainty as to whether any impact occurred due to dike construction. Evaluation of these uncertainties will continue to be assessed through the 2011 CREMP sampling. In addition to the CREMP and EAS studies, supplemental work has been conducted by Ryan Vanengen (AEM) since 2009 as part of his master's research; these results may also address some of the existing uncertainties.
- *Fish/Fish Habitat* – Bay-Goose Dike construction was completed in 2010. As a complement to baseline underwater video filmed in 2009 prior to dike construction, post-construction footage will be collected.

Table ES-1. Conclusions from all TSS Effects Assessment Studies, 2008 - 2010.

TSS EAS Component	East Dike TSS EAS	Bay-Goose TSS EAS
Water Quality and Limnology (studies conducted during major TSS release events (2008 for East Dike; 2009 for Bay-Goose Dike).		
TSS Exposure	Prevailing TSS concentrations at exposure areas in 2008 were estimated to be about 10 mg/L (Sept 13/14, 2008) and 6 mg/L (Sept 24/25, 2008).	Prevailing TSS concentrations at exposure areas in 2009 were estimated to be about 10 mg/L (Sept 17-19, 2009) and 8 mg/L (Sept 24-27, 2009).
Limnology	Elevated TSS reduced water clarity, but did not lead to changes in temperature or dissolved oxygen profiles over depth.	Similar to East Dike TSS EAS.
Water Quality	While certain metals and nutrients were elevated, dissolved concentrations were low and these were associated with particulate matter and not expected to result in direct effects to pelagic aquatic life.	Similar to East Dike TSS EAS.
Field Effects Measurements		
Primary Production - Pelagic ● Chlorophyll- α ● Phytoplankton biomass/taxonomy	Phytoplankton biomass was reduced in exposure areas in 2008. Biomass differences were much less two weeks later, suggesting a short-term effect.	Both phytoplankton biomass and chlorophyll-α were reduced in exposure areas in 2009. However, based on CREMP data they had recovered by November relative to the north and south basins.
Primary Production - Benthic ● Periphyton Community ● Sediment accumulation in mats.	Impacts of sedimentation were observed in Second Portage Lake in close proximity to the East Dike in 2009. Periphyton biomass was reduced in proportion to observed sediment content of periphyton mats. **The 2010 results confirmed these findings and provided better spatial resolution of affected areas.**	This component is scheduled for 2011 (i.e., the year after BG Dike completion). **STUDIES IN 2011 WILL FOCUS ON MAT SEDIMENT SURVEY AND UNDERWATER VIDEO (SEE FISH HABITAT BELOW).**
Secondary Production - Pelagic ● Zooplankton biomass/taxonomy	No differences in zooplankton biomass at exposure areas relative to reference areas.	Higher zooplankton biomass in 2009 in the east basin than observed in 2008 despite TSS exposure.
Secondary Production - Benthic ● Benthic community - Total abundance - Species richness - Simpson's Diversity Index - Bray Curtis Distance ● Surface sediment chemistry (coring) ● Surface sediment geochemistry - Sequential extraction analysis	Based on CREMP data from 2006 to 2009, the only effect identified was a marginal reduction in benthic abundance in Second Portage Lake (SP) in 2008. Abundance at SP improved in 2009 to baseline levels. **The 2010 SP results were somewhat anomolous; a large decrease in abundance was found that was not seen in the 2010 EAS data. This was concluded to be localized and not related to dike construction.** Higher resolution spatial sampling in 2009 did show specific areas in Second Portage Lake to differ from control areas. However, this may be due to inherently lower benthic abundance in Second Portage Lake and Tehek Lake (as seen in the CREMP) . **The 2010 EAS results showed a modest "recovery" at impact areas relative to the 2009 control areas.** Sediment coring conducted in 2009 did identify elevated metals in surface sediments (relative to 2008). **Follow-up studies in 2010 showed no sediment toxicity (see below) that metals were not bioavailable (based on sequential extraction analyses).**	**Based on CREMP data from 2006 to 2010, there has been a drop in benthic abundance and diversity coincident with dike construction. However, these results appear due to very high baseline (2007-2008) levels for both metrics. In 2009, the drop occurred despite low TSS exposure. In 2010, the drop was consistent with a general regional trend of reduced abundance and richness.** **Higher resolution spatial sampling in 2010 showed no differences between the east basin of Third Portage Lake and control areas. However, this may actually represent an effect given the baseline data (i.e., typically higher inherent abundance and richness than other lakes). Additional data should help differentiate these alternatives.** **CREMP SAMPLING (TPE) WILL BE CONDUCTED IN 2011 AS PLANNED.**
Fish/Fish Habitat ● Sediment Traps ● Underwater Video ● Food web (stable isotopes) ● Fish Population	Sediment trap data from open water 2008 and over winter 2008-2009 show increased sedimentation (1 - 2 mm), particularly in proximity to the East Dike. This was confirmed by the underwater video. HVH areas away from the dike were much less affected. 2010 results show some elevated accumulation due to BG Dike inputs. Stable isotope studies confirmed the importance of both benthic and pelagic food webs in 2008.	Sediment trap data show some accumulation (up to 1.1 mm) in proximity of HVH areas in 2009. 2010 results showed similar to higher accumulations (to nearly 2 mm) A subset of traps has been deployed over winter. **WINTER TRAPS RETRIEVED AGAIN IN 2011; PROGRAM ENDING.** Underwater video surveys conducted at HVH areas in the east basin in 2009 prior to construction; **THESE WILL BE RESURVEYED IN 2011.**
Laboratory Effects Measurements		
Zooplankton ● Lethal - *Daphnia magna* 48-hr LC50 ● Sublethal - *Ceriodaphnia dubia* 7-day growth/survival/repro	No direct effects were observed in toxicity tests of surface waters.	No direct effects were observed in toxicity tests of surface waters.
Fish ● Lethal - Rainbow trout 96-hr LC50 ● Sublethal - Rainbow trout embryo 7-day (w/out renewal) ● Sublethal - Rainbow trout embryo 7-day (with renewal) ● Sublethal - Rainbow trout swim-up larvae 7-day surv/growth	No effects were found for juvenile and larval tests. No effects were also seen in the standard (with renewal) embryo development test. Impaired development was seen in test without renewal, which suggests that physical settling of sediments could harm developing embryos.	No direct effects were observed in toxicity tests of surface waters.
Benthic Invertebrates (Sediment) ● Lethal/sublethal - *Hyalella azteca* 14-d survival/growth ● Lethal/sub - *Chironomus tentans* 10-d survival/growth	**No adverse effects in 2010 to survival or growth for amphipods (*Hyalella azteca*) or midges (*Chironomus tentans*) at impact areas relative to control areas. Sediments tested in Second Portage Lake are not toxic.**	

1. INTRODUCTION

1.1. Background

Agnico-Eagle Mines (AEM) Ltd.'s Meadowbank Mine is situated approximately 75 km north of the hamlet of Baker Lake, Nunavut. Construction phase for the mine started in 2008 and the operations phase started in late February 2010. An important component of mine development was the construction of major dikes across Second Portage Lake (East Dike) and the northwestern portion of the east basin of Third Portage Lake (Bay-Goose Dike) (**Figure 1-1**).

As described in detail elsewhere (Azimuth, 2009a and 2010a), East Dike (during 2008) and Bay-Goose Dike (during 2009 – 2010) construction activities resulted in widespread increases in total suspended solids (TSS) in Second and Third Portage Lake, respectively. The status of key local receiving environments since 2008 is provided in **Table 1-1** to help better characterize spatial and temporal patterns of TSS. In response to these situations, AEM commissioned studies in both 2008 (Azimuth, 2009b) and 2009 (2010b) to evaluate the potential for adverse ecological effects related to chronic exposure to elevated TSS concentrations (the TSS Effects Assessment Study, or TSS EAS).

The 2010 TSS EAS program was conducted by Azimuth Consulting Group Inc. (Azimuth) to address outstanding issues identified in last year's 2009 EAS report (Azimuth, 2010b), that are summarized in **Table 1-2** for studies pertaining to the East Dike and Bay-Goose Dike. The information provided in the table is a compilation of results (as of last year) for a suite of field and laboratory effects measurements; the table will be updated in **Section 4** to incorporate 2010 results.

1.2. Study Outline

This study was initiated in 2008 to assess the ecological significance of elevated TSS concentrations associated with construction of the East Dike (Azimuth, 2009b). The program was expanded in 2009 to address potential effects related to Bay-Goose Dike construction (Azimuth, 2010b). Details regarding the potential effects of elevated TSS to aquatic biota were summarized in last year's EAS report (Azimuth, 2010b).

An overview of the sampling components for 2010 included:

- **Sediment Chemistry** – Sediment was collected synoptically with samples for benthic invertebrate and sediment toxicity studies (see below). The results help characterize physical/chemical conditions at each sampling location to facilitate interpretation of the effects-based measurements (i.e., benthic community and toxicity testing). In addition to samples collected specifically to support the EAS, data from relevant CREMP areas (Azimuth, 2011) were also used where appropriate.

- **Benthic Invertebrates** – This component combines data collected in the CREMP (Azimuth, 2011) with samples collected for both the East Dike and Bay-Goose EAS studies. The data sets were used in a complementary manner to make inferences regarding potential adverse effects of construction-related sediment inputs. The original EAS strategy was to track benthic communities in depositional areas for the two years following dike construction. In 2010, the EAS program focused on Second Portage Lake (second year of East Dike EAS) and the east basin of Third Portage Lake (first year of Bay-Goose EAS).
- **Sediment Toxicity** – This program was added in 2010 to determine whether elevated metals identified during the 2008 and 2009 EAS studies in Second Portage Lake (Azimuth, 2009b; 2010b) were toxic. Two sediment toxicity tests (*Hyalella azteca* amphipod and *Chironomus tentans* midge larvae) were used to assess the likelihood that the elevated metals might be adversely affecting benthic invertebrate communities. Four samples were tested: two "exposure" stations (one located within the area enclosed by the turbidity barriers during East Dike construction [high sediment deposition relative to reference stations]; the other in the channel southeast of the East Dike downstream of the outlet from Third Portage [moderate to high deposition]) and two reference stations (one representing high natural mineralization [INUG] and the other just "typical" [TEFF]). Sampling focused on the top 2-cm of sediment only.
- **Metals Bioavailability** – This program was added in 2010 as a complement to the sediment toxicity testing described above. One of the limitations of bulk sediment chemistry analyses (e.g., those described above) is that they only provide total metals content, with little information on metals bioavailability. In contrast, geochemical analysis of sediments can be used to help characterize metals concentrations by for specific fractions of vastly different bioavailability. Sediments from each of the toxicity testing locations were subjected to a sequential extraction procedure (following a standardized European Union method) that uses progressively more aggressive digestions to quantify metals concentrations for four fractions: readily available, bound to iron/manganese oxyhydroxides, bound to organic matter or sulphides, or part of the sediment matrix.
- **Sediment Traps** – This program has been conducted since 2008 to monitor sediment deposition rates and thickness (and, where possible, sediment chemistry) at key locations relative to dike construction activities. Select traps were deployed

in September 2009 and retrieved in July 2010. Traps were redeployed in July 2010 for the open water season, then retrieved again in September.

- **Periphyton Community** – In 2009, potential effects to the periphyton community in Second Portage Lake construction-related (2008 East Dike construction) sediment inputs were assessed by direct measurement and underwater video. Those studies identified likely effects in close proximity to the East Dike due to sedimentation (**Table 1-2**). Further direct sampling was recommended for 2010 to assess the spatial extent of adverse effects. To that end, sampling was conducted at six stations on the northern side of Second Portage Lake along a sedimentation gradient (based on the 2008 East Dike event). Analyses included biomass, density, and total weight of sample (including loss on ignition analysis to determine sediment content in the periphyton mat).

1.3. Report Organization

Previous EAS reports have been organized primarily based on the TSS-release event (i.e., 2008 East Dike construction or 2009 Bay-Goose Dike construction). To facilitate interpretation of results across the events and to reduce redundancy, this year's EAS report is organized by study component. The remainder of this report is organized into the following sections:

- **Section 2** Methods – describes the methods used to collect data, and quality assurance/quality control measures taken.
- **Section 3** Results – presents and discusses the results for each study component.
- **Section 4** Conclusions and Recommendations – provides a summary of key results to date for the TSS EAS.

Table 1-1. Status of key receiving environments related to TSS in 2008, 2009 and 2010.

	2008				2009					2010				
	July	Aug	Sept	Oct - Dec	Jan - Jun	July	Aug	Sept	Oct - Dec	Jan - Jun	July	Aug	Sept	Oct - Dec
Third Portage Lake														
North Basin (TPN)	Background	Background	Background	Background	Dewatering - no apparent TSS increase	Dewatering stopped	Background	Background	Background?	Dewatering, TSS < 1 mg/L	Dewatering, TSS < 1 mg/L	Dewatering, TSS < 1 mg/L	Dewatering, TSS < 1 mg/L	Dewatering, TSS < 1 mg/L
South Basin (TPS)	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background
East Basin (TPE)	Background	Background	Background	Background	Background	BG Dike construction starts	TSS concentrations gradually increase, but mostly at depth	Strong winds mix TSS throughout water column and basin; TSS source finished	TSS drops over time; still above HVH trigger by end of October	TSS increases again during causeway construction	TSS generally < 2 mg/L	TSS generally < 5 mg/L	TSS generally < 5 mg/L	TSS drops?
Second Portage Lake														
Main Basin (SP)	Background	ED construction starts; TSS rises dramatically in third week	TSS drops over time; meets targets by end of month	TSS drops?	TSS drops initially, then dewatering starts in March	Background	Some TSS input from BG dike construction, but low concentrations	TSS increases slightly, but limited spatially	TSS drops over time	TSS generally < 1 mg/L; 2 mg/L in Apr/May	TSS generally < 1 mg/L	TSS generally < 1 mg/L	TSS generally < 1 mg/L	TSS drops?
NW Arm	Background	TSS rises in parallel to main basin, but lower concentrations than main basin	TSS reduced, but rises again during WC Dike construction	TSS drops	TSS drops initially, then increases due to dewatering	TSS elevated due to dewatering activities; dewatering stops in early July	Isolated	Isolated	Isolated	Isolated	Isolated	Isolated	Isolated	Isolated
Drilltrail Arm	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background
Tehek Lake														
Near-field Basin (TE)	Background	TSS rises during third week	TSS drops over time; meets targets by end of month	TSS drops?	TSS drops?	Background	Very slight increase in TSS	TSS slightly above background?	TSS drops over time?	TSS drops over time?	Background?	Background?	Background?	Background?
Far-field Basin (TEFF)	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background

Notes: Shaded months indicate ice cover on lakes.
Acronyms: ED = East Dike; BG = Bay-Goose Dike; TSS = total suspended solids; DCM = dike construction monitoring.
"?" indicates uncertain condition.
CREMP stations shown in (), where applicable

Table 1-2. Conclusions from previous TSS Effects Assessment Studies, 2008 and 2009 (taken from Azimuth, 2010b).

TSS EAS Component	East Dike TSS EAS	Bay-Goose TSS EAS
Water Quality and Limnology		
TSS Exposure	Prevailing TSS concentrations at exposure areas in 2008 were estimated to be about 10 mg/L (Sept 13/14) and 6 mg/L (Sept 24/25).	Prevailing TSS concentrations at exposure areas in 2009 were estimated to be about 10 mg/L (Sept 17-19) and 8 mg/L (Sept 24-27).
Limnology	Elevated TSS reduced water clarity, but did not lead to changes in temperature or dissolved oxygen profiles over depth.	Similar to East Dike TSS EAS.
Water Quality	While certain metals and nutrients were elevated, dissolved concentrations were low and these were associated with particulate matter and not expected to result in direct effects to pelagic aquatic life.	Similar to East Dike TSS EAS.
Field Effects Measurements		
Primary Production - Pelagic ● Chlorophyll- α ● Phytoplankton biomass/taxonomy	Phytoplankton biomass was reduced in exposure areas in 2008. Biomass differences were much less two weeks later, suggesting a short-term effect.	Both phytoplankton biomass and chlorophyll-α were reduced in exposure areas in 2009. However, based on CREMP data they had recovered by November relative to the north and south basins.
Primary Production - Benthic ● Periphyton Community ● Sediment accumulation in mats.	Impacts of sedimentation were observed in Second Portage Lake in close proximity to the East Dike in 2009. Periphyton biomass was reduced in proportion to observed sediment content of periphyton mats. **FOLLOW-UP IN 2010**.	This component will be conducted in 2011 after BG Dike completed.
Secondary Production - Pelagic ● Zooplankton biomass/taxonomy	No differences in zooplankton biomass at exposure areas relative to reference areas.	Higher zooplankton biomass in 2009 in the east basin than observed in 2008 despite TSS exposure.
Secondary Production - Benthic ● Benthic community - Total abundance - Species richness - Simpson's Diversity Index - Bray Curtis Distance ● Surface sediment chemistry (coring)	Based on CREMP data from 2006 to 2009, the only effect identified was a marginal reduction in benthic abundance in Second Portage Lake (SP) in 2008. Abundance at SP improved in 2009 to baseline levels. No other effects were found. Higher resolution spatial sampling in 2009 did show specific areas in Second Portage Lake to differ from control areas. However, this may be due to inherently lower benthic abundance in Second Portage Lake and Tehek Lake (as seen in the CREMP) . Follow-up sediment coring conducted in 2009 did identify elevated metals in surface sediments (relative to 2008). However, based on the benthic community results, direct toxicity is unlikely. **CONTINUE BENTHIC STUDIES AS PLANNED IN 2010; ADD TOXICITY TESTING IN 2010.**	Additional EAS benthic sampling areas in Third Portage Lake will be added to the program for 2010. Ryan Vanengen (AEM) is currently conducting M.Sc. Research (U. of Guelph) regarding the potential impacts of sedimentation on benthic invertebrates at Meadowbank. Results from this program will be integrated into future reports as it becomes available. **START IN 2010.**
Fish/Fish Habitat ● Sediment Traps ● Underwater Video ● Food web (stable isotopes) ● Fish Population	Sediment trap data from open water 2008 and over winter 2008-2009 show increased sedimentation (1 - 2 mm), particularly in proximity to the East Dike. This was confirmed by the underwater video. HVH areas away from the dike were much less affected. Stable isotope studies confirmed the importance of both benthic and pelagic food webs.	Sediment trap data show some accumulation (up to 1.1 mm) in proximity of HVH areas. A subset of traps has been deployed over winter. **TRAPS DEPLOYED AGAIN IN 2010.** Underwater video surveys were conducted at HVH areas in the east basin prior to construction; these areas will be surveyed again in 2011 after dike construction.
Laboratory Effects Measurements		
<u>Zooplankton</u> ● Lethal - *Daphnia magna* 48-hr LC50 ● Sublethal - *Ceriodaphnia dubia* 7-day growth/survival/repro	No direct effects were observed in toxicity tests of surface waters.	No direct effects were observed in toxicity tests of surface waters.
<u>Fish</u> ● Lethal - Rainbow trout 96-hr LC50 ● Sublethal - Rainbow trout embryo 7-day (w/out renewal) ● Sublethal - Rainbow trout embryo 7-day (with renewal) ● Sublethal - Rainbow trout swim-up larvae 7-day surv/growth	No effects were found for juvenile and larval tests. No effects were also seen in the standard (with renewal) embryo development test. Impaired development was seen in test without renewal, which suggests that physical settling of sediments could harm developing embryos.	No direct effects were observed in toxicity tests of surface waters.

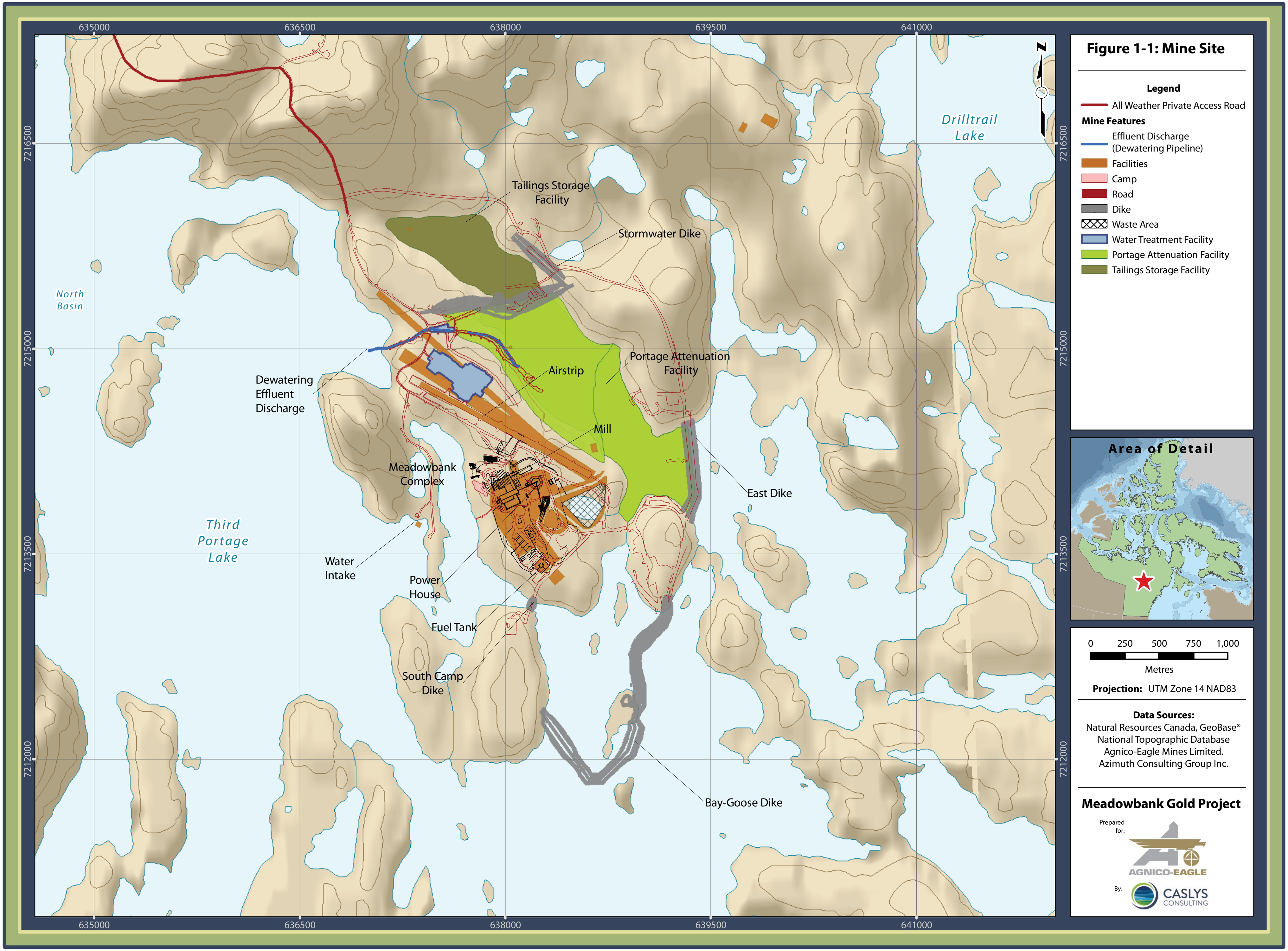


Figure 1-1: Mine Site

2. METHODS

2.1. Sediment Chemistry

Sediment was collected in August 2010, following the same procedures as the CREMP (Azimuth, 2011). The top 3-5 cm of sediment was collected from all stations using a Petite Ponar grab (sampling area of 0.023 m^2). Two or three grabs were composited and mixed into a bowl to comprise a sediment chemistry sample. Multiple grabs are composited, consistent with earlier work, to reduce the influence of within-station spatial heterogeneity. Sediment chemistry was collected after benthic invertebrate sampling to avoid possible disturbance of biota. EAS sediment chemistry sampling stations[1] are shown in **Figure 2-1**; UTM coordinates for each sample are presented in **Table 2-1**.

Only those grab samples that met the following acceptability criteria were retained for analysis: did not contain large foreign objects; adequate penetration depth (i.e., 10–15 cm); not overfilled (sediment surface not touching the top of sampler); did not leak (there was overlying water present and no visible leaks); and was undisturbed (sediment surface was relatively flat). Grabs that did not satisfy these conditions were discarded.

Sampling jars were placed in a cooler with ice packs and transported to ALS Environmental (Vancouver, BC) for analysis. A completed chain-of-custody form accompanied the samples during transport. Sediment samples were analyzed for pH, total organic carbon, moisture content, particle size (% gravel, sand, silt and clay), and total metals concentrations.

Sediment metals concentrations were compared to sediment quality guideline (SQG) concentrations developed by the Canadian Council of Ministers of the Environment (CCME, 2002) for the protection of aquatic life. There are two levels of SQGs: Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) concentrations. ISQGs are conservative values that represent the concentration below which adverse effects are unexpected. The PEL is less conservative and represents a concentration above which adverse effects may be observed, based on laboratory studies. It is important to realize that background concentrations of some metals in sediments routinely exceed both ISQG and PEL concentrations. This is common in many mineralized areas and this does not mean that adverse effects should be expected. All of the measured sediment chemistry concentrations from the study lakes were tabulated and compared against each other and, when available, the SQGs.

[1] Note that locations for CREMP areas are provided in Azimuth (2011).

Table 2-1. GPS sampling location coordinates (UTM, NAD83), Meadowbank EAS 2010.

Lake	**Benthos &Sediment Chemistry & Toxicity** (August)						**Sediment Traps** (July & September)						**Periphyton** (August)			
	Date	Replicate ID[1]	Sample Type[2]	Depth (m)	Easting	Northing	Season	Set Date	Retrieval Date	Trap ID[1]	Easting	Northing	Date	Replicate ID[1]	Easting	Northing
Second Portage Lake	20-Aug-10	SP-F1-1	B & C	7.7	14 W 640790	7213380	Winter 2009-2010	15-Sep-09	18-Jul-10	SP-ST1	14W 639661	7213999	22-Aug-10	SP-BL-1	14 W 639481	7214605
		SP-F1-2	B	9.6	14 W 640797	7213404		15-Sep-09	17-Jul-10	SP-ST6	14W 640072	7212805		SP-BL-2	14 W 639479	7214598
		SP-F1-3	B	8.5	14 W 640818	7213408		12-Sep-09	18-Jul-10	SP-ST7	15W 358781	7213838		SP-BL-3	14 W 639478	7214589
		SP-F1-4	B	9.7	14 W 640780	7213389		15-Sep-09	17-Jul-10	SP-ST8	14W 639687	7213350		SP-BL-4	14 W 639473	7214580
		SP-F1-5	B	9.9	14 W 640822	7213432								SP-BL-5	14 W 639463	7214567
	23-Aug-10	SP-F2-1	B & C	7.4	14 W 640444	7212475	Summer 2010	23-Jul-10	23-Sep-10	SP-ST1	14W 639651	7213991	23-Aug-10	SP-CREMP-1	14 W 641025	7213261
		SP-F2-2	B	7.8	14 W 640473	7212456		23-Jul-10	23-Sep-10	SP-ST6	14W 640077	7212803		SP-CREMP-2	14 W 641021	7213265
		SP-F2-3	B	7.2	14 W 640473	7212498		23-Jul-10	23-Sep-10	SP-ST7	15W 358779	7213871		SP-CREMP-3	14 W 641014	7213263
		SP-F2-4	B	7.2	14 W 640455	7212505								SP-CREMP-4	14 W 640979	7213245
		SP-F2-5	B	7.8	14 W 640486	7212444								SP-CREMP-5	14 W 640970	7213242
	23-Aug-10	SP-DT-1	B & C	7.4	14 W 641262	7213530							23-Aug-10	SP-DT-1	15W 358708	7213974
		SP-DT-2	B	8.5	14 W 641273	7213543								SP-DT-2	15W 358707	7213969
		SP-DT-3	B	8.7	14 W 641240	7213548							24-Aug-10	SP-DT-3	15W 358702	7213969
		SP-DT-4	B	7.3	14 W 641244	7213516								SP-DT-4	15W 358699	7213948
		SP-DT-5	B	9.8	14 W 641276	7213562								SP-DT-5	15W 358693	7213936
	22-Aug-10	SP-N1	T	9.0	14 W 639663	7213395							22-Aug-10	SP-GSM-1	14 W 639937	7214476
	20-Aug-10	SP-N1-1	B & C	8.0	14 W 639674	7213394								SP-GSM-2	14 W 639943	7214479
		SP-N1-2	B	7.5	14 W 639657	7213419								SP-GSM-3	14 W 639944	7214486
		SP-N1-3	B	7.1	NA									SP-GSM-4	14 W 639957	7214490
		SP-N1-4	B	10.0	NA									SP-GSM-5	14 W 639969	7214498
		SP-N1-5	B	7.2	NA											
	20-Aug-10	SP-N2-1	B & C	8.2	14 W 639946	7213765							22-Aug-10	SP-AZI-1	14 W 640538	7213838
		SP-N2-2	B	7.5	14 W 639950	7213740								SP-AZI-2	14 W 640539	7213843
		SP-N2-3	B	8.7	14 W 639946	7213720								SP-AZI-3	14 W 640548	7213848
		SP-N2-4	B	9.3	14 W 639965	7213722								SP-AZI-4	14 W 640555	7213848
		SP-N2-5	B	8.3	14 W 639981	7213781								SP-AZI-5	14 W 640567	7213848
	19-Aug-10	SP-N3-1	B & C	7.4	14 W 639592	7214608							21-Aug-10	SP-ISLA-1	14 W 640572	7213267
		SP-N3-2	B	8.9	14 W 639606	7214588								SP-ISLA-2	14 W 640562	7213268
		SP-N3-3	B	9.2	14 W 639589	7214573								SP-ISLA-3	14 W 640553	7213264
		SP-N3-4	B	8.7	14 W 639563	7214585								SP-ISLA-4	14 W 640543	7213257
		SP-N3-5	B	7.3	14 W 639570	7214615								SP-ISLA-5	14 W 640531	7213254
	22-Aug-10	SP-TRB2	T	7.0	14 W 639431	7214011										
	19-Aug-10	SP-TRB2	C	6.9	14 W 639422	7214034										

Table 2-1. GPS sampling location coordinates (UTM, NAD83), Meadowbank EAS 2010.

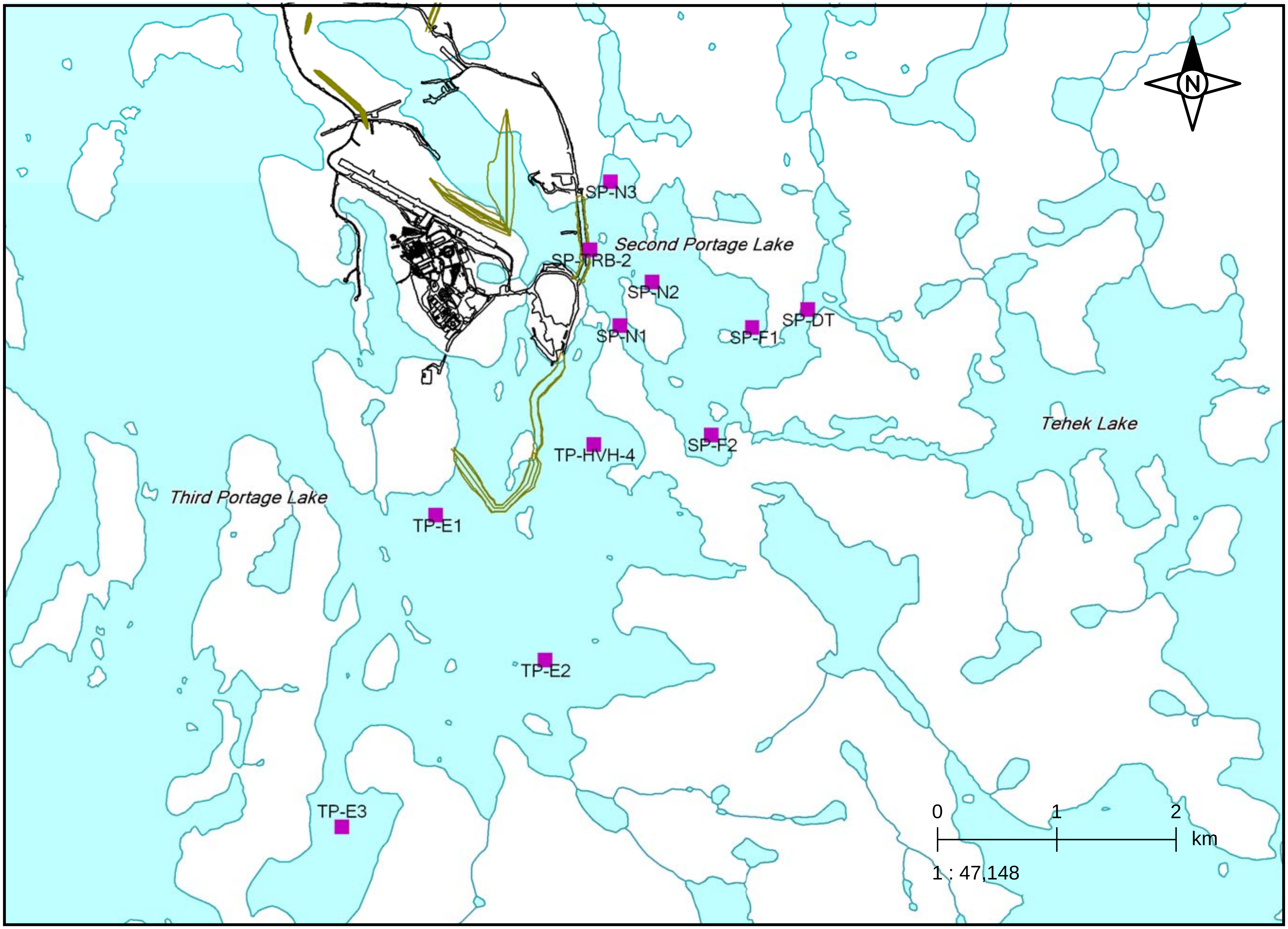
Lake	Benthos &Sediment Chemistry & Toxicity (August)						Sediment Traps (July & September)						Periphyton (August)			
	Date	Replicate ID[1]	Sample Type[2]	Depth (m)	Easting	Northing	Season	Set Date	Retrieval Date	Trap ID[1]	Easting	Northing	Date	Replicate ID[1]	Easting	Northing
Third Portage Lake	25-Aug-10	TP-E1-1	B & C	7.4	14 W 638122	7211799	Winter 2009-2010	13-Sep-09	16-Jul-10	BG-ST1	14W 638706	7211757				
		TP-E1-2	B	7.5	14 W 638109	7211814		13-Sep-09	16-Jul-10	BG-ST2	14W 638974	7211821				
		TP-E1-3	B	8.0	14 W 638118	7211782		13-Sep-09	27-Jul-10	BG-ST3	14W 639538	7211819				
		TP-E1-4	B	8.0	14 W 638091	7211762		13-Sep-09	27-Jul-10	BG-ST5	14W 639012	7211252				
		TP-E1-5	B	8.5	14 W 638080	7211783		16-Sep-09	23-Jul-10	BG-ST6	14W 639343	7213331				
	27-Aug-10	TP-E2-1	B & C	9.5	14 W 639041	7210576	Summer 2010	19-Jul-10	18-Sep-10	BG-ST2	14W 639011	7211788				
		TP-E2-2	B	10.0	14 W 639041	7210554		19-Jul-10	20-Sep-10	BG-ST4	14W 639517	7212414				
		TP-E2-3	B	9.9	14 W 639109	7210567		19-Jul-10	20-Sep-10	BG-ST6	14W 639343	7213331				
		TP-E2-4	B	9.0	14 W 639144	7210558										
		TP-E2-5	B	8.9	14 W 639174	7210561										
	25-Aug-10	TP-E3-1	B & C	11.0	14 W 637330	7209173	Winter 2009-2010	23-Sep-09	23-Jul-10	TPE-ST1	14W 637796	7211593				
		TP-E3-2	B	12.0	14 W 637327	7209136		23-Sep-09	24-Sep-10	TPE-ST2	14W 639014	7210490				
	28-Aug-10	TP-E3-3	B	10.0	14 W 637364	7209202		13-Sep-09	18-Jul-10	TPS-ST1	14W 635729	7208657				
		TP-E3-4	B	10.0	14 W 637377	7209188		13-Sep-09	23-Jul-10	TPS-ST2	14W 634334	7210449				
		TP-E3-5	B	10.0	14 W 637374	7209159										
	24-Aug-10	TP-HVH4-1	B & C	7.5	14 W 639454	7212393	Summer 2010	19-Jul-10	20-Sep-10	TPE-ST1	14W 637802	7211607				
		TP-HVH4-2	B	7.8	14 W 639435	7212405		19-Jul-10	20-Sep-10	TPE-ST2	14W 639043	7210495				
		TP-HVH4-3	B	7.0	14 W 639504	7212414		19-Jul-10	20-Sep-10	TPE-ST3	14W 637953	7210229				
		TP-HVH4-4	B	7.2	14 W 639490	7212441		19-Jul-10	24-Sep-10	TPE-ST4	14W 637344	7209104				
		TP-HVH4-5	B	8.0	14 W 639476	7212421		23-Jul-10	17-Sep-10	TPS-ST1	14W 635726	7208651				
								23-Jul-10	17-Sep-10	TPS-ST2	14W 634347	7201444				
INUG	25-Aug-10	INUG	T	6.8	14 W 622794	7216851										
Tehek Lake	27-Aug-10	TEFF	T	7.4	15 W 361518	7210684	Winter 2009-2010	17-Sep-09	20-Jul-10	TE-ST1	15W 359929	7212109				
								17-Sep-09	20-Jul-10	TE-ST4	15W 362003	7210391				
								17-Sep-09	20-Jul-10	TE-ST5	15W 363218	7208193				
							Summer 2010	20-Jul-10	21-Sep-10	TE-ST1	15W 359935	7212097				
								20-Jul-10	21-Sep-10	TE-ST4	15W 361998	7210374				
								20-Jul-10	21-Sep-10	TE-ST5	15W 363218	7208181				

Notes:

[1] Replicate/Trap IDs are as follows: SP=Second Portage Lake; F=farfield; DT=Drilltrail arm; N=nearfield; TRB=turbidity curtain; TP=Third Portage Lake; E=East basin; HVH=high-value habitat; INUG=Inuggugayualik Lake; TEFF=Tehek Lake - Farfield; ST=sediment trap; BG=Bay-Goose; TPE & TPS=Third Portage Lake - East & South basins; TE=Tehek Lake; BL=boat launch.

[2] Sample types are as follows: T = Toxicity; B = Benthos; C = chemistry.

Figure 2-1. Sediment chemistry stations, Meadowbank EAS 2010.



2.2. Sediment Metals Bioavailability

2.2.1. Overview

As described in **Section 1.2**, sediment inputs from the construction of the East Dike in 2008 resulted in elevated metals in surface sediments of Second Portage Lake (based on comparison of the top 1-2 cm of sediment from coring programs conducted in 2008 [CREMP; Azimuth, 2009c] and 2009 [EAS; Azimuth, 2010b]). Consequently, Azimuth recommended that follow-up sediment toxicity be conducted in 2010 as part of the EAS program.

Two sediment toxicity tests (described below) were used to assess whether the elevated metals have caused toxicity. In addition, and as a complement to the sediment toxicity testing, sequential extraction analysis (described below) was also conducted on the 2010 sediments. This is a geochemical analysis to determine how the metals are present in the sediment matrix (i.e., metals bioavailability). The intent of this study was to provide a sound scientific basis to support the toxicity test results.

2.2.2. Field Sampling

Sediment was collected only once in August 2010, using the same techniques and following the same acceptability criteria described in **Section 2.1**. The top 2 cm were collected from several grabs and composited until there was enough volume to fill 1 x 4L container (sediment toxicity) and 2 x 125ml bottles (sequential extraction) per station.

Four stations were tested: two "exposure" stations (i.e., one adjacent to the center of the former turbidity barrier for the East Dike [SP-TRB2] and the other in the channel southeast of the East Dike downstream of the outlet from Third Portage [SP-N1]) and two reference stations (one representing high natural mineralization [INUG] and the other just "typical" [TEFF]). Sampling stations are shown in **Figure 2-2**; UTM coordinates for each sample are presented in **Table 2-1**.

Sampling containers were placed in a cooler with ice packs and transported to Maxxam Analytics Inc. (Burnaby, BC) for both analyses. A completed chain-of-custody form accompanied the samples during transport. Sediment samples were analyzed as described in the tests below. Sediment toxicity tests were initiated on September 17, 2010.

2.2.3. Laboratory Tests

2.2.3.1. Sediment Toxicity

Two organisms were used to assess whether the elevated metals have caused sediment toxicity: an amphipod (*Hyalella azteca*) and a midge larva (*Chironomus tentans*). Organisms were both tested for endpoints of survival and growth.

The *Hyalella* test is a static, non-renewal test using juvenile (2-9 days old) amphipods, exposed to whole sediment for 14-days. This test was conducted at 23°C, using 5 replicates per treatment including a laboratory control, with 10 organisms per replicate.

The *Chironomus* test is a static, non-renewal test using 3rd instar larvae exposed to whole sediment for 10-days. This test was conducted at 23°C, using 5 replicates per treatment including a laboratory control, with 10 organisms per replicate.

2.2.3.2. Sequential Extraction

There are many sequential extraction procedures (SEP) that can be used for understanding the behavior of metals in sediments but most SEPs follow similar fractional degradation with minor variations (Zimmerman and Weindorf, 2010). The SEP followed in this study was a standard European Union method (BCR 701) that was developed to provide suitable reference materials for enabling the validation of the methodologies, and to control the quality of the measurements (Pueyo et al., 2001).

The theory behind sequential extraction is that the solid material (sediment in this case) can be partitioned into specific fractions that can be extracted selectively by using appropriate reagents (Tessier et al., 1979). The most mobile trace metals will be removed in the first fraction and continue in order of decreasing of mobility (Zimmerman and Weindorf, 2010). Typically, metals of anthropogenic inputs tend to reside in the first three fractions and metals found in the residual fraction occur as a geological matrix in the parent rock (Ratuzny et al., 2009). The BCR method follows an optimized three-step sequential extraction procedure that allows for characterization of metals availability into these four groups or fractions (Pueyo et al., 2001) as follows:

Carbonate-bound Fraction: step 1 uses acetic acid to remove metals that are weakly adsorbed to the surface of sediment particles and associated with carbonate coatings, otherwise readily available. Metals in this fraction will desorb with changes in pH.

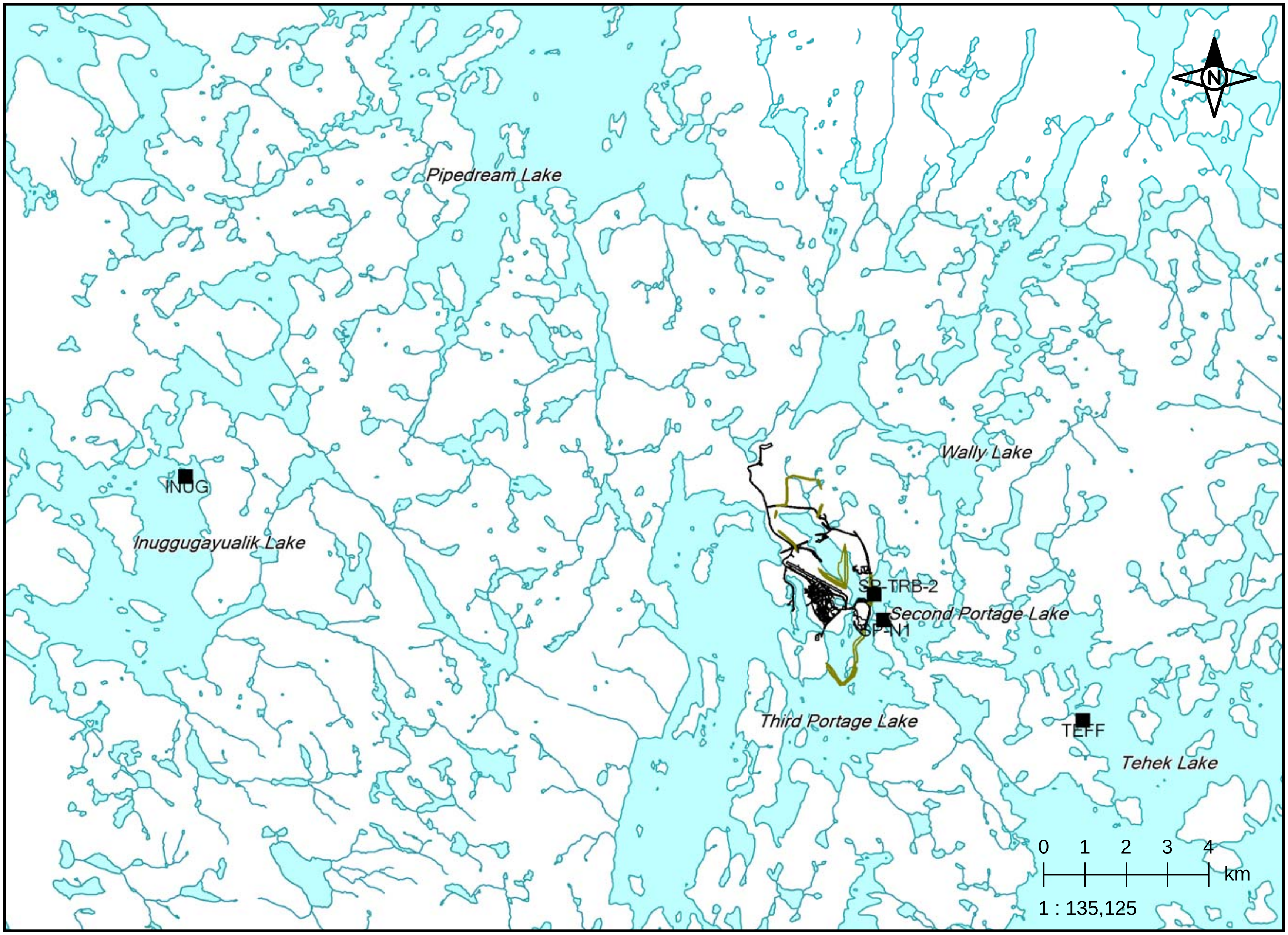
Fe / Mn oxide-bound Fraction: step 2 uses hydroxylamine hydrochloride to remove metals that are associated with iron and manganese oxide coatings on the surface of sediment grains. Metals in this fraction will only be released under anoxic conditions.

Organic matter or Sulphide-bound Fraction: step 3 uses hydrogen peroxide (H_2O_2) / ammonium acetate to remove metals that are associated with organic matter (e.g., living organisms, detritus, coatings on mineral particles, etc) and with sulphide mineral coatings. Metals in this fraction will be released under oxidizing conditions, as organic material is degraded.

Residual Fraction: this fraction is what remains once the first three fractions have been removed. This fraction will only contain primary and secondary minerals that are essentially part of the sediment matrix. Metals in this fraction are not expected to be released under natural conditions (Tessier et al., 1979).

The fraction resulting from each step is then analyzed for dissolved metals by ICPMS and dissolved hardness ($CaCO_3$).

Figure 2-2. Sediment toxicity stations, Meadowbank EAS 2010



2.3. Sediment Traps

Sediment traps have been an integral part of dike construction monitoring and the TSS EAS since 2008. The initial network (focused on the East Dike) was expanded in 2009 to support monitoring efforts for the Bay-Goose Dike. Trap deployment throughout the year since 2008 provides us with a good understanding of spatial and temporal dynamics in sedimentation.

A network of 19 sediment trap installations (each consisting of 4 replicate trap tubes) was deployed throughout the local receiving environments during Bay-Goose Dike construction activities. Traps were deployed in September 2009, retrieved in July 2010 (winter traps, **Figure 2-3**), re-deployed and retrieved again in September 2010 (summer traps, **Figure 2-4**)[2]. The trap locations were primarily set near high value habitat to provide data on sediment deposition in proximity to important fish habitat. Sediment trap coordinates are presented in **Table 2-1**.

In 2009, the sediment trap frames were fully painted prior to deployment to remove any concern for rust formation. The same design was maintained in 2010. Each installation consisted of up to four PVC sediment trap tubes, positioned vertically, open-end up, in a grid formation on a small metal frame. Two types of trap tubes were used in 2010 with the following dimensions: (1) 7.6 cm inner diameter opening, 51.4 cm long, and (2) 10.1 cm inner diameter opening, 51.4 cm long. These differing diameters were accounted for when calculating deposition rates. Traps were deployed in the open water by looping sideline to all corners of the frame, gathering the line into a single loop and slowly lowering the trap to the lake bottom while keeping it level. Each trap was marked with a labeled surface buoy (winter traps were set up so that the buoy would be below the ice).

Sediment traps were retrieved by slowly pulling the line when the boat was directly above the buoy to keep the trap vertical. In a few cases, sediment traps could not be located for retrieval (either because the trap had moved over winter or because the water was too turbid to see the buoy 2–3 m below the surface). In other cases, one of the four trap tubes was missing or was cracked and leaking when the trap was retrieved. In another instance, the entire trap assembly was found on its side (likely due to ice). Once removed from the lake, each trap tube was capped, removed from the frame and left to settle for at least one day. Overlying water was decanted from each trap tube until the onset of resuspension, at which point the remaining water was swirled vigorously to suspend all sediments and transferred to pre-labeled 1-L containers. The overlying water was collected into a squirt bottle and used to fully rinse the trap tubes and ensure all sediment was collected into the 1-L container.

[2] A network of winter traps was set up once again starting in September 2010.

Sampling containers were transported to ALS Environmental (Vancouver, BC) for analysis. A completed chain-of-custody form accompanied the samples during transport. In the laboratory, samples were filtered through pre-weighed glass fiber filters then dried at 105°C. The dry weight of the sample was determined by subtracting the weight of the filter from the total dry weight. A portion of the samples were ashed by further drying the sample at 550°C and subtracting the ash weight from the dry weight of the sample.

Figure 2-3. Sediment traps deployed in September (2009) and retrieved in July (2010), Meadowbank EAS 2010.

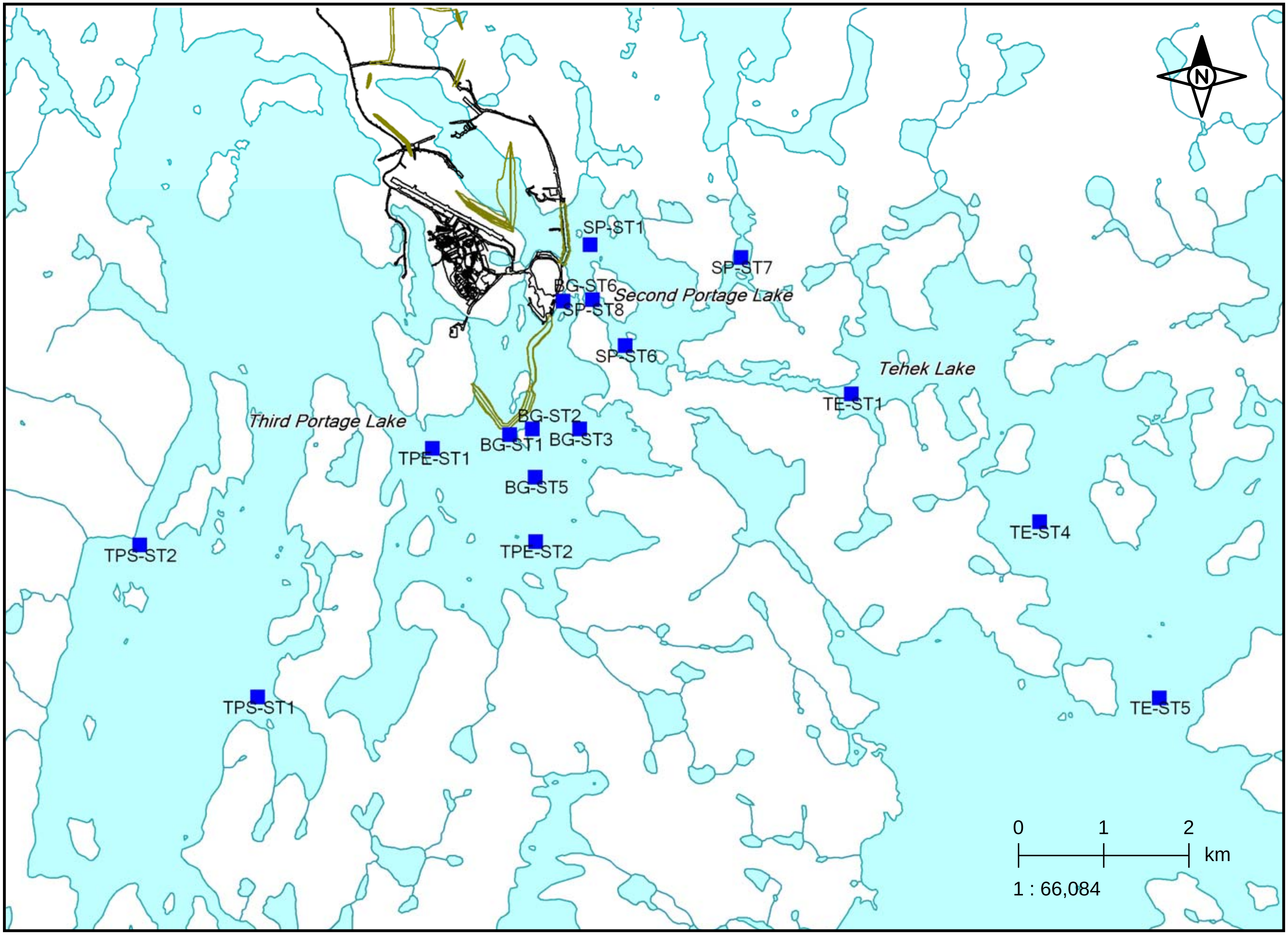
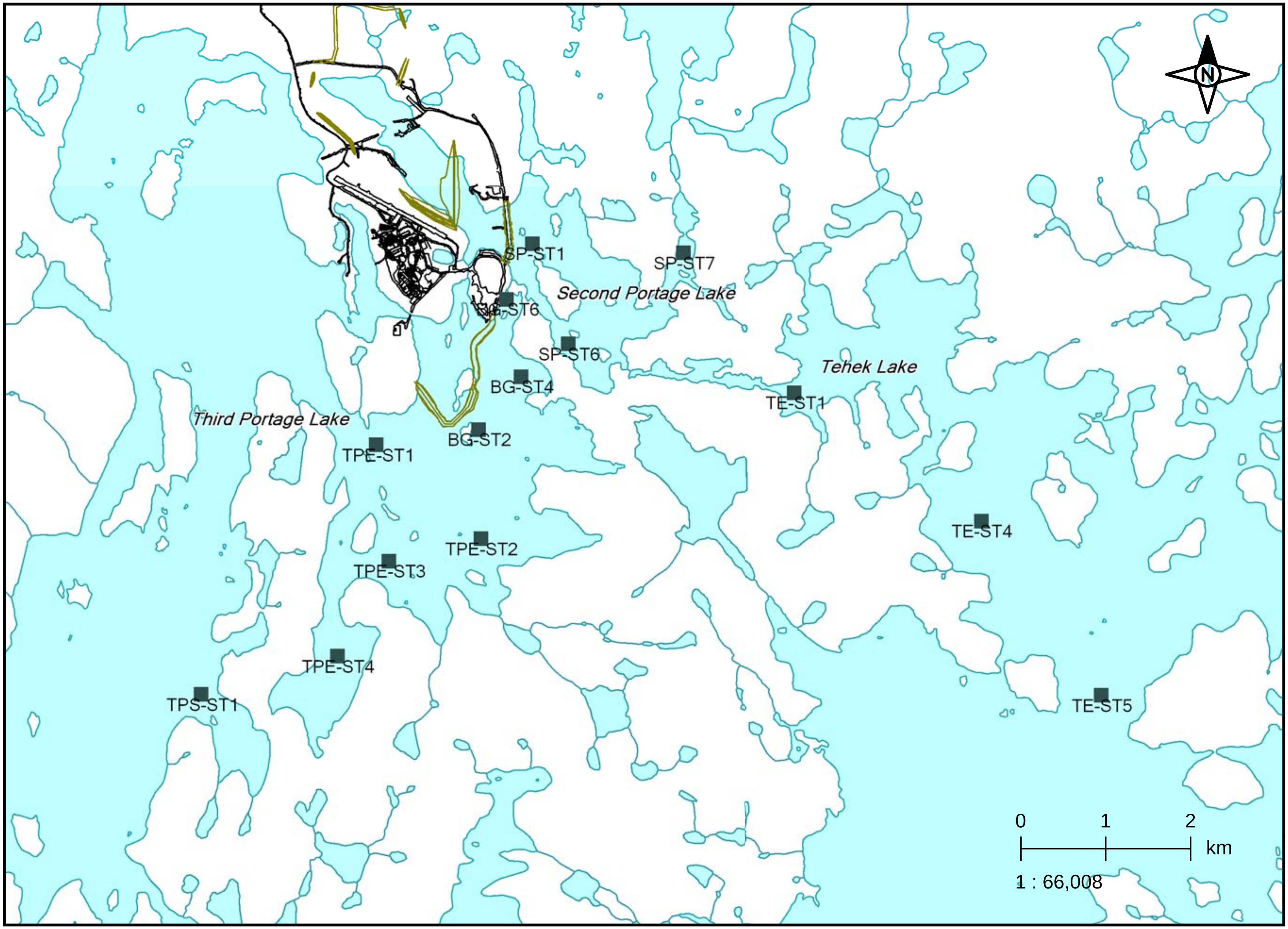


Figure 2-4. Sediment traps deployed in July (2010) and retrieved in September (2010), Meadowbank EAS 2010.



2.4. Periphyton Community

As described in **Section 1.2**, potential effects of construction-related sedimentation to the periphyton community were assessed in 2009 using underwater video and direct sampling as part of the East Dike EAS (Azimuth, 2010b). Apparent effects were identified in close proximity to the dike construction zone, but there was high uncertainty regarding the extent of potential impacts. Consequently, in addition to the three quantitative sampling areas targeted in 2009 (SP-BL, SP-CREMP, SP-DT), three more were added in 2010 on the northern side of the lake to provide greater spatial resolution (**Figure 2-5**). Collectively, these areas span a gradient in sedimentation from the 2008 East Dike event and should provide insights into the spatial and temporal extent and magnitude of effects to periphyton in Second Portage Lake.

Two sample types were collected from each location: one for determining periphyton density (cells/cm^2) and biomass (µg/cm^2) by major taxonomic groups, and the other for determining the relative mass of sediment (based on loss on ignition) within the periphyton mat.

The stations are listed below in order of increasing distance from the East Dike (and hence decreasing exposure to construction-related sedimentation) in Second Portage Lake:

- *Second Portage Lake Boat Launch (SP-BL)* – this is a near-field station located just outside (east) of the area that was enclosed by turbidity barriers in 2008; this station would have been exposed to relatively high TSS concentrations in 2008. Sampled in 2009 and 2010.
- *Second Portage new near-field (SP-GSM)* – this is a near-field station located on the north shore of the lake about 0.5 km east of the dike.
- *Second Portage new far-field (SP-AZI)* – this is a far-field station located in a flat area at the base of a steep slope on the north shore of the lake about 1.0 km east of the dike.
- *Second Portage new far-field (SP-ISLA)* – this is a far-field station located on the south side of an island about 1.4 km southeast of the dike.
- *Second Portage CREMP location (SP-CREMP)* – this is a far-field station located on the north shore of the lake about 1.8 km southeast of the dike, at the south tip of the entrance to the Drilltrail Arm; this area was likely exposed to slightly elevated TSS in 2008.
- *Drilltrail Arm (SP-DT)* – this is a reference station located on the west shore about half way up the Drilltrail Arm. This station was not affected by the

sedimentation event (i.e., due to the continued inflow into the upper arm from the Wally Lake watershed).

UTM coordinates for each station are presented in **Table 2-1**. Five replicate samples were collected from each station and analyzed independently for all analyses. Sampling locations were chosen according to the following criteria: a sufficient number of large, flat rocks from a water depth of 0.5 m with a flat surface facing upwards as much as possible, and with uniform algal coverage, not uniformly dense or sparse. Periphyton growth is naturally variable due to differences in wave action, aspect to sun, water depth and clarity, nutrient availability, rock type, water temperature and other factors.

Periphyton samples for biomass and density analyses were acquired using a specially designed periphyton 'scrubber'. The procedures for collecting the samples are outlined in detail in the SOP for Periphyton Sampling (AEM, 2009) but generally, 20cm^2 (the surface area of the 'scrubber') was thoroughly scrubbed from 3 rocks for each replicate station. These samples were preserved in the field with a small amount of Lugol's solution and sent to Plankton R Us Inc. (Winnipeg, MB) for taxonomic identification and analysis.

In the laboratory, each periphyton sample was mixed well before subsampling of a 2-mL aliquot that is suspended and sonicated for 10–20 seconds using a Sonifer Cell Disruptor (model w140) and gravity settled for 24 h in an Ütermohl chamber (Findlay et al., 1999). Counts were performed on an inverted microscope at magnifications of 125X, 400X, and 1200X with phase contrast illumination. Cells were identified, counted and measured from random fields until 100 cells of the dominant species were found. Cell counts were converted to wet weight biomass (mg/m^2) by approximating cell volume. Estimates of cell volume for each species were obtained by measurements of up to 50 cells of an individual species and applying the geometric formula best fitted to the shape of the cell (Vollenweider, 1968; Rott, 1981). Data were reported in terms of density (number of cells/cm^2) and biomass (µg/cm^2).

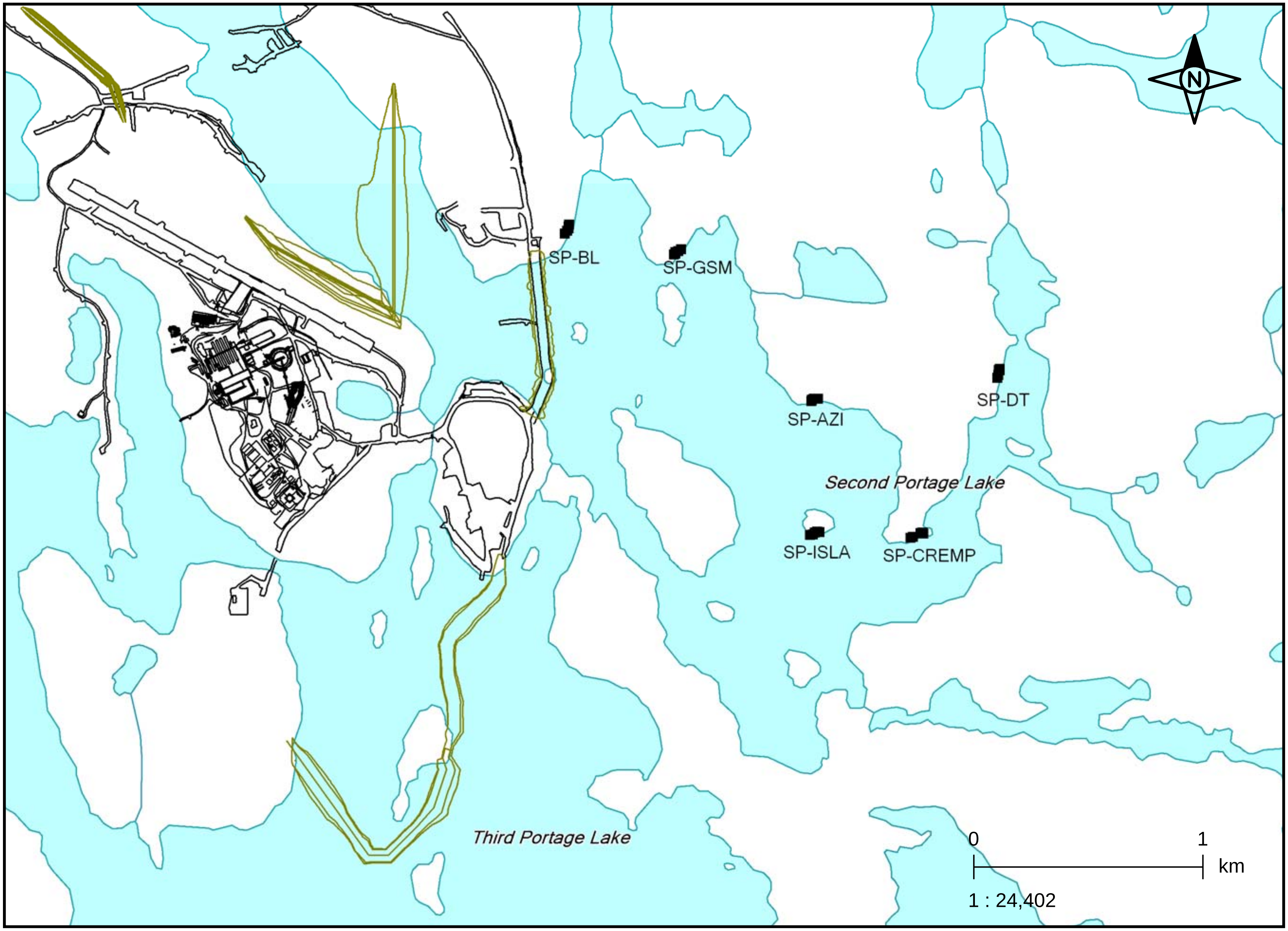
Simpson's diversity index was calculated for each station to quantify periphyton species diversity among stations and replicate samples (Washington, 1984). Simpson's diversity is calculated as shown in **Section 2.5**.

Periphyton samples for loss on ignition analysis were also acquired by using the periphyton 'scrubber'; however, in this case the scrubber was used only to scribe a circle onto the chosen rock (one rock per replicate). Using two knifes (one thin filleting knife and one wider more spatula shaped knife) the circle was carefully scraped. The scraped sample was placed into a 125-ml glass sampling jar which had been pre-labeled with the station ID. Samples were frozen until the time of shipping.

Sampling containers were packed frozen and transported to ALS Environmental (Vancouver, BC) for analysis. A completed chain-of-custody form accompanied the samples during transport. In the laboratory, samples were filtered through pre-weighed glass fiber filters then dried at 105°C, and dry weight recorded (total weight minus the filter weight). Samples were then further dried at 550°C. This procedure ‘ashes’ the sample which produces yields the inorganic (sediment) component of the sample. Subtracting the ash weight from the dry weight yields the organic component of the sample.

Details regarding statistical analyses of periphyton are provided in **Appendix A**.

Figure 2-5. Periphyton sampling locations, Meadowbank EAS 2010.



2.5. Benthic Invertebrates

As described in **Section 1.2**, the assessment of TSS-related impacts to the benthic invertebrate community has relied on two data sets:

- *CREMP* – This data set includes key areas from the CREMP, that has been conducted at most areas since 2006. This data set, focusing on comparisons among basins or lakes, complements the EAS data set in that it provides a broader context from both a temporal and spatial perspective. The methods described below for the EAS would largely apply to the CREMP as well; further details regarding locations are provided in the CREMP report (Azimuth, 2011). CREMP areas are shown in **Figure 2-6**.
- *EAS* – This program is designed with a higher degree of spatial resolution in areas potentially impacted by construction-related sedimentation. Samples were collected to address both the East Dike EAS (**Figure 2-7**) and the Bay-Goose EAS (**Figure 2-8**). Details regarding locations and sampling methods are provided below.

Benthic invertebrates were collected from each sampling station in August 2010, using a Petite Ponar grab (0.023 m^2) and a 500-µm sieve at the same time and locations as sediment chemistry samples. Sampling locations pertaining to the East Dike EAS and Bay-Goose EAS are illustrated in **Figures 2-7 and 2-8**, respectively; UTM coordinates for each sample are presented in **Table 2-1**. Five replicate samples were collected per station. Two independent grabs (subsamples) per replicate were composited to form a single sample to reduce sampling variation within stations and to increase the surface area sampled. Depths ranged from 6.8 to 12.0 m.

Only those grab samples that met the following acceptability criteria outlined in **Section 2.1** were retained for analysis. Grabs that did not satisfy these conditions were discarded. The procedures for collecting the benthic invertebrate samples are outlined in detail in the SOP for Benthos and Sediment Sampling (AEM, 2009).

Benthos samples were preserved in the field with a 10% buffered formalin solution and sent to Zaranko Environmental Assessment Services (ZEAS) (Nobleton, ON) for taxonomic identification and analysis. Upon arrival at ZEAS, samples were immediately logged and inspected to ensure adequate preservation to a minimum level of 10% buffered formalin and checked for correct labeling. Benthos samples were sorted at a magnification of between 7 and 10 times with the use of a stereomicroscope. To expedite sorting prior to processing, all samples were stained with a protein dye that is absorbed by aquatic organisms but not by organic material, such as detritus and algae.

Prior to sorting, samples were washed free of formalin in a 500-µm sieve. Benthos were enumerated and sorted into major taxonomic groups, (i.e., order and family), placed in glass bottles and re-preserved in 80% ethanol for more detailed taxonomic analysis by senior staff. Each bottle was labeled internally with the survey name, date, station and replicate number.

Abundance of organisms/m^2 was determined from the total number of organisms enumerated. Nematodes and ostracods were not reported, nor were they included in abundance and richness calculations because they are too small to be reliably retained on a 500-µm sieve.

The following endpoints were used for assessing benthic community structure, based on sensitivity, objectivity, ease of interpretation and cost-effectiveness:

- Taxa richness (i.e., corresponds to the number of species or taxa per sample and provides a measure of diversity).
- Total abundance (i.e., number of organisms per m^2).
- Abundance and richness of all major taxa (e.g., insects, molluscs, worms).
- Simpson's Diversity index (D), calculated as follows:

$$D = \sum \frac{n_i(n_i - 1)}{N(N-1)}$$

  where: N is the total number of organisms/station; n_i is the total number of organisms of the *ith* taxa/station.

- Bray-Curtis index (B-C), calculated as follows:

$$B\text{-}C = \frac{\sum_{i=1}^{n} |y_{i1} - y_{i2}|}{\sum_{i=1}^{n} (y_{i1} + y_{i2})}$$

  where: Y_{i1} is the count for species i at site 1, Y_{i2} is the median of the count for species i at the references site(s), and n is the total number of species present at the two sites.

Details regarding statistical analyses of benthic invertebrates are provided in **Appendix A**.

Figure 2-6. Benthic invertebrate stations, Meadowbank CREMP, 2010.

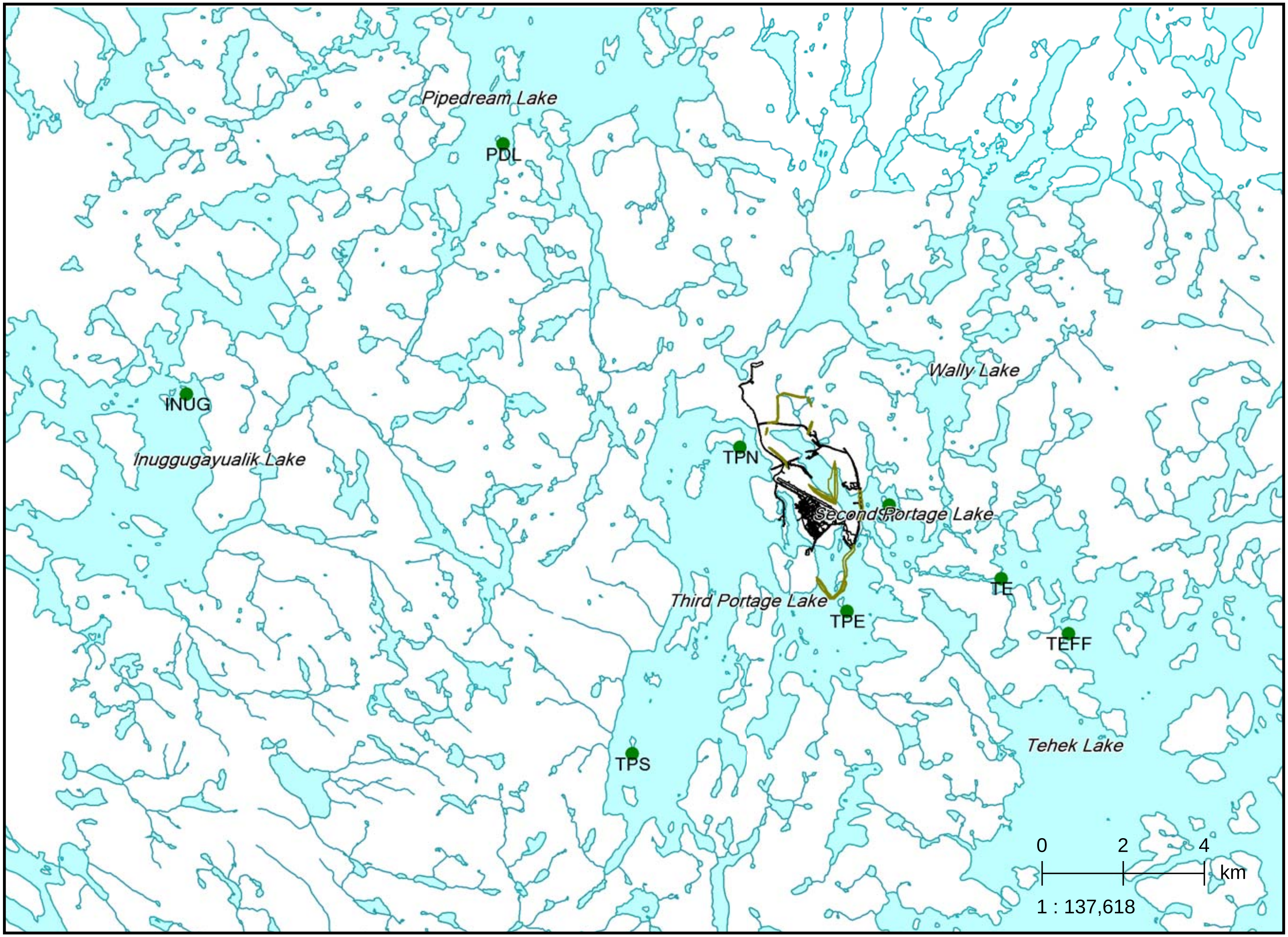


Figure 2-7. Benthic invertebrate stations, Meadowbank East Dike EAS, 2010.

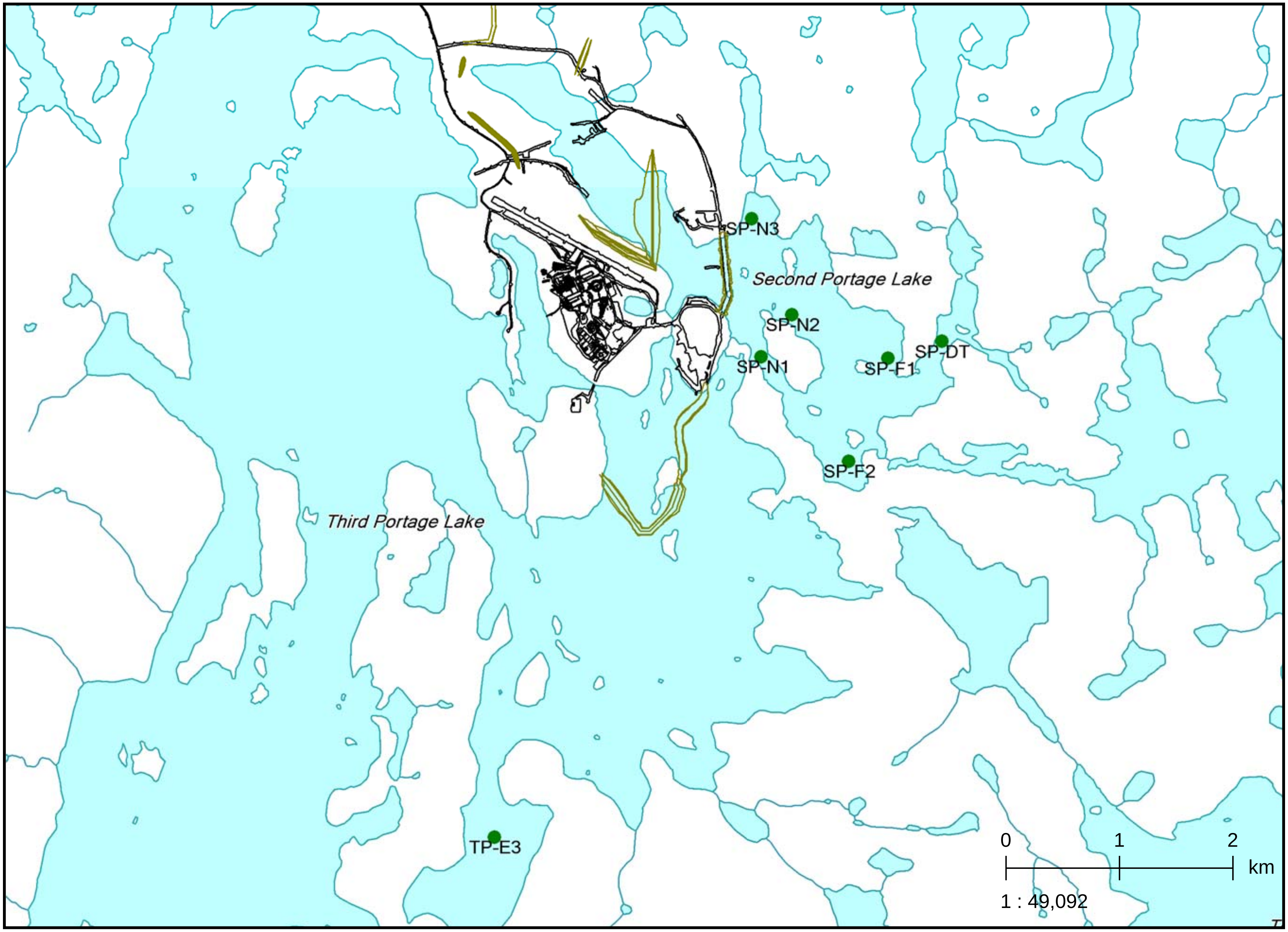
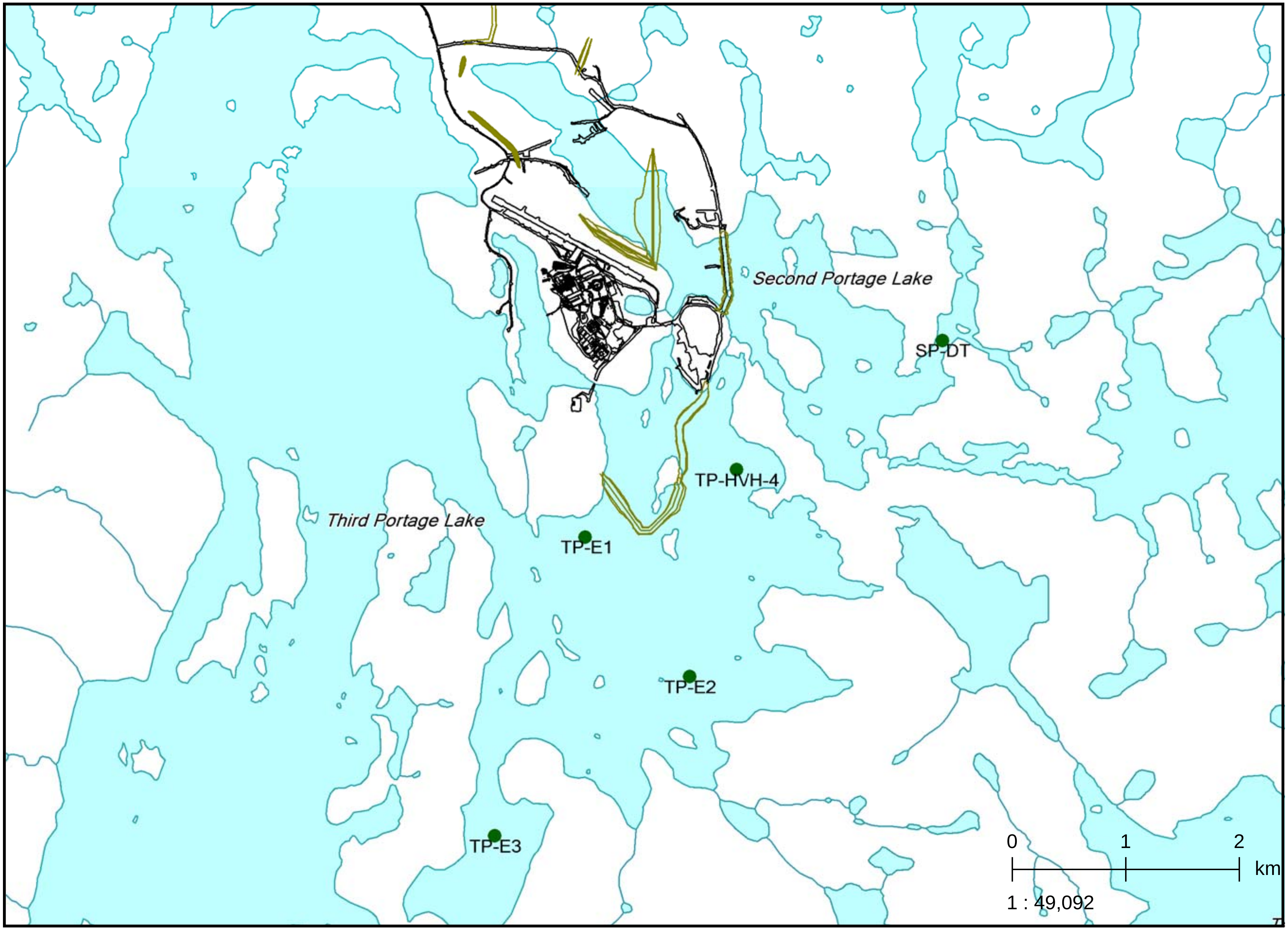


Figure 2-8. Benthic invertebrate stations, Meadowbank Bay-Goose EAS, 2010.



2.6. Quality Assurance / Quality Control

The objective of quality assurance and quality control (QA/QC) is to ensure that the chemical and biological data collected are representative of the material or populations being sampled, are of known quality, are properly documented, and are scientifically defensible. Data quality was assured throughout the collection and analysis of samples using specified standardized procedures, by the employment of laboratories that have been certified for all applicable methods, and by staffing the program with experienced technicians.

Laboratory and Field QA/QC: Sediment Sampling – Sediment chemistry analyses were conducted at ALS Environmental; this is an analytical laboratory accredited by the Canadian Association of Environmental Analytical Laboratories. This accreditation ensures that laboratories achieve and demonstrate the highest levels of technical and management excellence for their services.

Laboratory duplicate results were assessed at using the relative percent difference (RPD) between measurements for sediment chemistry results from grabs. The equation used to calculate a RPD is:

$$RPD = \frac{(A - B)}{((A + B)/2)} \times 100$$

where: A = analytical result; B = duplicate result.

The laboratory data quality objectives (DQO) for this project were 25% RPD for concentrations that exceed 10x the method detection limit (MDL).

RPD values may be either positive or negative, and ideally should provide a mix of the two, clustered around zero. Consistently positive or negative values may indicate a bias. Large variations in RPD values are often observed between duplicate samples when the concentrations of analytes are very low and approaching the detection limit. RPDs are not calculated for cases where either of the samples (i.e., either A and/or B above) is below detection.

Sediment toxicity tests were conducted at Maxxam Analytics; this laboratory follows a comprehensive QA/QC program to ensure that the data generated are of high quality and scientifically defensible. The *Hyalella* sediment test is considered valid if the mean survival in the controls is ≥80% and the average dry weight is ≥0.1 mg/amphipod. The *Chironomus* sediment test is considered valid if the mean survival in the controls is ≥70% and the average dry weight is ≥0.6 mg/larvae. Reference toxicant tests for each organism were run concurrently with the toxicity tests, using the same batch of organisms used in each test. QA/QC methodology for sediment toxicity testing is summarized in their report (**Appendix B**).

Sediment sequential extraction analyses were also conducted at Maxxam Analytics. As part of the laboratory quality assurance, two duplicate sediment samples were used to assess variability in the trace-element concentration data for each step of the sequential extraction process. One of the duplicates was the standard reference material BCR-701, for which certified concentrations of cadmium, chromium, copper, lead, nickel, and zinc have been determined for the sequential extraction procedures. The other sediment sample used for duplicate analysis was the aliquot from sample SP-TRB-2.

Field QA/QC standards during sediment sampling consisted of taking care between sampling areas, by rinsing and cleaning the Petite Ponar grab, stainless steel compositing bowls and spoons using site water and phosphate-free cleaning detergent, avoided the possibility of cross-contamination. No field duplicates were collected for sediment chemistry; however, field replicates were collected for sediment trap samples to determine natural variability and heterogeneity within and among stations.

Laboratory and Field QA/QC: Benthic Invertebrate Sampling – Standard procedures were used to collect benthic invertebrate samples. All sampling gear was thoroughly rinsed between sampling stations to ensure that there was no inadvertent introduction (i.e., cross-contamination) of biota from one station to another.

ZEAS incorporates the following set of QA/QC procedures in all benthic projects undertaken by the company to ensure the generation of high quality and reliable data:

- Samples were logged upon arrival, inspected, and enumerated;
- Samples were checked for proper preservation;
- Samples were stained to facilitate sorting;
- Taxonomic identifications were based on the most updated and widely used keys;
- 10% of the samples were re-sorted, and re-counted, targeting >90% recovery;
- Precision and accuracy estimates were calculated;
- A voucher collection was compiled;
- Sorted sediments and debris were re-preserved in 10% formalin and are retained for up to three months. For samples subject to subsampling, sorted and unsorted fractions were re-preserved separately.

Field replicates (5 per station) were collected for benthos to determine natural variability and heterogeneity. Replicates were collected at least 20 m apart from one another, within the defined sampling areas, as described in **Section 2.5**.

Laboratory and Field QA/QC: Periphyton Sampling – As a measure of laboratory QA/QC on the enumeration method, replicate counts were performed on 10% of the samples. Laboratory replicate samples were chosen at random and processed at different times from the original analysis to reduce biases. The laboratory replicate is a new aliquot (10 ml) from the sample jar and is counted from the start in the same manner as the original aliquot (10 ml) taken from the jar.

Field replicates (5 per station) were collected for periphyton to test consistency in field methods and to determine natural variability and spatial heterogeneity within and among stations. When collection of each replicate sample was completed, the ‘scrubber’ was rinsed in lake water to ensure that no debris remained in the bristles.

3. RESULTS

3.1. Quality Assurance / Quality Control

QA/QC procedures consisted of a combination of careful field collection and sample handling, the collection of field duplicate samples and the analysis of laboratory replicates and standard reference materials. Results of the QA/QC analyses are presented in **Tables 3-1 to 3-4** for sediment chemistry, sediment sequential extraction, periphyton and benthos, respectively.

Sediment Chemistry – Laboratory duplicate results were assessed using the relative percent difference (RPD) between measurements. None of the RPD values exceed the DQO for lab duplicate samples in the sediment grab data (**Table 3-1**). This result confirms that sediments were well homogenized by the laboratory.

Sediment Toxicity – Results of QA/QC for sediment toxicity testing showed that all the tests met the acceptability criteria for test validity specified in their respective protocols. The *Hyalella* tests performed met the survival and dry weight validity criteria. The *Chironomus* tests performed met the survival and dry weight validity criteria. However, the average head capsule width of the larvae before test initiation was 0.53 mm, greater than the Environment Canada recommended range of 0.33 – 0.45 mm. This does not invalidate a test, since the larvae are still considered third instar at this size. However, it does account for the number of pupae and midges recovered at test completion. All statistical and raw data for these tests are included in the report prepared by Maxxam (**Appendix B**).

Sediment Sequential Extraction – The sediment sequential extraction analyses that were conducted at Maxxam followed a three-step procedure that was performed on the aliquots of each of the sediment samples and the standard reference material BCR-701. Laboratory duplicates were analyzed for each of the three steps. These samples showed a high degree of consistency and precision (**Table 3-2**). In only one case out of a possible 120 cases did the RPD exceed 25% (i.e., copper in step 3). There were, however, a few cases where the measured concentrations exceeded the RPD of 25% but were less than 10x the MDL (i.e., titanium and sodium in step 1, and tungsten in step 2). Consequently, DQOs were met in all samples.

Periphyton Sampling – Quantitative periphyton samples collected from prescribed areas of rock surface were quantified by biomass (µg/cm^2) and density (cells/cm^2). A randomly chosen sample was selected for a laboratory duplicate re-count (which accounted for 10% QA). The quality of the data is evaluated based on *total* density and *total* biomass of the laboratory duplicate. Although laboratory duplicates in some cases showed high within-taxa variability, RPDs for *total* density and *total* biomass consistently met the DQOs (i.e., <25%) (**Table 3-3**).

Benthic Invertebrate Sampling – For benthic invertebrate samples, laboratory replicate counts were performed on 10% of all samples. Replicate samples were chosen at random and processed at different times from the original analysis to reduce bias. Of the re-sorted samples, 0/68 (0%), 3/60 (5%), 5/84 (6%), 1/58 (1.7%), and 2/23 (8.7%) organisms were missed (**Table 3-4**), with an overall omission rate of less than 4.5%. These results suggest that the vast majority of animals observed in benthic samples by the taxonomist were recovered. A reference collection of benthic taxa has been compiled.

Table 3-1. QA/QC data for sediment chemistry parameters, Meadowbank EAS 2010.

Analytes	MDLs	Various Lakes Original August	Various Lakes Laboratory Duplicate	RPD (%)
CONVENTIONAL PARAMETERS				
Physical & Organic Parameters				
pH	0.10	6.38	6.38	0.0
Total Organic Carbon (% dw)	0.10	3.18	3.08	3.2
Particle Size				
% Gravel (>2mm)	0.10	<0.10	<0.10	NA
% Sand (2.00mm - 0.063mm)	0.10	3.66	3.79	-3.5
% Silt (0.063mm - 4µm)	0.10	63.3	66.1	-4.3
% Clay (<4µm)	0.10	33.0	30.1	9.2
TOTAL METALS (mg/kg dw)				
Aluminum	50	25400	25600	-0.8
Antimony	10	<10	<10	NA
Arsenic	5.0	33.3	33.2	0.3
Barium	1.0	96.4	96.8	-0.4
Beryllium	0.50	1.69	1.69	0.0
Cadmium	0.50	<0.50	<0.50	NA
Chromium	2.0	183	180	1.7
Cobalt	2.0	20.7	20.7	0.0
Copper	1.0	62.2	62.4	-0.3
Lead	30	<30	<30	NA
Mercury	0.0050	0.017	0.015	15.2
Molybdenum	4.0	6.8	6.6	3.0
Nickel	5.0	89.3	89.9	-0.7
Selenium	2.0	0.95	0.92	3.2
Silver	2.0	<2.0	<2.0	NA
Thallium	1.0	<1.0	<1.0	NA
Tin	5.0	<5.0	<5.0	NA
Uranium	0.050	16.3	16.3	0.0
Vanadium	2.0	45.7	45.3	0.9
Zinc	1.0	107	108	-0.9

Notes:

RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

Shaded RPDs exceed 25% (lab duplicates)

NA = RPDs have not been calculated for cases where one of the samples is below detection and the other is not and in cases where both are below detection.

Table 3-2. QA/QC data for sediment sequential extraction analyses, Meadowbank EAS 2010.

Analytes	MDLs			STEP 1			STEP 2			STEP 3		
	STEP 1	STEP 2	STEP 3	Original SP-TRB2	Laboratory Duplicate	RPD (%)	Original SP-TRB2	Laboratory Duplicate	RPD (%)	Original SP-TRB2	Laboratory Duplicate	RPD (%)
CONVENTIONAL PARAMETERS (mg/kg)												
Dissolved Hardness ($CaCO_3$)	30	30	25.5	15000	15240	-1.6	5238	4986	4.9	2647	2718	-2.7
DISSOLVED METALS (mg/kg dw)												
Dissolved Aluminum	0.060	0.120	0.102	161	149	7.7	1080	1164	-7.5	355	340	4.3
Dissolved Antimony	0.006	0.012	0.0102	<0.006	<0.006	NA	<0.012	0.012	NA	<0.0102	<0.0102	NA
Dissolved Arsenic	0.006	0.012	0.0102	0.516	0.516	0.0	1.84	1.88	-2.3	0.265	0.281	-5.6
Dissolved Barium	0.006	0.012	0.0102	39.5	35.8	9.9	17.5	18.2	-4.0	8.42	8.47	-0.6
Dissolved Beryllium	0.0030	0.0060	0.0051	0.0876	0.0876	0.0	0.102	0.108	-5.7	0.0408	0.0408	0.0
Dissolved Bismuth	0.0018	0.0030	0.0026	0.0048	0.0042	13.3	0.284	0.312	-9.5	0.0235	0.0224	4.4
Dissolved Boron	18.0	30.0	25.5	<18	<18	NA	<30	<30	NA	<25.5	<25.5	NA
Dissolved Cadmium	0.0018	0.0030	0.0026	0.0402	0.0408	-1.5	0.0120	0.0138	-14.0	0.00918	0.00816	11.8
Dissolved Cesium	0.0180	0.0300	0.0255	<0.018	<0.018	NA	0.150	0.144	4.1	0.0459	0.0408	11.8
Dissolved Chromium	0.030	0.060	0.051	0.588	0.540	8.5	2.94	2.94	0.0	3.67	3.83	-4.1
Dissolved Cobalt	0.0018	0.0030	0.0026	1.22	1.19	2.0	1.04	1.07	-3.4	0.867	0.898	-3.5
Dissolved Copper	0.0180	0.0300	0.0255	7.50	7.32	2.4	7.92	8.16	-3.0	2.04	38.9	-180.1
Dissolved Iron	0.30	0.60	0.51	1116	1128	-1.1	1914	1782	7.1	423.8	400.9	5.6
Dissolved Lanthanum	0.018	0.030	0.0255	1.81	1.79	1.0	21.9	22.6	-3.2	5.97	5.66	5.3
Dissolved Lead	0.0018	0.0030	0.00255	0.642	0.624	2.8	5.68	6.06	-6.4	0.668	0.668	0.0
Dissolved Lithium	0.180	0.300	0.255	0.300	0.360	-18.2	1.02	1.14	-11.1	1.84	1.79	2.8
Dissolved Manganese	0.018	0.030	0.0255	188	189	-0.3	36.4	37.4	-2.9	17.4	18.0	-3.2
Dissolved Molybdenum	0.018	0.030	0.0255	<0.018	<0.018	NA	<0.03	<0.03	NA	0.785	0.811	-3.2
Dissolved Nickel	0.006	0.012	0.0102	2.41	2.33	3.5	2.99	2.90	3.1	3.33	3.19	4.2
Dissolved Phosphorus	0.60	1.20	1.02	3.0	3.0	0.0	500	507	-1.3	35.2	34.2	2.9
Dissolved Rubidium	0.018	0.030	0.0255	0.852	0.864	-1.4	1.21	1.26	-3.9	0.995	0.938	5.8
Dissolved Selenium	0.012	0.024	0.0204	<0.012	<0.012	NA	<0.024	<0.024	NA	0.046	0.046	0.0
Dissolved Silicon	30	60	51	264	240	9.5	720	660	8.7	408	357	13.3
Dissolved Silver	0.0018	0.003	0.00255	<0.0018	<0.0018	NA	0.0360	0.0366	-1.7	0.0337	0.0393	-15.4
Dissolved Strontium	0.018	0.030	0.0255	25.3	25.6	-1.4	7.02	7.50	-6.6	1.50	1.51	-1.0
Dissolved Tellurium	0.006	0.012	0.0102	<0.006	<0.006	NA	<0.012	<0.012	NA	<0.0102	<0.0102	NA
Dissolved Thallium	0.0006	0.0012	0.00102	0.0042	0.0042	0.0	0.014	0.015	-4.1	0.0087	0.0082	6.1
Dissolved Thorium	0.0018	0.003	0.00255	0.0108	0.0090	18.2	0.026	0.022	15.0	0.117	0.130	-10.3
Dissolved Tin	0.003	0.006	0.0051	<0.003	<0.003	NA	0.006	<0.006	NA	0.036	0.036	0.0
Dissolved Titanium	0.18	0.30	0.255	1.74	1.14	**41.7**	11.4	11.2	2.1	218	216	0.7
Dissolved Tungsten	0.003	0.006	0.0051	<0.003	<0.003	NA	0.006	0.012	**-66.7**	0.2295	0.2397	-4.3
Dissolved Uranium	0.0006	0.0012	0.00102	0.375	0.381	-1.6	1.29	1.38	-6.7	0.704	0.689	2.2
Dissolved Vanadium	0.06	0.12	0.102	0.30	0.24	22.2	2.58	2.76	-6.7	3.77	3.83	-1.3
Dissolved Zinc	0.03	0.06	0.051	2.33	2.21	5.5	7.98	7.68	3.8	3.83	3.77	1.3
Dissolved Zirconium	0.03	0.06	0.051	0.102	0.090	12.5	0.24	0.24	0.0	0.153	0.153	0.0
Dissolved Calcium	18	30	25.5	5442	5556	-2.1	1344	1242	7.9	428	454	-5.8
Dissolved Magnesium	18	30	25.5	348	330	5.3	456	462	-1.3	383	383	0.0
Dissolved Potassium	18	30	25.5	222	216	2.7	84	90	-6.9	168	163	3.1
Dissolved Sodium	18	30	25.5	24	18	**28.6**	<30	<30	NA	91.8	91.8	0.0
Dissolved Sulphur	3000	6000	5100	<3000	<3000	NA	<6000	<6000	NA	<5100	<5100	NA

Notes:

RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

Shaded RPDs exceed 25% (lab duplicates).

Bolded RPDs exceed 25%, but < 10 x MDL.

NA = RPDs have not been calculated for cases where one of the samples is below detection and the other is not and in cases where both are below detection.

Table 3-3. QA/QC data for periphyton, Meadowbank EAS 2010.

	Second Portage Lake			Second Portage Lake			Second Portage Lake		
	SP-AZI-1 22-Aug-10	**Lab Duplicate**	**RPD (%)**	**SP-BL-3 22-Aug-10**	**Lab Duplicate**	**RPD (%)**	**SP-DT-4 24-Aug-10**	**Lab Duplicate**	**RPD (%)**
Phytoplankton Density (cells/cm²)									
Cyanobacteria	580199	511413	13	345428	338699	2	720763	750670	-4
Chlorophyte	14954	26917	-57	0	0	0	14954	11963	22
Diatom	352905	340942	3	412719	399261	3	155517	149536	4
Total	**948057**	**879271**	**8**	**758147**	**737959**	**3**	**891234**	**912169**	**-2**
Phytoplankton Biomass (ug/cm²)									
Cyanobacteria	244.1	192.9	23	21.4	15.2	34	25.8	39.4	-42
Chlorophyte	85.7	154.3	-57	0	0	0	31.4	25.0	23
Diatom	304.3	298.3	2	131.6	123.5	6	86.5	99.7	-14
Total	**634.1**	**645.6**	**-2**	**153.0**	**138.6**	**10**	**143.6**	**164.0**	**-13**

Notes:

RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

Shaded RPDs exceed 25% (lab duplicates).

Table 3-4. Percent recovery of benthic invertebrate samples, Meadowbank EAS, 2010.

Station	Number of Organisms Recovered	Number of Organisms in Re-sort	Percent Recovery
SP-F1-2	68	68	100.0%
SP-N1-2	57	60	95.0%
TP-E2-1	79	84	94.0%
TP-E2-2	57	58	98.3%
TRB-2-5	21	23	91.3%
		Average % Recovery	95.7%

Notes: all 50 samples were sorted in their entirety.

3.2. Sediment Chemistry

Total metals concentrations (mg/kg dry weight), pH, moisture content, total organic carbon and particle size were measured in sediment from each EAS benthic community and/or toxicity testing sampling station during August 2010 (laboratory report attached as **Appendix C**). The purpose of collecting these data was to support the interpretation of the benthic invertebrate community and toxicity testing results reported in **Sections 3.6 and 3.3**, respectively; the purpose was not to assess changes in sediment chemistry related to dike construction, as that was done with an intensive coring program in 2009 that focused only on the top 1-2 cm (Azimuth, 2010b). The 2010 EAS results are described below for some context.

Chemistry results for 2010 are summarized in **Table 3-5**. Sediment was collected at depths ranging from 7.0–11.0 m. To ensure consistency and provide relevant information for benthic communities, sediment was collected synoptically with benthos samples. For this reason, sediment grain size was consistent among stations and was dominated by fine sediments (82–99% silt/clay).

Total organic carbon concentrations ranged from 2.9–6.7% dry weight over the study lakes (except for SP-TRB2 that was located inside the silt curtains adjacent to the dike, which had a TOC of 0.52%). These values are consistent with previous years data (Azimuth, 2010b; 2009b; 2008a, b) and are reasonably high for an oligotrophic system and illustrates the likely small amount of inorganic input into the lakes due to low sedimentation rate.

Sediment metals concentrations measured in each of the study lakes were compared against federal (CCME, 2002) ISQG and PEL sediment quality guidelines (**Table 3-5**) for those metals for which there are SQG guidelines. Note that exceedances of these guideline values does not necessarily imply that adverse effects have occurred or are expect to occur. These values are relatively conservative and do not reflect site-specific conditions, regional geochemistry or adaptations by benthic organisms to regional characteristics.

Arsenic, chromium and copper exceeded ISQGs in all samples in 2010, which was consistent with results from all previous years at all locations (Azimuth, 2010b; 2009b; 2008a, b). Arsenic exceeded the PEL at 8 of the 11 stations, while chromium exceeded the PEL in 7 of the 11 stations. Zinc exceeded the ISQGs at 5 stations, 4 of them in Second Portage Lake while cadmium twice exceeded the ISQG in Second Portage Lake only. Historical sediment chemistry data has shown similar metals exceedances (Azimuth, 2010b; 2009b; 2008a, b). Given that the 2009 and 2010 sediment chemistry data appear to be within the range of metals values seen in baseline data, the exceedances of federal sediment quality guidelines are not likely to indicate effects from dike construction; this will be explored more in **Section 3.3**.

Table 3-5. Conventional sediment chemistry and total metals (mg/kg), Meadowbank EAS 2010.

Lake & Basin			Second Portage Lake							Third Portage Lake			
Station ID	**Sediment Quality Guidelines (CCME 2002)[1]**		SP-DT	SP-F1	SP-F2	SP-N1	SP-N2	SP-N3	SP-TRB2	TP-E1	TP-E2	TP-E3	HVH-4
Date Sampled	**ISQG**	**PEL**	23-Aug-10	20-Aug-10	23-Aug-10	20-Aug-10	20-Aug-10	19-Aug-10	19-Aug-10	25-Aug-10	27-Aug-10	25-Aug-10	24-Aug-10
CONVENTIONAL PARAMETERS													
Physical & Organic Parameters													
pH	NG	NG	5.83	6.38	6.40	6.20	6.40	5.78	8.26	5.88	5.50	5.86	6.00
Total Organic Carbon	NG	NG	4.96	4.10	6.70	2.88	4.40	4.22	0.52	2.86	3.18	3.12	2.77
Particle Size													
% Gravel (>2mm)	NG	NG	*<0.10*	*<0.10*	*<0.10*	0.29	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	1.09
% Sand (2.0mm - 0.063mm)	NG	NG	5.83	7.31	2.73	17.3	2.98	1.95	0.68	2.59	3.66	3.34	2.89
% Silt (0.063mm - 4um)	NG	NG	67.9	66.1	73.5	61.0	69.6	70.8	80.7	64.1	63.3	70.1	48.4
% Clay (<4um)	NG	NG	26.3	26.5	23.8	21.4	27.5	27.2	18.6	33.3	33.0	26.5	47.6
TOTAL METALS (mg/kg dw)													
Aluminum	NG	NG	29400	25400	29900	22500	28100	27600	28000	25400	26200	26500	36100
Antimony	NG	NG	17	*<10*	*<10*	*<10*	*<10*	*<10*	*<10*	*<10*	*<10*	*<10*	*<10*
Arsenic	5.9	17.0	**59.2**	**50.2**	15.2	10.8	**35.5**	**104**	11.1	**23.2**	**32.4**	**24.6**	**26.6**
Barium	NG	NG	145	98.0	163	102	123	119	149	103	104	131	139
Beryllium	NG	NG	2.81	2.06	2.48	1.59	2.20	2.12	0.61	1.91	1.88	1.66	2.55
Cadmium	0.6	3.5	2.6	<0.50	0.8	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chromium	37.3	90.0	71.5	80.5	**91.2**	75.2	**95.5**	86.8	**156**	**111**	**97.9**	**115**	**119**
Cobalt	NG	NG	12.2	13.3	10.6	9.5	18.0	13.6	21.2	17.5	17.2	23.7	20.1
Copper	35.7	197	134	73.7	130	59.6	87.1	97.5	39.6	53.7	65.5	84.4	89.2
Lead	35.0	91.3	33	*<30*	*<30*	*<30*	*<30*	*<30*	*<30*	*<30*	*<30*	*<30*	33
Mercury	0.17	0.486	0.0392	0.0270	0.0290	0.0210	0.0274	0.0244	*<0.0050*	0.0102	0.0149	0.0235	0.0133
Molybdenum	NG	NG	13.4	9.0	6.2	*<4.0*	7.0	10.3	*<4.0*	5.2	7.3	5.7	7.2
Nickel	NG	NG	54.5	54.9	85.6	52.8	70.9	67.2	102	73.0	62.0	142	80.1
Selenium	NG	NG	*<2.0*	0.62	*<2.0*	*<2.0*	0.73	0.88	*<2.0*	0.70	*<2.0*	0.86	*<2.0*
Silver	NG	NG	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*	*<2.0*
Thallium	NG	NG	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Tin	NG	NG	*<5.0*	*<5.0*	*<5.0*	*<5.0*	*<5.0*	*<5.0*	*<5.0*	*<5.0*	*<5.0*	*<5.0*	*<5.0*
Uranium	NG	NG	26.2	17.6	25.9	14.5	18.7	22.2	3.12	16.7	19.0	15.4	27.9
Vanadium	NG	NG	40.4	40.6	45.1	37.3	44.3	43.1	54.7	42.3	42.8	43.4	57.7
Zinc	123	315	152	113	160	102	123	131	86.3	106	109	115	141

Notes:

NG = no guideline.

[1]CCME (Canadian Council of Ministers of the Environment) Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999, updated in 2002.

ISQG = Interim freshwater Sediment Quality Guideline, PEL = Probable Effect Level.

Shaded concentrations = or > ISQG.

Boxed, bold concentrations also > PEL.

Italicized numbers are below detection limits.

3.3. Sediment Metals Bioavailability

3.3.1. Toxicity

Sediment toxicity testing was conducted to assess the potential for adverse metals-related effects to the benthic community from exposure to the elevated metals reported in Second Portage Lake (Azimuth, 2009c; 2010b). The basic study design was a spatial "control-impact" design that involved comparisons of two "control" areas (i.e., reference areas not affected by the TSS events) and two "impact" areas (i.e., areas thought to have high deposition of sediments released during construction of the East Dike).

Reference areas are important to include as sediment conditions can vary substantially between field-collected samples and the sediment used as negative laboratory control. Physical factors are known to influence the performance of test organisms. **Table 3-6** includes a summary of grain size and organic carbon content for test samples and the laboratory controls; there is a substantial difference between test sediments and the control sediment.

Results for the amphipod (*Hyalella*) and midge (*Chironomus*) tests are summarized in **Table 3-6** (see **Appendix B** for full details). Decisions regarding the presence/absence of toxicity were made as follows:

- *Point of Comparison* – While laboratory control results were used as a point of comparison to estimate effect sizes, decisions regarding the presence/absence of toxicity were ultimately made using control-impact comparisons (i.e., comparing the results of SP-TRB2 and SP-N1 to the results of INUG and TEFF relative to the critical effect size discussed below). As described above, the reference sediments are considered a better comparator as they are much more similar from a physical perspective.
- *Critical Effect Size* – A change of 20% in an endpoint (in impact area sediment relative to reference [field control] sediments) was used to define an adverse effect. This value is commonly used to assess risks of contaminated sediment to aquatic organisms (e.g., Science Advisory Board, 2008).

While the comparisons of interest were between control and impact areas, it is relevant to point out that there were no statistically significant differences between the laboratory controls and any of the four samples for all four test endpoints. As for the comparisons between control and impact areas, none of the test endpoints showed any indication of elevated toxicity in impact areas relative to control areas. Consequently, the elevated metals found in these samples do not appear to be toxic. Given the bulk sediment results, which showed high metals concentrations relative to sediment quality guidelines (see

Table 3-5), the lack of toxicity observed in these tests suggests limited metals bioavailability in these sediments. This idea is tested in the following section.

3.3.2. Sequential Extraction Analyses

As a complement to the sediment toxicity testing, sequential extraction analysis was conducted on the same four sediment samples tested for toxicity. This geochemical analysis was used to determine in what form metals that are present in the sediment matrix are found. Raw data can be found in **Appendix D**.

As described in **Section 2.2.3.2**, sequential extraction analysis partitions the trace elements within each sample into four operationally defined fractions that have been related to the bioavailability and mobility of elements. Concentrations for key metals are plotted in **Figure 3-1** showing for each of the sample stations the amount partitioning into each fraction; or in other words, the availability of the particular metals a given sample sediment. The "residual" fraction shown for each sample station and each metal was estimated by subtracting the sum of the other 3 fractions from the total (totals as reported in **Section 3.2** and in the CREMP report for INUG and TEFF [Azimuth, 2011]). For comparison, the 2009 bulk sediment metals concentrations are shown in **Figure 3-1** at the top of each station bar and guidelines (ISQG & PEL) are also shown where available. It is clear from these plots that most of the metals are found in the "residual" fraction relative to the total and are thus unlikely to be bioavailable.

This result is also shown in **Table 3-7**, where total metals concentration measured in each sediment fraction is reported on a percentage basis along with physical attributes of the sediment samples. For all metals, the proportion of the total in the carbonate-bound and Fe/Mn-bound fractions (i.e, the most 'bioavailable') is relatively low for all stations. The highest percentage of metal is in the residual sediment fraction (shown in bold in **Table 3-7**), with little variation. Copper and beryllium were the only metals that have less than 50% in the residual fraction; all samples except SP-TRB2 have less than 50% copper in the residual fraction and TEFF (37%) and INUG (50%) have lower percentages of beryllium in the un-available fraction.

Comparing across stations, in most cases the reference areas (INUG and TEFF) actually have a somewhat greater proportion of available metals (e.g., all metals in **Table 3-7** in the carbonate-bound fraction except vanadium), although there is not much variability. Overall, most metals were predominantly associated with the residual fraction concentrations, so are unlikely to be bioavailable. This is consistent with the findings of the toxicity tests.

Table 3-6. Magnitude of effects for sediment toxicity testing, Meadowbank EAS 2010.

Sample Station Collection Date	**Control**	**SP-TRB2** 22-Aug-10	**SP-N1** 22-Aug-10	**INUG** 25-Aug-10	**TEFF** 27-Aug-10
Sediment attributes during testing					
% Total Organic Carbon	0.1	0.5	1.9	2.6	2.5
% Gravel (>2mm)	<0.01	<0.01	2.9	<0.01	<0.01
% Sand (2.0mm-0.053mm)	97.7	1.2	24.4	15.3	7.4
% Silt (0.053mm-2um)	<0.01	84.8	39.0	42.9	38.9
% Clay (<2um)	2.4	14.0	33.7	41.9	53.7
14-d *Hyalella azteca* survival and growth test					
Mean Survival (%) ± SD	*98 ± 4*	88 ± 13	90 ± 12	100 ± 0	88 ± 16
Effect Size		***-10%***	***-8.2%***	***2.0%***	***-10%***
Mean Dry Weight (mg) ± SD	*0.11 ± 0.02*	0.17 ± 0.03	0.11 ± 0.02	0.15 ± 0.04	0.11 ± 0.02
Effect Size		***55%***	***0%***	***36%***	***0%***
10-d *Chironomus tetans* survival and growth test					
Mean Survival (%) ± SD	*94 ± 9*	80 ± 10	94 ± 5	84 ± 15	88 ± 8
Effect Size		***-15%***	***0%***	***-11%***	***-6.4%***
Mean Dry Weight (mg) ± SD	*1.71 ± 0.35*	1.83 ± 0.29	2.08 ± 0.15	2.13 ± 0.42	1.86 ± 0.23
Effect Size		***7.0%***	***22%***	***25%***	***8.8%***

Notes:

Effect size calculated as (sample-control) / control.

Table 3-7. Sediment attributes and proportion of total metals concentration in each sediment fraction.

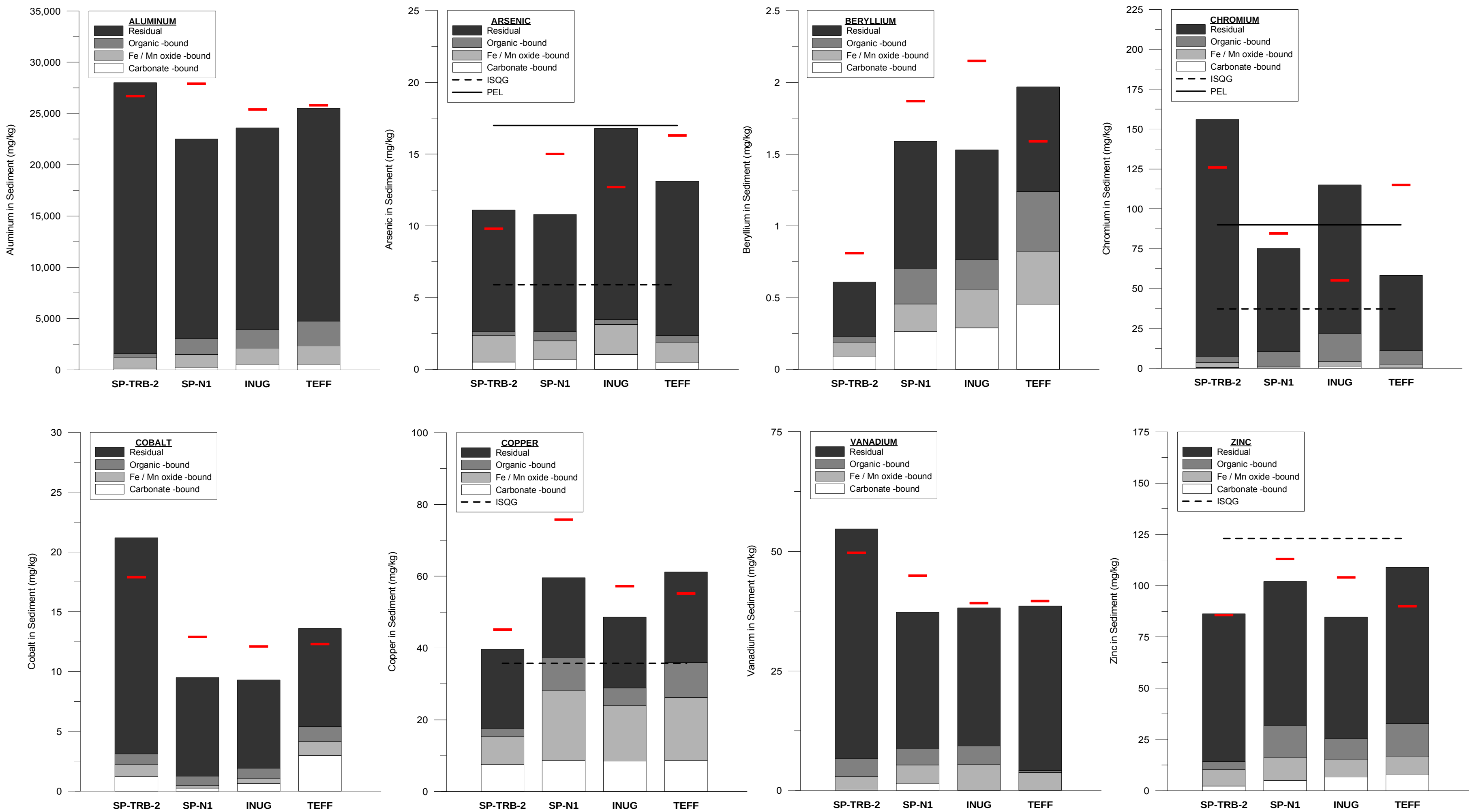
Sample Station		**SP-TRB2**	**SP-N1**	**INUG**	**TEFF**
Collection date		22-Aug-10	22-Aug-10	25-Aug-10	27-Aug-10
Sediment attributes					
% Total Organic Carbon		0.52	2.88	2.66	3.38
% Gravel (>2mm)		<0.10	0.29	<0.10	<0.10
% Sand (2.0mm-0.063mm)		0.68	17.3	13.4	5.80
% Silt (0.063mm-4um)		80.7	61.0	62.8	75.9
% Clay (<4um)		18.6	21.4	23.9	18.3
Fractions	**Metals**				
Carbonate-bound	Aluminum	0.6	0.9	2.0	1.9
	Arsenic	4.6	6.2	6.1	3.4
	Beryllium	14	17	19	23
	Chromium	0.4	0.3	0.8	0.6
	Cobalt	5.7	2.8	7.0	22
	Copper	19	14	17	14
	Vanadium	0.5	4.2	0.2	0.2
	Zinc	2.7	4.9	7.9	7.0
Fe / Mn oxide-bound	Aluminum	3.9	5.7	7.0	7.2
	Arsenic	17	12	13	11
	Beryllium	17	12	17	19
	Chromium	1.9	1.4	3.0	3.0
	Cobalt	4.9	2.5	4.2	8.6
	Copper	20	33	32	29
	Vanadium	4.7	10	14	10
	Zinc	9.2	11	10	8.0
Organic matter-bound / Sulphide-bound	Aluminum	1.3	7.1	7.7	10
	Arsenic	2.4	6.0	2.0	3.5
	Beryllium	6.7	15	14	21
	Chromium	2.4	12	15	16
	Cobalt	4.1	7.9	9.3	9.2
	Copper	5.2	16	10	16
	Vanadium	6.9	9.0	10	1.1
	Zinc	4.4	15	12	15
Residual*	Aluminum	**94**	**86**	**83**	**81**
	Arsenic	**76**	**76**	**79**	**82**
	Beryllium	**62**	**56**	**50**	**37**
	Chromium	**95**	**86**	**81**	**81**
	Cobalt	**85**	**87**	**79**	**60**
	Copper	**56**	**37**	**41**	**41**
	Vanadium	**88**	**77**	**76**	**89**
	Zinc	**84**	**69**	**70**	**70**

Notes:

bolded numbers indicate in which fraction the largest proportion of each metal is found, for each sample.

* the residual fraction was estimated by subtracting the sum of the other 3 fractions from the total.

Figure 3-1. Dissolved metals concentrations (mg/kg dw) detected in each of 4 fractions resulting from sequential extraction procedure (BCR 701).



Notes:

Red dashes above each bar indicate total concentration measured in 2009 bulk sediment grabs (Azimuth, 2010a, 2010c). Sediment quality guidelines are represented by either a dashed bar (ISQG) or solid black bar (PEL).

The residual fraction was estimated by subtracting the sum of the other three fractions from the total.

3.4. Sediment Traps

Trap retrieval rates were better than expected. Out of the 19 traps deployed over winter (2009–2010), 16 were successfully recovered, although one of those traps was not found until September. Out of the 19 traps re-deployed over summer (2010), 15 were successfully recovered. Sediment trap set locations are shown in **Figure 2-3** (winter 2009-2010) and **Figure 2-4** (summer 2010).

As noted in previous years, many traps contained more than just sediment (e.g., biota). Consequently, rather than just drying and weighing trap contents, as was done in 2008, 2009 and 2010 samples were also ashed (see **Section 2.3** for methods) to remove organic matter. All sedimentation estimates were made using the ash weights (i.e., non-organic content weight).

Results for sediment deposition rates and estimated deposition thickness are presented in **Tables 3-8 and 3-9** (lab reports in **Appendix E**). Sediment deposition was estimated based on wet weight density relative to tube diameter. Sediment deposition in the main body of Second Portage Lake appears to have decreased substantially in 2010 relative to 2008 (East Dike construction). For example, we estimated that 1.79 mm of sediment was deposited at SP-ST1 during the 2008 summer and a further 0.03 mm during the 2008-2009 winter (Azimuth, 2009b; 2010b). This past year, we estimated that only 0.57 mm was deposited in SP-ST1 during the 2009-2010 winter and a further 0.18 mm during the 2010 summer. This was not the case for the southern channel area, which receives water from Third Portage Lake (along with sediment inputs from Bay-Goose Dike construction). At SP-ST6, deposition thickness was estimated at 0.39 mm from September 2008 to September 2009; it was 1.23 mm from September 2009 to September 2010.

Sediment accumulation patterns in the east basin of Third Portage Lake were fairly consistent with TSS plumes related to construction patterns for Bay-Goose Dike. In 2009 summer, during the first season of Bay-Goose Dike construction, the sediment trap closest to the dike construction zone, BG-ST6 (right before discharge to Second Portage Lake), had the highest deposition rates (approximately 0.14 g wet/day) and accumulated 1.1 mm of sediment over the summer (Azimuth, 2010b). Most other traps (BG-ST1 through BG-ST5), however, accumulated much less sediment (~6–17 times less). Over winter 2009-2010 winter (i.e., when the causeway was being constructed and no turbidity barriers were in place), substantial sediment accumulation occurred at BG sediment traps, particularly at BG-ST3 (1.83 mm) and BG-ST6 (1.95 mm) (**Table 3-8**). In summer 2010 (i.e., when turbidity barriers were in place and work continued on the southern portion of the dike), 0.5 mm or less was deposited in BG sediment traps, whereas 0.50 to 0.73 mm of accumulation was observed in TPE-ST traps, particularly TPE-ST1 and TPE-ST3

(**Table 3-9**). However, accumulation was still quite low, at <1 mm for all summer 2010 sediment traps.

Sediment traps in Tehek Lake and Third Portage South accumulated very little sediment. In all cases (winter 2009-2010 and summer 2010) TE and TPS sediment traps had <0.3 mm accumulation (**Tables 3-8 and 3-9**).

Table 3-8. Sediment deposition rates and estimated accumulation for sediment traps, Second Portage, Third Portage, and Tehek Lakes, Winter 2009-2010.

Lake	Sediment Trap ID	UTM Location Easting	UTM Location Northing	Set date	Retrieval date[1]	Trap contents (g dry weight)	Trap contents[2] (g wet weight)	Set length (days)	Deposition Rate (g wet weight/day)	Accumulation[3] (mm)
Second Portage Lake	SP-ST1	14W 639661	7213999	15-Sep-09	18-Jul-10	0.8	5.3	306	0.017	0.57
	SP-ST6	14W 640072	7212805	15-Sep-09	17-Jul-10	0.5	3.3	305	0.011	0.35
	SP-ST7	15W 358781	7213838	12-Sep-09	18-Jul-10	0.2	1.0	309	0.003	0.11
	SP-ST8	14W 639687	7213350	15-Sep-09	17-Jul-10	0.7	5.0	305	0.016	0.54
Third Portage Lake	BG-ST1	14W 638706	7211757	13-Sep-09	16-Jul-10	1.5	9.8	306	0.032	1.05
	BG-ST2	14W 638974	7211821	13-Sep-09	16-Jul-10	0.8	5.3	306	0.017	0.57
	BG-ST3	14W 639538	7211819	13-Sep-09	27-Jul-10	2.2	14.9	317	0.047	1.83
	BG-ST4	14W 639521	7212410	13-Sep-09	NA	-	-	-	-	-
	BG-ST5	14W 639012	7211252	13-Sep-09	27-Jul-10	1.2	7.7	317	0.024	0.83
	BG-ST6	14W 639343	7213331	16-Sep-09	23-Jul-10	2.7	18.1	310	0.058	1.95
	TPE-ST1	14W 637796	7211593	23-Sep-09	23-Jul-10	2.5	16.4	303	0.054	1.76
	TPE-ST2[4]	14W 639014	7210490	23-Sep-09	24-Sep-10	1.3	8.9	366	0.024	0.95
	TPE-ST3	14W 638166	7210188	23-Sep-09	NA	-	-	-	-	-
	TPE-ST4	14W 637352	7209098	23-Sep-09	NA	-	-	-	-	-
	TPS-ST1	14W 635729	7208657	13-Sep-09	18-Jul-10	0.2	1.5	308	0.005	0.18
	TPS-ST2	14W 634334	7210449	13-Sep-09	23-Jul-10	0.4	2.5	313	0.008	0.31
Tehek Lake	TE-ST1	15W 359929	7212109	17-Sep-09	20-Jul-10	0.4	2.8	306	0.009	0.30
	TE-ST4	15W 362003	7210391	17-Sep-09	20-Jul-10	0.7	4.8	306	0.016	0.52
	TE-ST5	15W 363218	7208193	17-Sep-09	20-Jul-10	0.3	1.8	306	0.006	0.20

Notes:

[1] NA = not retrieved successfully

[2] Assumes 85% moisture content

[3] Assumes mean material density of 2 g/cm^3

[4] Sediment trap TPE-ST2 was not retrieved until September 2010

Table 3-9. Sediment deposition rates and estimated accumulation for sediment traps, Second Portage, Third Portage, and Tehek Lakes, Summer 2010.

Lake	Sediment Trap ID	UTM Location Easting[1]	UTM Location Northing	Set date	Retrieval date[1]	Trap contents (g dry weight)	Trap contents[2] (g wet weight)	Set length (days)	Deposition Rate (g wet weight/day)	Accumulation[3] (mm)
Second Portage Lake	SP-ST1	14W 639651	7213991	23-Jul-10	23-Sep-10	0.2	1.7	62	0.027	0.18
	SP-ST6	14W 640077	7212803	23-Jul-10	23-Sep-10	1.2	8.2	62	0.133	0.88
	SP-ST7	15W 358779	7213871	23-Jul-10	23-Sep-10	0.1	0.7	62	0.012	0.05
	SP-ST8	14W 639677	7213354	23-Jul-10	NA	-	-	-	-	-
Third Portage Lake	BG-ST1	14W 638428	7211601	19-Jul-10	NA	-	-	-	-	-
	BG-ST2	14W 639011	7211788	19-Jul-10	18-Sep-10	0.7	4.8	61	0.079	0.52
	BG-ST3	14W 639488	7211998	19-Jul-10	NA	-	-	-	-	-
	BG-ST4	14W 639517	7212414	19-Jul-10	20-Sep-10	0.7	4.5	63	0.071	0.48
	BG-ST5	14W 639011	7211235	19-Jul-10	NA	-	-	-	-	-
	BG-ST6	14W 639343	7213331	19-Jul-10	20-Sep-10	0.7	4.8	63	0.076	0.51
	TPE-ST1	14W 637802	7211607	19-Jul-10	20-Sep-10	1.0	6.8	63	0.108	0.73
	TPE-ST2	14W 639043	7210495	19-Jul-10	20-Sep-10	0.7	4.6	63	0.073	0.50
	TPE-ST3	14W 637953	7210229	19-Jul-10	20-Sep-10	1.6	10.5	63	0.166	0.65
	TPE-ST4	14W 637344	7209104	19-Jul-10	24-Sep-10	0.7	5.0	67	0.074	0.53
	TPS-ST1	14W 635726	7208651	23-Jul-10	17-Sep-10	0.5	3.2	56	0.056	0.34
	TPS-ST2	14W 634347	7201444	23-Jul-10	17-Sep-10	0.2	1.1	56	0.020	0.07
Tehek Lake	TE-ST1	15W 359935	7212097	20-Jul-10	21-Sep-10	0.4	2.4	63	0.039	0.26
	TE-ST4	15W 361998	7210374	20-Jul-10	21-Sep-10	0.5	3.4	63	0.054	0.21
	TE-ST5	15W 363218	7208181	20-Jul-10	21-Sep-10	0.5	3.1	63	0.049	0.19

Notes:

[1] NA = not retrieved successfully

[2] Assumes 85% moisture content

[3] Assumes mean material density of 2 g/cm^3

3.5. Periphyton Community

Periphyton are unicellular and colonial aquatic algae species attached to and coating rocks and other hard substrates beneath the water surface (i.e. the epithelial layer). Periphyton provide an important food source for certain benthic invertebrate species and together with phytoplankton and benthic algae form the base of the food web. Periphyton are most abundant between the surface and several meters water depth, and typically increase in biomass during the course of the open water season, reaching maximum abundance during late summer, and decline during late fall and winter, as light diminishes.

Species composition and biomass of periphyton are indirect indicators of lake productivity, reflecting nutrient concentrations in the lake, and are sometimes indicators of the presence of physical or chemical stressors. As described in **Section 1.2**, follow-up studies on the periphyton community were conducted in 2010 to better understand the spatial extent of adverse effects identified last year close to the East Dike (Azimuth, 2010b). These focused on repeating the quantitative analyses conducted last year (i.e., periphyton biomass and the relative amount of sediment in the periphyton mat), but at more stations to provide better resolution. This provided a temporal perspective to complement the increased spatial resolution.

It should be noted that estimates of periphyton biomass are inherently variable due to many factors including small surface area sampled, nutrient availability, grazing pressure, substrate type, sun aspect, wave action and others. Variability was minimized to some extent by attempting to choose rocks that were not overly dense or bare, with similar apparent sun exposure and aspect (i.e., angle towards the sun), water depth and substrate type. Although we tried to select rocks with similar characteristics (e.g., depths, aspects and coverage by periphyton), this can only limit variability to a limited extent and some differences between stations may be due to these factors. Furthermore, while “flat”, “smooth” rocks were targeted, it was impossible to achieve total uniformity within and among stations. Nevertheless, this technique is useful for detecting gross differences or changes in periphyton community, especially during colonization of new habitats or substrates (e.g., Azimuth, 2010d). Given this inherent variation, it may be difficult to discern between sampling bias and real effects. Consequently, while results are presented in absolute terms of density or biomass, the relative composition of the periphyton community is probably the most robust metric to characterize results and is thus presented in this manner also.

A total of 64 periphyton taxa were identified at the 6 sampling stations in Second Portage Lake, represented by 5 major taxonomic groups. This is a slight increase over 2009 results where 61 genera/species represented by 3 major taxonomic groups were identified (Azimuth 2010b).

Both in terms of density and biomass, the periphyton community was co-dominated by cyanophytes and diatoms, with chlorophytes making up the remaining minority (**Figure 3-2**). Chrysophytes and dinoflagellates (pelagic) were found in very low numbers (a single individual in a single sample at a single station). A matrix of the periphyton species presence/absence at each sampling station is presented in **Appendix F**.

As expected, total periphyton density was quite variable both within and among stations and ranged from 294,959 cells/cm^2 at SP-ISLA to 1.43 million cells/cm^2 at SP-DT (**Table 3-10**). Cyanophytes comprised 69% of the total periphyton density at all stations, and diatoms had the next highest density at only 30% (**Table 3-10**).

While biomass (µg/cm^2) is a more ecologically important metric than density, it is subject to limitations described above. Like density, total biomass per sample was also variable and ranged from 102 - 634 µg/cm^2, with diatoms (56%) and cyanophytes (29%) making up the majority of the mean station biomass (**Table 3-11**). Despite the differences in biomass and density, periphyton species richness was fairly similar among stations, ranging from 14 to 21 (**Table 3-11**). Simpson's diversity did not differ much among stations and ranged from 0.64 to 0.82, with an average of 0.74 (**Table 3-11**).

As shown in **Table 3-11** and **Figure 3-3,** total station biomass tended to increase with distance from the East Dike (i.e., along the gradient of decreasing exposure to TSS in 2008 from construction of the East Dike), with biomass at SP-BL (148 µg/cm^2) adjacent to the dike, being substantially lower than all other 2010 stations. This was the finding in 2009 as well, where SP-BL had significantly lower periphyton biomass than the other 2009 stations, including notably less chlorophyte biomass (Azimuth 2010b). Comparing the 2009 and 2010 data, all three stations (SP-BL, SP-CREMP, SP-DT) had significantly lower biomass in 2010 than 2009 (**Figure 3-4**; see **Appendix A** for results of statistical comparisons). This suggests, similar to the benthic invertebrate results (**see Section 3.6**), that there was a natural regional (or at least lake-wide) trend of suboptimal conditions for periphyton productivity that was unrelated to TSS effects. This needs to be taken into consideration when looking at the results for new stations as they all would have likely had higher biomass in 2009 relative to what was found in 2010. Overall, the biomass results suggest that adverse effects were limited to SP-BL where greatest sedimentation occurred.

The second part of the study quantified the inorganic sediment content of the periphyton mat at each location (based on loss-on-ignition analyses) which is assumed to be directly related to the magnitude of settling of suspended solids from the water column. LOI analysis was conducted on periphyton samples to determine the ratio of inorganic (sediment) to organic content. Results are presented in **Table 3-12** and raw data can be viewed in **Appendix G.** Generally, the amount of sediment accumulation in the periphyton mat decreased as distance from the dike increased. In both 2009 and 2010, sediment content in samples related to periphyton biomass, with sediment content decreasing as periphyton biomass increased (**Figure 3-4**). In general, this relationship can likely be attributed to dike construction sedimentation as it would be expected that sediment levels would be greatest at areas closest to the construction. Heavier sediment, such as sand and coarse silt particles will settle out more quickly and in closer proximity to the source. Fine silt and clay particles were distributed throughout the lake and will settle more evenly in the lake and most of it, not until an ice cover had developed, which prevents re-circulation and suspension of the sediment particles by horizontal and vertical wind-driven currents. However, given that the major sediment release event occurred in 2008, it is difficult to explain the significantly elevated mat sediment content observed at SP-BL in 2010 relative to 2009. This result is probably due to local spatial heterogeneity. As stated earlier in this section, there are a multitude of factors that contribute to this medium being inherently variable. Despite best efforts to collect samples of specific characteristics (again, see above text in this section), there is considerable variation in the absolute sediment content between each SP-BL replicate in both 2009 and 2010.

Based on available literature, periphyton communities should be fairly resilient to disturbances such as the elevated TSS associated with dike construction. Sedimentation has been shown to affect the periphyton growth (Yamada and Nakamura, 2002). Izagirre et al. (2009) assessed the effects of pulse sediment deposition on periphyton, and found that within 2 weeks of the event, periphyton almost fully recovered in terms of chlorophyll-α content, but failed to regain community composition within the same time frame. These data suggest that impacts to periphyton productivity will not likely be persistent. While the community at SP-BL appeared worse off in 2010 than it did in 2009, this observation is partly due to local heterogeneity and the regional (or lake-wide) trend of lower periphyton biomass in general. In actuality, the SP-BL community decreased proportionately less (27%) between 2009 and 2010 than did SP-CREMP (51%) or SP-DT (30%), which may indicate some recovery. However, the results were not statistically significant (see **Appendix A**).

Table 3-10. Seasonal density (cells/cm^2) of major periphyton groups, Meadowbank EAS 2010.

Station	Date	Phytoplankton Density (cells/cm^2)					
		Cyanobacteria	Chlorophyte	Chrysophyte	Diatom	Dinoflagellate	Total
SP-BL-1	22-Aug-10	239257	0	0	436645	0	675902
SP-BL-2	22-Aug-10	481505	2991	0	496459	0	980955
SP-BL-3	22-Aug-10	345428	0	0	412719	0	758147
SP-BL-4	22-Aug-10	174316	0	0	430663	0	604979
SP-BL-5	22-Aug-10	190658	0	0	372344	0	563002
	station mean	***286233***	***598***	***0***	***429766***	***0***	***716597***
	as %	***40%***	***0%***	***0%***	***60%***	***0%***	
SP-GSM-1	22-Aug-10	915159	13458	0	260192	0	1188810
SP-GSM-2	22-Aug-10	724950	21533	14355	376830	0	1137669
SP-GSM-3	22-Aug-10	852354	8972	0	358886	0	1220213
SP-GSM-4	22-Aug-10	493468	8972	0	195144	0	697585
SP-GSM-5	22-Aug-10	354400	11215	0	139068	0	504684
	station mean	***668066***	***12830***	***2871***	***266024***	***0***	***949792***
	as %	***70%***	***1%***	***0%***	***28%***	***0%***	
SP-AZI-1	22-Aug-10	580199	14954	0	352905	0	948057
SP-AZI-2	22-Aug-10	376830	15951	0	303059	0	695840
SP-AZI-3	22-Aug-10	287109	17944	0	311035	0	616088
SP-AZI-4	22-Aug-10	520385	17944	0	155517	0	693846
SP-AZI-5	22-Aug-10	287109	42618	0	293838	0	623565
	station mean	***410326***	***21882***	***0***	***283271***	***0***	***715479***
	as %	***57%***	***3%***	***0%***	***40%***	***0%***	
SP-ISLA-1	21-Aug-10	857738	3589	0	165088	0	1026414
SP-ISLA-2	21-Aug-10	613695	0	0	226098	0	839793
SP-ISLA-3	21-Aug-10	531600	6729	0	213089	0	751418
SP-ISLA-4	21-Aug-10	385803	6729	0	159256	0	551787
SP-ISLA-5	21-Aug-10	170471	7851	0	116638	0	294959
	station mean	***511861***	***4980***	***0***	***176034***	***0***	***692874***
	as %	***74%***	***1%***	***0%***	***25%***	***0%***	
SP-CREMP-1	23-Aug-10	1073069	21533	0	254809	3589	1353000
SP-CREMP-2	23-Aug-10	888243	0	0	191406	0	1079649
SP-CREMP-3	23-Aug-10	882860	10767	0	276342	0	1169968
SP-CREMP-4	23-Aug-10	720336	0	0	151245	0	871580
SP-CREMP-5	23-Aug-10	741698	29907	0	101684	0	873289
	station mean	***861241***	***12441***	***0***	***195097***	***718***	***1069497***
	as %	***81%***	***1%***	***0%***	***18%***	***0%***	
SP-DT-1	23-Aug-10	1143949	0	0	287109	0	1431058
SP-DT-2	23-Aug-10	968992	26917	0	130096	0	1126005
SP-DT-3	24-Aug-10	815184	20508	0	156372	0	992064
SP-DT-4	24-Aug-10	720763	14954	0	155517	0	891234
SP-DT-5	24-Aug-10	674193	25635	0	274292	0	974119
	station mean	***864616***	***17603***	***0***	***200677***	***0***	***1082896***
	as %	***80%***	***2%***	***0%***	***19%***	***0%***	
Relative Abundance (%)		***59***	***1***	***0***	***26***	***0***	

Table 3-11. Seasonal density (cells/cm²) of major periphyton groups, Meadowbank EAS 2010.

Station	Date	Phytoplankton Density (cells/cm²)					
		Cyanobacteria	Chlorophyte	Chrysophyte	Diatom	Dinoflagellate	Total
SP-BL-1	22-Aug-10	239257	0	0	436645	0	675902
SP-BL-2	22-Aug-10	481505	2991	0	496459	0	980955
SP-BL-3	22-Aug-10	345428	0	0	412719	0	758147
SP-BL-4	22-Aug-10	174316	0	0	430663	0	604979
SP-BL-5	22-Aug-10	190658	0	0	372344	0	563002
	station mean	***286233***	***598***	***0***	***429766***	***0***	***716597***
	as %	***40%***	***0%***	***0%***	***60%***	***0%***	
SP-GSM-1	22-Aug-10	915159	13458	0	260192	0	1188810
SP-GSM-2	22-Aug-10	724950	21533	14355	376830	0	1137669
SP-GSM-3	22-Aug-10	852354	8972	0	358886	0	1220213
SP-GSM-4	22-Aug-10	493468	8972	0	195144	0	697585
SP-GSM-5	22-Aug-10	354400	11215	0	139068	0	504684
	station mean	***668066***	***12830***	***2871***	***266024***	***0***	***949792***
	as %	***70%***	***1%***	***0%***	***28%***	***0%***	
SP-AZI-1	22-Aug-10	580199	14954	0	352905	0	948057
SP-AZI-2	22-Aug-10	376830	15951	0	303059	0	695840
SP-AZI-3	22-Aug-10	287109	17944	0	311035	0	616088
SP-AZI-4	22-Aug-10	520385	17944	0	155517	0	693846
SP-AZI-5	22-Aug-10	287109	42618	0	293838	0	623565
	station mean	***410326***	***21882***	***0***	***283271***	***0***	***715479***
	as %	***57%***	***3%***	***0%***	***40%***	***0%***	
SP-ISLA-1	21-Aug-10	857738	3589	0	165088	0	1026414
SP-ISLA-2	21-Aug-10	613695	0	0	226098	0	839793
SP-ISLA-3	21-Aug-10	531600	6729	0	213089	0	751418
SP-ISLA-4	21-Aug-10	385803	6729	0	159256	0	551787
SP-ISLA-5	21-Aug-10	170471	7851	0	116638	0	294959
	station mean	***511861***	***4980***	***0***	***176034***	***0***	***692874***
	as %	***74%***	***1%***	***0%***	***25%***	***0%***	
SP-CREMP-1	23-Aug-10	1073069	21533	0	254809	3589	1353000
SP-CREMP-2	23-Aug-10	888243	0	0	191406	0	1079649
SP-CREMP-3	23-Aug-10	882860	10767	0	276342	0	1169968
SP-CREMP-4	23-Aug-10	720336	0	0	151245	0	871580
SP-CREMP-5	23-Aug-10	741698	29907	0	101684	0	873289
	station mean	***861241***	***12441***	***0***	***195097***	***718***	***1069497***
	as %	***81%***	***1%***	***0%***	***18%***	***0%***	
SP-DT-1	23-Aug-10	1143949	0	0	287109	0	1431058
SP-DT-2	23-Aug-10	968992	26917	0	130096	0	1126005
SP-DT-3	24-Aug-10	815184	20508	0	156372	0	992064
SP-DT-4	24-Aug-10	720763	14954	0	155517	0	891234
SP-DT-5	24-Aug-10	674193	25635	0	274292	0	974119
	station mean	***864616***	***17603***	***0***	***200677***	***0***	***1082896***
	as %	***80%***	***2%***	***0%***	***19%***	***0%***	
Relative Abundance (%)		***59***	***1***	***0***	***26***	***0***	

Table 3-12. Weights and content ratio of periphyton samples collected for loss on ignition (LOI) analysis.

Station	n	Sample Weight (g)			Ratio (sediment:organic)
		Sediment	Organic	Total	
SP-BL	5	1.90	0.12	2.01	16.5:1
SP-GSM	5	0.69	0.12	0.81	5.7:1
SP-AZI	5	0.43	0.09	0.51	5.0:1
SP-ISLA	5	0.75	0.10	0.84	7.8:1
SP-CREMP	5	0.39	0.16	0.56	2.4:1
SP-DT	5	0.17	0.16	0.33	1.1:1

Figure 3-2. Relative periphyton biomass (top) (µg/cm^2) and density (bottom) (cells/cm^2) in Second Portage Lake.

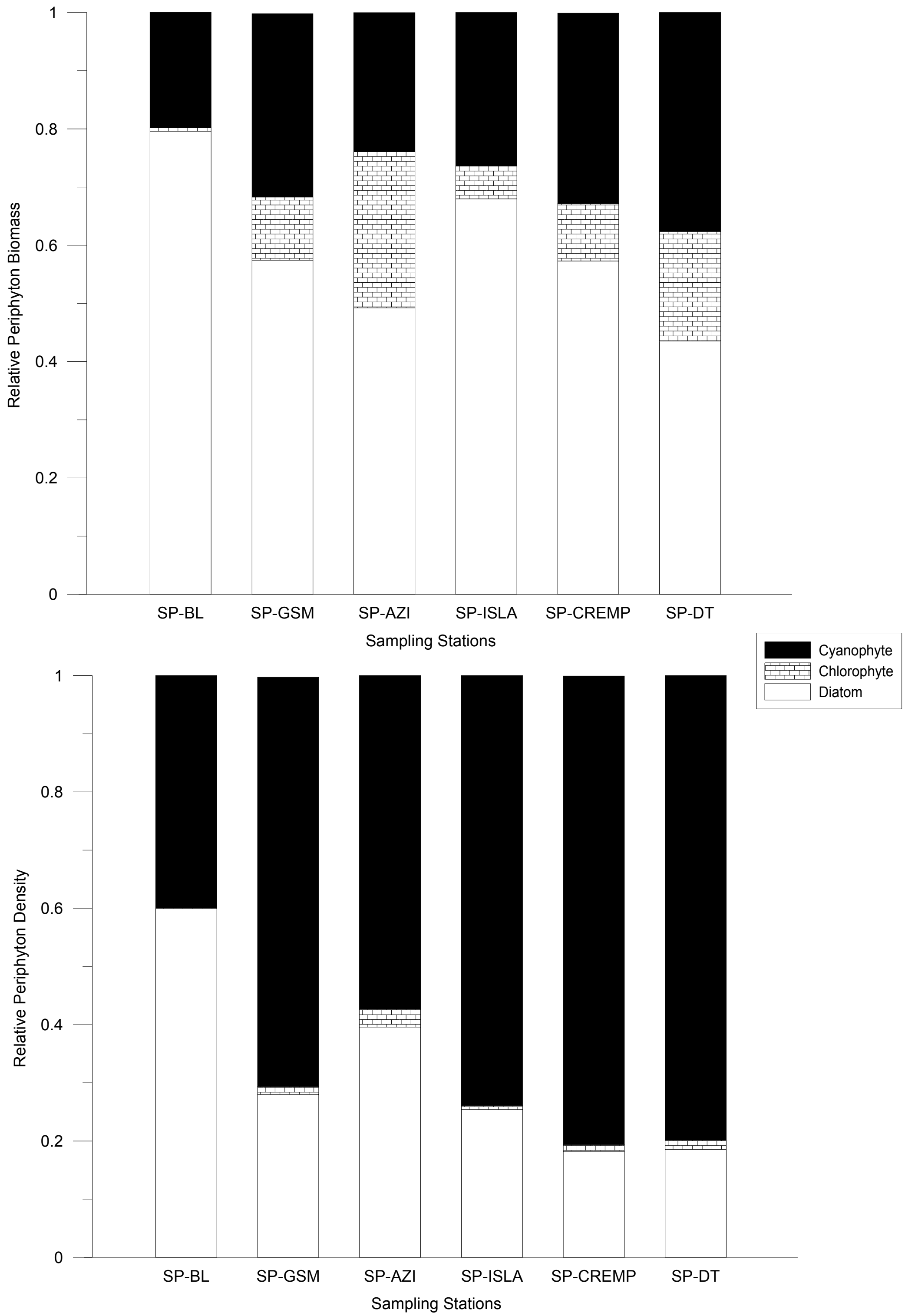


Figure 3-3. Historical and 2010 periphyton community biomass in Second Portage Lake.

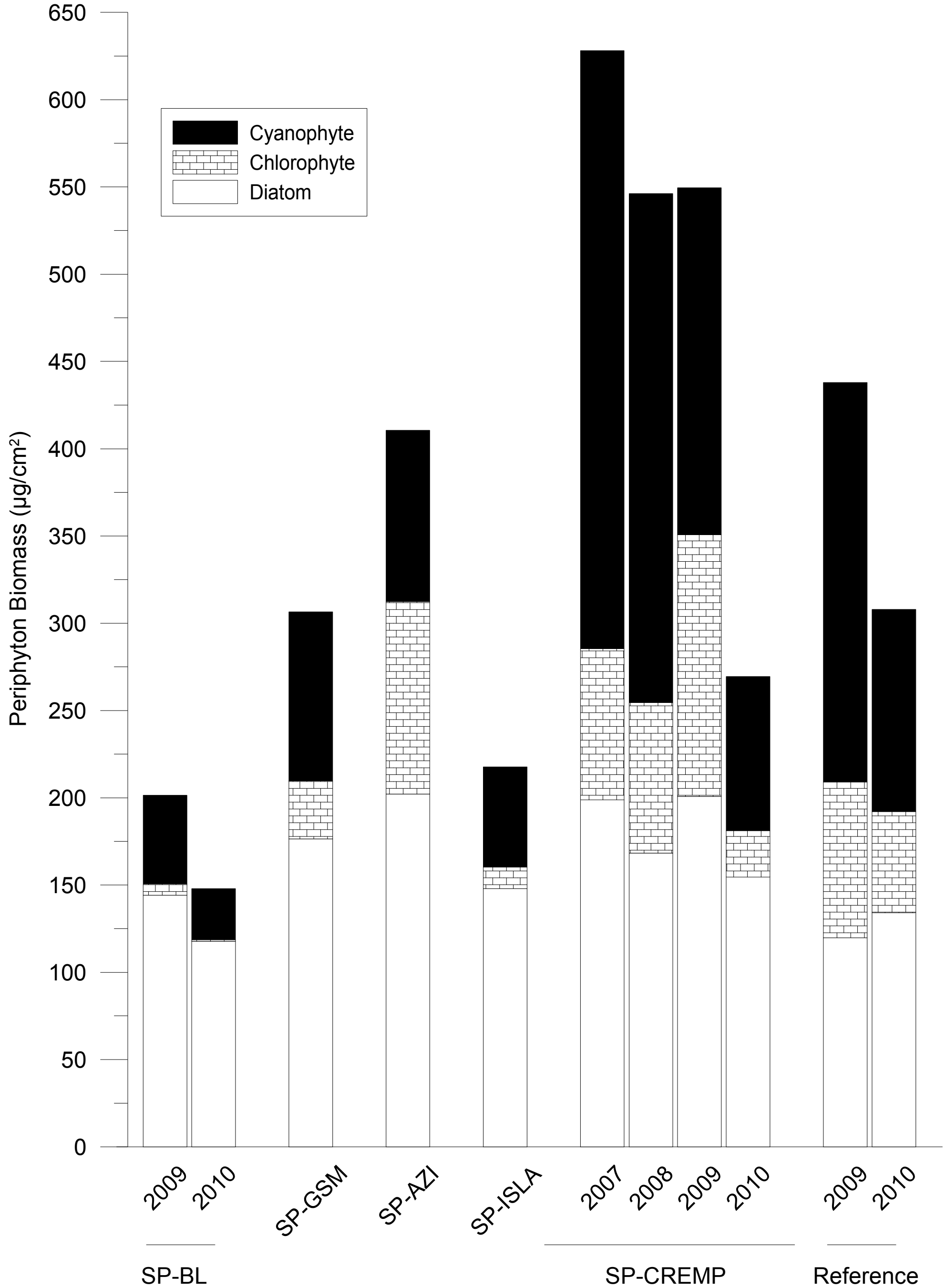
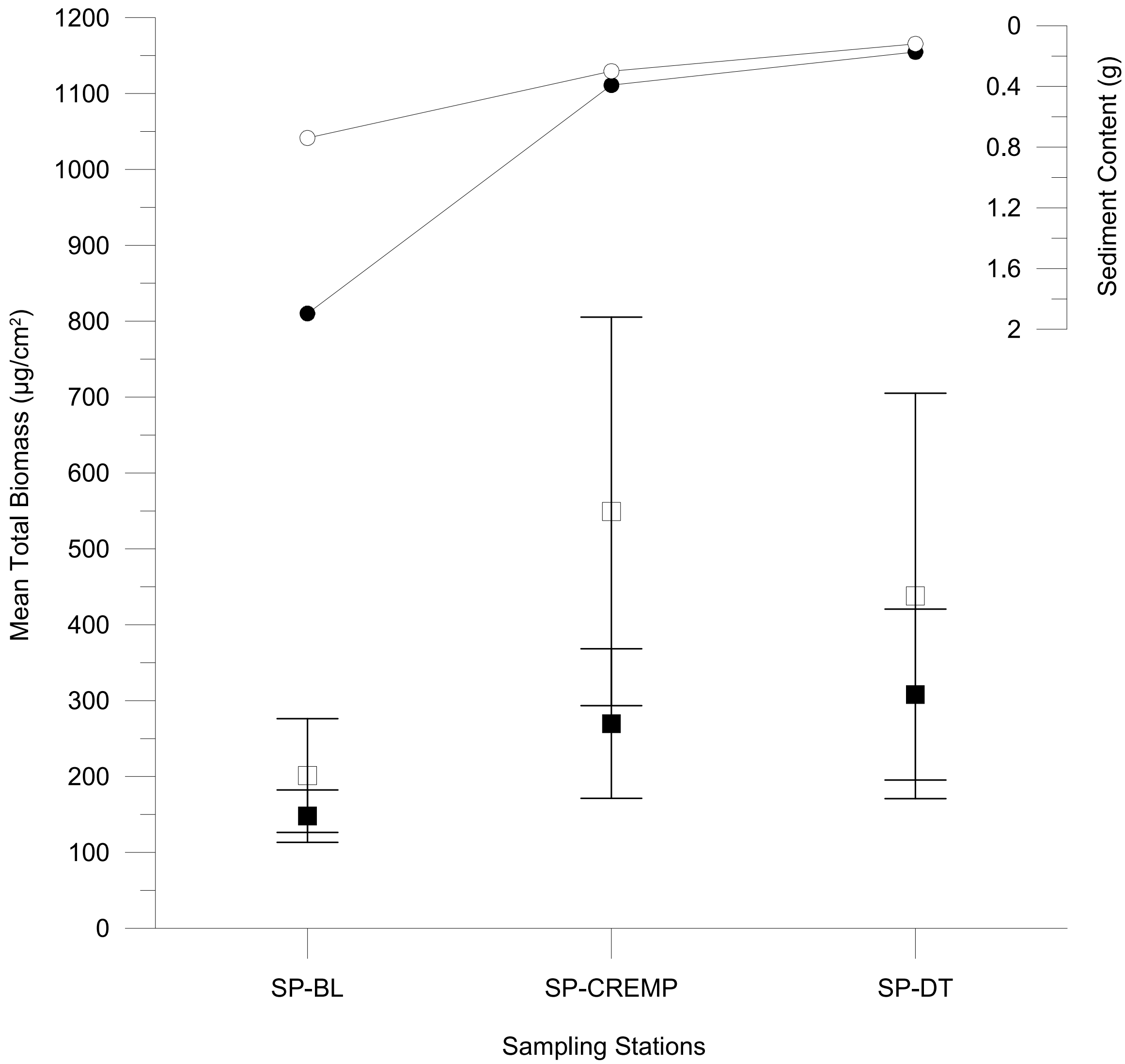


Figure 3-4. Mean total periphyton biomass (µg/cm^2, squares) and sediment content (g, circles) from loss on ignition analysis for 2009 (open) and 2010 (filled).



Error bars depict standard deviation.

3.6. Benthic Invertebrates

This section summarizes results of the CREMP and EAS benthic invertebrate community studies to provide insights into the potential for adverse effects from TSS related to dike construction.

The following provides an overview of basic study design information for each component:

- *Benthic Community Structure Drivers* – The available data sets (i.e., CREMP and EAS, for 2009 and 2010) were combined to help identify key factors in driving benthic community structure. It is well known that physical (e.g., depth, grain size, organic carbon content) and chemical (e.g., metals concentrations) factors can play a significant role in structuring the benthic community. This portion of the study looked at the relative importance of these natural factors and of total suspended solids (TSS; as a surrogate for construction-related sedimentation) using a linear regression approach. Details regarding the statistical analyses are provided in **Appendix A**.
- *CREMP Benthic Invertebrates* – CREMP monitoring has been conducted since 2006 at a number of lakes surrounding the Meadowbank Mine. As such, it includes pre-development baseline data and thus provides context regarding spatial and temporal variability in the benthic community. The data set has been used to complement the finer-resolution EAS data sets to aid in the interpretation of the EAS results. The CREMP areas relevant to this year's EAS are shown in **Figure 2-6**[3]. The potential for mining-related impacts in each sampling area has been tracked annually since the construction phase of the development started in 2008. The status of specific areas over time is shown in **Table 3-13**. This data set was used to test for specific area-year impacts relative to control area-years and for specific longer-term impacts by area (i.e., for areas where more subtle, but prolonged, effects may have occurred). Details on statistical analyses are provided in **Appendix A**.
- *East Dike EAS Benthic Invertebrates* – This is the second of a two-year benthic community monitoring program targeting the potential effects of sedimentation on the benthic community related to construction of the East Dike. A before-after-control-impact (BACI) approach was used to look for two types of differences:

[3] The Baker Lake areas and Wally Lake were not included. Baker Lake benthos and sediment chemistry is quite different from the Meadowbank project lakes. Wally, which is one of the Meadowbank project lakes, was not included as it is inherently different (e.g., shallow, high TOC and more productive) than the other project lakes.

spatial differences between control and impact areas, and spatial-temporal differences (e.g., determining the presence of a recovery signal among impact areas relative to control areas). This program is complementary to the broader-focused CREMP (see next bullet) in that the intent of this component was to provide higher spatial-resolution information (i.e., spatial extent of effects within Second Portage Lake). However, similar to last year, the East Dike EAS data set was also expanded to include relevant CREMP areas. Not only does the CREMP addition increase the power of the statistical analyses, but it also serves to facilitate data interpretation over time from discrete locations (e.g., since temporal and spatial trends are better characterized in the CREMP). The expanded data set includes six control areas (two from the EAS [SP-DT, TP-E3] and four from the CREMP [INUG, PDL, TPS, TEFF]) and six impact areas (four from the EAS [SP-N1, SP-N3, SP-F1, SP-F2) and two from the CREMP [SP and TE]) (see **Figure 2-6** for CREMP areas and **Figure 2-7** for East Dike EAS areas). The availability of two years of data allowed us to test for evidence of a recovery at impact areas in 2010. Details regarding the statistical analyses are provided in **Appendix A**.

- *Bay-Goose Dike EAS Benthic Invertebrates* – This was the first of a two-year post-construction benthic community monitoring program targeting the potential effects of sedimentation on the benthic community related to Bay-Goose Dike construction in 2009 and 2010. The data set consists entirely of "after" data for a single year (2010). Consequently, a control-impact (CI) approach was used to detect for spatial differences between control and impact areas. Similar to the East Dike EAS data set, the Bay-Goose Dike data set was expanded to include relevant CREMP areas. The expanded data set includes six control areas (two from the EAS [SP-DT, TP-E3] and four from the CREMP [INUG, PDL, TPS, TEFF]) and six impact areas (three from the EAS [TP-E1, TP-E2, TP-HVH4) and three from the CREMP [SP, TE and TPE]; see **Figure 2-6** for CREMP areas and **Figure 2-8** for Bay-Goose EAS areas). Details regarding the statistical analyses are provided in **Appendix A**.

Response variables for all benthic community analyses were selected to match the requirements of Environment Canada (2002), as follows (see **Section 2.5** for details regarding each variable):

- Total abundance (#/m^2; this is actually density) of all taxa
- Total species richness (# taxa/sample)
- Simpson's diversity (D)

- Bray Curtis Distance (BC)[4]

3.6.1. Benthic Community Structure Drivers

Benthic invertebrate communities are known to be strongly influenced by physical (e.g., grain size, total organic carbon [TOC] and depth) and chemical parameters (e.g., aluminum, arsenic, cadmium, chromium, copper, and zinc were selected as they typically exceeded CCME sediment quality criteria and/or they have been singled out in previous EAS studies). While the studies were designed to minimize differences in these factors (i.e., by selecting areas with similar sediment characteristics and depth), formal comparisons were made between each response variable (means for each area/year combination) and a number of physical and chemical variables (typically sampled once per area/year) to determine the extent to which the latter were important in shaping the former.

This analysis looked at all 2009 and 2010 data (CREMP and EAS) where benthic invertebrate samples were collected synoptically with sediment chemistry. There were a total of 33 cases (see **Appendix A** for summaries of chemistry/physical [**Table A3-12**] and benthic [**Tables A3-2, A3-8 and A3-10**] data). The results of linear regression (i.e., predicted fit plus/minus 95% confidence intervals) are shown in **Figures 3-5 to 3-7**. Given that 44 relationships were tested (four benthic community metrics x 11 physical/chemical variables), a Bonferroni correction was made to the critical p-value (0.05/44 = 0.001) to properly set the Type 1 (i.e., "false positive") error rate. Given the large number of comparisons (44), simple odds dictate that 2 of 40 comparisons would be deemed significant due to chance. (i.e., with $\alpha = 0.05$ there is a 5% chance that a result will be statistically significant based on chance alone). None of the relationships in **Figures 3-5** to **3-7** had p-values within an order of magnitude of 0.001, so none were considered statistically significant. With a sample size of 33, strong relationships should easily have p-values less than 0.001. Furthermore, only one of the 44 relationships had a $p<0.05$ ($p=0.02$ for a negative relationship between Simpson's diversity and depth). Thus, none of the physical or chemical factors we examined showed strong negative relationships with the four benthic community metrics.

The results above indicate that general physical and chemical differences among area/year combinations were unlikely to be responsible for any observed trends (see following sections) in benthic community metrics. For the physical factors, this also

[4] Bray-Curtis is essentially an index of dissimilarity and the distance is based on comparison to reference (control) areas). It should be noted that large distances can be based on compositional differences between areas that are not related to impairment of the community. Consequently, caution must be used in interpreting this metric.

validates efforts to minimize differences among areas in grain size and depth across all studies (CREMP and EAS).

3.6.2. CREMP

Detailed results are provided in **Appendix A**. The CREMP data set is summarized by each Area[5] and Year in **Appendix A** (see **Table A3-2** of **Appendix A** for the summary and **Appendix A1** for the raw data file). Results by Area and Year for each variable are shown in **Figure 3-8**, highlighting Area-Year combinations (dark points) potentially impacted by mining activities.

Statistical analyses focused on testing for single-year effects and for multi-year effects based on the following rationale for key areas:

- *SP and TE* – These areas were exposed to elevated TSS concentrations in 2008 and are the main focus of these analyses. While exposure concentrations were much lower in 2009 and 2010, they remain impact areas.
- *TPE* – In 2009, this area was sampled on August 13/14, which was during construction of the first phase of the Bay-Goose Dike (monitoring results showed that TSS concentrations had increased relative to background). Consequently, while TSS exposure was relatively low, this area was designated as "impact" starting in 2009.
- *TPN* – Dewatering discharges from the NW Arm of Second Portage Lake were directed into this basin from March through early July 2009. While CREMP water quality monitoring results for that basin showed negligible exposure conditions, the area was conservatively designated as an impact area for 2009. While not directly related to dike construction activities, TSS is the major constituent of interest in the dewatering effluent and therefore relevant to the EAS.

Results for short-term (i.e., testing for effects in each year since initial exposure to TSS) and long-term (i.e., testing for effects in all years since initial exposure to TSS) effects are reported in **Table 3-14** (2008 & 2009; single-year effects), **Table 3-15** (2010; single-year effects) and **Table 3-16** (2008-2010 or 2009-2010; multi-year effects) each benthic community metric. Graphical representations of the analyses are shown in box-whisker plots for short-term (**Figure 3-9**) and long-term (**Figure 3-10**) effects. Key results for each area are as follows (followed by a brief discussion of uncertainty):

- *SP (2008, 2009, 2010, and 2008-2010)* – As reported for the past two years, the 2008 EAS (Azimuth, 2009b) reported a marginal trend ($0.05<P<0.1$) for

[5] Note that variables used in statistical analyses are capitalized.

decreased total abundance at SP that did not extend to TE (see **Table 3-14**). As shown in **Figures 3-8 and 3-9**, abundance at SP rebounded in 2009 to slightly below "no-effect" predictions for that area and within the range of SP baseline results (i.e., 2006 – 2007). The 2010 results are similar to those seen in 2008 however, with >50% reduction in abundance compared to what was expected, based on 2009 data. Given the single year results, it was not surprising to find a significant multi-year adverse effect for abundance at SP. There were no significant reductions in taxa richness, Simpson's Diversity[6] or Bray Curtis distance for the short-term or long-term effects. Overall, the 2010 results for abundance at SP are unexpected and warrant further discussion after analysis of the higher-resolution East Dike EAS data set (see **Section 3.6.5** for more discussion).

- *TE (2008, 2009, 2010, and 2008-2010)* – As discussed above, the marginal trend in abundance observed in 2008 at SP did not extend into (for abundance or any other response variable; see **Tables 3-14 through 3-16**). The other single-year (2009 and 2010) and the multi-year (2008-2010) results confirm that finding and reaffirm that there does not appear to be any significant changes at TE related to mining activity. **Figure 3-8** probably shows this the best for all response variables. Most results for TE since 2008 are within the range of baseline results. The two low Simpson's Diversity results for TE in 2009 are due to replicate samples that contained relatively high numbers of sphaerid clams, which substantially reduced the diversity scores for those replicates (but not richness).
- *TPE (2009, 2010 and 2009-2010)* – Given that this area is up-gradient of the East Dike and in the same basin (i.e., East Basin of Third Portage Lake) as the Bay-Goose Dike, the results for this area are only relevant for the Bay-Goose EAS. The main trends seen at this station were a decrease in benthic invertebrate abundance (not significant for 2009 or 2010 separately [**Tables 3-14 and 3-15**], but significant for the 2009-2010 multi-year effect [**Table 3-16**]) and an increase in Simpson's Diversity (marginal for 2010 [**Table 3-15**] and significant for 2009-2010 [**Table 3-16**]). The overall results for abundance are heavily influenced by the 2008 data, where abundance and richness were anomalously elevated relative to what would be expected in that basin (see **Figure A3-6 and A3-7** in **Appendix A**).
- *TPN (2009, 2010 and 2009-2010)* – As discussed above, this area was potentially exposed to elevated TSS during dewatering of the NW arm of Second Portage

[6] Simpson's diversity index is sensitive to how organisms are allocated across taxa, not to the number of taxa.

Lake starting in March 2009. During dewatering, AEM was required to discharge water that was lower than TSS thresholds to minimize the potential for adverse effects in Third Portage Lake north basin. Based on CREMP water quality (Azimuth, 2010b; 2011) and Bay-Goose dike construction (Azimuth, 2010c) monitoring, TSS values in the north basin were very low (< 1 mg/L), suggesting that adverse effects to the benthic community would be unlikely. This was confirmed by the CREMP benthos results, which had no significant adverse effects. The only significant changes observed were increases for richness (2010; **Table 3-15**) and Simpson's Diversity (2009-2010; **Table 3-16**).

As discussed in **Appendix A**, effect sizes and associated confidence intervals help to place the observed results into perspective. As seen in **Tables 3-14 to 3-16**, the confidence intervals associated with reported effect sizes were quite large in a number of cases (i.e., reflective of high uncertainty in the estimated effect size). These confidence intervals are due to the fairly high degree of spatial and temporal variability that exists naturally in this region. The larger the confidence interval, the larger the effect size required for a statistically significant result (i.e., lower power). The degree to which the confidence interval extends above zero (or below for an adverse positive change, such as Bray Curtis distance) is a rough measure of how much larger an effect would have needed to be in order to be considered statistically significant.

The implication of this situation is that statistical significance should not be the only consideration when evaluating these results. As per previous year's EAS reports (Azimuth 2009a, 2010a), which highlighted the decrease in abundance at SP in 2008, marginal trends have been highlighted when p-values range between $0.05 < p < 0.15$. A variety of graphical methods have also been used to help visualize what the statistical models are actually testing.

The observed changes in the CREMP data set will be discussed in more detail in **Section 3.6.5** using a weight-of-evidence approach once the other data sets have been analyzed and interpreted.

3.6.3. East Dike EAS

The full East Dike EAS data set is summarized by each Area and Year in **Appendix A** (see **Table A3-10** of **Appendix A** for the summary and **Appendix A1** for the raw data file; summarized and raw 2010 results are provided in **Appendix H**).

Results by Area for each variable are shown in **Figure 3-11**; point shape (square for control and round for impact) and fill (none for all areas in 2009, grey for control areas in 2010 and black for impact areas in 2010) are used to highlight potential spatial and temporal trends.

Given that the major TSS release into Second Portage Lake occurred during East Dike construction in 2008, this analysis focused on:

- Assessing whether there is evidence of a prolonged difference between control and impact areas (i.e., indicating a potential TSS-related effects).
- Determining whether the data indicate that a recovery has occurred between 2009 and 2010 at impact areas (i.e., as shown by a differential improvement at impact areas relative to control areas).

Given that the spatial control-impact analysis primarily compares Second Portage Lake areas (and one Tehek Lake area) to other lakes, observed spatial differences could be related to inherent lake-specific factors (e.g., productivity) rather than to TSS exposure. The identification of a recovery at the impact areas, however, would provide stronger evidence that observed differences between control-impact areas in 2009 were likely related to TSS exposure. Ultimately, the strongest inferences regarding potential TSS-related impacts to the benthic community can be made by considering any trends identified in the East Dike EAS dataset with the results of the CREMP and Bay-Goose EAS data sets (see **Section 3.6.5**). Consequently, the remainder of this section focuses on results and leaves further interpretation to later in the report.

Key results[7] (summarized in **Table 3-17** and shown in **Figure 3-12**) are as follows:

- *Total abundance* – There was a significant difference in Effect (C vs. I areas; $p<0.05$), with the impact areas being 36% lower in abundance. While this difference may be attributable to TSS exposure, it could also be due to inherent differences in Second Portage Lake. There was also a significant difference for Year, with a 37% drop between years. This is consistent with the results of the CREMP, which showed this fairly consistently across the project lakes. The Effect*Year interaction, which tests for differential changes over time at C and I areas (e.g., a potential recovery) was marginal ($0.05<p<0.15$) for total abundance, showing a recovery magnitude of 43% (but with confidence intervals including a "no recovery" possibility).
- *Total taxa richness* – Similar to abundance, significant decreases in total species richness were detected for Effect (32% drop in richness at I areas; $p<0.001$) and Year (20% drop in richness in 2010). The Effect*Year results show a recovery trend with a magnitude of 28% ($0.05<p<0.15$; confidence intervals barely overlap the "no recovery" possibility).

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[7] Magnitude of response for Effect and Year are shown relative to Control areas in 2009.

- *Simpson's Diversity* – Caution must be used interpreting these results as model assumptions were not met and none of the transformation options assessed (typical or advanced) worked. The results showed a modest (-8%), but significant ($p<0.05$), reduction at impact areas for Effect. The 5% drop in 2010 for Year was not significant. The Effect*Year interaction results showed no evidence for a recovery at impact areas in 2010.
- *Bray Curtis Distance* – This metric showed significant differences for Effect (impact areas 14% "further away" from control areas) and Year (2010 areas "further away" than 2009 areas). The Effect*Year interaction term results showed no evidence for a recovery at impact areas in 2010.

The observed changes in the ED EAS data set will be discussed in more detail in **Section 3.6.5** using a weight-of-evidence approach once the other data sets have been analyzed and interpreted.

3.6.4. Bay-Goose EAS

Detailed results are provided in **Appendix A**. The full Bay-Goose EAS data set is summarized by each Area and Year in **Appendix A** (see **Table A3-12** of **Appendix A** for the summary and **Appendix A1** for the raw data file). Results by Area for each variable are shown in **Figure 3-13**.

Statistical analyses focused on testing differences between control and impact areas. The "Effect" dummy variable for was coded with two levels: controls (INUG, PDL, TPS, TEFF, SP-DT, and TP-E3) and impact (TP-E1, TP-E2, TPE, and TPL-HVH4). Boxplots of response variables by Effect grouping are shown in **Figure 3-14**.

Results of statistical analyses are presented in **Table 3-18**. No significant differences were found between control and impact groups for any response variable. Given that this is based on one year of data only, we cannot rule out the possibility that the impact areas may have had healthier communities in past years (i.e., that the real effect size was much larger). This possibility will be explored more in **Section 3.6.5**.

3.6.5. Benthos Weight of Evidence

Three data sets were analyzed to assess the potential effects of dike-construction-related-TSS on benthic invertebrate communities (see preceding sections for details). While each independently provides some insights into the potential for TSS related impacts, collectively they support making stronger inferences regarding the nature of observed changes. Ideally, consideration of broader spatial and temporal patterns in the data should help to better elucidate the relative importance of natural variability *versus* TSS in explaining observed changes.

Tables 3-19 and 3-20 present weight-of-evidence assessments for Second Portage Lake (i.e., targeting potential effects related to sediment releases from construction of the East Dike in 2008) and for the east basin of Third Portage Lake (i.e., targeting potential effects related to sediment releases from construction of the Bay-Goose Dike in 2009 and 2010). Given that results of the toxicity testing and sequential extraction analyses (i.e., sediment metals are largely not bioavailable) indicate that contaminant-related effects are unlikely, physical smothering is considered the most likely mechanism for TSS-related adverse effects to the benthic community. However, based on the sediment trap data, the magnitude of this effect is also expected to be small. Consequently, the expectation would be that impacts would not be long-lived, so the assessment generally looked for evidence of recovery. That said, the possibility for longer-term impacts was also considered. Given these impact hypotheses, the lack of an observed "recovery" would essentially suggest that there may not have been an adverse effect from which to recover.

3.6.5.1. Second Portage Lake

Overall, the results for Second Portage Lake are inconclusive (**Table 3-19**). There is reasonable (but not conclusive) evidence to suggest that changes to the benthic community observed in the CREMP 2008 were due to construction-related sediment inputs (i.e., SP had the lowest abundance measured at that area compared to baseline data). While there is some evidence of a subsequent recovery (e.g., starting with the CREMP and EAS in 2009 and possibly extending to the EAS in 2010), this is clouded by contradictory results (mainly CREMP in 2010) and by an inherently less abundant and diverse benthic community in Second Portage Lake (and Tehek Lake too) in 2010. Given the prevailing pattern in the EAS data for Second Portage Lake in 2010, the 2010 CREMP result for SP must be considered highly localized (i.e., not representative of general conditions in Second Portage Lake in 2010) and unlikely related to dike construction. Consequently, the results for the 2008 to 2010 long-term effects also need to be viewed with caution.

Notwithstanding, even if the 2010 CREMP results were excluded from consideration, explanations for the observed changes, particularly those in the 2010 EAS, are still not completely clear. For example, the rebound in abundance at SP in the 2009 CREMP (mean 778; range 630 to 913) to within the range of baseline abundance levels for Second Portage Lake (means 623 and 913; ranges 522 to 1435) suggests a full recovery from the 2008 (mean 413; range 239 to 565) depression. Given that mean abundance results for all 2009 EAS areas (means range from 652 to 1474) were also within or exceeded the range of baseline conditions for Second Portage Lake, this suggests that the differences observed between control and impact areas in the 2009 EAS are unlikely due to the residual effects of construction-related sediment inputs (i.e., but rather to inherent inter-lake differences in abundance, as can be seen in **Figures A3-6 and A3-7 in Appendix**

A). However, there was evidence of a continued "recovery"[8] in the 2010 EAS results, which is difficult to explain in light of the 2009 results. Perhaps the best explanation for this is that, similar to the 2009 results, it is due to inherent inter-lake differences that confound comparisons between control and impact areas.

While inconclusive, much of the available data for Second Portage Lake suggest that impacts were limited temporally (and spatially) and that recovery probably occurred within a year. The regionally lower trend in benthic community abundance confounds our ability to discern possible residual impacts in SP related to 2008 dike construction. Another year of data may help resolve some of the existing uncertainties.

3.6.5.2. Third Portage Lake – East Basin

The results for the east basin of Third Portage Lake are also somewhat inconclusive (**Table 3-20**), again related to challenges discerning between natural variability and low level TSS exposure. In this case, the main cause is the high (but potentially anomalous) invertebrate abundance measured during baseline period at the CREMP area TPE. Firstly, despite low exposure to TSS in 2009, a large (but not statistically significant) drop in benthos abundance was observed at the CREMP area TPE. Given the low exposure to TSS, this observed change was likely due to natural variability. Secondly, the further change in abundance observed at TPE in 2010 was also not statistically significant and was likely due to the regional trend discussed in **Section 3.6.2** (as can be seen in **Figures A3-6 and A3-7 in Appendix A**). Thirdly, the 2010 EAS data showed no significant difference in abundance between the east basin impact areas and the control areas. While these results point to a general lack of impact to the benthic community from sediment inputs from the construction of the Bay-Goose Dike, the successive drops in abundance at TPE are statistically significant when combined (i.e., the 2009 to 2010 long-term effect summarized in **Table 3-16)** and match the general exposure pattern (i.e., higher TSS exposure in 2009 and 2010).

While inconclusive, the prevailing patterns in the available data for the east basin of Third Portage Lake do not support the presence of a TSS-related impact (i.e., the abundance reductions observed in the CREMP data do not appear related to TSS).

[8] The "recovery" is based on differential changes in the impact areas relative to control areas. In 2010, there was a general regional trend of decreased abundance and richness observed at most areas in 2010 relative to 2009. The EAS stations in Second Portage Lake, however, responded much less than would have been expected, thus representing a relative "recovery".

Table 3-13. Area "effect" status by year for CREMP data set.

Year	INUG	PDL	TPS	TEFF	SP	TE	TPE	TPN
2006	C		C		C		C	
2007	C		C		C	C	C	C
2008	C		C		I	I	C	C
2009	C	C	C	C	I	I	I	I
2010	C	C	C	C	I	I	I	I

Note: 1. Area designations: C = control; I = impact.

Table 3-14. Results of statistical analyses of benthic invertebrate community descriptors for the 2006 - 2009 CREMP data set, short-term Effect (from 2009 EAS report; Azimuth, 2010).

	Total Abundance (#/m^2)	Taxa Richness (# taxa/ sample)	Simpson's Diversity (unitless)[5]	Bray Curtis Distance (unitless)
Data Transformation[1]	Log10	None	None	Log10
Advanced Transformation[2]	Log10(x-120)	NA	NA	NA
Tests relative to controls				
C-SP2008 Differences?	Marginal	No	Marginal	No
p-value	0.08	0.27	0.12	0.95
Effect Size	-578	-2.4	0.11	-0.01
95% Upper CI[3]	-775	-7.1	-0.04	-0.24
95% Lower CI[3]	184	2.3	0.26	0.33
C-TE2008 Differences?	No	No	Marginal	No
p-value	0.47	0.89	0.14	0.24
Effect Size	-396	0.3	0.12	-0.16
95% Upper CI[3]	-881	-5.0	-0.05	-0.36
95% Lower CI[3]	1824	5.6	0.28	0.16
C-SP2009 Differences?	No	No	No	No
p-value	0.68	0.26	0.60	0.75
Effect Size	-195	-2.6	0.04	-0.04
95% Upper CI[3]	-693	-7.7	-0.12	-0.24
95% Lower CI[3]	1948	2.5	0.20	0.27
C-TE2009 Differences?	No	No	No	No
p-value	0.51	0.37	0.80	0.77
Effect Size	-384	-2.3	-0.02	-0.04
95% Upper CI[3]	-893	-7.9	-0.20	-0.26
95% Lower CI[3]	2195	3.4	0.16	0.31
C-TPE2009 Differences?	No	No	No	No
p-value	0.19	0.68	0.24	0.65
Effect Size	-2047	-0.9	0.08	-0.04
95% Upper CI[3]	-3197	-5.7	-0.07	-0.21
95% Lower CI[3]	2512	3.9	0.23	0.21

Notes:

1. Initial transformation options discussed in **Section 2**.
2. Advanced transformations determined using Box-Cox method (Venables & Ripley
3. Confidence intervals reported relative to direction of effect (i.e., positive or negative).
4. Results are for model adjusted to account for unequal variances (see text for details).
5. Model assumptions not met, see text for details.

Table 3-15. Results of statistical analyses of benthic invertebrate community descriptors for the 2010 CREMP data set, short-term Effects.

	Total Abundance (#/m^2)	**Taxa Richness** (# taxa/ sample)	**Simpon's Diversity** (unitless)[5]	**Bray Curtis Distance** (unitless)
Data Transformation[1]	Log10	None	None	Log10
Advanced Transformation[2]	Log10(x-70)	NA	NA	NA
Tests relative to controls				
C-SP2010 Differences?	Marginal	No	No	No
p-value	0.07	0.55	0.67	0.49
"No Effect" Mean[3]	599	5.7	0.67	0.67
Effect Size	-362	-1.3	0.03	0.08
95% Upper CI[4]	-483	-6.2	-0.11	-0.15
95% Lower CI[4]	83	3.6	0.16	0.43
C-TE2010 Differences?	No	No	No	No
p-value	0.57	0.74	0.29	0.94
"No Effect" Mean	697	5.6	0.64	0.66
Effect Size	-194	0.8	0.07	-0.01
95% Upper CI[4]	-524	-4.6	-0.07	-0.23
95% Lower CI[4]	1203	6.3	0.22	0.33
C-TPE2010 Differences?	No	No	Marginal	No
p-value	0.23	0.50	0.06	0.45
"No Effect" Mean	2160	8.4	0.67	0.60
Effect Size	-1035	1.4	0.12	-0.07
95% Upper CI[4]	-1780	-3.2	-0.01	-0.23
95% Lower CI[4]	1506	6.1	0.24	0.16
C-TPN2010 Differences?	No	Yes (incr.)	Marginal	No
p-value	0.55	0.05	0.11	0.88
"No Effect" Mean	714	5.4	0.67	0.60
Effect Size	263	5.0	0.10	0.02
95% Upper CI[4]	-392	0.1	-0.03	-0.18
95% Lower CI[4]	2614	9.8	0.23	0.30

Notes:

1. Initial transformation options discussed in **Section 2**.
2. Advanced transformations determined using Box-Cox method (Venables & Ripley 2002).
3. "No Effect" Mean estimated by not including the Effect coefficient when estimating Area-Year mean.
4. Confidence intervals estimated using 2 * Std. Error of Effect Size estimate.
5. Model assumptions not met, see text for details.

Table 3-16. Results of statistical analyses of benthic invertebrate community descriptors for the2006 to 2010 CREMP data set, long-term Effects.

	Total Abundance (#/m²)	Taxa Richness (# taxa/ sample)	Simpon's Diversity (unitless)[5]	Bray Curtis Distance (unitless)
Data Transformation[1]	Log10	None	None	Log10
Advanced Transformation[2]	Log10(x-70)	NA	NA	NA
Tests relative to controls				
C-SP'08-'10 Differences?	Yes	No	Marginal	No
p-value	0.04	0.18	0.15	1.00
"No Effect" Mean[3]	849	8.30	0.70	0.67
Effect Size	-444	-2.1	0.06	0.00
95% Upper CI[4]	-629	-5.3	-0.03	-0.14
95% Lower CI[4]	-32	1.1	0.16	0.17
C-TE'08-'10 Differences?	No	No	No	No
p-value	0.32	0.84	0.21	0.37
"No Effect" Mean[3]	993	8.16	0.67	0.67
Effect Size	-340	-0.36	0.06	-0.08
95% Upper CI[4]	-699	-4.16	-0.04	-0.22
95% Lower CI[4]	595	3.45	0.17	0.11
C-TPE'09-'10 Differences?	Yes	No	Yes	No
p-value	0.04	0.80	0.01	0.25
"No Effect" Mean[3]	2988	10.13	0.68	0.58
Effect Size	-1622	0.37	0.13	-0.07
95% Upper CI[4]	-2366	-2.76	0.04	-0.16
95% Lower CI[4]	-280	3.49	0.21	0.07
C-TPN'09-'10 Differences?	No	Marginal	Yes	No
p-value	0.77	0.11	0.04	0.63
"No Effect" Mean[3]	979	7.19	0.68	0.59
Effect Size	109	2.61	0.10	-0.03
95% Upper CI[4]	-496	-0.70	0.01	-0.14
95% Lower CI[4]	1264	5.92	0.19	0.13

Notes:
1. Initial transformation options discussed in **Section 2**.
2. Advanced transformations determined using Box-Cox method (Venables & Ripley 2002).
3. "No Effect" Mean estimated by not including the Effect coefficient when estimating Area-Year mean.
4. Confidence intervals estimated using 2 * Std. Error of Effect Size estimate.
5. Model assumptions not met, see text for details.

Table 3-17. Results of statistical analyses of benthic invertebrate community descriptors for the 2009 to 2010 East Dike EAS data set.

	Total Abundance (#/m^2)	Taxa Richness (# taxa/ sample)	Simpon's Diversity (unitless)	Bray Curtis Distance (unitless)
Data Transformation[1]	Log10	None	None	Log10
Advanced Transformation[2]	Log10(x+230)	NA	NA	Log10(x-0.24)
Model Results				
C-I Effect Difference?	Yes	Yes	Yes	Yes
p-value	0.037	<0.001	0.049	0.020
Magnitude	-36%	-32%	-8%	14%
Year Difference	Yes	Yes	No	Yes
p-value	0.014	0.003	0.174	0.037
Magnitude	-37%	-20%	-5%	12%
Effect*Year Difference?	Marginal	Marginal	No	No
p-value	0.148	0.075	0.950	0.829
"No Effect" Mean	513	5.4	0.71	0.64
Actual Mean	734	6.9	0.71	0.63
"Recovery" Size	221	1.5	0.00	-0.01
"Recovery" Magnitude	43%	28%	0%	-2%
95% Lower CI[3] of Recovery Size	-77	-0.2	-0.08	-0.10
95% Upper CI[3] of Recovery Size	652	3.2	0.08	0.10

Notes:

1. Initial transformation options discussed in **Section 2**.

2. Advanced transformations determined using Box-Cox method (Venables & Ripley 2002).
3. Confidence intervals estimated using 2 * Std. Error of Effect Size estimate.

Table 3-18. Results of statistical analyses of benthic invertebrate community descriptors for the 2010 Bay Goose Dike EAS data set.

	Total Abundance ($\#/m^2$)	**Taxa Richness** (# taxa/ sample)	**Simpon's Diversity** (unitless)	**Bray Curtis Distance** (unitless)
Data Transformation[1]	Log10	None	None	Log10
Advanced Transformation[2]	NA	NA	NA	NA
Tests relative to control [C]				
C-I Effect Difference?	No	No	No	No
p-value	0.381	0.757	0.729	0.416
Control Group Mean	777	8.6	0.75	0.56
Impact Group Mean	622	8.3	0.76	0.59
Effect Size	-155	-0.3	0.02	0.03
Effect Magnitude (%)	-20%	-4%	2%	5%
95% Upper CI[3] of Effect Size	-416	-2.5	-0.09	-0.05
95% Lower CI[3] of Effect Size	292	1.9	0.12	0.12

Notes:

1. Initial transformation options discussed in **Section 2**.

2. Advanced transformations determined using Box-Cox method (Venables & Ripley 2002).
3. Confidence intervals estimated using 2 * Std. Error of Effect Size estimate.

Table 3-19. Weight-of -evidence assessment of potential TSS-related impacts to benthic invertebrates for Second Portage Lake from construction of the East Dike.

Lake (Basin)	Year(s)	CREMP	EAS	Weight-of-Evidence Interpretation
Second Portage Lake				
Elevated TSS primarily from East Dike construction in 2008, but also to a much lower degree from Bay-Goose Dike construction in 2009 and 2010.	2008	Marginally significant, but large drop in abundance was found at SP in 2008. This trend did not extent to TE.	No data.	Benthic community change (while statistically marginal) was substantial and affected both abundance and richness. Responses patterns at SP and TE consistent with TSS exposure gradient (i.e., much lower TSS in Tehek Lake).
	2009	Apparent recovery seen at area SP in 2009, particularly for abundance, which was within the range of baseline conditions.	EAS study initiated; Community abundance and richness about 30% lower at impact areas relative to controls in 2009. The impact area results were, however, within the range of baseline conditions for Second Portage Lake. These results are consisten with inherent differences between the EAS impact areas (largely in Second Portage Lake) and the EAS control areas (i.e., consisting of one within-lake reference and a number of other CREMP areas), but could be due (in part) to TSS-related effects.	The apparent recovery at SP (CREMP) suggests that the differences observed in the 2009 EAS data are likely due to inherent inter-lake differences rather than to TSS exposure (i.e., SP and TE communities were typically lower in abundance and richness than other lakes from baseline studies). This is supported by the EAS impact area data largely meeting or exceeding baseline conditions in Second Portage Lake. Some contribution from the residual TSS effects, however, cannot be ruled out (particularly given the 2010 results below).
	2010	A marginally significant, but large drop was seen again at area SP in 2010, for both abundance and richness. This was over and above the general decrease in abundance and richness observed at most CREMP areas in 2010 (regional trend).	Evidence of a "recovery" (see text) at impact areas in 2010 was observed relative to 2009 results. Similar to 2009, it is difficult to attribute this to a true recovery as the data (except for SP) were within or exceeded the range of baseline conditions for the lake. That said, it is also difficult to understand why the lake wouldn't respond to a regional trend like most of the control areas.	SP was the only impact station in the EAS data set to drop substantially in 2010, suggesting a highly local trend at SP (not expected to be related to TSS exposure). The overall "recovery" observed at EAS impact areas (despite the drop at SP) suggests an improvement in 2010 relative to control areas. However, it is difficult to attribute this to a true recovery (as opposed to inherent inter-lake differences).
	2008 to 2010	When the above years are looked at together (i.e., asking whether there have been longer-term changes since the TSS event), there are statistically significant reductions in community abundance and diversity compared to controls.	2010 data show relative improvements relative to 2009, with impact area means well within the historical range for SP.	The CREMP result is strongly influenced by SP in 2010, which is thought to be localized and likely unrelated to TSS exposure (see above). Consequently, the long-term effects identified in the CREMP should be viewed with caution.

Table 3-20. Weight-of -evidence assessment of potential TSS-related impacts to benthic invertebrates for Third Portage Lake (east basin) from construction of the Bay-Goose Dike.

Lake (Basin)	Year(s)	CREMP	EAS	Weight-of-Evidence Interpretation
Third Portage Lake - East Basin				
Elevated TSS primarily from Bay-Goose Dike in 2009 and 2010.	2009	Baseline conditions were variable with high abundance and diversity in 2006 and 2008. Despite a substantial drop in abundance and richness in 2009, none were statisitically significant. Exposure to TSS was also quite low, suggesting that the observed responses were likely due to natural fluctuations.	No data.	Results for TPE show a large drop that was not statistically significant, likely due to high variability at this station in baseline years and in the 2009 data.
	2010	Another drop in abundance and richness was observed in 2010, but of similar magnitude to the general regional trend of decreased abundance and diversity observed at most CREMP areas. None were statistically significant.	No significant differences identified between impact and control areas.	Both found no significant differences relative to controls, but variability was high (resulting in large confidence intervals) so there is uncertainty in this conclusion.
	2009 to 2010	Significantly reduced abundance at TPE from 2009 to 2010. This result is likely influenced by the anomalously high abundance observed in 2008.	Only 2010 data available; see above.	The CREMP results are strongly influenced by the very high abundance found at TPE during 2008. While the 2009 TPE results were within the baseline range, the 2010 results were the about a third lower than was measured at TPE in 2009. That said, there was a general trend of decreased abundance at most CREMP areas in 2010 (regional trend).

Figure 3-5. Key benthic community descriptors (abundance, richness, Simpson's Diversity, and Bray Curtis distance) as a function of key physical variables (depth, total organic carbon, sand, and silt) for 2009 and 2010 CREMP and EAS datasets.

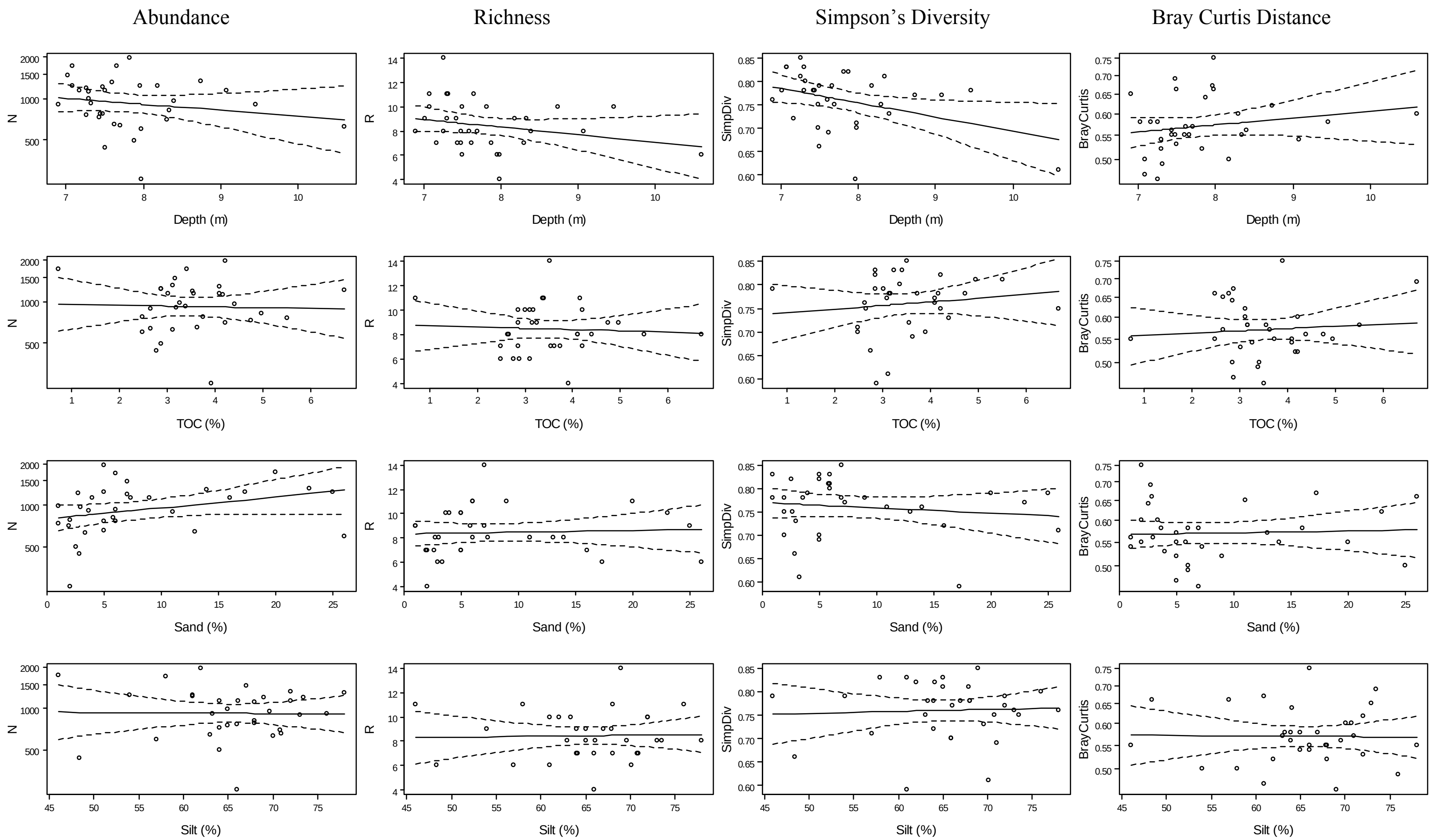


Figure 3-6. Key benthic community descriptors (abundance, richness, Simpson's Diversity, and Bray Curtis distance) as a function of key physical variables (clay, aluminum, arsenic, and cadmium) for 2009 and 2010 CREMP and EAS datasets.

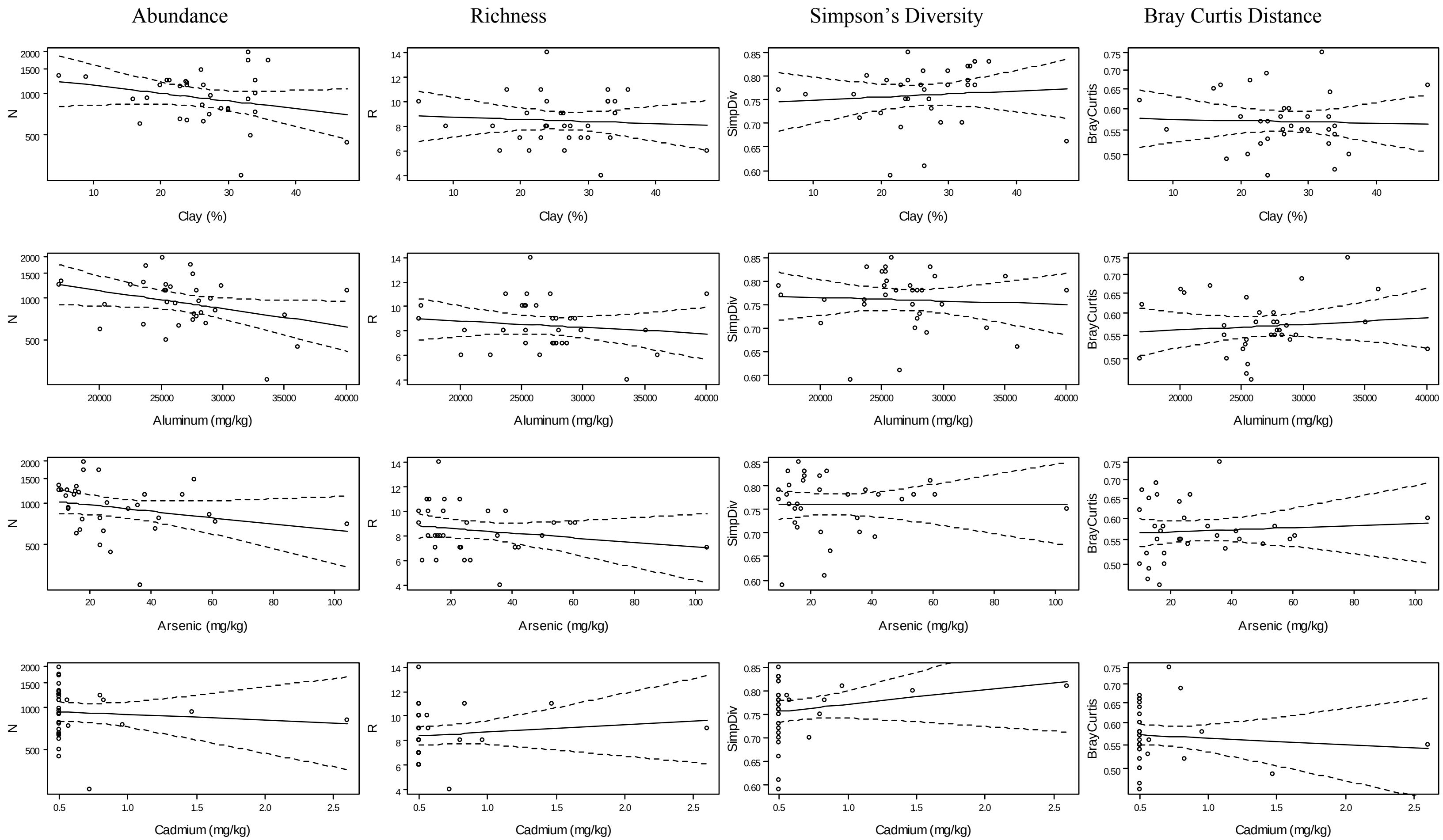


Figure 3-7. Key benthic community descriptors (abundance, richness, Simpson's Diversity, and Bray Curtis distance) as a function of key physical variables (chromium, copper and zinc) for 2009 and 2010 CREMP and EAS datasets.

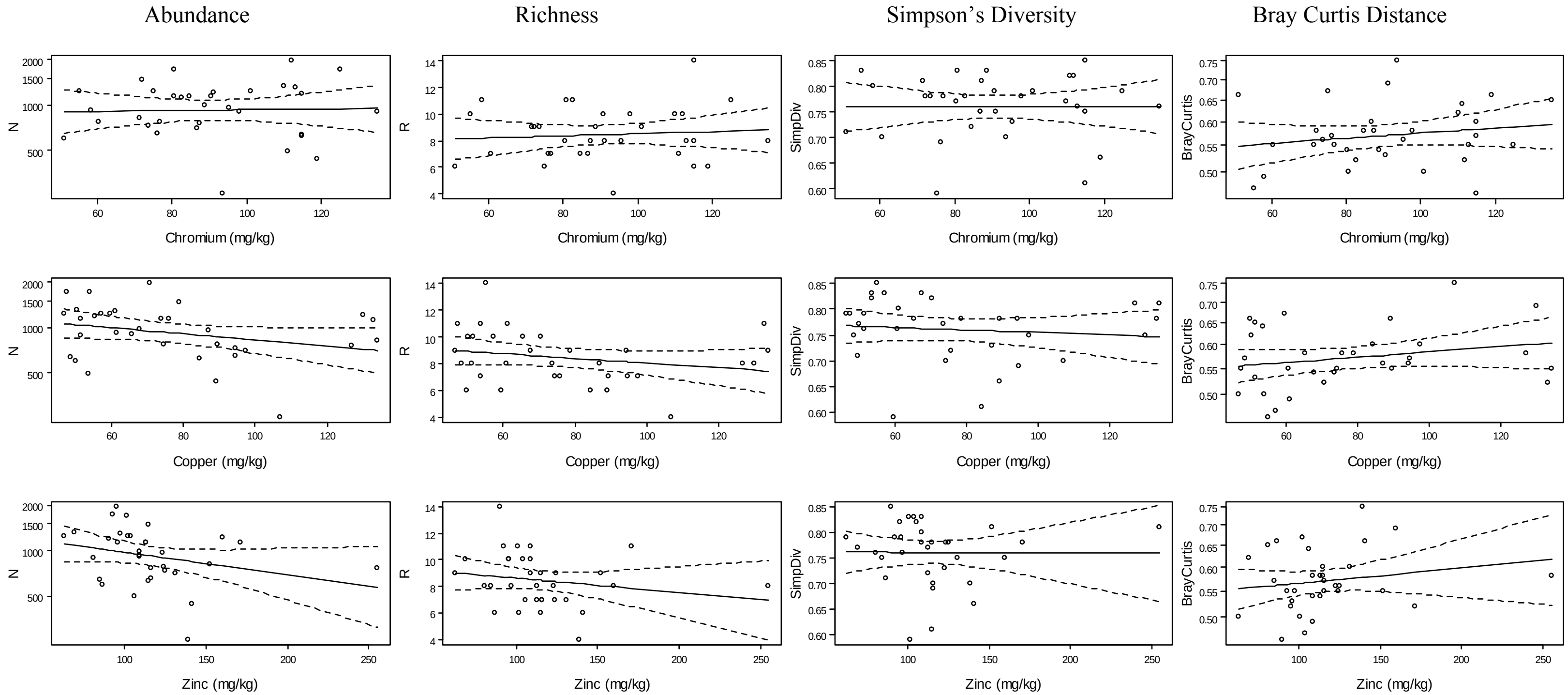


Figure 3-8. Benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) across CREMP areas for 2006 through 2010.

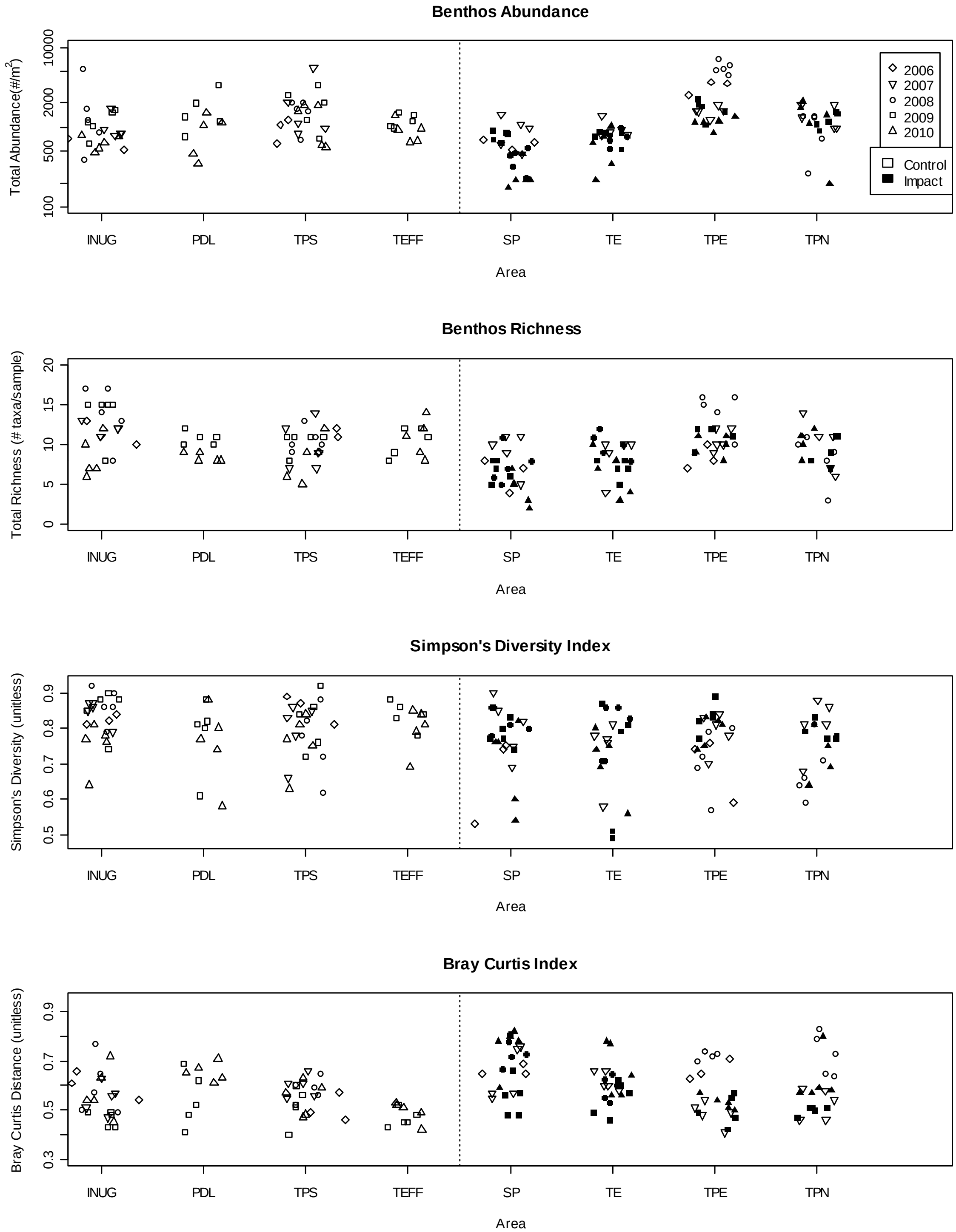


Figure 3-9. Boxplots of benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) by short-term Effect grouping for CREMP data set.

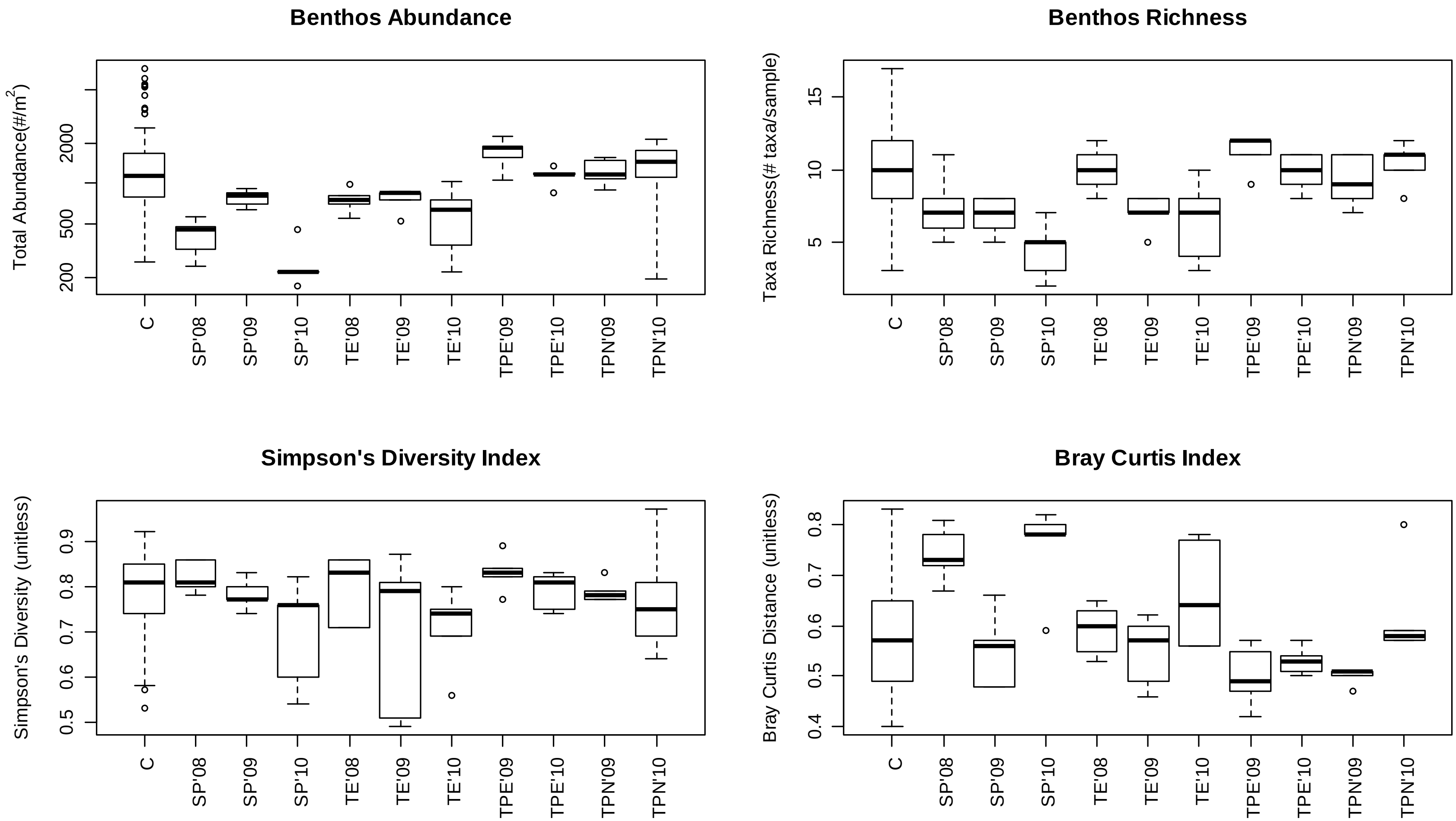


Figure 3-10. Boxplots of benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) by long-term Effect grouping for CREMP data set.

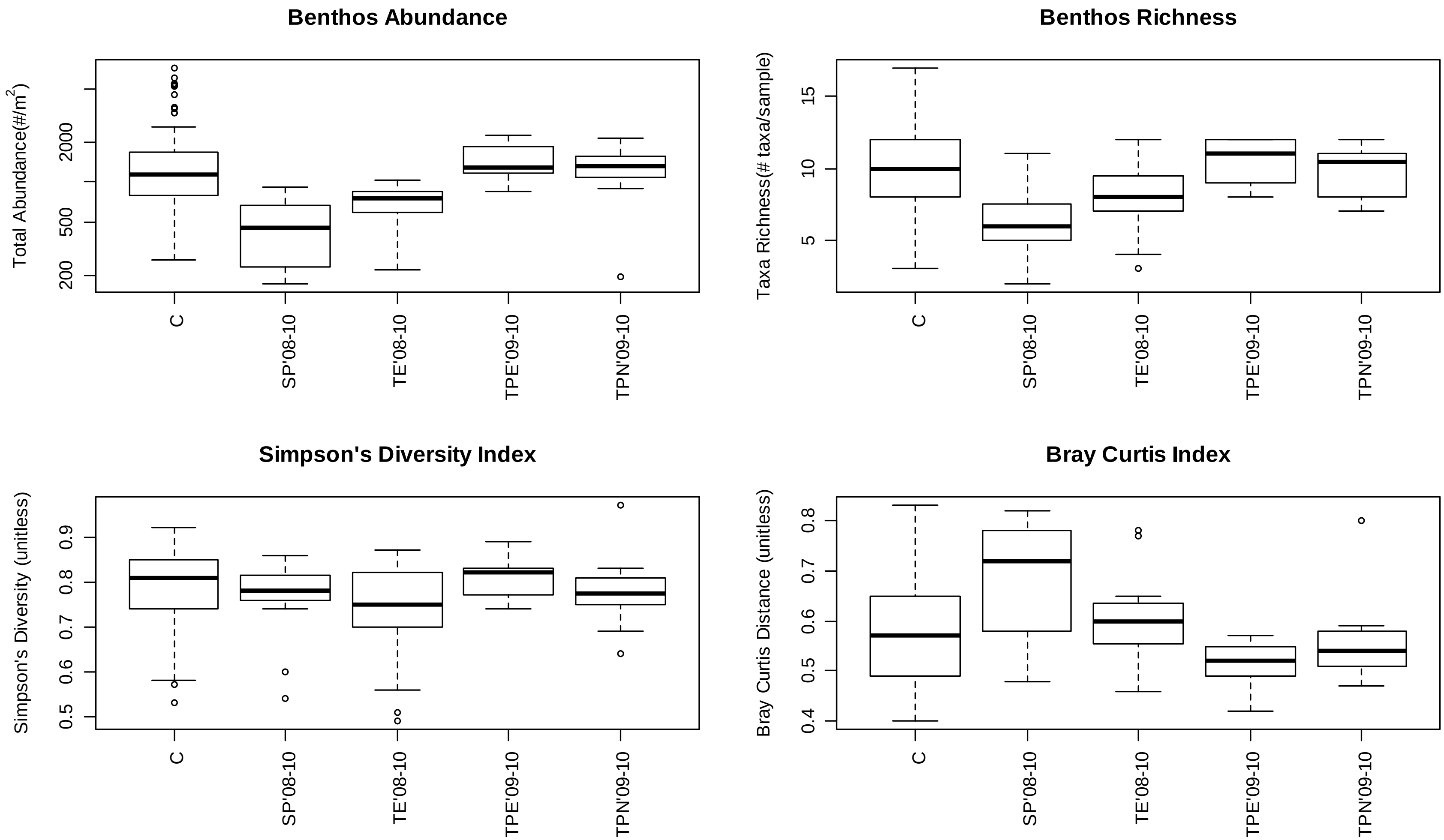


Figure 3-11. Benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) across Control and Impact areas for East Dike EAS 2010.

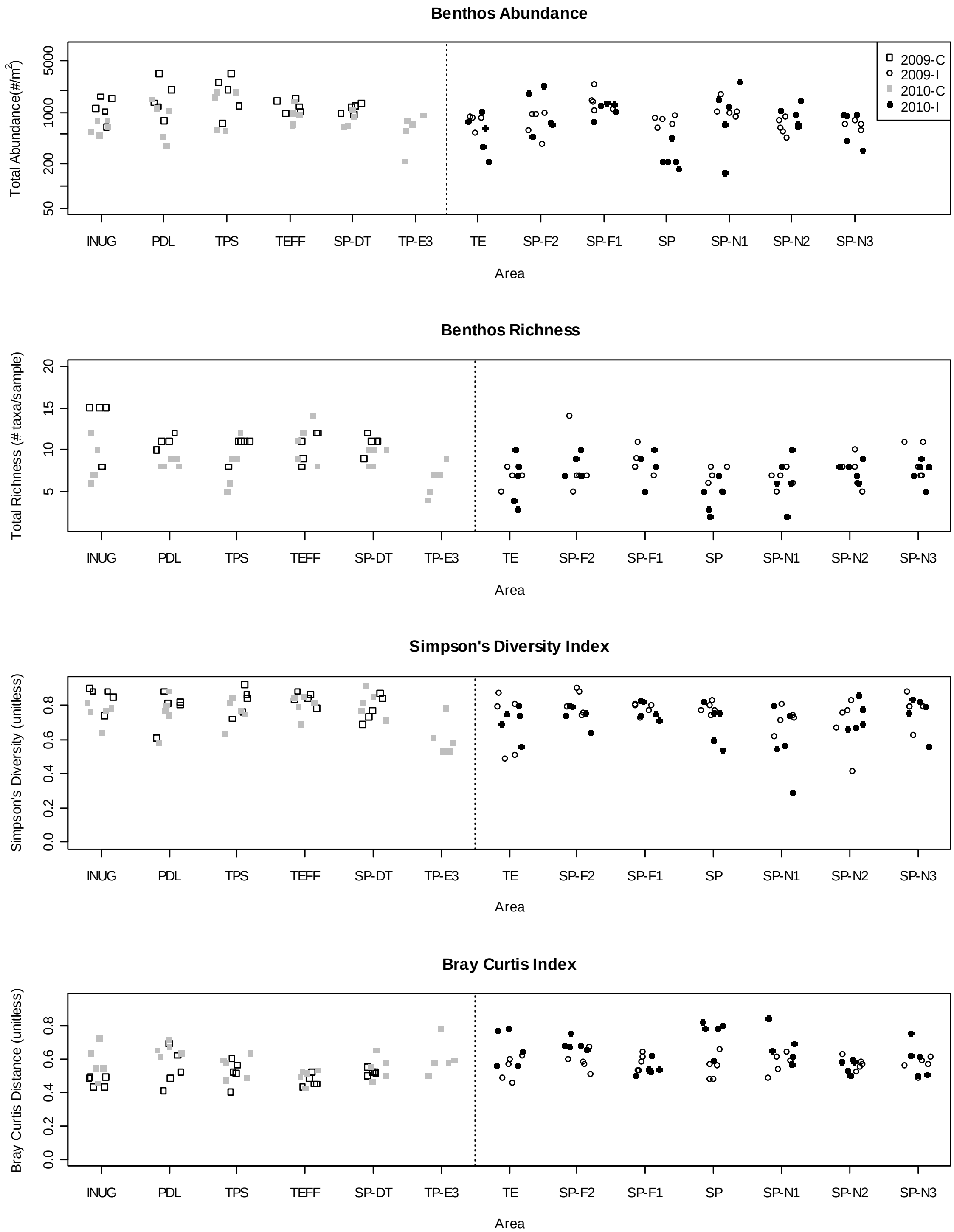


Figure 3-12. Boxplots of benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) by Effect grouping for East Dike EAS data set. Year-specific boxplots are provided as well to facilitate data interpretation.

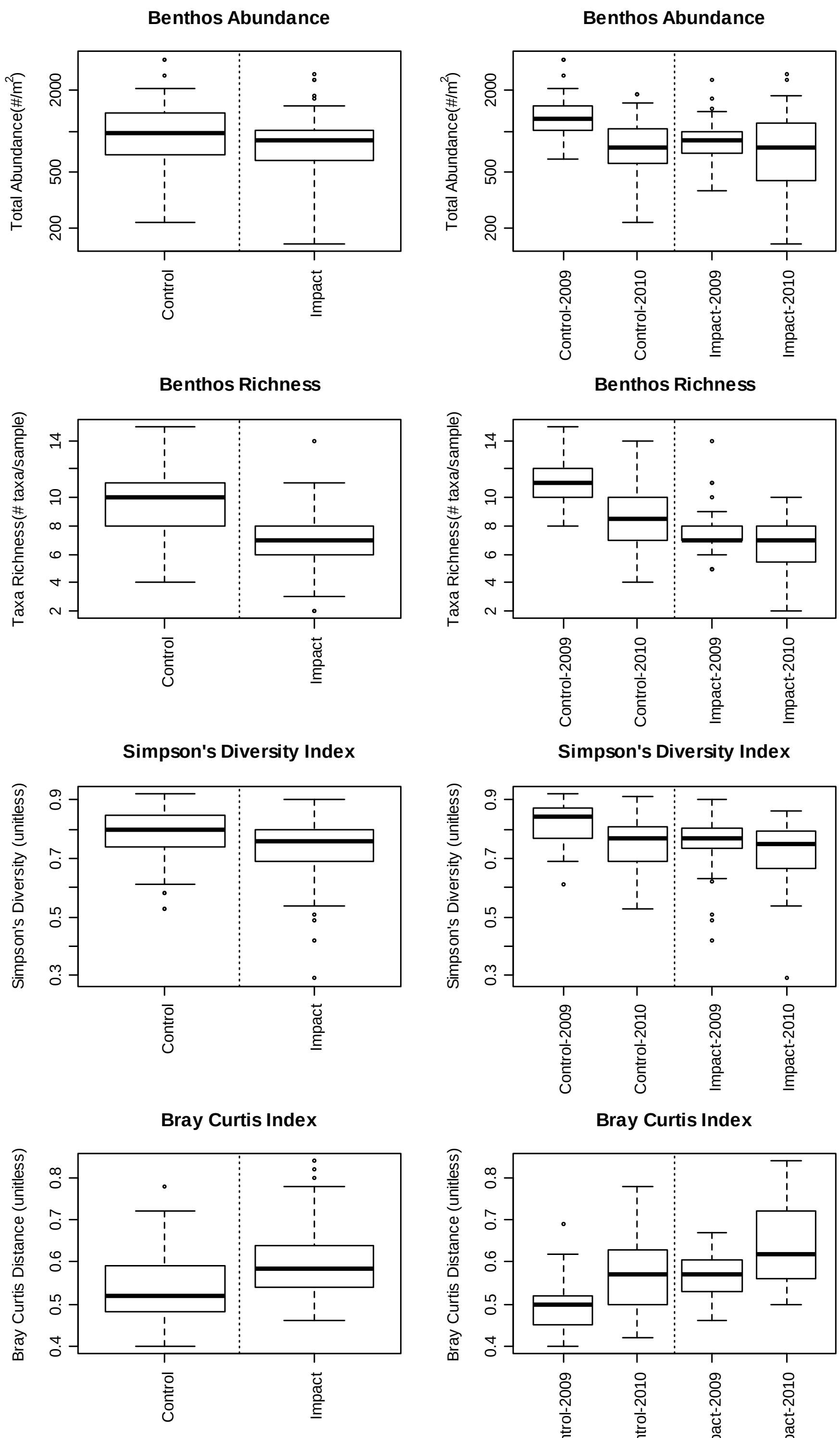


Figure 3-13. Benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) across Control and Impact areas for Bay Goose Dike EAS 2010.

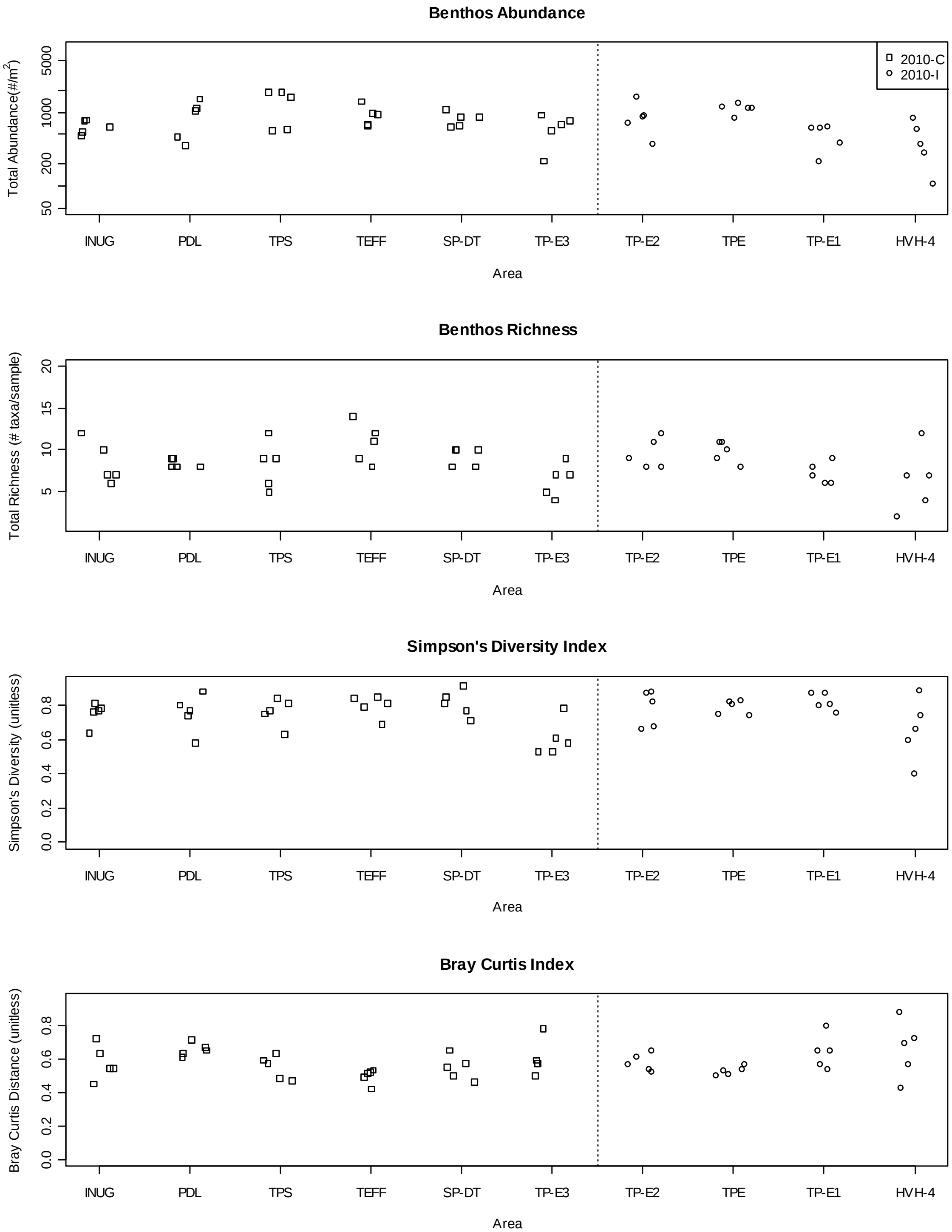
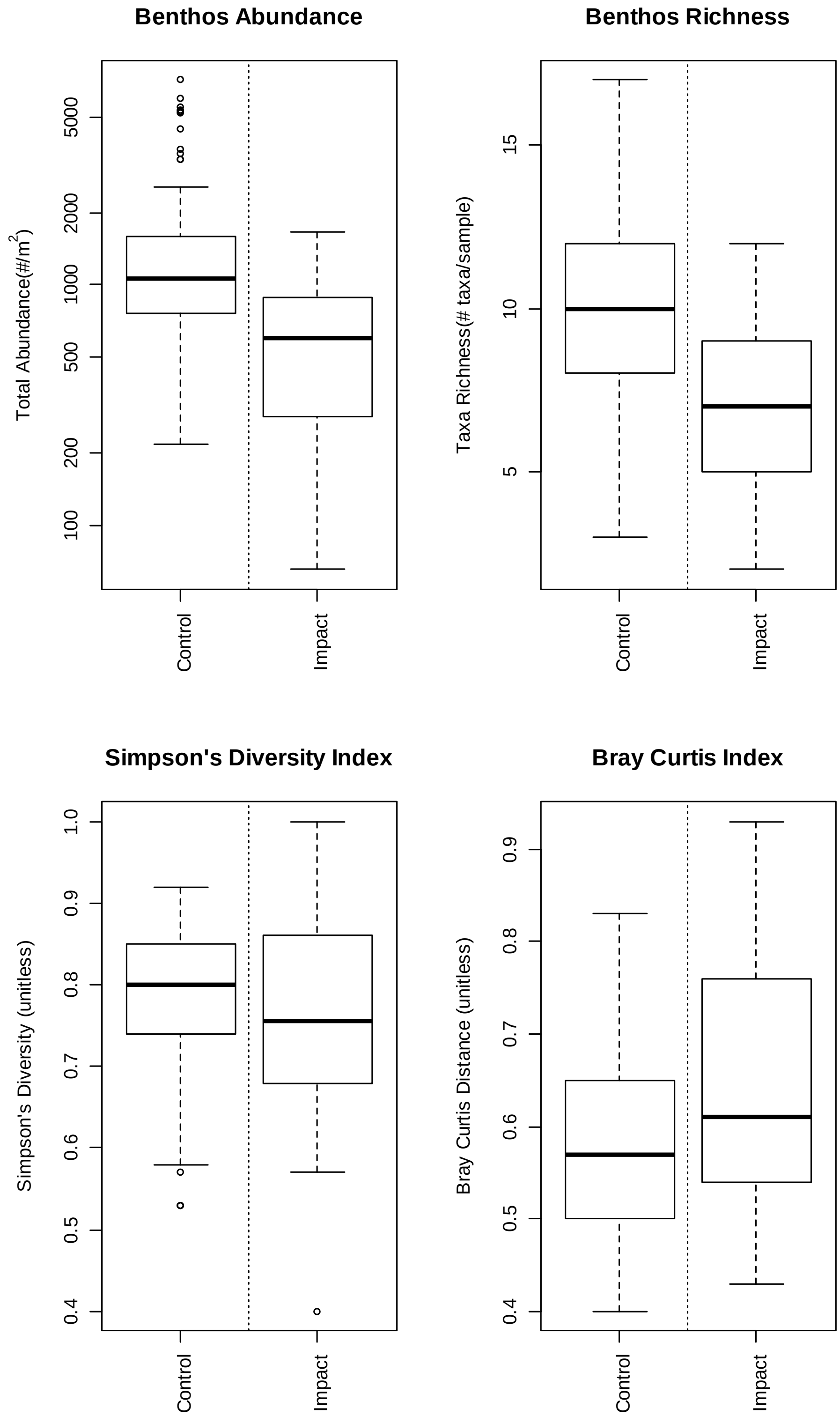


Figure 3-14. Boxplots of benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) by Effect grouping for Bay-Goose Dike EAS data set.



4. CONCLUSIONS AND RECOMMENDATIONS

AEM commissioned studies in each of the last three years (2008 - 2010) to address concerns regarding the potential impacts of elevated TSS concentrations on local receiving environment from dike construction. Based on the literature, elevated TSS concentrations can directly or indirectly affect the entire range of organisms in the aquatic environment, so these studies have addressed a broad array of ecosystem elements.

The East Dike TSS EAS was initiated in 2008 and targets the effects of TSS from East Dike construction, primarily on Second Portage Lake, but also extending into Tehek Lake (Azimuth, 2009b). As planned, this study continued in 2009 (Azimuth, 2010b) and 2010 (this report), focusing more on characterizing potential deposition-related impacts, largely to periphyton and benthic invertebrate communities.

The Bay-Goose TSS EAS was initiated in 2009 and targets the effects of TSS from Bay-Goose construction, primarily on the east basin of Third Portage Lake, but also downstream into Second Portage Lake and Tehek Lake. Due to the phased nature of construction of the Bay-Goose Dike (i.e., Phase 1 in 2009; Phase 2 in 2010), the timing of study components is variable, with some conducted in 2009 (Azimuth, 2009b) and others slated for either 2010 (this report).

Collectively, the results of these studies have improved our understanding of the potential short-term and long-term effects of elevated TSS on a broad range of ecosystem elements in local receiving environments. Results to date for each major study component have been summarized in **Table 4-1** (2010 results highlighted in **bold**) for both TSS EAS studies to provide a more holistic perspective.

TSS EAS studies have targeted both the pelagic zone (i.e., water column) and benthic zone (i.e., lake bottom) of receiving environments. Elevated TSS concentrations over basin-wide spatial scales were well documented for both studies, lasting on the scale of weeks-to-months. While the TSS had obvious consequences for water clarity (and thus light penetration), no other substantial changes to local limnology were identified. From a water chemistry perspective, elevated metals and nutrients was largely associated with particulates rather than dissolved (and more bioavailable). From a water column (pelagic zone) perspective, both TSS EAS studies identified some short-term effects to primary productivity (e.g., phytoplankton biomass). However, these did not appear to cascade up the food chain to zooplankton. Consequently, based on available data, indirect effects to higher-level organisms through reduced prey biomass are considered unlikely. This was also corroborated in the laboratory with a larval trout test using live zooplankton as a food resource. With respect to potential direct effects in the water column, no adverse effects to zooplankton or fish were seen in toxicity tests. Thus, the body of evidence collected to date suggests that while some effects have been seen in the water column, they are likely limited in time and have not been shown to propagate up the food chain.

In contrast to the pelagic zone, where potential effects would be linked to suspended sediments in the water column and thus less likely to have prolonged consequences, the benthic zone is susceptible to the potential effects of sedimentation. Sediment traps have been used to document sedimentation rates, deposition thickness and chemistry of settled matter over the last three years, both during the open water season and under ice cover. The 2008 results suggested that between 1 to 2 mm of construction-related deposition occurred in Second Portage Lake and identified possible changes to surface sediment chemistry (i.e., settled material in the traps contained elevated concentrations of several metals). Surface sediment chemistry results for 2009 did confirm that certain metals had increased in concentration in Second Portage Lake and in Tehek Lake relative to baseline. Thus, concerns in this zone relate primarily to physical smothering and to metals toxicity.

The concerns regarding metals toxicity were directly tested in 2010 using sediment toxicity tests and sequential extraction analysis. Results of amphipod (*Hyalella azteca*) and midge (*Chironomus tentans*) survival and growth endpoints in bioassays showed that surface sediments collected from within or adjacent to the East Dike construction zone (i.e., the zone delineated by the turbidity barriers) were not toxic relative to local reference sediment. The sequential extraction results showed that the most of the metals in the sediment are associated with the residual matrix fraction, which is not considered bioavailable. Consequently, metals toxicity is not likely an issue in Second Portage Lake.

From an physical effects perspective, initial studies on periphyton biomass and community structure in Second Portage Lake conducted in 2009 identified reduced biomass and altered community composition in close proximity to the East Dike (i.e., in an area that would have been exposed to high TSS concentrations in 2008); these differences were not observed in an area exposed to lower TSS concentrations in 2008 (Azimuth, 2010b). Follow-up studies conducted in 2010 provided greater spatial resolution, confirming that effects were limited to the area closest to the East Dike.

For benthic invertebrates, the 2008 CREMP data indicated reduced benthic invertebrate abundances (a marginal trend) in Second Portage Lake (that did not extend to Tehek Lake); this was no longer observed in 2009 (i.e., abundance was similar to baseline), suggesting a short-term physical effect and subsequent recovery. The higher resolution EAS results in 2009 highlighted natural differences between Second Portage Lake (and Tehek) and the control areas (i.e., inherent inter-lake differences). Unfortunately, the 2010 results were contradictory, with the CREMP showing an even bigger drop in 2010 than that observed in 2008 (despite very low TSS exposure in 2010) and the EAS data suggesting further recovery relative to control areas. When considered together, the 2010 CREMP results are likely highly localized and unrelated to TSS.

Available data for potential effects to benthic invertebrate communities in the east basin of Third Portage Lake are also inconclusive. While most results point to the lack of any TSS-related impacts to the community, there have been two successive drops in abundance that coincide with dike construction. However, these "drops" are likely due to natural variability (2009) or a regional trend of decreased abundance and richness (2010).

As for fish and fish habitat, the 2008 results raised concerns regarding physical effects due to sedimentation on high-value habitats. These concerns were raised based on the sediment trap results (discussed above) and on the trout embryo development toxicity (no renewal) test, which suggested that physical settling of particles onto embryos could impair development. Unfortunately, we will have to wait a number of years to determine if there was any impact to the 2009 year class of all key fish species (i.e., lake trout, Arctic char and round whitefish) in Second Portage Lake. Underwater video was used in 2009 to examine high-value fish habitat for evidence of increased sediment deposition; areas close to the East Dike were found to contain more obvious signs of sediment accumulation than areas further away.

TSS EAS studies are scheduled to continue in 2011 with a focus on evaluating the potential effects on periphyton and fish habitat related to the Bay-Goose Dike EAS; the evaluation of benthic invertebrate community will continue at the TPE CREMP station. **Table ES-1** highlights (in **BOLD CAPS**) the activities currently scheduled for 2011, which are summarized below:

- *Periphyton Community* – The 2010 results for Second Portage Lake provided some spatial bounds to the observed depression in periphyton biomass. Given the correlation between mat sediment load and biomass, we recommend that a mat sediment survey be conducted in Third Portage Lake. This will be complemented with underwater video footage collected as part of the fish habitat assessment (below).
- *Benthic Invertebrate Community* – East Dike EAS results largely point to an impact in 2008 and subsequent recovery in 2009, but there is some uncertainty. For the Bay-Goose Dike EAS, there is some uncertainty as to whether any impact occurred due to dike construction. Evaluation of these uncertainties will continue to be assessed through the 2011 CREMP sampling. In addition to the CREMP and EAS studies, supplemental work has been conducted by Ryan Vanengen (AEM) since 2009 as part of his master's research; these results may also address some of the existing uncertainties.
- *Fish/Fish Habitat* – Bay-Goose Dike construction was completed in 2010. As a complement to baseline underwater video filmed in 2009 prior to dike construction, post-construction footage will be collected.

Table 4-1. Conclusions from all TSS Effects Assessment Studies, 2008 - 2010.

TSS EAS Component	East Dike TSS EAS	Bay-Goose TSS EAS
Water Quality and Limnology (studies conducted during major TSS release events (2008 for East Dike; 2009 for Bay-Goose Dike).		
TSS Exposure	Prevailing TSS concentrations at exposure areas in 2008 were estimated to be about 10 mg/L (Sept 13/14, 2008) and 6 mg/L (Sept 24/25, 2008).	Prevailing TSS concentrations at exposure areas in 2009 were estimated to be about 10 mg/L (Sept 17-19, 2009) and 8 mg/L (Sept 24-27, 2009).
Limnology	Elevated TSS reduced water clarity, but did not lead to changes in temperature or dissolved oxygen profiles over depth.	Similar to East Dike TSS EAS.
Water Quality	While certain metals and nutrients were elevated, dissolved concentrations were low and these were associated with particulate matter and not expected to result in direct effects to pelagic aquatic life.	Similar to East Dike TSS EAS.
Field Effects Measurements		
Primary Production - Pelagic ● Chlorophyll- α ● Phytoplankton biomass/taxonomy	Phytoplankton biomass was reduced in exposure areas in 2008. Biomass differences were much less two weeks later, suggesting a short-term effect.	Both phytoplankton biomass and chlorophyll-α were reduced in exposure areas in 2009. However, based on CREMP data they had recovered by November relative to the north and south basins.
Primary Production - Benthic ● Periphyton Community ● Sediment accumulation in mats.	Impacts of sedimentation were observed in Second Portage Lake in close proximity to the East Dike in 2009. Periphyton biomass was reduced in proportion to observed sediment content of periphyton mats. **The 2010 results confirmed these findings and provided better spatial resolution of affected areas.**	This component is scheduled for 2011 (i.e., the year after BG Dike completion). **STUDIES IN 2011 WILL FOCUS ON MAT SEDIMENT SURVEY AND UNDERWATER VIDEO (SEE FISH HABITAT BELOW).**
Secondary Production - Pelagic ● Zooplankton biomass/taxonomy	No differences in zooplankton biomass at exposure areas relative to reference areas.	Higher zooplankton biomass in 2009 in the east basin than observed in 2008 despite TSS exposure.
Secondary Production - Benthic ● Benthic community - Total abundance - Species richness - Simpson's Diversity Index - Bray Curtis Distance ● Surface sediment chemistry (coring) ● Surface sediment geochemistry - Sequential extraction analysis	Based on CREMP data from 2006 to 2009, the only effect identified was a marginal reduction in benthic abundance in Second Portage Lake (SP) in 2008. Abundance at SP improved in 2009 to baseline levels. **The 2010 SP results were somewhat anomolous; a large decrease in abundance was found that was not seen in the 2010 EAS data. This was concluded to be localized and not related to dike construction.** Higher resolution spatial sampling in 2009 did show specific areas in Second Portage Lake to differ from control areas. However, this may be due to inherently lower benthic abundance in Second Portage Lake and Tehek Lake (as seen in the CREMP) . **The 2010 EAS results showed a modest "recovery" at impact areas relative to the 2009 control areas.** Sediment coring conducted in 2009 did identify elevated metals in surface sediments (relative to 2008). **Follow-up studies in 2010 showed no sediment toxicity (see below) that metals were not bioavailable (based on sequential extraction analyses).**	**Based on CREMP data from 2006 to 2010, there has been a drop in benthic abundance and diversity coincident with dike construction. However, these results appear due to very high baseline (2007-2008) levels for both metrics. In 2009, the drop occurred despite low TSS exposure. In 2010, the drop was consistent with a general regional trend of reduced abundance and richness.** **Higher resolution spatial sampling in 2010 showed no differences between the east basin of Third Portage Lake and control areas. However, this may actually represent an effect given the baseline data (i.e., typically higher inherent abundance and richness than other lakes). Additional data should help differentiate these alternatives.** **CREMP SAMPLING (TPE) WILL BE CONDUCTED IN 2011 AS PLANNED.**
Fish/Fish Habitat ● Sediment Traps ● Underwater Video ● Food web (stable isotopes) ● Fish Population	Sediment trap data from open water 2008 and over winter 2008-2009 show increased sedimentation (1 - 2 mm), particularly in proximity to the East Dike. This was confirmed by the underwater video. HVH areas away from the dike were much less affected. 2010 results show some elevated accumulation due to BG Dike inputs. Stable isotope studies confirmed the importance of both benthic and pelagic food webs in 2008.	Sediment trap data show some accumulation (up to 1.1 mm) in proximity of HVH areas in 2009. 2010 results showed similar to higher accumulations (to nearly 2 mm) A subset of traps has been deployed over winter. **WINTER TRAPS RETRIEVED AGAIN IN 2011; PROGRAM ENDING.** Underwater video surveys conducted at HVH areas in the east basin in 2009 prior to construction; **THESE WILL BE RESURVEYED IN 2011.**
Laboratory Effects Measurements		
Zooplankton ● Lethal - *Daphnia magna* 48-hr LC50 ● Sublethal - *Ceriodaphnia dubia* 7-day growth/survival/repro	No direct effects were observed in toxicity tests of surface waters.	No direct effects were observed in toxicity tests of surface waters.
Fish ● Lethal - Rainbow trout 96-hr LC50 ● Sublethal - Rainbow trout embryo 7-day (w/out renewal) ● Sublethal - Rainbow trout embryo 7-day (with renewal) ● Sublethal - Rainbow trout swim-up larvae 7-day surv/growth	No effects were found for juvenile and larval tests. No effects were also seen in the standard (with renewal) embryo development test. Impaired development was seen in test without renewal, which suggests that physical settling of sediments could harm developing embryos.	No direct effects were observed in toxicity tests of surface waters.
Benthic Invertebrates (Sediment) ● Lethal/sublethal - *Hyalella azteca* 14-d survival/growth ● Lethal/sub - *Chironomus tentans* 10-d survival/growth	**No adverse effects in 2010 to survival or growth for amphipods (*Hyalella azteca*) or midges (*Chironomus tentans*) at impact areas relative to control areas. Sediments tested in Second Portage Lake are not toxic.**	

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APPENDICES

Appendix A – Statistical Analyses for TSS Effects Assessment Study 2010

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APPENDICES

1. INTRODUCTION

This appendix documents the statistical analyses conducted to support the 2010 TSS Effects Assessment Study (EAS) for the Meadowbank Mine. The 2010 EAS included components targeting potential environmental effects of East Dike construction in 2008 and Bay-Goose Dike construction in 2009 and 2010. This appendix is organized as follows:

- **Section 2** – presents an overview of the general approach used for statistical analysis of the EAS data set.
- **Section 3** – presents the results of the 2010 benthic invertebrate studies related to construction of both the East Dike and the Bay-Goose Dike.
- **Section 4** – presents the results of the 2010 periphyton studies related to East Dike construction.

This appendix must be read along with the main report, because (1) raw data and basic descriptive statistics and graphs presented in the report are not generally repeated in the appendix, and (2) the main report provides an integrative assessment of these results.

2. GENERAL STATISTICAL APPROACH

2.1. Overview

All statistical analyses were conducted using R software (v. 2.10.1). Further information on all methods used in this appendix can be found in Dalgaard (2008), Pinheiro and Bates (2000), Venables and Ripley (2002), Gelman and Hill (2006), and Zar (1984).

The following process was generally followed for each response variable[1]:

(1) Individual replicates were plotted by area (and year if applicable). These plots were used to get a sense of the general response pattern and natural variability within and among areas (years). Plots were also used to identify potential outliers.

(2) Model assumptions of normality and homogeneity of variance were tested formally using Shapiro-Wilk's and Bartlett's tests, respectively. In cases where either failed, four transformation options were evaluated: square root, fourth root, $\log_{10}$, and $\log_{10}(y+1)$. The selected option is displayed in the results tables for each response variable.

[1] Note that names were generally capitalized when referring specifically to a variable and not capitalized when making general references to the factors they represent.

(3) In cases where none of the basic transformation options were sufficient to meet model assumptions, the Box-Cox method (Pinheiro and Bates 2000) was used to determine an optimal transformation.

(4) Hypotheses regarding adverse changes to response variables were tested using one of the following two general models (each explained further in **Section 2.2**):

   a. Spatial control-impact (CI) model

   b. Spatial-temporal before-after, control-impact (BACI) model

(5) Statistical significance was based on $\alpha = 0.05$ (see **Section 2.3** for more information). In addition, p values between 0.05 and 0.15 were highlighted as "marginal trends." Note that effect sizes[2] and associated confidence intervals are typically provided to help interpret the results and put non-significant results into perspective.

(6) Model assumptions were retested using visual methods (e.g., examination of model residuals and quartile-quartile plots). Where model assumptions were not fully met, several model variations were explored to determine the implications of the situation for model output; these options are explained further in the text.

2.2. Statistical Models

This section presents the basic model structure for CI and BACI type statistical models. Variations on these themes used for specific analyses are documented in the results sections.

Spatial (CI-type) – Model 1

This model is used to test for differences between control (C) and impact (I) areas. This is used when there is no temporal component to the study design. The C and I aspects of the design are coded into a single effect variable (i.e., a dummy variable with levels for each type of station). At Meadowbank, the CI designs usually incorporate multiple C and/or I areas. Note that when multiple I areas occur in the design, the effect coding can be the same for both or different to reflect different exposure levels (e.g., a simple exposure gradient). Basic model format is a two-factor model (i.e., response is a function of area + effect + error), which is formally represented as follows:

(1)
$$X_{jrs} = \mu + \beta_j + \gamma_{r(j)} + \varepsilon_{jrs}$$

where:

X_{jrs} is the response associated with subsample *s* at Area *j*, which has Effect level *m*

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[2] Effects sizes are typically reported in absolute terms (e.g., a negative value means a drop in a value relative to what would have been expected in the absence of an effect).

μ is an intercept term

β_j is the coefficient for Area *j*

$\gamma_{r(j)}$ is the coefficient for Effect level *r* associated with Area *j*

ε_{jrs} is the error term where *s* denotes the number of subsamples taken in each Area *j*

This model is coded in R as follows (where "y" is the response variable):

lm (y ~ Area + Effect)

Spatial-Temporal (BACI-type) - Model 2

This study design is an extension of the basic BACI approach (e.g., Underwood 1991, 1992, 1994). While the actual designs at Meadowbank are not necessarily the same across response variables, all have the same general factors: Area, Year, an Effect variable coded to distinguish two or more TSS exposure levels (e.g., 0 = not exposed, 1 = exposed; or 0 = none, 1 = minor exposure and 2 = major exposure) across years. This results in a three-factor additive model (i.e., response is a function of Area + Year + Effect + error). In addition, we also include a term for Area:Year interactions to properly characterize patterns of inter-annual variation that innately differ among areas (not just between the ones we are testing with the variable 'Effect'), therefore. The model then becomes:

(2) $$X_{kjrs} = \mu + \beta_j + \tau_k + \gamma_{r(kj)} + (\tau\beta)_{kj} + \varepsilon_{kjrs} \ .$$

where:

X_{kjrs} is the response associated with subsample *s* in Year *k* at Area *j*, which has Effect level *r*

μ is an intercept term

β_j is the coefficient for Area *j*

τ_k is the coefficient for Year *k*

$\gamma_{r(kj)}$ is the coefficient for effect level *r* associated with Year *k* and Area *j*

$(\tau\beta)_{kj}$ is the Area:Year interaction term

ε_{kjrs} is the error term where *s* denotes the number of subsamples taken for each Area-Year (*jk*) combination

This model can be coded in R in the following ways (depending on whether or not the design is balanced [i.e., same number of replicates in all Area-Year combinations]) (where "y" is the response variable):

- Balanced: lm (y ~ Area * Year + Effect)
- Unbalanced lmer (y ~ Area + Year + Effect + (1|Area:Year))

For balanced designs, both of these models yield the same coefficients for the fixed effects.

2.3. Determining Statistical Significance

As described above, the determination of statistical significance in these analyses relied on evaluating p values relative to $\alpha = 0.05$ ("marginal trends" were highlighted with $0.05 < p < 0.15$). It is important to note that estimation of p values is dependent on the interpretation of the study design and the primary inferences being made, which ultimately dictate the statistical degrees of freedom. Inappropriately defined experimental units can lead to pseudoreplication (Hurlbert, 1984), which is the use of inferential statistics to test impact effects when either treatments are not replicated or replicate samples are not temporally or spatially independent.

Hurlbert (1984) described several types of pseudoreplication: simple, sacrificial, temporal, and implicit. For the purposes of this discussion, we focus on the first two:

- *Simple pseudoreplication* – is the lack of independent replication of study treatments. Replication can be considered as the <u>independent</u> application (or occurrence) of the <u>same</u> treatment. As recognized by Stewart-Oaten et al. (1986, 1992), accidental environmental perturbations rarely occur in an independent, yet similar, manner. Thus, we are usually left with attempting to make inferences regarding the effects of the perturbation without proper replication. Statistical comparisons between control and impact areas are ultimately confounded by possible inherent differences between the areas that would exist in the absence of the perturbation. Consequently, inferences regarding impact-related differences between control and impact areas are only as strong as the evidence available to support the fundamental assumption that the areas were similar prior to the perturbation; this is particularly important for control-impact (CI) designs where no data were available prior to the perturbation.

- *Sacrificial pseudoreplication* – occurs when treatments are replicated, but where the subsample data for replicates are pooled (thus sacrificing information regarding true within-treatment variance) for analysis or where measurements taken within experimental units (i.e., subsamples) are treated as independent replicates (Hurlbert, 1984). The primary implication of sacrificial pseudoreplication is its effect on the estimation of error through the inflation of its degrees of freedom, which ultimately lowers the p value of the fixed effects being tested.

Although they are quite different in their nature, the end result of both types of pseudoreplication is the increased probability of Type 1 error (i.e., incorrectly concluding that a difference exists, a "false positive").

Due to the nature of the EAS (i.e., determining the potential effects of construction-related sediment inputs), the study designs used in the EAS are not immune to pseudoreplication. From a practical perspective, the assessment of unplanned impacts has to acknowledge the reality of some level of pseudoreplication associated with the lack of proper treatment replication and employ strategies to deal with the non-independence among samples (Wiens and Parker, 1995). The following are examples of the main strategies used to minimize the influence of pseudoreplication on EAS conclusions:

- *"Replication" of Treatments* – While true replication of the treatments was not possible, the extent of elevated TSS in the receiving environment often allowed multiple areas to be sampled within the zone of elevated TSS. Coupled with multiple control areas, this reduced (but did not eliminate) the potential for natural differences between control and impact treatments to drive conclusions.
- *Verifying Area Similarity Prior to Treatment* – For CI designs (i.e., no "before" data), information from other monitoring programs (where available) was used to assess the validity of the assumption that control and impact areas were similar prior to exposure to elevated TSS.
- *Scale of Inference and the Independence of Samples* – The scale of inference was matched to the study design. When inferences were made regarding differences between control and impact groups, then the degrees of freedom for the

Basic EAS CI Study Designs

The following represent the general hierarchy present in most of the EAS CI-type study designs. Design specifics are discussed later in the text for each study component.

Control – Impact Grouping
Sampling "Areas" (see below) were grouped according to whether or not they were exposed to elevated TSS concentrations.

Within C or I Groups
Multiple Areas were usually sampled within the above groupings.

Within Areas
Multiple measurements were randomly taken within areas.

Basic EAS BACI-type Study Designs

In addition to the sampling hierarchy used in the spatial CI designs (see previous text box), the BACI-type design also included the element of time, as follows:

Before – After Grouping
Sampling "Years" (see below) were grouped according to whether or not the impact treatment had occurred.

Within B or A Groups
Multiple Years (some or all Areas) were sometimes sampled within the above groupings.

error term (see below for more information) was based on the Areas as the experimental unit (rather than on the number of subsamples taken in each Area). In contrast, where study design constraints prevented this scale of inference, conclusions were made regarding differences among areas (with degrees of freedom based on subsamples), with a qualitative discussion of the potential influence of TSS across the collective pool of impact areas.

In light of the previous discussion, careful consideration was given to how the statistical models were structured so that the p values were estimated in an appropriate manner for the intended scale of inference. Depending on the R package used to run the statistical model, the desired p values (and associated degrees of freedom) were either included directly as part of the model outputs (e.g., for lm or lme functions) or they were calculated in R (see below) based on the model outputs (for coefficient estimates and standard errors) and on our calculated degrees of freedom (e.g., for lmer function).

R's lme4 package for mixed-effects modeling does not include p values or degrees of freedom in model outputs[3]. Consequently, these were calculated in R after determining the appropriate degrees of freedom.

The following table shows the general formulations for the degrees of freedom and expected mean-squared error (E[MS]) for various model terms (note that CI designs would not include year as an element [or an interaction term] unless multiple "after" years were sampled; model terms as per **Section 2.2**):

Term	Levels	Df	E[MS]
Effect (γ)	$r = 1, 2, \ldots, R$	$R - 1$	$\sigma^2 + Q + SK\sigma_\beta^2 + S\sigma_{\tau\beta}^2$
Area (β)	$j = 1, 2, \ldots, J$	$J - R$	$\sigma^2 + SK\sigma_\beta^2 + S\sigma_{\tau\beta}^2$
Year (τ)	$k = 1, 2, \ldots, K$	$K - 1$	$\sigma^2 + SJ\sigma_\tau^2 + S\sigma_{\tau\beta}^2$
Interaction ($\beta\tau$)		$(J - 1)(K - 1)$	$\sigma^2 + S\sigma_{\tau\beta}^2$
Error (ε)	$s = 1, 2, \ldots, S$	$(S - 1)JK$	σ^2

For a mixed-effects CI model with Effect as the fixed effect and Area as the random effect, overall significance of the Effect term would be tested by defining the appropriate F ratio as MS[Effect]/MS[Area] with degrees of freedom = (R -1), (J - R). For R = 2 (e.g., only two levels of Effect, control and impact), this provides the same result as the t-test for the treatment coefficient γ with degrees of freedom = $J - R$. If R > 2 (e.g., when

[3] The primary reason for omitting these results is to avoid errors in model output. Mixed effect models can be quite complex, making estimation of the degrees of freedom statistically challenging. While there are computational methods that work for most situations, they fail to produce appropriate results in certain cases. Methods for determining the appropriate degrees of freedom for the simple mixed-effects models documented in this report are well established.

multiple impact areas were coded separately [0 for control areas and 1, 2, … for impact areas) to allow estimation of impacts at specific areas, then each *t*-test comparing the specific impact level to controls would have df = $J – R$.

For a mixed-effects BACI model with Year and Effect as fixed effects and Area-Year as the random effect, overall significance of the Effect term would be tested by defining the appropriate *F* ratio as MS[Effect]/MS[Area*Year]. Numerator degrees of freedom are the same as discussed for the CI example, $R – 1$. The calculation of denominator degrees of freedom starts with $(J - 1) * (K - 1)$, then subtracts the Effect coefficients ($R – 1$), then subtracts 1 for each Area-Year combination missing from the data set (e.g., for unbalanced designs). Again, for R = 2 (e.g., only two levels of Effect, control and impact, where the latter are specific Area-Year combinations exposed to elevated TSS), this provides the same result as the *t*-test for the treatment coefficient γ using the denominator degrees of freedom. Also, if R > 2, then the denominator degrees of freedom would be used in each *t*-test comparing the specific impact level (e.g., Area SP in 2008) to controls.

In R, p values for the overall *F*-test for the Effect term were determined as follows:

```
p.value = 1-pf(F.ratio, df1=df1, df2=df2))
```

where:

pf is an R function that gives the *F* distribution function

F.ratio is the *F* ratio from the model ouput

Df1 is the numerator degrees for freedom for the *F*-test (see text above)

Df2 is the denominator degrees of freedom for the *F*-test (see text above)

For *t*-tests of specific Effect levels relative to controls, the p values were determined using the following R code:

```
p.value = 2 * (1-pt(abs(t.stat), Df=df2))
```

where:

pt is an R function that gives the Student t distribution

t.stat is the t statistic from the model output

Df is the appropriate degrees of freedom

3. BENTHIC INVERTEBRATE COMMUNITY STUDIES - 2010

3.1. Study Design Overview

The following provides an overview of basic study design information for each component:

- *CREMP Benthic Invertebrates* – CREMP monitoring has been conducted since 2006 at a number of lakes surrounding the Meadowbank Mine. As such, it includes pre-development baseline data and thus provides context regarding spatial and temporal variability in the benthic community. The data set has been used to complement the finer-resolution EAS data sets to aid in the interpretation of the EAS results. The CREMP areas relevant to this year's EAS are shown in **Figure A3-1**[4]. The potential for mining-related impacts in each sampling area has been tracked annually since the construction phase of the development started in 2008. The status of specific areas over time is shown in **Table A3-1**. This data set was used to test for specific area-year impacts relative to control area-years and for specific longer-term impacts by area (i.e., for areas where more subtle, but prolonged, effects may have occurred). Details on Effect coding are provided in the results in **Section 3.2.1**. The BACI (Model 2) model was used for the analysis to test for both types (i.e., single-year and multi-year) of effects.

- *East Dike EAS Benthic Invertebrates* – This is the second of a two-year follow-up benthic community monitoring program targeting the potential effects of sedimentation related to construction of the East Dike. While this data set consists entirely of "after" sampling, the BACI model (Model 2) was used to look for two types of differences: spatial differences between control and impact areas, and spatial-temporal differences (e.g., determining the presence of a recovery signal among impact areas relative to control areas). This program is complementary to the broader-focused CREMP (see next bullet) in that intent of this component was to provide higher-resolution information (e.g., spatial extent of effects within Second Portage Lake). However, similar to last year, the East Dike EAS data set was expanded to include relevant CREMP areas. Not only does the CREMP addition increase the power of the statistical analyses, but it also serves to facilitate data interpretation (e.g., since temporal and general spatial trends are better characterized in the CREMP). The expanded data set includes six control areas (two from the EAS [SP-DT, TP-E3] and four from the CREMP [INUG,

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[4] The Baker Lake areas and Wally Lake were not included. Baker Lake has a marine influence and is substantially different from the Meadowbank project lakes. Wally, which is one of the Meadowbank project lakes, was not included as it is inherently different (e.g., shallower and more productive) than the other project lakes.

PDL, TPS, TEFF]) and six impact areas (four from the EAS [SP-N1, SP-N3, SP-F1, SP-F2) and two from the CREMP [SP and TE]) (see **Figure A3-1** for CREMP areas and **Figure A3-2** for East Dike EAS areas). The availability of two years of data allowed us to test for evidence of a recovery at impact areas in 2010 using Model 2. Details are provided in **Section 3.2.2**.

- *Bay-Goose Dike EAS Benthic Invertebrates* – This was the first of a two-year post-construction benthic community monitoring program targeting the potential effects of sedimentation related to the construction of the Bay-Goose Dike in 2009 and 2010. The data set consists entirely of "after" data for a single year (2010). Consequently, the CI model (Model 1) was used to try to detect spatial differences between control and impact areas. Similar to the East Dike EAS data set, the Bay-Goose Dike data set was expanded to include relevant CREMP areas. The expanded data set includes six control areas (two from the EAS [SP-DT, TP-E3] and four from the CREMP [INUG, PDL, TPS, TEFF]) and six impact areas (three from the EAS [TP-E1, TP-E2, TP-HVH4) and three from the CREMP [SP, TE and TPE]; see **Figure A3-1** for CREMP areas and **Figure A3-3** for Bay-Goose EAS areas). Details are provided in **Section 3.2.3**.
- *Benthic Community Structure Drivers* **–** The available data sets (i.e., CREMP and EAS, across years) were combined to help identify key factors in driving benthic community structure. It is well known that physical factors (e.g., depth, grain size, organic carbon content) and chemical factors (e.g., metals concentrations) can play a significant role in structuring the benthic community. This portion of the study looked at the relative importance of these natural factors and of total suspended solids (TSS; as a surrogate for construction-related sedimentation) using a linear regression approach. Results are presented in **Section 3.2.4**.

3.2. Results

Response variables for all benthic community analyses were selected to match the guidance of Environment Canada (2002), as follows (see main EAS report for details regarding each variable):

- Total abundance (#/m^2; this is actually density) of all taxa
- Total species richness (# taxa/sample)
- Simpson's diversity (D)
- Bray Curtis Distance (BC)

3.2.1. CREMP

Summary data for these variables are presented in **Table A3-2** (the raw data file is provided in **Appendix A1**). Results by Area and Year for each variable are shown in **Figure A3-4**, highlighting Area-Year combinations (dark points) potentially impacted by mining activities.

Statistical analyses focused on testing specific Area-Year combinations against the rest of the data set. Two “Effect” dummy variables were coded (for separate analysis) based on **Table A3-1**: one targeting single-year effects (**Table A3-3**) and the other multi-year effects (**Table A3-4**). Rationale for Effect codes were as follows:

- *TE and SP* – These areas were exposed to elevated TSS concentrations in 2008 and are the main focus of these analyses. While exposure concentrations were much lower in 2009 and 2010, they remain impact areas.
- *TPE* – In 2009, this area was sampled on August 13/14, which was during construction of the first phase of the Bay-Goose Dike (monitoring results showed that TSS concentrations had increased relative to background). Consequently, while TSS exposure was relatively low, this area was designated as “impact” starting in 2009.
- *TPN* – Dewatering discharges from the NW Arm of Second Portage Lake were directed into this basin from March through early July 2009. While CREMP water quality monitoring results for that basin showed negligible exposure conditions, the area was conservatively designated as an impact area for 2009. While not directly related to dike construction activities, TSS is the major constituent of interest in the dewatering effluent and therefore relevant to the EAS.

Model 2 (unbalanced design) was used to identify statistically significant ($p<0.05$) differences between the base Effect levels (i.e., the control Area-Year[s] combination; see **Tables A3-3 and A3-4**) and each subsequent Effect level (i.e., each impact Area-Year[s] combination) (note that PDL and TEFF, while shown in many graphs, were not included in the analyses as these areas were only added in 2009). In cases where key model assumptions (i.e., normality and equality of variance) were not fully met, between two and five model variations were tested to assess the potential implications on the robustness of the conclusions. These included various combinations of basic vs. advanced transformations (e.g., log10[x] vs Box-Cox results for abundance), with/without certain outliers (identified in plots of various model output diagnostics) removed and with explicit modeling of heterogeneous within-group variances (see Heteroscedasticity Modeling in **Section 3.2.2** for more information). In general, the analyses were robust to observed variations from key model assumptions; results of these secondary analyses were only reported when they would result in substantive changes to a conclusion regarding effects.

Results for short-term and long-term effects are reported in **Table A3-5** (2008 & 2009; single-year effects), **Table A3-6** (2010; single-year effects) and **Table A3-7** (2008-2010 or 2009-2010; multi-year effects) each benthic community metric. Graphical representations of the analyses are shown in two ways: box-whisker plots for the Effect groupings (**Figures A3-5 and A3-6**) and Area-Year interaction plots for each response variable (**Figures A3-7 through A3-10**). Key results for each area are as follows (followed by a brief discussion of uncertainty):

- *SP (2008, 2009, 2010, and 2008-2010)* – As reported for the past two years, the 2008 EAS (Azimuth, 2009) reported a marginal trend (0.05<P<0.1) for decreased total abundance at SP that did not extend to TE (see **Table A3-4**). As shown in **Figures A3-4, A3-5 and A3-7**, abundance at SP rebounded in 2009 to slightly below "no-effect" predictions for that area and within the range of SP baseline results (i.e., 2006 – 2007). The 2010 results are similar to those seen in 2008, with >50% reduction in abundance compared to what was expected. Given the single year results, it was not surprising to find a significant multi-year adverse effect for abundance at SP. There were no significant reductions in taxa richness, Simpson's Diversity[5] or Bray Curtis distance for the short-term or long-term effects. Overall, the 2010 results for abundance at SP are unexpected and warrant further discussion after analysis of the higher-resolution East Dike EAS data set.
- *TE (2008, 2009, 2010, and 2008-2010)* – As discussed above, the marginal trend in abundance observed in 2008 at SP did not extend to TE (for abundance or any other response variable; see **Tables A3-5 through A3-7**). The other single-year (2009 and 2010) and the multi-year (2008-2010) results confirm that finding and reaffirm that there does not appear to be any significant changes at TE related to mining activity. **Figure A3-4** probably shows this the best for all response variables. Most results for TE since 2008 are within the range of baseline results. The two low Simpson's Diversity results for TE in 2009 are due to replicate samples that contained relatively high numbers of sphaerid clams, which substantially reduced the diversity scores for those replicates (but not richness).
- *TPE (2009, 2010 and 2009-2010)* – Given that this area is up-gradient of the East Dike and in the same basin (i.e., East Basin of Third Portage Lake) as the Bay-Goose Dike, the results for this area are most relevant for the Bay-Goose EAS. The main trends seen at this station were a decrease in benthic invertebrate abundance (not significant for 2009 or 2010 separately [**Tables A3-5 and A3-6**], but significant for the 2009-2010 multi-year effect [**Table A3-7**]) and an increase in Simpson's Diversity (marginal for 2010 [**Table A3-6**] and significant for 2009-2010 [**Table A3-7**]). The overall results for abundance are heavily influenced by the 2008 data, where abundance and richness were anomalously elevated relative to what would be expected in that basin (see **Figures A3-7 and A3-8**).

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[5] Simpson's diversity index is sensitive to how organisms are allocated across taxa, not to the number of taxa.

- *TPN (2009, 2010 and 2009-2010)* – As discussed above, this area was potentially exposed to elevated TSS during dewatering of the NW arm of Second Portage Lake starting in March 2009. Based on CREMP water quality (Azimuth, 2010b; 2011a) and Bay-Goose dike construction (Azimuth, 2010c) monitoring, TSS exposure in the north basin was likely low, suggesting that adverse effects to the benthic community would be unlikely. This was confirmed by the CREMP benthos results, which showed no significant adverse effects. The only significant changes observed were increases for richness (2010; **Table A3-6**) and Simpson's Diversity (2009-2010; **Table A3-7**).

As discussed in **Section 2**, effect sizes and associated confidence intervals help to place the observed results in to perspective. As seen in **Table A3-7**, the confidence intervals associated with reported effect sizes were quite large in a number of cases (i.e., reflective of high uncertainty in the estimated effect size). These confidence intervals are due to the fairly high degree of spatial and temporal variability that exists naturally in this region. The larger the confidence interval, the larger the effect size required for a statistically significant result (i.e., lower power). The degree to which the confidence interval extends above zero (or below for an adverse positive change, such as Bray Curtis distance) is a rough measure of how much larger an effect would have needed to be in order to be considered statistically significant.

The implication of this situation is that statistical significance should not be the only consideration when evaluating these results. As per previous year's EAS reports (Azimuth 2009a, 2010a), which highlighted the decrease in abundance at SP in 2008, marginal trends have been highlighted even when P values exceed 0.05. A variety of graphical methods have also been used to help visualize what the statistical models are actually testing.

The observed changes in the CREMP data set will be discussed in more detail in **Section 3.6.5** of the main EAS document using a weight-of-evidence approach.

3.2.2. East Dike EAS Benthic Invertebrates

Summary data for these variables are presented in **Table A3-8** (the raw data file is provided in **Appendix A1**). Results by Area for each variable are shown in **Figure A3-9**; point shape (square for control and round for impact) and fill (none for all areas in 2009, grey for control areas in 2010 and black for impact areas in 2010) are used to highlight potential spatial and temporal trends.

Given that the major TSS release into Second Portage Lake occurred during East Dike construction in 2008, this analysis focused on:

- Assessing whether there is evidence of a prolonged difference between control and impact areas (i.e., indicating potential TSS-related effects).

- Determining whether the data indicate that a recovery has occurred between 2009 and 2010 at impact areas (i.e., as shown by a differential improvement at impact areas relative to control areas).

Given that the spatial control-impact analysis primarily compares Second Portage Lake areas (and one Tehek Lake area) to other lakes, observed spatial differences could be related to inherent lake-specific factors (e.g., productivity) rather than to TSS exposure. The identification of a recovery at the impact areas, however, would provide stronger evidence that observed differences between control-impact areas in 2009 were likely related to TSS exposure. Ultimately, the strongest inferences regarding potential TSS-related impacts to the benthic community can be made by considering any trends identified in the East Dike EAS dataset with the results of the CREMP and Bay-Goose EAS data sets (see **Section 3.6.5** of the main EAS document). Consequently, the remainder of this section focuses on results and leaves further interpretation to later in the report.

A variation of Model 2 was used to analyze this data set (R code: lmer (y ~ Effect*Year + (1|Area) + (1|Area:Year))). In this model, Effect was a dummy variable coded with two levels: control (INUG, PDL, TPS, TEFF, SP-DT) and impact (TE, SP-F1, SP-F2, SP, SP-N1, SP-N2, SP-N3); Year is a factor with levels 2009 and 2010; and the other two are random effects terms characterizing variability associated with Area (i.e., differences related to Area, regardless of Year) and Area:Year (i.e., differences related to specific Area/Year combinations). The interaction term Effect*Year is of particular interest to test for differential changes at impact (I) areas over time relative to control (C) areas (i.e., as would occur if a recovery were occurring).

Results of statistical analyses are presented in **Table A3-9**. Between one and four model variations were tested for each response variable to assess the robustness of conclusions and the potential implications of minor violations in model assumptions. These included various combinations of basic vs. advanced transformations (e.g., log10[x] vs log10[x+230] for abundance) and with/without certain outliers removed. Where the inclusion/exclusion of specific outliers affected the conclusions regarding model results, the specific cases are discussed in more detail to help understand the implications on the conclusions. Results reported in **Table A3-9** are for the following combinations (unless otherwise noted): abundance (advanced transformation:no outlier removal), richness (no transformation:no outlier removal), Simpson's Diversity (no transformation:no outlier removal), and Bray Curtis Distance (log10 transformation:no outlier removal). Where advanced transformations still failed to meet model assumptions in formal testing, model residuals were plotted and examined for major patterns.

Key results[6] from **Table A3-9** are as follows:

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[6] Magnitude of response for Effect and Year are shown relative to Control areas in 2009.

- *Total abundance* – There was a significant difference in Effect (C vs. I areas; $p<0.05$), with the impact areas being 36% lower in abundance. While this difference may be attributable to TSS exposure, it could also be due to inherent differences in Second Portage Lake. There was also a significant difference for Year, with a 37% drop between years. This is consistent with the results of the CREMP, which showed this fairly consistently across the project lakes. The Effect*Year interaction, which tests for differential changes over time at C and I areas (e.g., a potential recovery) was marginal ($0.05<p<0.15$) for total abundance, showing a recovery magnitude of 43% (but with confidence intervals including a "no recovery" possibility).
- *Total taxa richness* – Similar to abundance, significant decreases in total species richness were detected for Effect (32% drop in richness at I areas; $p<0.001$) and Year (20% drop in richness in 2010). The Effect*Year results show a recovery trend with a magnitude of 28% ($0.05<p<0.15$; confidence intervals barely overlap the "no recovery" possibility).
- *Simpson's Diversity* – Caution must be used interpreting these results as model assumptions were not met and none of the transformation options assessed (typical or advanced) worked. The results showed a modest (-8%), but significant ($p<0.05$), reduction at impact areas for Effect. The 5% drop in 2010 for Year was not significant. The Effect*Year interaction results showed no evidence for a recovery at impact areas in 2010.
- *Bray Curtis Distance* – This metric showed significant differences for Effect (impact areas 14% "further away" from control areas) and Year (2010 areas "further away" than 2009 areas). The Effect*Year interaction term results showed no evidence for a recovery at impact areas in 2010.

The observed changes in the ED EAS data set will be discussed in more detail in **Section 3.6.5** of the main EAS document using a weight-of-evidence approach.

3.2.3. Bay-Goose EAS Benthic Invertebrates

Summary data for these variables by Area are presented in **Table A3-10** (the raw data file is provided in **Appendix A1**). Results by Area for each variable are shown in **Figure A3-12**.

Statistical analyses focused on testing differences between control and impact areas. The "Effect" dummy variable for was coded with two levels: controls (INUG, PDL, TPS, TEFF, SP-DT, and TP-E3) and impact (TP-E1, TP-E2, TPE, and TPL-HVH4). Boxplots of response variables by Effect grouping are shown in **Figure A3-13**.

Model 1 was modified to a mixed-effects model (Pinheiro and Bates 2002) by considering Area as a random effect (R code: lmer (y ~ Effect + (1|Area))). This was done to ensure that Effect term was compared to the appropriate denominator degrees of freedom (see **Section 2.2 and 2.3**) Results of statistical analyses are presented in **Table**

A3-11. Model assumptions were generally met for all four response metrics, so only the model was run only once per metric (i.e., model variations with different transformations or with outlier removal were not needed). No significant differences were found between control and impact groups for any response variable. Given that this is based on one year of data only, we cannot rule out the possibility that the impact areas may have had healthier communities in past years (i.e., that the real effect size was much larger). This possibility will be explored more in **Section 3.6.5** of the main EAS document.

3.2.4. Potential Influence of Physical and Chemical Parameters

Benthic invertebrate communities are known to be strongly influenced by physical variables (e.g., grain size, total organic carbon [TOC] and depth) and chemical variables (aluminum, arsenic, cadmium, chromium, copper, and zinc were selected as they typically exceed CCME sediment quality criteria and/or they have been singled out in previous EAS studies). While the studies were designed to minimize differences in the physical variables (e.g., by selecting areas with similar sediment characteristics and depth), formal comparisons were made between each response variable (means for each area/year combination) and a number of physical and chemical variables (typically sampled once per area/year) to determine the extent to which the latter were important in shaping the former.

This analysis looked at all 2009 and 2010 data where benthic invertebrate samples were collected synoptically with sediment chemistry. There were a total of 33 cases, for which the physical and chemical variables have been summarized in **Table A3-12**; benthic data for those area/year combinations have been previously summarized in **Tables A3-2, A3-8 and A3-10**. The results of linear regression analyses (i.e., predicted fit plus/minus 95% confidence intervals) are shown in **Figures A3-14 to A3-16**. Given that 44 relationships were tested (four benthic community metrics x 11 physical/chemical variables), a Bonferroni correction was made to the critical p-value (0.05/44 = 0.001) to properly set the Type 1 error (i.e., “false positives”) rate. None of the relationships had p-values within an order of magnitude of 0.001 (based on both Spearman [non-parametric] and Pearson [parametric] correlations), so none were considered statistically significant.

The results above indicate that general physical and chemical differences among area/year combinations were unlikely to be responsible for any observed trends (see preceding sections) in benthic community metrics. For the physical factors, this also validates efforts to minimize differences among areas in grain size and depth across all studies (CREMP and EAS).

Table A3-1. Area "effect" status by year for CREMP data set.

(Note: Only CREMP areas relevant to 2010 EAS are shown.)

Year	INUG	PDL	TPS	TEFF	SP	TE	TPE	TPN
2006	C		C		C		C	
2007	C		C		C	C	C	C
2008	C		C		I	I	C	C
2009	C	C	C	C	I	I	I	I
2010	C	C	C	C	I	I	I	I

Note: 1. Area designations: C = control; I = impact.

Table A3-2. Benthic invertebrate descriptors by sampling area and year for the CREMP data set.

		Depth					Abundance					Richness					Simpson's Diversity Index					Bray Curtis Index				
Area	**Year**	**Mean**	**SD**	**Med**	**Min**	**Max**	**Mean**	**SD**	**Med**	**Min**	**Max**	**Mean**	**SD**	**Med**	**Min**	**Max**	**Mean**	**SD**	**Med**	**Min**	**Max**	**Mean**	**SD**	**Med**	**Min**	**Max**
INUG	2006	8	0	8	8	8	761	264	717	522	1043	10.3	2.5	10	8	13	0.82	0.02	0.82	0.81	0.84	0.60	0.06	0.61	0.54	0.66
INUG	2007	9.1	1.1	9.6	7.8	10.1	1022	393	848	783	1717	11.8	0.8	12	11	13	0.85	0.03	0.86	0.79	0.87	0.55	0.06	0.56	0.47	0.63
INUG	2008	9.4	1.9	8.7	8	12.6	1900	1975	1239	391	5326	13.8	3.7	14	8	17	0.87	0.05	0.86	0.79	0.92	0.60	0.12	0.57	0.49	0.77
INUG	2009	7.3	0.5	7	6.9	7.9	1191	407	1130	630	1630	13.6	3.1	15	8	15	0.85	0.06	0.88	0.74	0.90	0.46	0.03	0.48	0.43	0.49
INUG	2010	7.7	0.9	8	6.7	8.7	639	133	630	478	783	8.4	2.5	7	6	12	0.75	0.07	0.77	0.64	0.81	0.58	0.10	0.54	0.45	0.72
PDL	2009	7.7	0.5	7.5	7.2	8.3	1726	999	1348	761	3326	10.8	0.8	11	10	12	0.78	0.10	0.81	0.61	0.88	0.54	0.11	0.52	0.41	0.69
PDL	2010	6.9	0.5	6.8	6.5	7.7	896	484	1043	348	1500	8.4	0.5	8	8	9	0.75	0.11	0.77	0.58	0.88	0.65	0.04	0.65	0.61	0.71
TPS	2006	8.7	0	8.7	8.7	8.7	971	305	1065	630	1217	10.7	1.5	11	9	12	0.86	0.04	0.87	0.81	0.89	0.51	0.06	0.49	0.46	0.57
TPS	2007	9.1	1.3	8.4	8.3	11.4	2100	1961	1130	826	5500	9.8	3.1	9	7	14	0.80	0.08	0.83	0.66	0.86	0.60	0.04	0.61	0.55	0.66
TPS	2008	10.1	1	9.9	9.1	11.7	1604	552	1674	696	2043	10.6	1.5	10	9	13	0.76	0.10	0.78	0.62	0.88	0.58	0.05	0.59	0.52	0.65
TPS	2009	7.8	1.1	7.3	6.8	9.7	1961	1035	2022	717	3326	10.4	1.3	11	8	11	0.82	0.08	0.84	0.72	0.92	0.52	0.07	0.52	0.40	0.60
TPS	2010	7.6	0.7	7.6	6.7	8.4	1296	667	1587	565	1870	8.2	2.8	9	5	12	0.76	0.08	0.77	0.63	0.84	0.55	0.07	0.57	0.47	0.63
TEFF	2009	7.1	0.5	6.9	6.6	7.8	1235	249	1196	978	1543	10.4	1.8	11	8	12	0.84	0.04	0.84	0.78	0.88	0.47	0.04	0.45	0.43	0.52
TEFF	2010	7.3	0.5	7.4	6.6	8	922	298	935	652	1391	10.8	2.4	11	8	14	0.80	0.06	0.81	0.69	0.85	0.49	0.04	0.51	0.42	0.53
SP	2006	7.8	0.0	7.8	7.8	7.8	623	91	652	522	696	6.3	2.1	7	4	8	0.67	0.12	0.74	0.53	0.75	0.66	0.02	0.65	0.65	0.69
SP	2007	9.1	1.0	9.1	8	10.6	913	390	978	457	1435	9.2	2.5	10	5	11	0.80	0.08	0.82	0.69	0.90	0.64	0.11	0.57	0.55	0.76
SP	2008	9.6	2.4	9.9	7	13.2	413	130	457	239	565	7.4	2.3	7	5	11	0.82	0.04	0.81	0.78	0.86	0.74	0.05	0.73	0.67	0.81
SP	2009	7.4	0.5	7.5	6.8	8.1	778	114	804	630	913	6.8	1.3	7	5	8	0.78	0.03	0.77	0.74	0.83	0.55	0.07	0.56	0.48	0.66
SP	2010	8.0	0.9	8	6.8	8.9	257	113	217	174	457	4.4	1.9	5	2	7	0.70	0.12	0.76	0.54	0.82	0.75	0.09	0.78	0.59	0.82
TE	2007	9.1	1.3	9.1	7.1	10.7	952	251	870	783	1391	8.6	2.6	10	4	10	0.74	0.09	0.77	0.58	0.81	0.62	0.04	0.60	0.58	0.66
TE	2008	10.9	2.4	11.7	7.5	13.1	757	159	761	543	978	10.0	1.6	10	8	12	0.79	0.08	0.83	0.71	0.86	0.59	0.05	0.60	0.53	0.65
TE	2009	7.5	0.6	7.4	6.9	8.2	770	145	848	522	870	7.0	1.2	7	5	8	0.69	0.18	0.79	0.49	0.87	0.55	0.07	0.57	0.46	0.62
TE	2010	8.0	1.0	7.7	6.9	9.6	596	322	630	217	1022	6.4	2.9	7	3	10	0.71	0.09	0.74	0.56	0.80	0.66	0.11	0.64	0.56	0.78
TPE	2006	8.0	0.0	8	8	8	3261	606	3543	2565	3674	8.3	1.5	8	7	10	0.70	0.09	0.74	0.59	0.76	0.66	0.04	0.65	0.63	0.71
TPE	2007	8.5	0.8	8.7	7.6	9.5	1578	240	1609	1217	1891	10.6	1.3	10	9	12	0.79	0.06	0.81	0.70	0.84	0.49	0.05	0.49	0.41	0.54
TPE	2008	9.6	1.6	8.9	7.8	11.5	5626	1013	5261	4478	7152	14.2	2.5	15	10	16	0.71	0.09	0.72	0.57	0.80	0.73	0.02	0.73	0.70	0.74
TPE	2009	7.1	0.6	6.9	6.5	7.8	1713	439	1826	1065	2239	11.2	1.3	12	9	12	0.83	0.04	0.83	0.77	0.89	0.50	0.06	0.49	0.42	0.57
TPE	2010	7.5	0.9	7.5	6.5	8.4	1139	182	1152	848	1348	9.8	1.3	10	8	11	0.79	0.04	0.81	0.74	0.83	0.53	0.03	0.53	0.50	0.57
TPN	2007	8.9	0.6	9.2	8	9.4	1422	471	1326	978	1935	9.8	3.3	11	6	14	0.81	0.08	0.81	0.68	0.88	0.53	0.06	0.54	0.46	0.59
TPN	2008	8.3	0.6	8.4	7.8	9.2	1017	509	1326	261	1391	8.2	3.1	9	3	11	0.68	0.08	0.66	0.59	0.81	0.73	0.08	0.73	0.64	0.83
TPN	2009	8.2	0.7	8.5	7.1	8.8	1239	279	1174	891	1565	9.2	1.8	9	7	11	0.79	0.02	0.78	0.77	0.83	0.50	0.02	0.51	0.47	0.51
TPN	2010	8.7	0.8	8.8	7.5	9.5	1322	731	1435	196	2109	10.4	1.5	11	8	12	0.77	0.13	0.75	0.64	0.97	0.62	0.10	0.58	0.57	0.80

Abbreviations: SD = standard deviation (presented for interest only on raw data as variables may not be normally distributed) ; Med = median; Min = minimum; Max = maximum.

Table A3-3. Area-year “effects” coding for short-term effects, CREMP data set.

Year	INUG	PDL	TPS	TEFF	SP	TE	TPE	TPN
2006	0		0		0		0	
2007	0		0		0	0	0	0
2008	0		0		1	4	0	0
2009	0	0	0	0	2	5	7	9
2010	0	0	0	0	3	6	8	10

Note: 1. Area designations: C = control; I = impact.

Table A3-4. Area-year "effect" coding for long-term effects, CREMP data set.

Year	INUG	PDL	TPS	TEFF	SP	TE	TPE	TPN
2006	0		0		0		0	0
2007	0		0		0	0	0	0
2008	0		0		1	2	0	0
2009	0	0	0	0	1	2	3	4
2010	0	0	0	0	1	2	3	4

Note: 1. Area designations: C = control; I = impact.

Table A3-5. Results of statistical analyses of benthic invertebrate community descriptors for the 2006 - 2009 CREMP data set, short-term Effect (from 2009 EAS report; Azimuth, 2010).

	Total Abundance ($\#/m^2$)	**Taxa Richness** (# taxa/ sample)	**Simpson's Diversity** (unitless)[5]	**Bray Curtis Distance** (unitless)
Data Transformation[1]	Log10	None	None	Log10
Advanced Transformation[2]	Log10(x-120)	NA	NA	NA
Tests relative to controls				
C-SP2008 Differences?	Marginal	No	Marginal	No
p-value	0.08	0.27	0.12	0.95
Effect Size	-578	-2.4	0.11	-0.01
95% Upper CI[3]	-775	-7.1	-0.04	-0.24
95% Lower CI[3]	184	2.3	0.26	0.33
C-TE2008 Differences?	No	No	Marginal	No
p-value	0.47	0.89	0.14	0.24
Effect Size	-396	0.3	0.12	-0.16
95% Upper CI[3]	-881	-5.0	-0.05	-0.36
95% Lower CI[3]	1824	5.6	0.28	0.16
C-SP2009 Differences?	No	No	No	No
p-value	0.68	0.26	0.60	0.75
Effect Size	-195	-2.6	0.04	-0.04
95% Upper CI[3]	-693	-7.7	-0.12	-0.24
95% Lower CI[3]	1948	2.5	0.20	0.27
C-TE2009 Differences?	No	No	No	No
p-value	0.51	0.37	0.80	0.77
Effect Size	-384	-2.3	-0.02	-0.04
95% Upper CI[3]	-893	-7.9	-0.20	-0.26
95% Lower CI[3]	2195	3.4	0.16	0.31
C-TPE2009 Differences?	No	No	No	No
p-value	0.19	0.68	0.24	0.65
Effect Size	-2047	-0.9	0.08	-0.04
95% Upper CI[3]	-3197	-5.7	-0.07	-0.21
95% Lower CI[3]	2512	3.9	0.23	0.21

Notes:

1. Initial transformation options discussed in **Section 2**.
2. Advanced transformations determined using Box-Cox method (Venables & Ripley
3. Confidence intervals reported relative to direction of effect (i.e., positive or negative).
4. Results are for model adjusted to account for unequal variances (see text for details).
5. Model assumptions not met, see text for details.

Table A3-6. Results of statistical analyses of benthic invertebrate community descriptors for the 2010 CREMP data set, short-term Effects.

	Total Abundance (#/m²)	**Taxa Richness** (# taxa/ sample)	**Simpon's Diversity** (unitless)[5]	**Bray Curtis Distance** (unitless)
Data Transformation[1]	Log10	None	None	Log10
Advanced Transformation[2]	Log10(x-70)	NA	NA	NA
Tests relative to controls				
C-SP2010 Differences?	Marginal	No	No	No
p-value	0.07	0.55	0.67	0.49
"No Effect" Mean[3]	599	5.7	0.67	0.67
Effect Size	-362	-1.3	0.03	0.08
95% Upper CI[4]	-483	-6.2	-0.11	-0.15
95% Lower CI[4]	83	3.6	0.16	0.43
C-TE2010 Differences?	No	No	No	No
p-value	0.57	0.74	0.29	0.94
"No Effect" Mean	697	5.6	0.64	0.66
Effect Size	-194	0.8	0.07	-0.01
95% Upper CI[4]	-524	-4.6	-0.07	-0.23
95% Lower CI[4]	1203	6.3	0.22	0.33
C-TPE2010 Differences?	No	No	Marginal	No
p-value	0.23	0.50	0.06	0.45
"No Effect" Mean	2160	8.4	0.67	0.60
Effect Size	-1035	1.4	0.12	-0.07
95% Upper CI[4]	-1780	-3.2	-0.01	-0.23
95% Lower CI[4]	1506	6.1	0.24	0.16
C-TPN2010 Differences?	No	Yes (incr.)	Marginal	No
p-value	0.55	0.05	0.11	0.88
"No Effect" Mean	714	5.4	0.67	0.60
Effect Size	263	5.0	0.10	0.02
95% Upper CI[4]	-392	0.1	-0.03	-0.18
95% Lower CI[4]	2614	9.8	0.23	0.30

Notes:

1. Initial transformation options discussed in **Section 2**.
2. Advanced transformations determined using Box-Cox method (Venables & Ripley 2002).
3. "No Effect" Mean estimated by not including the Effect coefficient when estimating Area-Year mean.
4. Confidence intervals estimated using 2 * Std. Error of Effect Size estimate.
5. Model assumptions not met, see text for details.

Table A3-7. Results of statistical analyses of benthic invertebrate community descriptors for the2006 to 2010 CREMP data set, long-term Effects.

	Total Abundance (#/m²)	**Taxa Richness** (# taxa/ sample)	**Simpon's Diversity** (unitless)[5]	**Bray Curtis Distance** (unitless)
Data Transformation[1]	Log10	None	None	Log10
Advanced Transformation[2]	Log10(x-70)	NA	NA	NA
Tests relative to controls				
C-SP'08-'10 Differences?	Yes	No	Marginal	No
p-value	0.04	0.18	0.15	1.00
"No Effect" Mean[3]	849	8.30	0.70	0.67
Effect Size	-444	-2.1	0.06	0.00
95% Upper CI[4]	-629	-5.3	-0.03	-0.14
95% Lower CI[4]	-32	1.1	0.16	0.17
C-TE'08-'10 Differences?	No	No	No	No
p-value	0.32	0.84	0.21	0.37
"No Effect" Mean[3]	993	8.16	0.67	0.67
Effect Size	-340	-0.36	0.06	-0.08
95% Upper CI[4]	-699	-4.16	-0.04	-0.22
95% Lower CI[4]	595	3.45	0.17	0.11
C-TPE'09-'10 Differences?	Yes	No	Yes	No
p-value	0.04	0.80	0.01	0.25
"No Effect" Mean[3]	2988	10.13	0.68	0.58
Effect Size	-1622	0.37	0.13	-0.07
95% Upper CI[4]	-2366	-2.76	0.04	-0.16
95% Lower CI[4]	-280	3.49	0.21	0.07
C-TPN'09-'10 Differences?	No	Marginal	Yes	No
p-value	0.77	0.11	0.04	0.63
"No Effect" Mean[3]	979	7.19	0.68	0.59
Effect Size	109	2.61	0.10	-0.03
95% Upper CI[4]	-496	-0.70	0.01	-0.14
95% Lower CI[4]	1264	5.92	0.19	0.13

Notes:

1. Initial transformation options discussed in **Section 2**.
2. Advanced transformations determined using Box-Cox method (Venables & Ripley 2002).
3. "No Effect" Mean estimated by not including the Effect coefficient when estimating Area-Year mean.
4. Confidence intervals estimated using 2 * Std. Error of Effect Size estimate.
5. Model assumptions not met, see text for details.

Table A3-8. Benthic invertebrate descriptors by sampling area and year for the East Dike EAS data set.

		Depth					Abundance					Richness					Simpson's Diversity Index					Bray Curtis Index				
Area	Year	Mean	SD	Med	Min	Max	Mean	SD	Med	Min	Max	Mean	SD	Med	Min	Max	Mean	SD	Med	Min	Max	Mean	SD	Med	Min	Max
INUG	2009	7	0	7	6.9	7.9	1191	407	1130	630	1630	13.6	3.1	15	8	15	0.85	0.06	0.88	0.74	0.90	0.46	0.03	0.48	0.43	0.49
INUG	2010	8	1	8	6.7	8.7	639	133	630	478	783	8.4	2.5	7	6	12	0.75	0.07	0.77	0.64	0.81	0.58	0.10	0.54	0.45	0.72
PDL	2009	8	0	7.5	7.2	8.3	1726	999	1348	761	3326	10.8	0.8	11	10	12	0.78	0.10	0.81	0.61	0.88	0.54	0.11	0.52	0.41	0.69
PDL	2010	7	0	6.8	6.5	7.7	896	484	1043	348	1500	8.4	0.5	8	8	9	0.75	0.11	0.77	0.58	0.88	0.65	0.04	0.65	0.61	0.71
TPS	2009	8	1	7.3	6.8	9.7	1961	1035	2022	717	3326	10.4	1.3	11	8	11	0.82	0.08	0.84	0.72	0.92	0.52	0.07	0.52	0.40	0.60
TPS	2010	8	1	7.6	6.7	8.4	1296	667	1587	565	1870	8.2	2.8	9	5	12	0.76	0.08	0.77	0.63	0.84	0.55	0.07	0.57	0.47	0.63
TEFF	2009	7	0	6.9	6.6	7.8	1235	249	1196	978	1543	10.4	1.8	11	8	12	0.84	0.04	0.84	0.78	0.88	0.47	0.04	0.45	0.43	0.52
TEFF	2010	7	1	7.4	6.6	8	922	298	935	652	1391	10.8	2.4	11	8	14	0.80	0.06	0.81	0.69	0.85	0.49	0.04	0.51	0.42	0.53
SP-DT	2009	7	0	7.5	6.5	7.6	1122	159	1174	935	1304	10.8	1.1	11	9	12	0.78	0.07	0.77	0.69	0.87	0.52	0.02	0.52	0.50	0.55
SP-DT	2010	8	1	8.5	7.3	9.8	817	186	848	630	1087	9.2	1.1	10	8	10	0.81	0.08	0.81	0.71	0.91	0.55	0.07	0.55	0.46	0.65
TP-E3	2010	11	1	10	10	12	626	262	674	217	913	6.4	1.9	7	4	9	0.61	0.10	0.58	0.53	0.78	0.60	0.11	0.57	0.50	0.78
TE	2009	7	1	7.4	6.9	8.2	770	145	848	522	870	7.0	1.2	7	5	8	0.69	0.18	0.79	0.49	0.87	0.55	0.07	0.57	0.46	0.62
TE	2010	8	1	7.7	6.9	9.6	596	322	630	217	1022	6.4	2.9	7	3	10	0.71	0.09	0.74	0.56	0.80	0.66	0.11	0.64	0.56	0.78
SP-F2	2009	7	0	7.1	6.9	7.6	757	273	935	370	978	8.0	3.5	7	5	14	0.81	0.07	0.79	0.74	0.90	0.59	0.06	0.58	0.51	0.67
SP-F2	2010	7	0	7.4	7.2	7.8	1213	824	717	478	2348	8.0	1.4	7	7	10	0.75	0.06	0.76	0.64	0.80	0.69	0.04	0.68	0.66	0.75
SP-F1	2009	7	0	7	6.8	7.3	1474	531	1391	1043	2370	8.6	1.5	8	7	11	0.78	0.03	0.80	0.73	0.81	0.58	0.05	0.58	0.53	0.64
SP-F1	2010	9	1	9.6	7.7	9.9	1135	244	1239	761	1348	8.0	1.9	8	5	10	0.77	0.05	0.75	0.71	0.83	0.54	0.05	0.54	0.50	0.62
SP	2009	7	1	7.5	6.8	8.1	778	114	804	630	913	6.8	1.3	7	5	8	0.78	0.03	0.77	0.74	0.83	0.55	0.07	0.56	0.48	0.66
SP	2010	8	1	8	6.8	8.9	257	113	217	174	457	4.4	1.9	5	2	7	0.70	0.12	0.76	0.54	0.82	0.75	0.09	0.78	0.59	0.82
SP-N1	2009	7	0	7.2	6.5	7.7	1135	342	1022	891	1739	6.6	1.1	7	5	8	0.72	0.07	0.73	0.62	0.81	0.57	0.06	0.59	0.49	0.64
SP-N1	2010	8	1	7.5	7.1	10	1239	926	1217	152	2609	6.4	3.0	6	2	10	0.59	0.20	0.57	0.29	0.80	0.67	0.10	0.65	0.57	0.84
SP-N2	2009	8	1	7.4	6.9	8.9	652	170	609	457	870	7.4	1.9	8	5	10	0.69	0.16	0.76	0.42	0.83	0.57	0.04	0.57	0.52	0.63
SP-N2	2010	8	1	8.3	7.5	9.3	957	317	935	652	1435	7.6	1.1	8	6	9	0.73	0.09	0.69	0.66	0.86	0.56	0.04	0.58	0.50	0.60
SP-N3	2009	7	0	7.4	6.9	8	730	128	696	565	913	8.8	2.0	8	7	11	0.78	0.09	0.79	0.63	0.88	0.56	0.05	0.57	0.49	0.61
SP-N3	2010	8	1	8.7	7.3	9.2	700	314	913	304	935	7.4	1.5	8	5	9	0.75	0.11	0.79	0.56	0.84	0.60	0.10	0.61	0.50	0.75

Abbreviations: SD = standard deviation (presented for interest only on raw data as variables may not be normally distributed) ; Med = median; Min = minimum; Max = maximum.

Table A3-9. Results of statistical analyses of benthic invertebrate community descriptors for the 2009 to 2010 East Dike EAS data set.

	Total Abundance ($\#/m^2$)	Taxa Richness (# taxa/ sample)	Simpon's Diversity (unitless)	Bray Curtis Distance (unitless)
Data Transformation[1]	Log10	None	None	Log10
Advanced Transformation[2]	Log10(x+230)	NA	NA	Log10(x-0.24)
Model Results				
C-I Effect Difference?	Yes	Yes	Yes	Yes
p-value	0.037	<0.001	0.049	0.020
Magnitude	-36%	-32%	-8%	14%
Year Difference	Yes	Yes	No	Yes
p-value	0.014	0.003	0.174	0.037
Magnitude	-37%	-20%	-5%	12%
Effect*Year Difference?	Marginal	Marginal	No	No
p-value	0.148	0.075	0.950	0.829
"No Effect" Mean	513	5.4	0.71	0.64
Actual Mean	734	6.9	0.71	0.63
"Recovery" Size	221	1.5	0.00	-0.01
"Recovery" Magnitude	43%	28%	0%	-2%
95% Lower CI[3] of Recovery Size	-77	-0.2	-0.08	-0.10
95% Upper CI[3] of Recovery Size	652	3.2	0.08	0.10

Notes:

1. Initial transformation options discussed in **Section 2**.

2. Advanced transformations determined using Box-Cox method (Venables & Ripley 2002).
3. Confidence intervals estimated using 2 * Std. Error of Effect Size estimate.

Table A3-10. Benthic invertebrate descriptors by sampling area and year for the Bay Goose Dike EAS data set.

		Depth					Abundance					Richness					Simpson's Diversity Index					Bray Curtis Index				
Area	Year	Mean	SD	Med	Min	Max	Mean	SD	Med	Min	Max	Mean	SD	Med	Min	Max	Mean	SD	Med	Min	Max	Mean	SD	Med	Min	Max
INUG	2010	8	1	8	6.7	8.7	639	133	630	478	783	8.4	2.5	7	6	12	0.75	0.07	0.77	0.64	0.81	0.58	0.10	0.54	0.45	0.72
PDL	2010	7	0	6.8	6.5	7.7	896	484	1043	348	1500	8.4	0.5	8	8	9	0.75	0.11	0.77	0.58	0.88	0.65	0.04	0.65	0.61	0.71
TPS	2010	8	1	7.6	6.7	8.4	1296	667	1587	565	1870	8.2	2.8	9	5	12	0.76	0.08	0.77	0.63	0.84	0.55	0.07	0.57	0.47	0.63
TEFF	2010	7	1	7.4	6.6	8	922	298	935	652	1391	10.8	2.4	11	8	14	0.80	0.06	0.81	0.69	0.85	0.49	0.04	0.51	0.42	0.53
SP-DT	2010	8	1	8.5	7.3	9.8	817	186	848	630	1087	9.2	1.1	10	8	10	0.81	0.08	0.81	0.71	0.91	0.55	0.07	0.55	0.46	0.65
TP-E3	2010	11	1	10	10	12	626	262	674	217	913	6.4	1.9	7	4	9	0.61	0.10	0.58	0.53	0.78	0.60	0.11	0.57	0.50	0.78
TP-E2	2010	9	1	9.5	8.9	10	909	469	891	370	1652	9.6	1.8	9	8	12	0.78	0.10	0.82	0.66	0.88	0.58	0.05	0.57	0.52	0.65
TPE	2010	8	1	7.5	6.5	8.4	1139	182	1152	848	1348	9.8	1.3	10	8	11	0.79	0.04	0.81	0.74	0.83	0.53	0.03	0.53	0.50	0.57
TP-E1	2010	8	0	8	7.4	8.5	496	186	609	217	652	7.2	1.3	7	6	9	0.82	0.05	0.81	0.76	0.87	0.64	0.10	0.65	0.54	0.80
HVH-4	2010	8	0	7.5	7	8	439	286	370	109	848	6.4	3.8	7	2	12	0.66	0.18	0.66	0.40	0.89	0.66	0.17	0.69	0.43	0.88

Abbreviations: SD = standard deviation (presented for interest only on raw data as variables may not be normally distributed) ; Med = median; Min = minimum; Max = maximum.

Table A3-11. Results of statistical analyses of benthic invertebrate community descriptors for the 2010 Bay Goose Dike EAS data set.

	Total Abundance ($\#/m^2$)	**Taxa Richness** (# taxa/ sample)	**Simpon's Diversity** (unitless)	**Bray Curtis Distance** (unitless)
Data Transformation[1]	Log10	None	None	Log10
Advanced Transformation[2]	NA	NA	NA	NA
Tests relative to control [C]				
C-I Effect Difference?	No	No	No	No
p-value	0.381	0.757	0.729	0.416
Control Group Mean	777	8.6	0.75	0.56
Impact Group Mean	622	8.3	0.76	0.59
Effect Size	-155	-0.3	0.02	0.03
Effect Magnitude (%)	-20%	-4%	2%	5%
95% Upper CI[3] of Effect Size	-416	-2.5	-0.09	-0.05
95% Lower CI[3] of Effect Size	292	1.9	0.12	0.12

Notes:

1. Initial transformation options discussed in **Section 2**.

2. Advanced transformations determined using Box-Cox method (Venables & Ripley 2002).
3. Confidence intervals estimated using 2 * Std. Error of Effect Size estimate.

Table A3-12. Physical and chemical characteristics (means) by sampling area and year for the CREMP & EAS data sets.

Area	Year	Depth (m)	TOC (%)	Sand (%)	Silt (%)	Clay (%)	Aluminum (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Zinc (mg/kg)
INUG	2009	7.26	3.52	7	69	24	25800	16.3	0.5	115	55.2	90
INUG	2010	7.7	2.66	13	63	24	23600	16.8	0.5	115	48.6	84.7
PDL	2009	7.66	0.72	20	46	33	27400	23.1	0.5	125	47.5	92.6
PDL	2010	6.9	2.65	11	73	16	20400	13	0.5	135	51.4	80.9
TPN	2009	8.18	2.86	25	54	21	16700	9.8	0.5	101	46.7	62.8
TPN	2010	8.74	3.11	23	72	5	16900	9.8	0.5	110	50.3	69.3
TPS	2009	7.82	4.22	5	62	33	25100	18	0.5	112	70.6	95.3
TPS	2010	7.6	4.1	14	78	9	23600	15.8	0.5	113	60.9	97.3
TPE	2009	7.08	3.41	6	58	36	23800	18.1	0.5	80.7	53.8	101
TPE	2010	7.5	3.02	4	72	24	25300	38.1	0.56	90.7	51.5	95.9
HVH-4	2009	7.3	3.26	1	65	34	29000	25.6	0.5	88.8	67.7	109
HVH-4	2010	7.5	2.77	3	48	48	36100	26.6	0.5	119	89.2	141
TP-E1	2010	7.88	2.86	3	64	33	25400	23.2	0.5	111	53.7	106
TP-E2	2010	9.46	3.18	4	63	33	26200	32.4	0.5	97.9	65.5	109
TP-E3	2010	10.6	3.12	3	70	27	26500	24.6	0.5	115	84.4	115
SP	2009	7.44	3.74	2	68	30	28300	42.5	0.5	76.9	89.5	124
SP	2010	7.98	3.91	2	66	32	33600	36.2	0.72	93.7	107	139
SP-F1	2009	7.02	3.16	7	67	26	27600	54	0.5	72.2	78.8	115
SP-F1	2010	9.08	4.1	7	66	27	25400	50.2	0.5	80.5	73.7	113
SP-F2	2009	7.26	5.51	6	65	30	35100	17.7	0.96	87.4	127	255
SP-F2	2010	7.48	6.7	3	74	24	29900	15.2	0.8	91.2	130	160
SP-N1	2009	7.17	3.56	16	64	20	27900	15	0.5	84.7	75.8	113
SP-N1	2010	7.96	2.88	17	61	21	22500	10.8	0.5	75.2	59.6	102
SP-N2	2009	7.62	3.63	5	71	23	28700	41.3	0.5	76.2	94.6	116
SP-N2	2010	8.4	4.4	3	70	28	28100	35.5	0.5	95.5	87.1	123
SP-N3	2009	7.43	4.75	1	64	34	27900	60.9	0.57	73.7	94.4	125
SP-N3	2010	8.3	4.22	2	71	27	27600	104	0.5	86.8	97.5	131
SP-DT	2009	7.3	4.17	9	68	23	40100	12.3	0.83	82.7	133	171
SP-DT	2010	8.34	4.96	6	68	26	29400	59.2	2.6	71.5	134	152
TE	2009	7.48	2.49	5	66	29	27700	23.5	0.5	60.5	74.4	116
TE	2010	7.98	2.49	26	57	17	20100	15.7	0.5	51.1	49.9	86.7
TEFF	2009	7.08	2.87	5	61	34	25400	12.7	0.5	55.2	57.2	104
TEFF	2010	7.32	3.38	6	76	18	25500	13.1	1.47	58.2	61.2	109

Figure A3-1. Benthic invertebrate stations, Meadowbank CREMP, 2010.

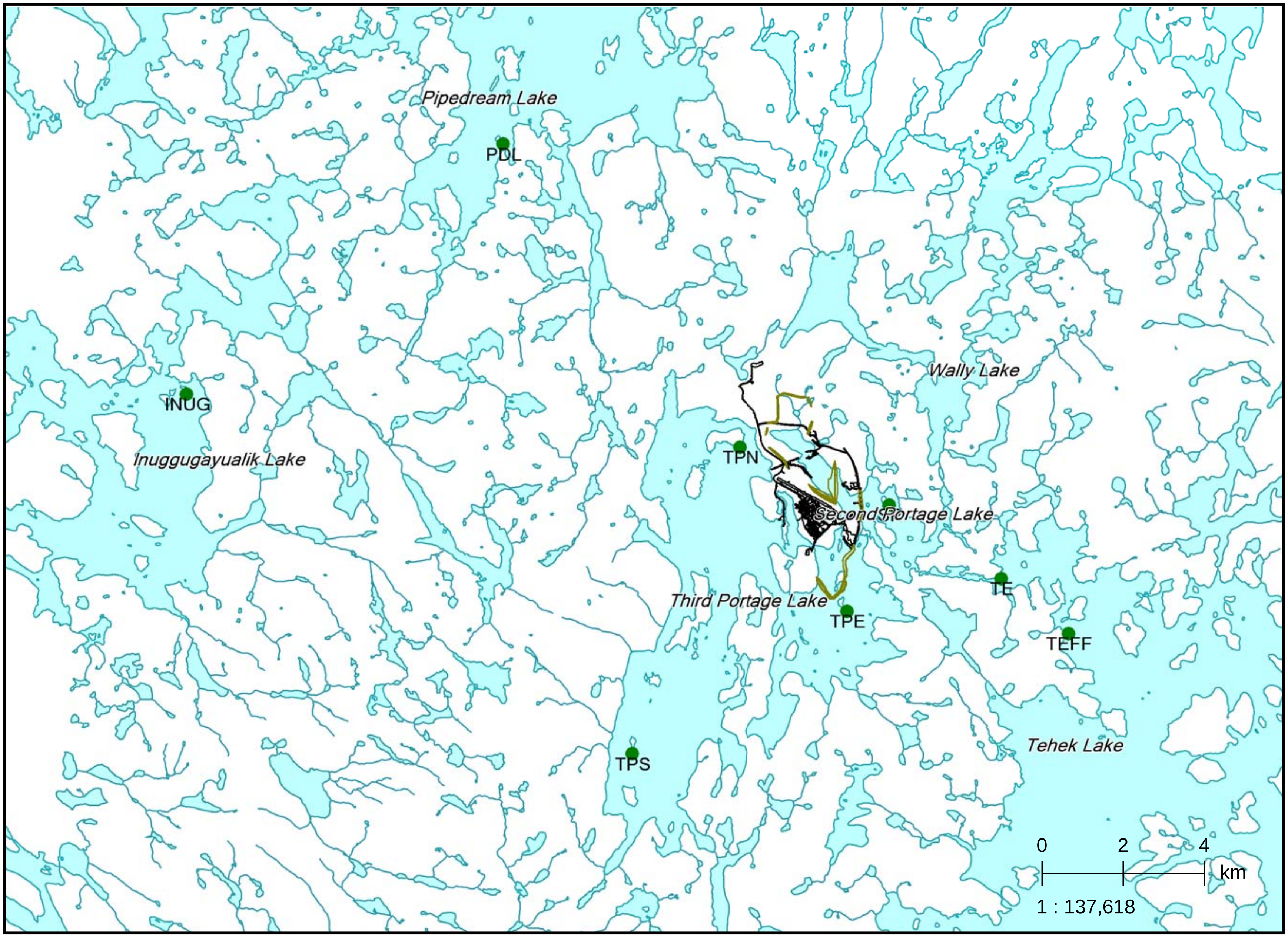


Figure A3-2. Benthic invertebrate stations, Meadowbank East Dike EAS, 2010.

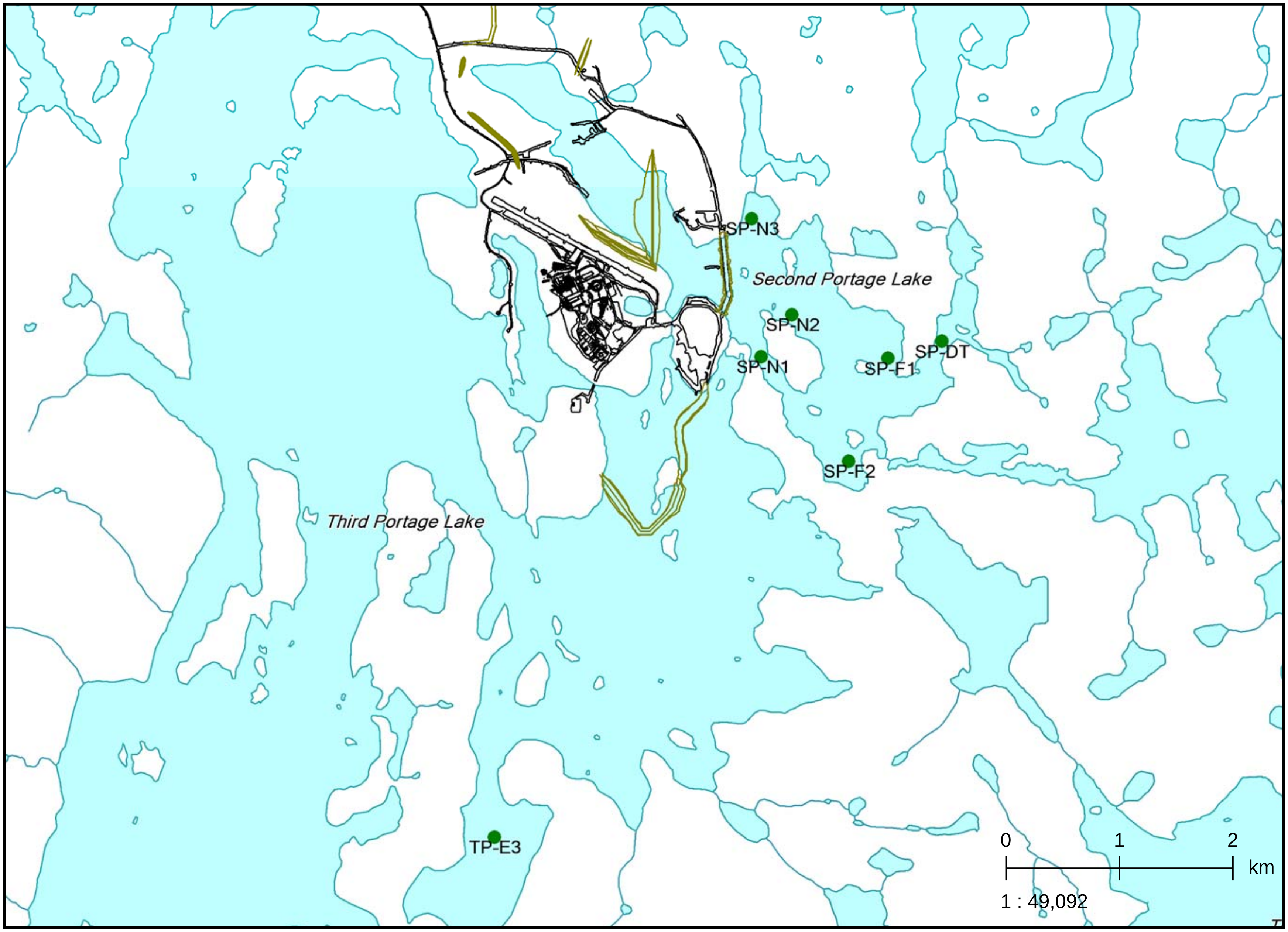


Figure A3-3. Benthic invertebrate stations, Meadowbank Bay-Goose EAS, 2010.

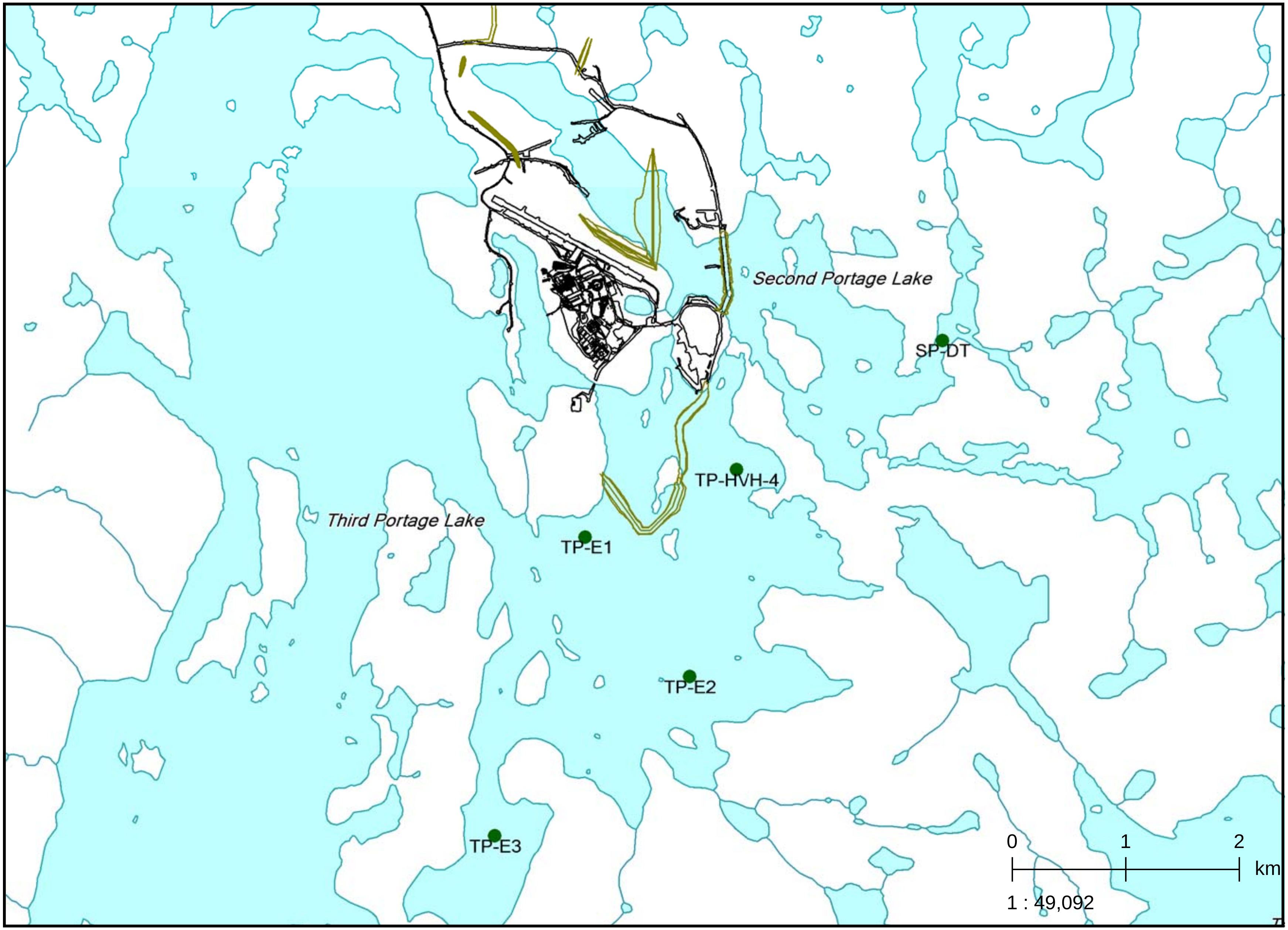


Figure A3-4. Benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) across CREMP areas for 2006 through 2010.

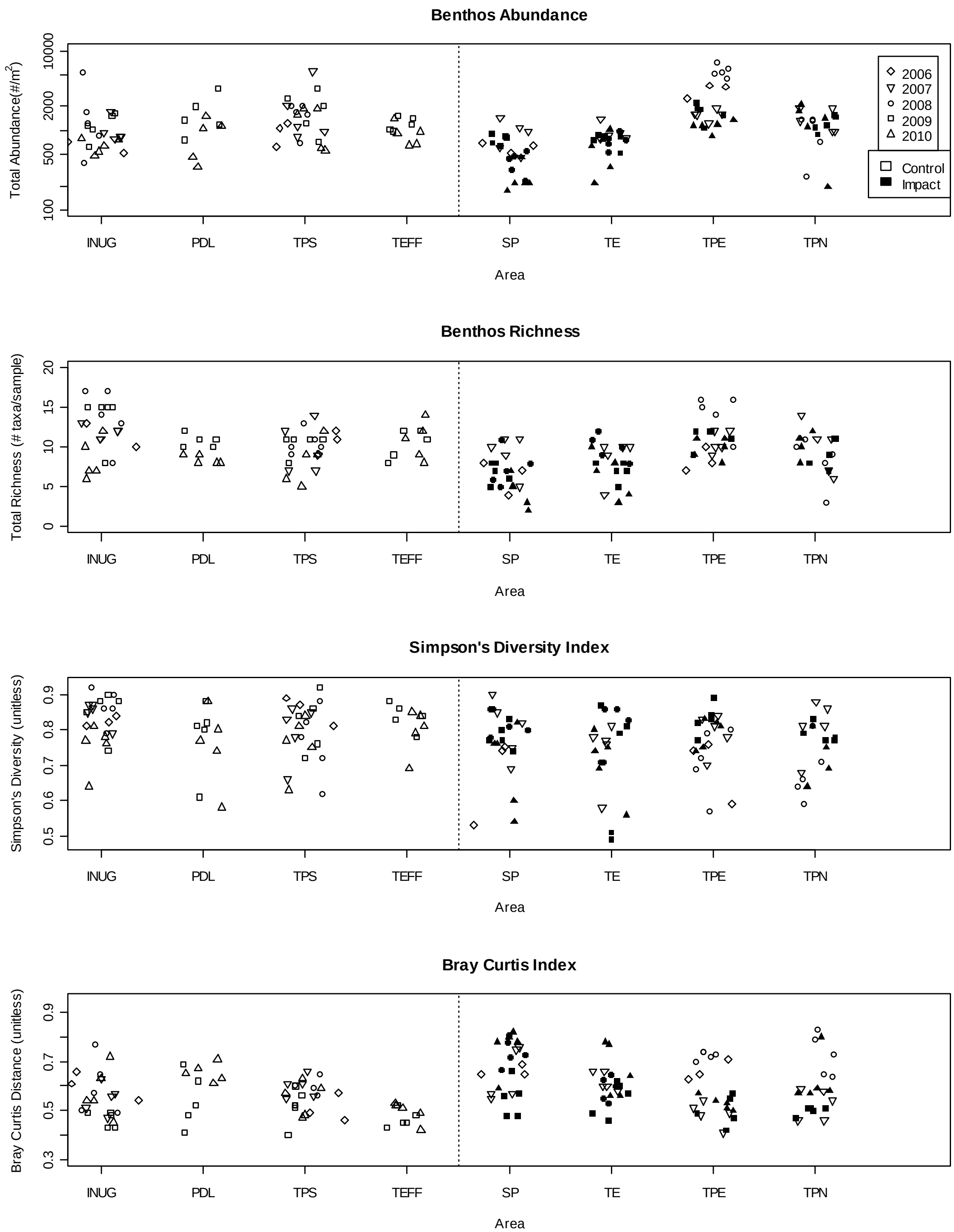


Figure A3-5. Boxplots of benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) by short-term Effect grouping for CREMP data set.

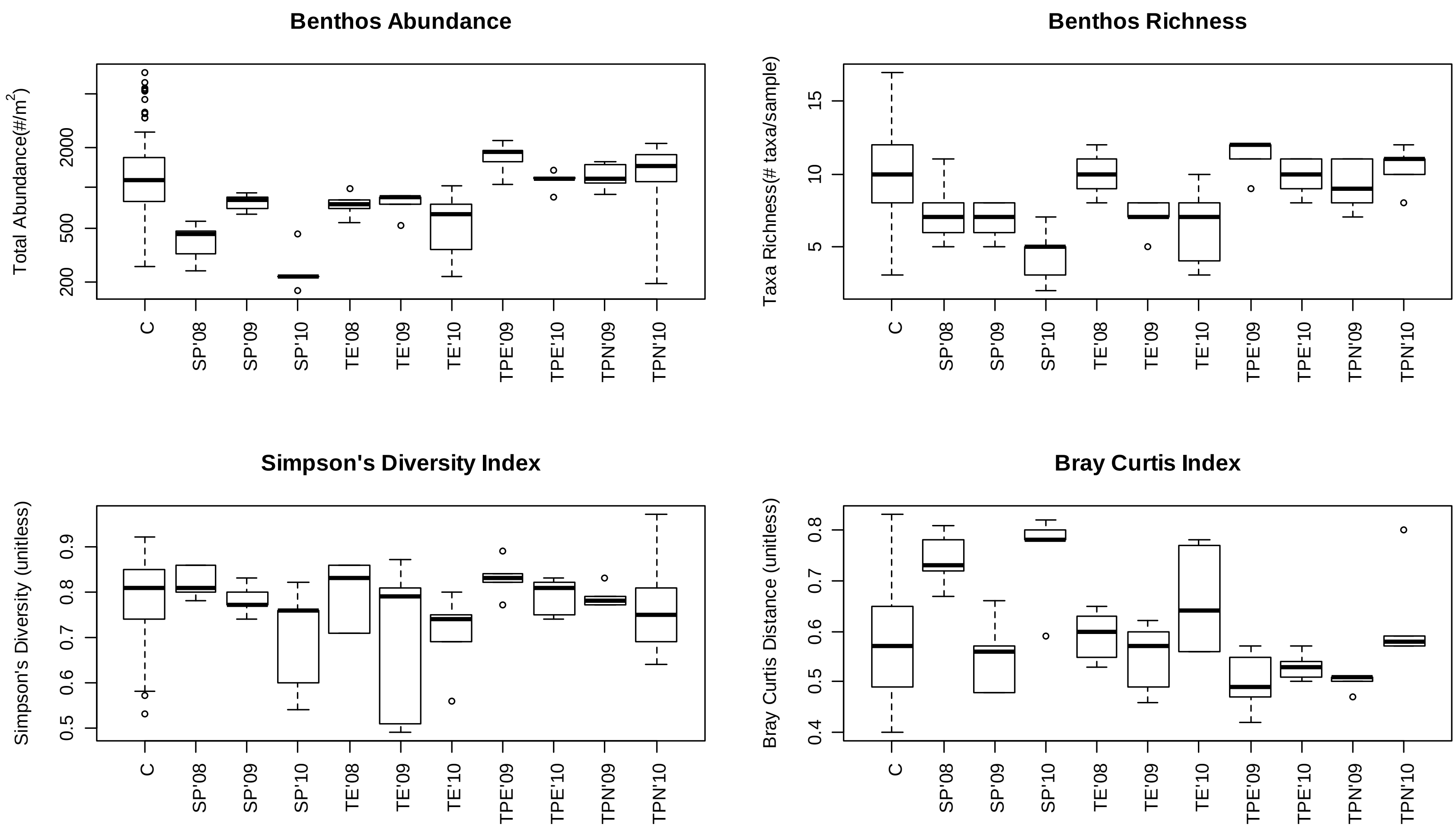


Figure A3-6. Boxplots of benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) by long-term Effect grouping for CREMP data set.

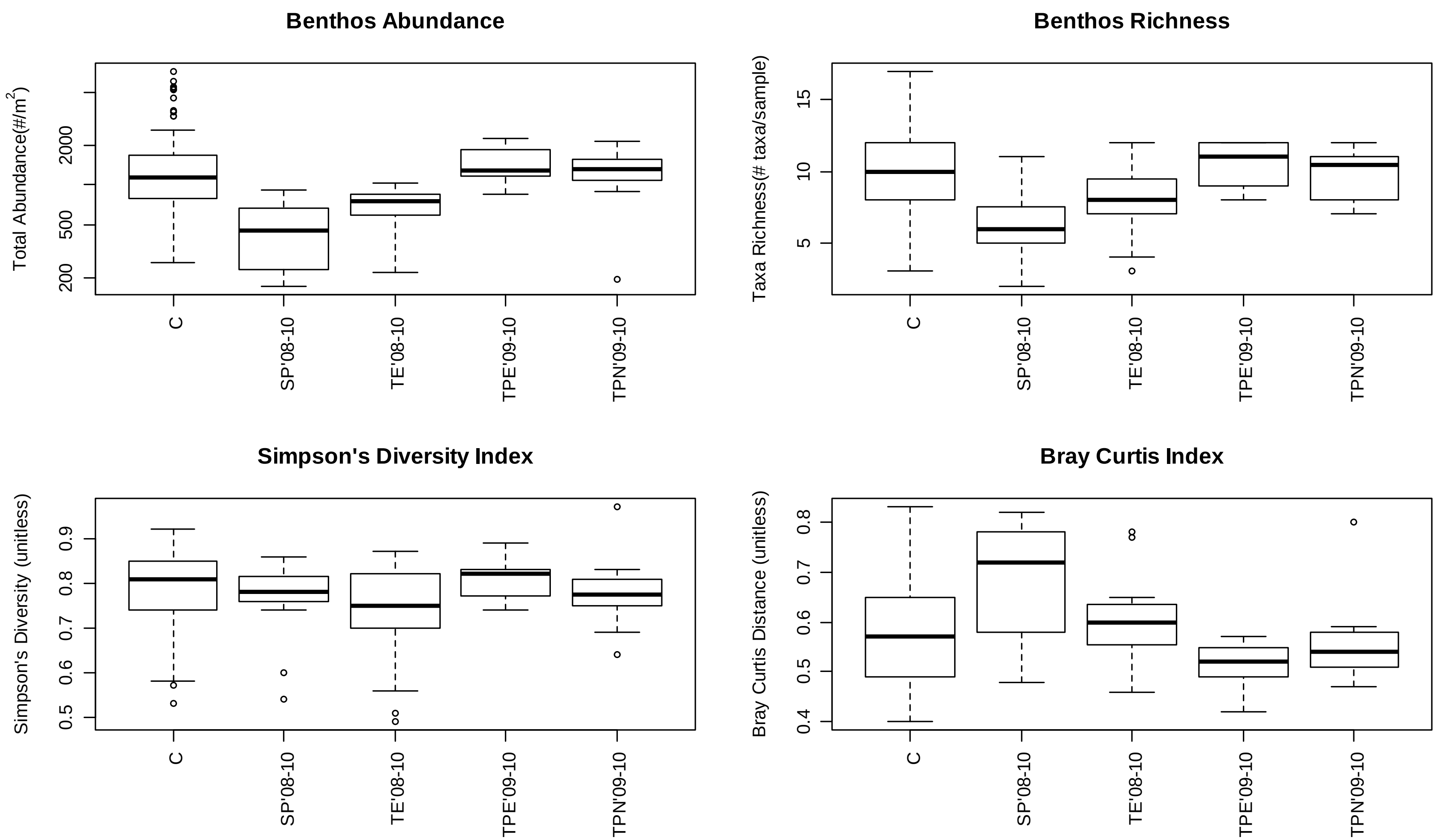
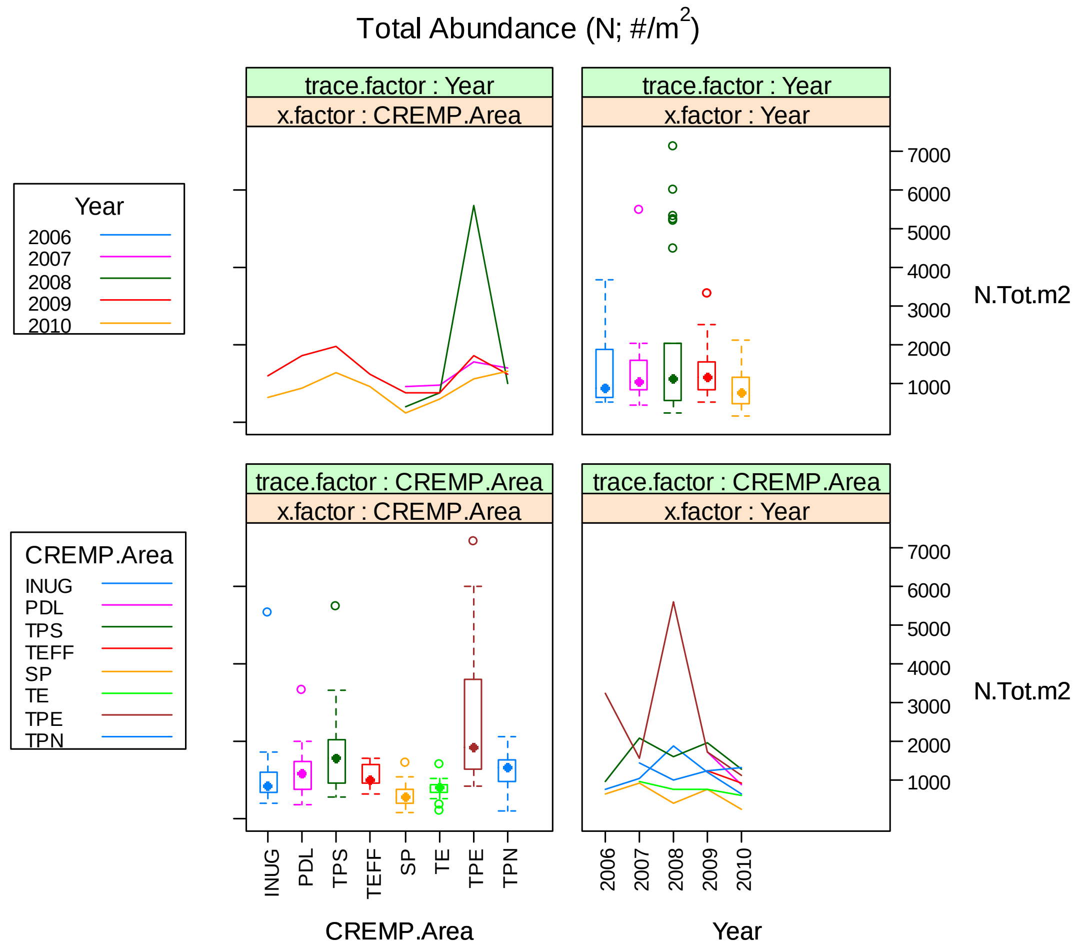


Figure A3-7. Interaction Plot for total benthic abundance by Area and Year for the CREMP data set.



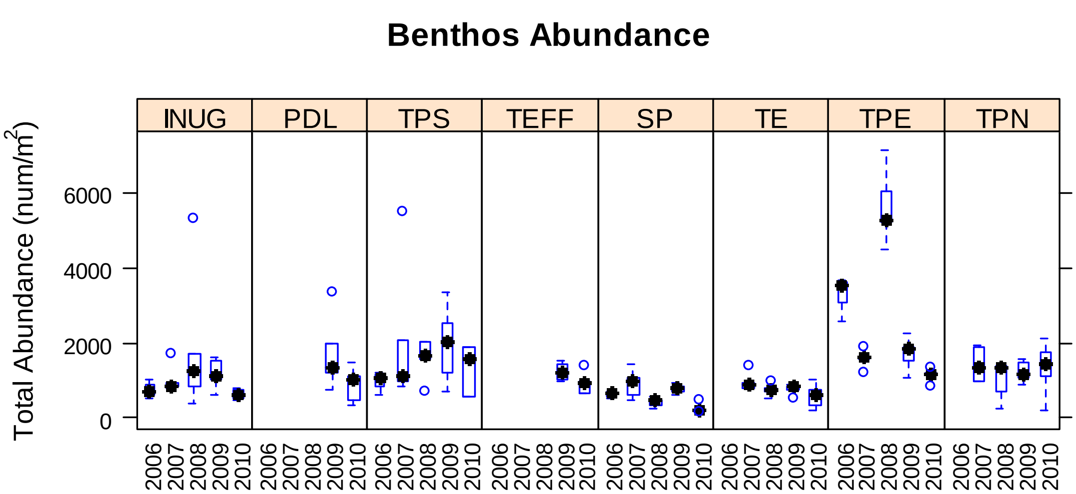
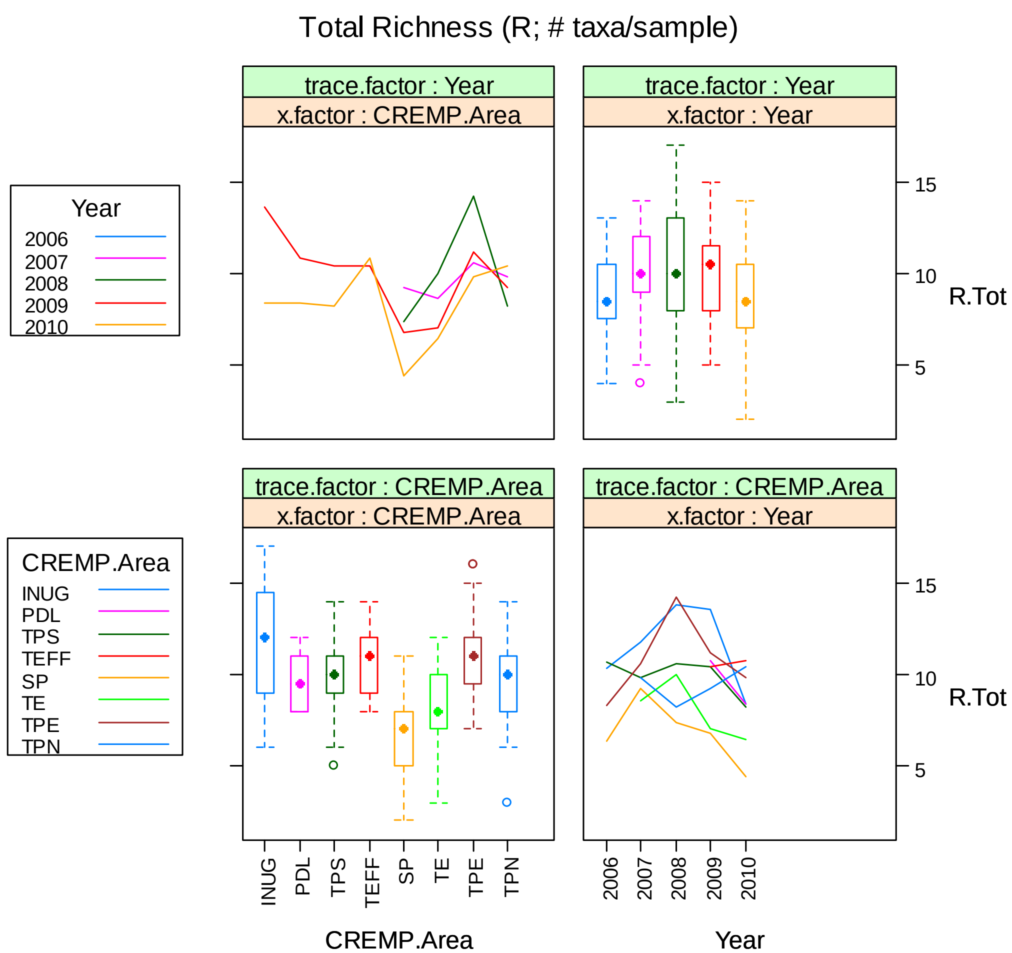


Figure A3-8. Interaction Plot for total benthic richness by Area and Year for the CREMP data set.



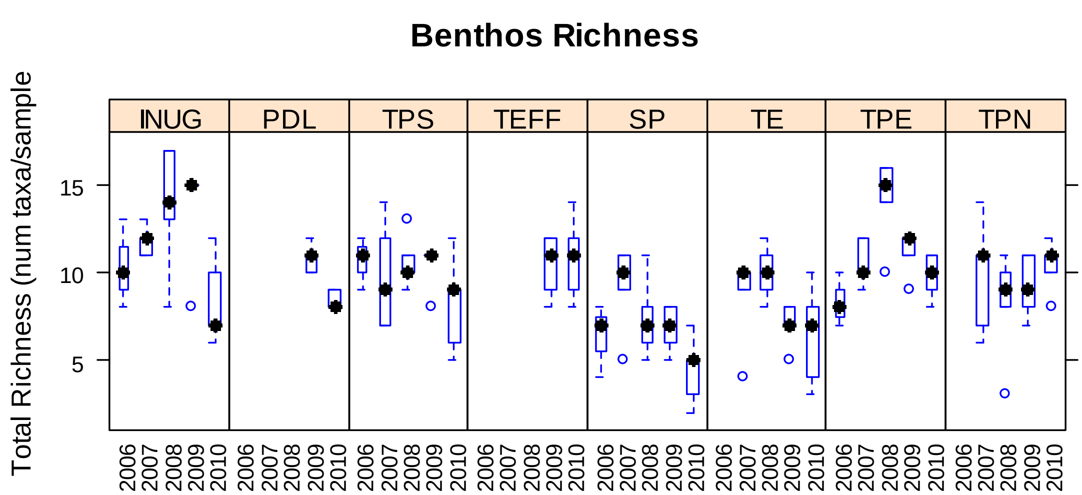
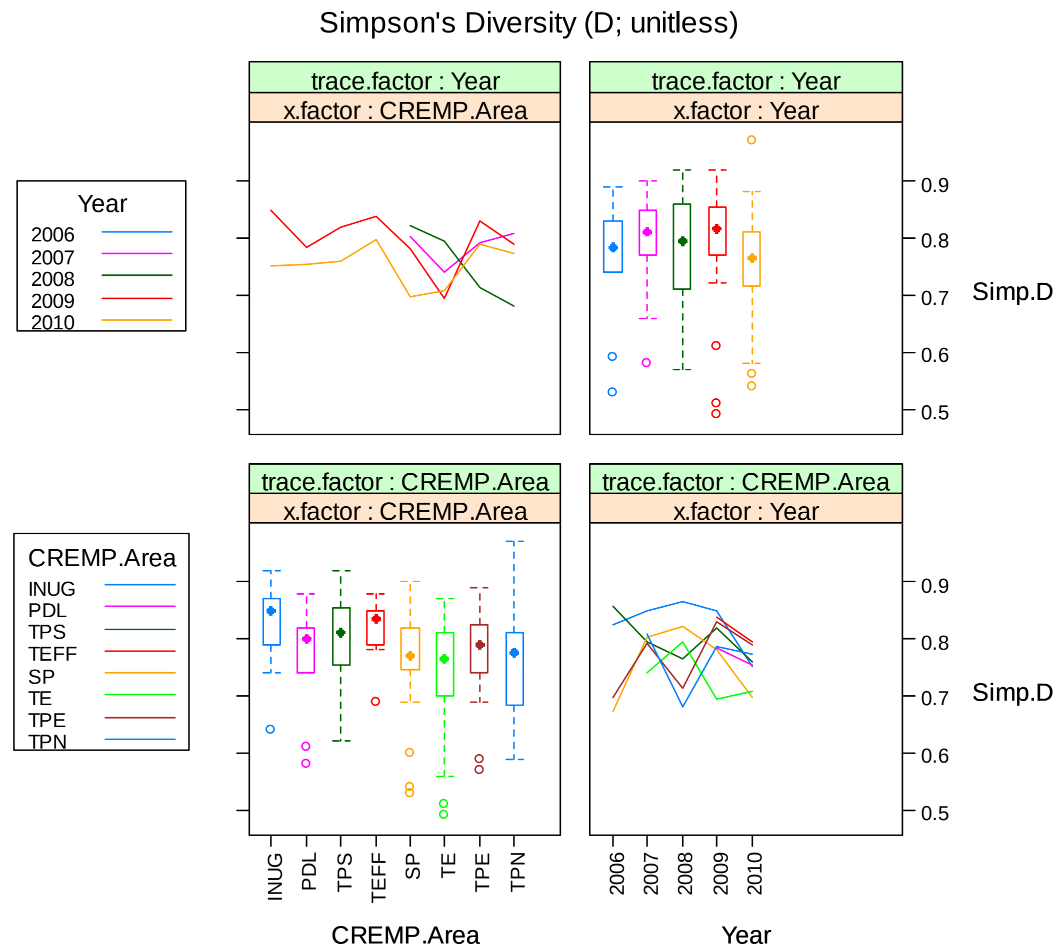


Figure A3-9. Interaction Plot for benthic Simpson's Diversity by Area and Year for the CREMP data set.



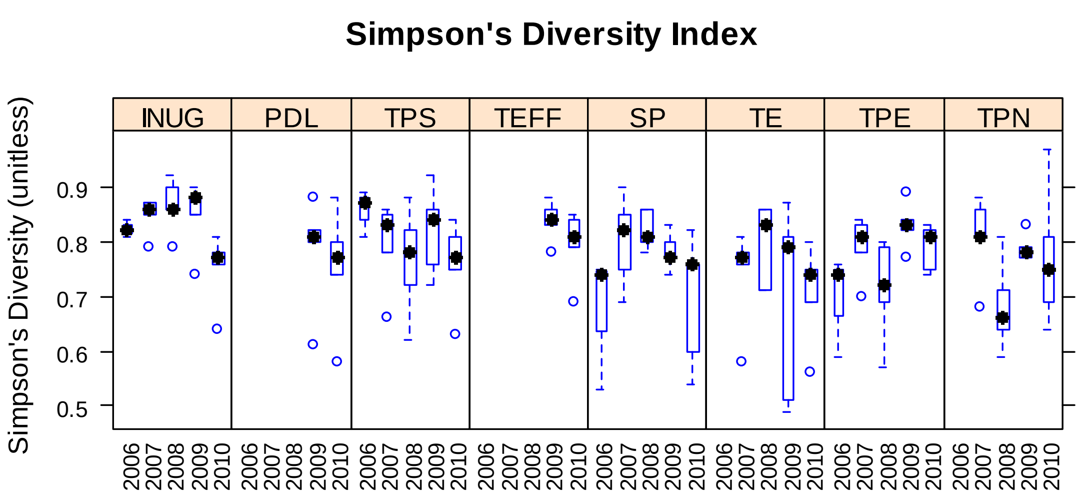
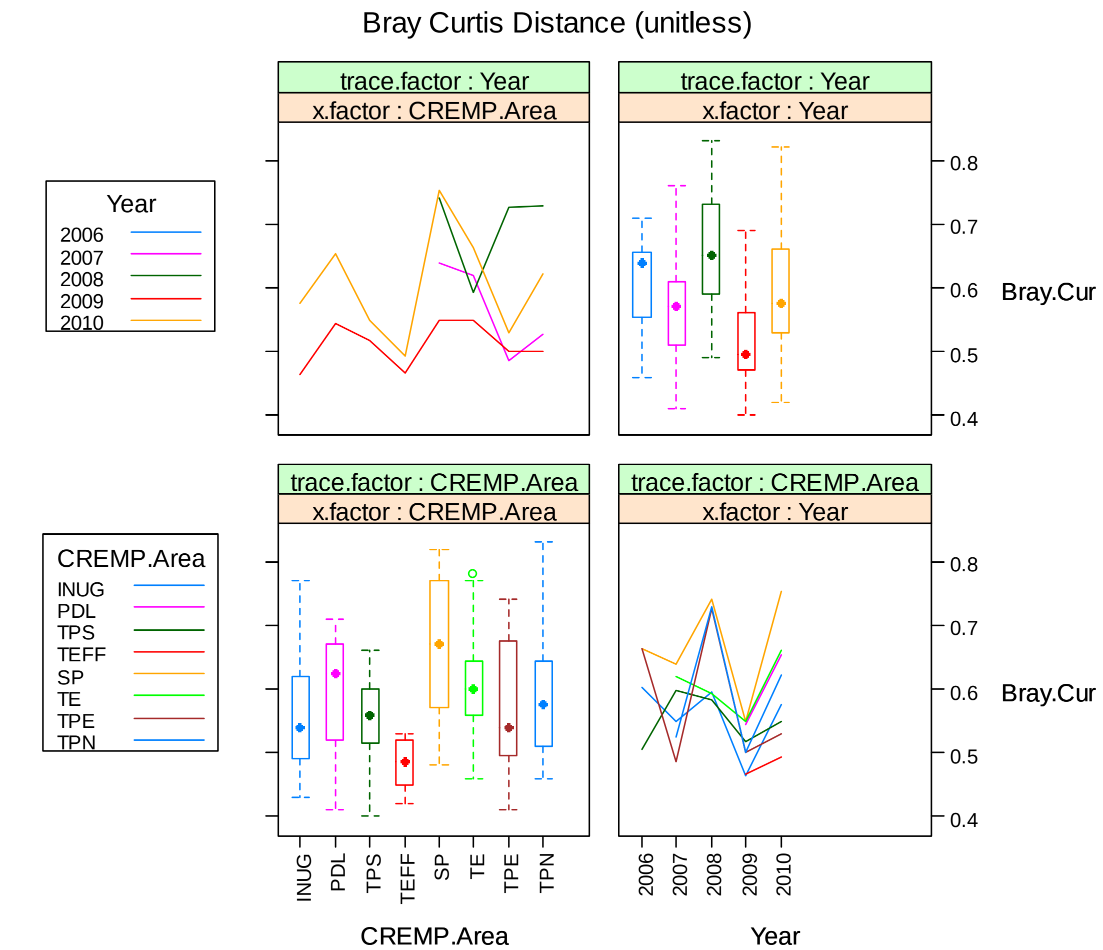


Figure A3-10. Interaction Plot for Bray Curtis distance by Area and Year for the CREMP data set.



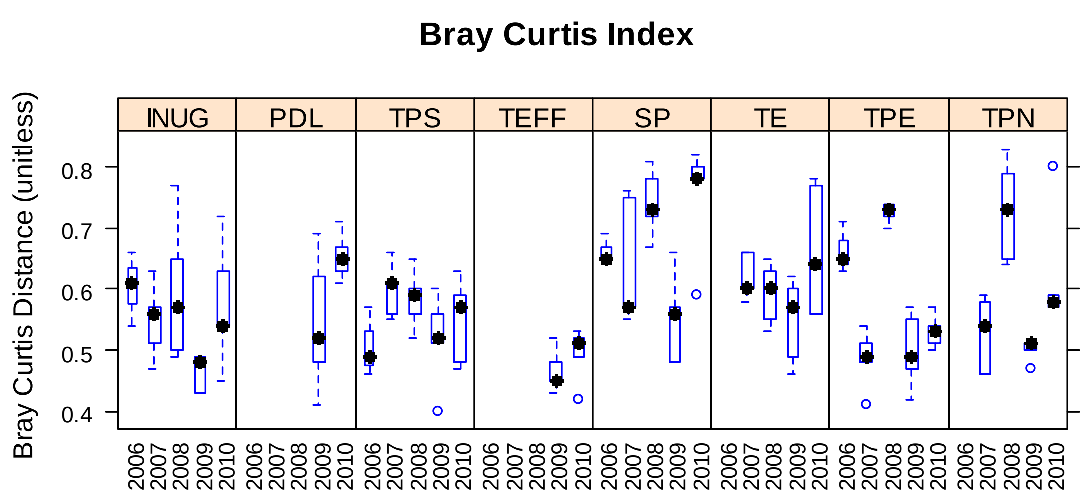


Figure A3-11. Benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) across Control and Impact areas for East Dike EAS 2010.

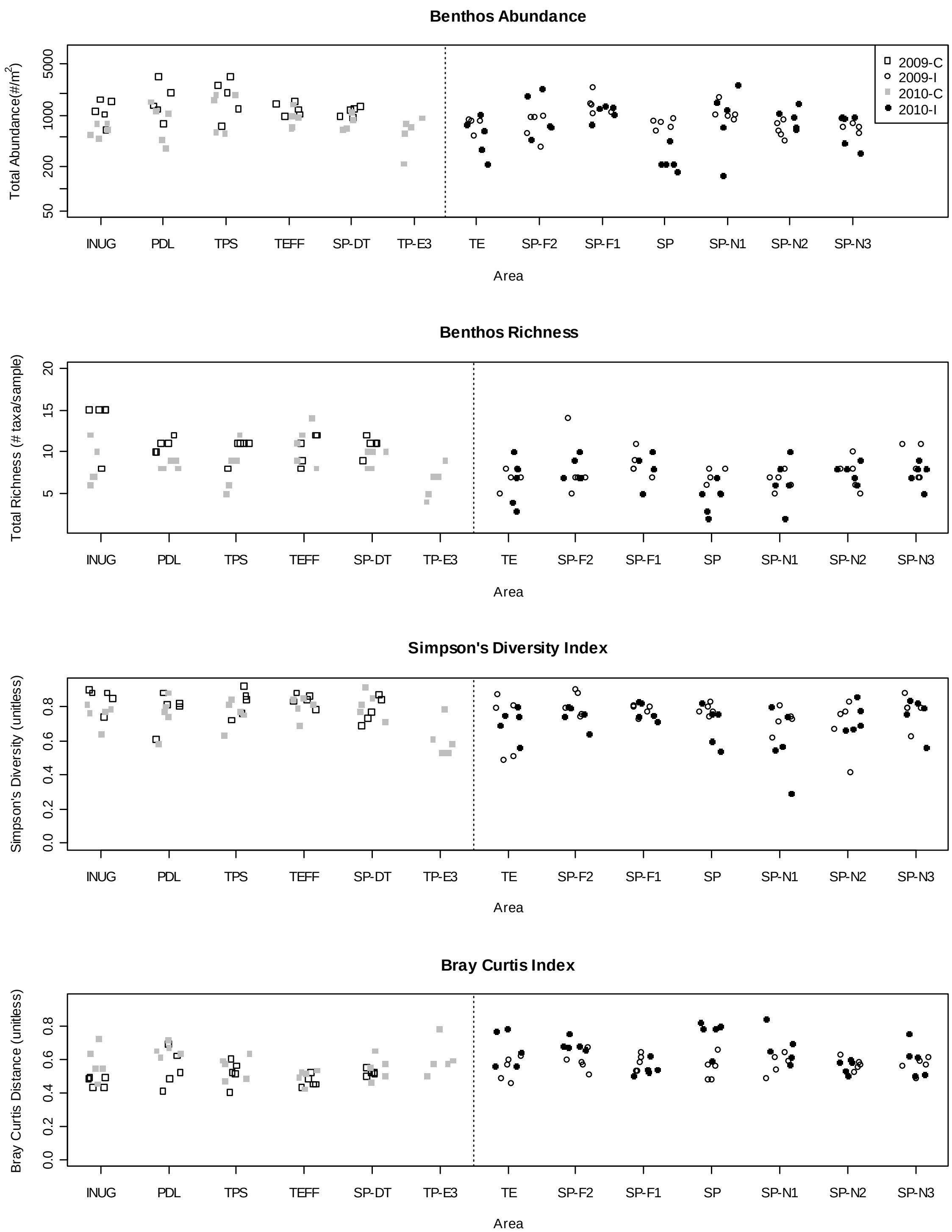


Figure A3-12. Boxplots of benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) by Effect grouping for East Dike EAS data set. Year-specific boxplots are provided as well to facilitate data interpretation.

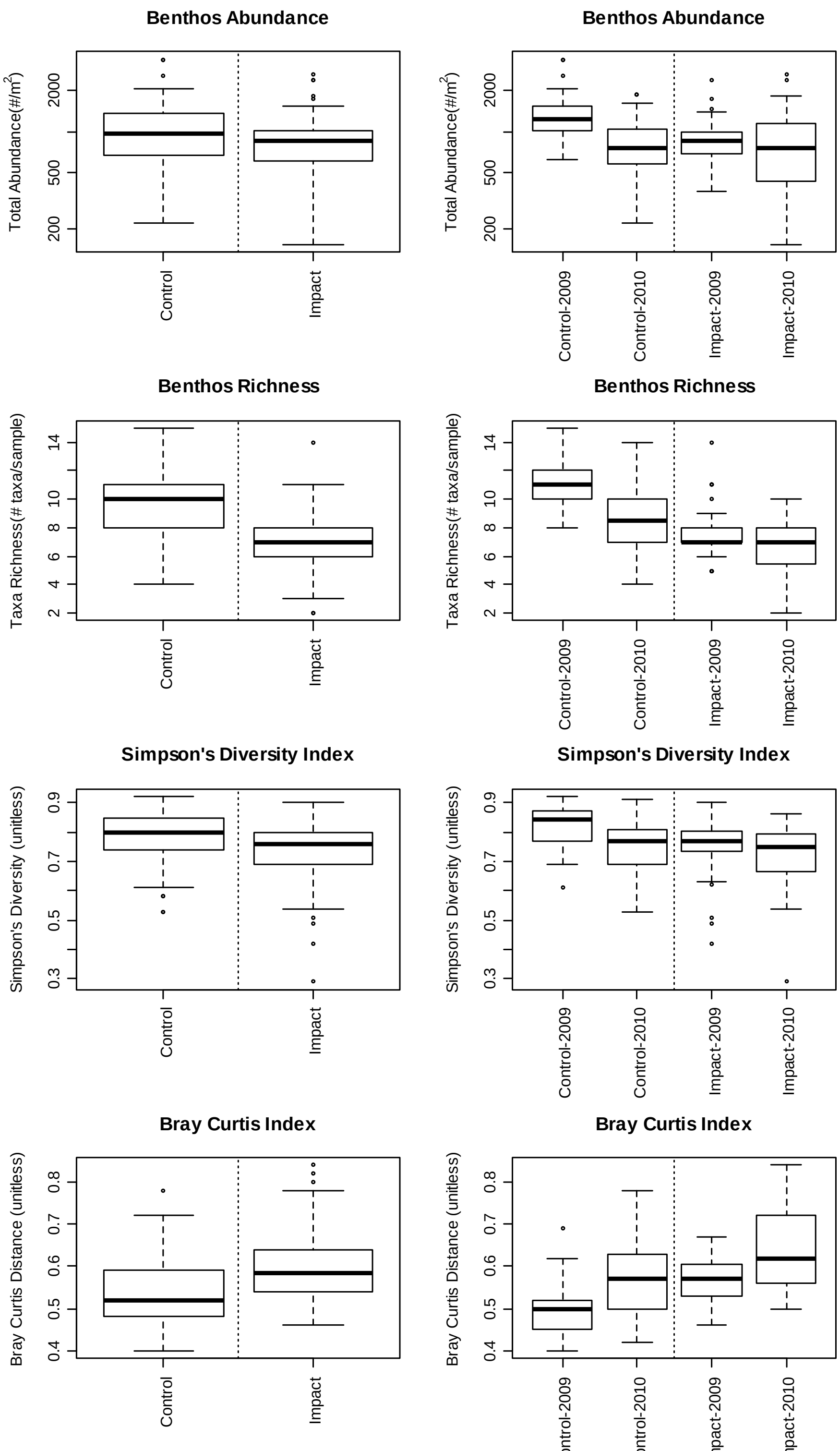


Figure A3-13. Benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) across Control and Impact areas for Bay Goose Dike EAS 2010.

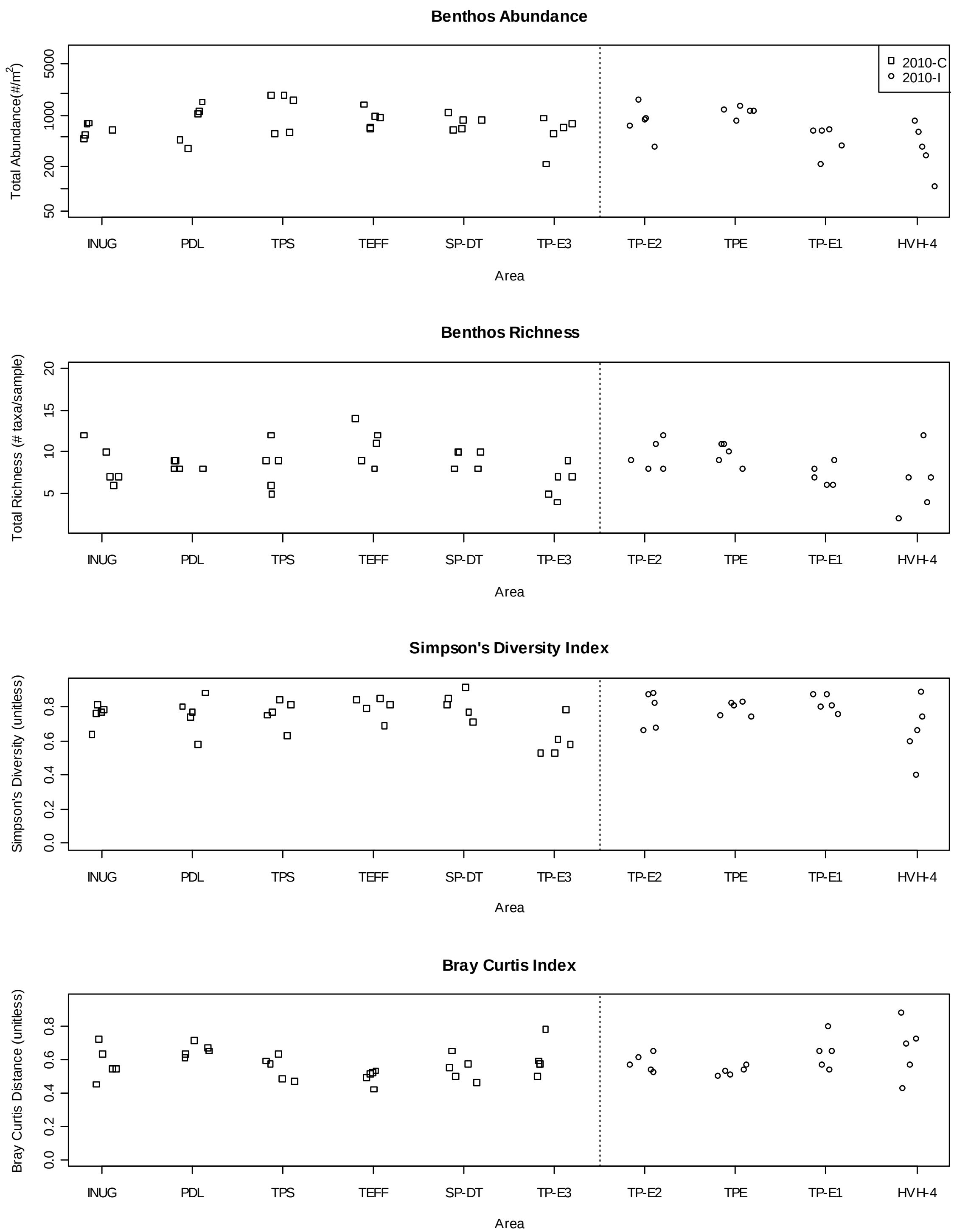


Figure A3-14. Boxplots of benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) by Effect grouping for Bay-Goose Dike EAS data set.

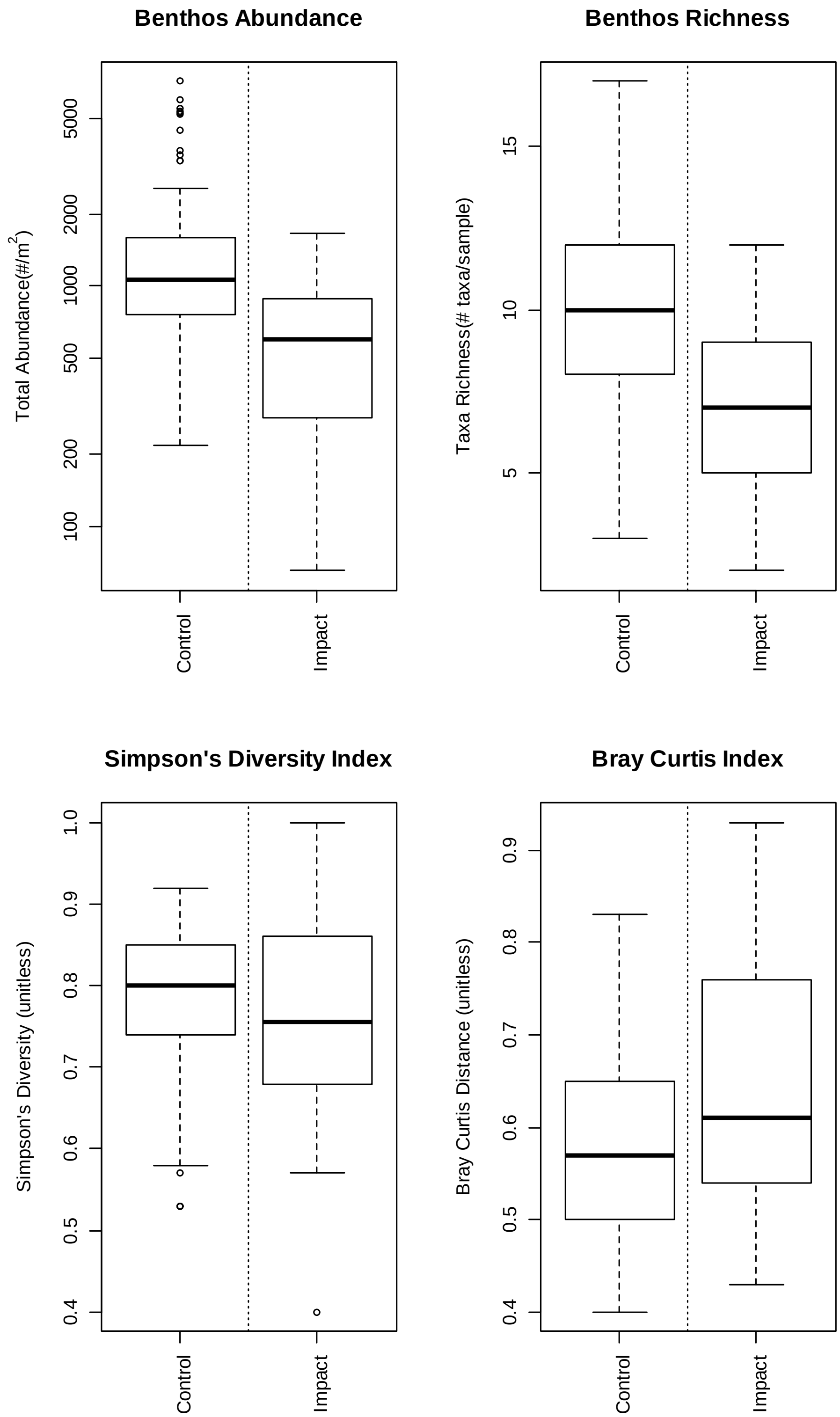


Figure A3-15. Key benthic community descriptors (abundance, richness, Simpson's Diversity, and Bray Curtis distance) as a function of key physical variables (depth, total organic carbon, sand, and silt) for 2009 and 2010 CREMP and EAS datasets.

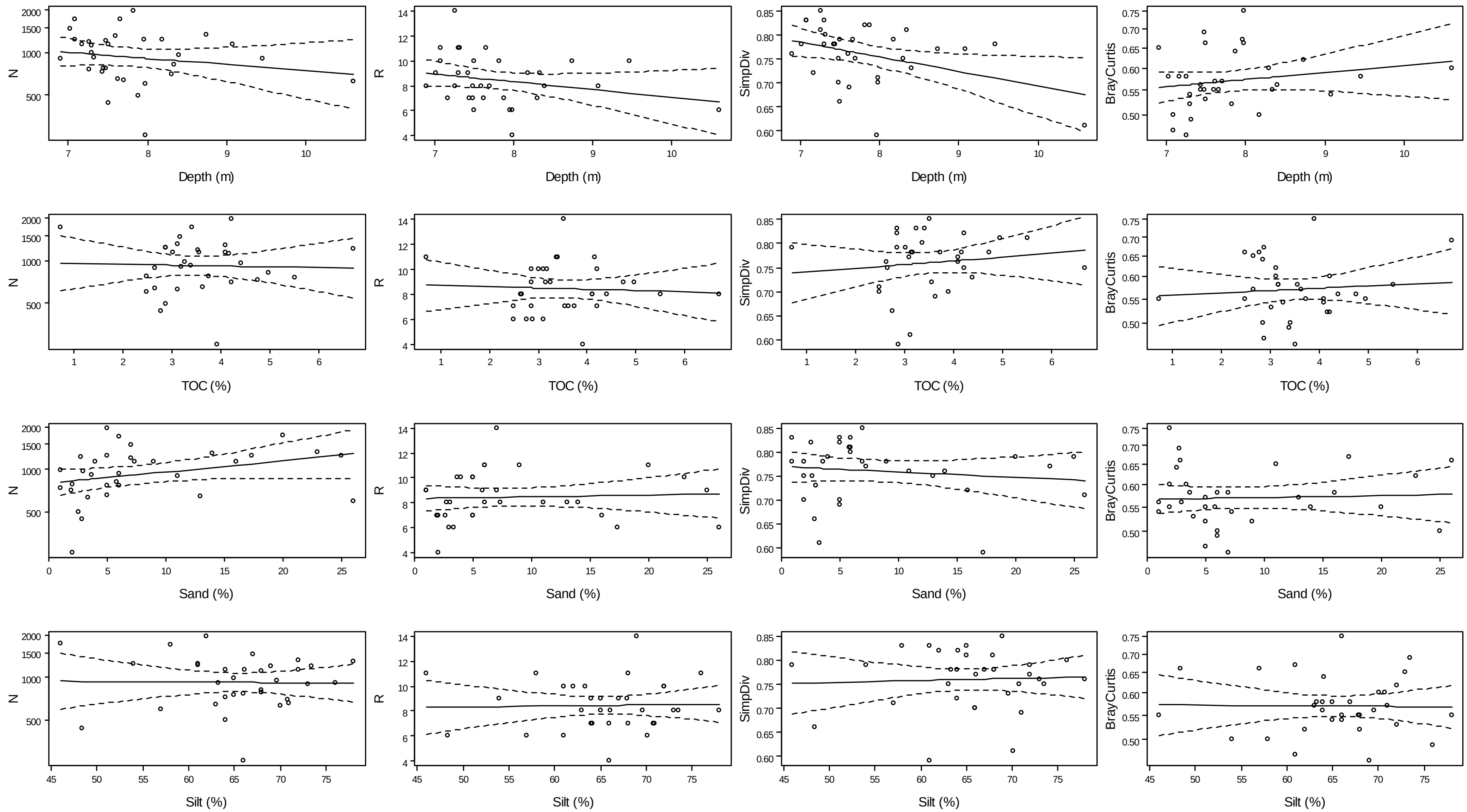


Figure A3-16. Key benthic community descriptors (abundance, richness, Simpson's Diversity, and Bray Curtis distance) as a function of key physical variables (clay, aluminum, arsenic, and cadmium) for 2009 and 2010 CREMP and EAS datasets.

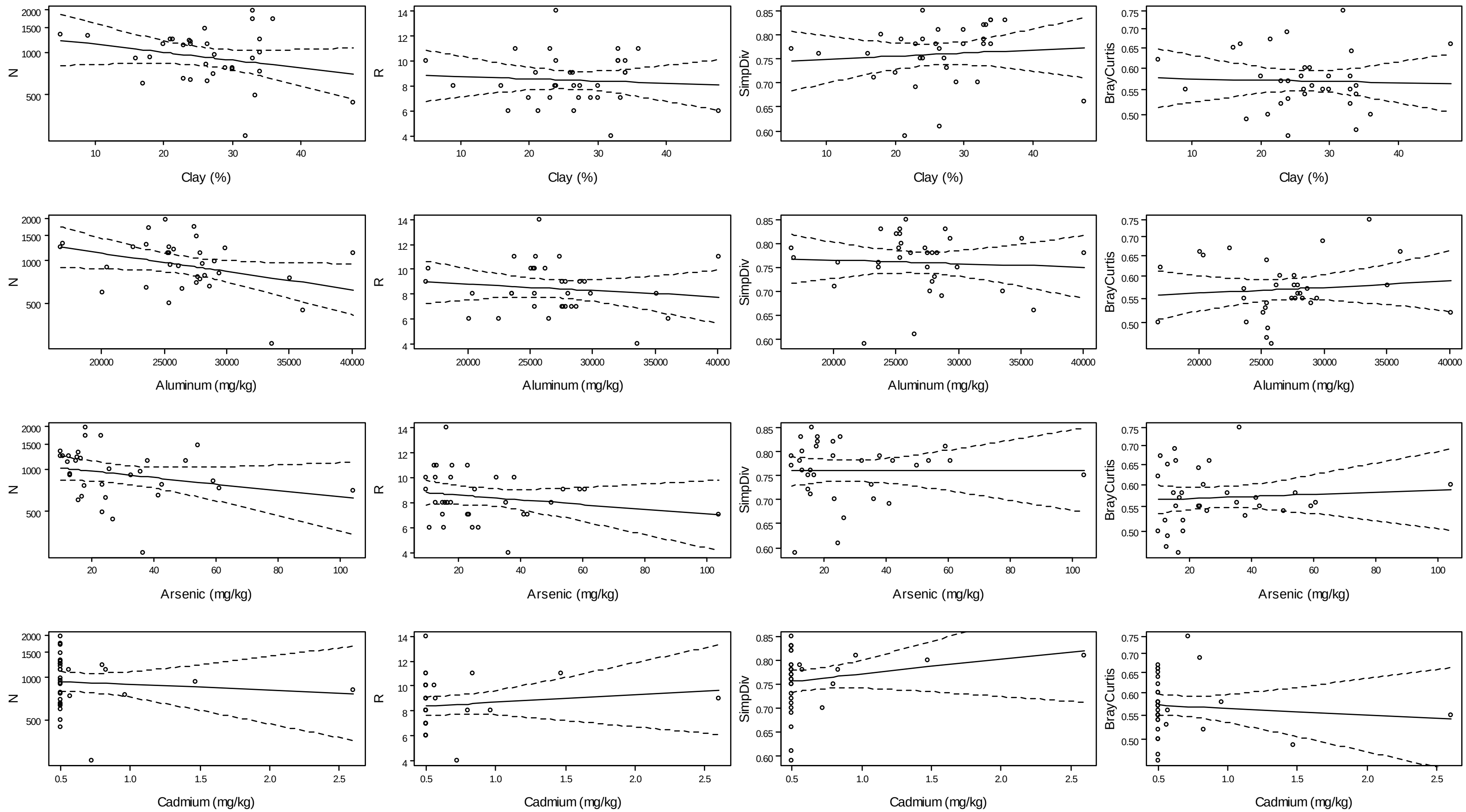
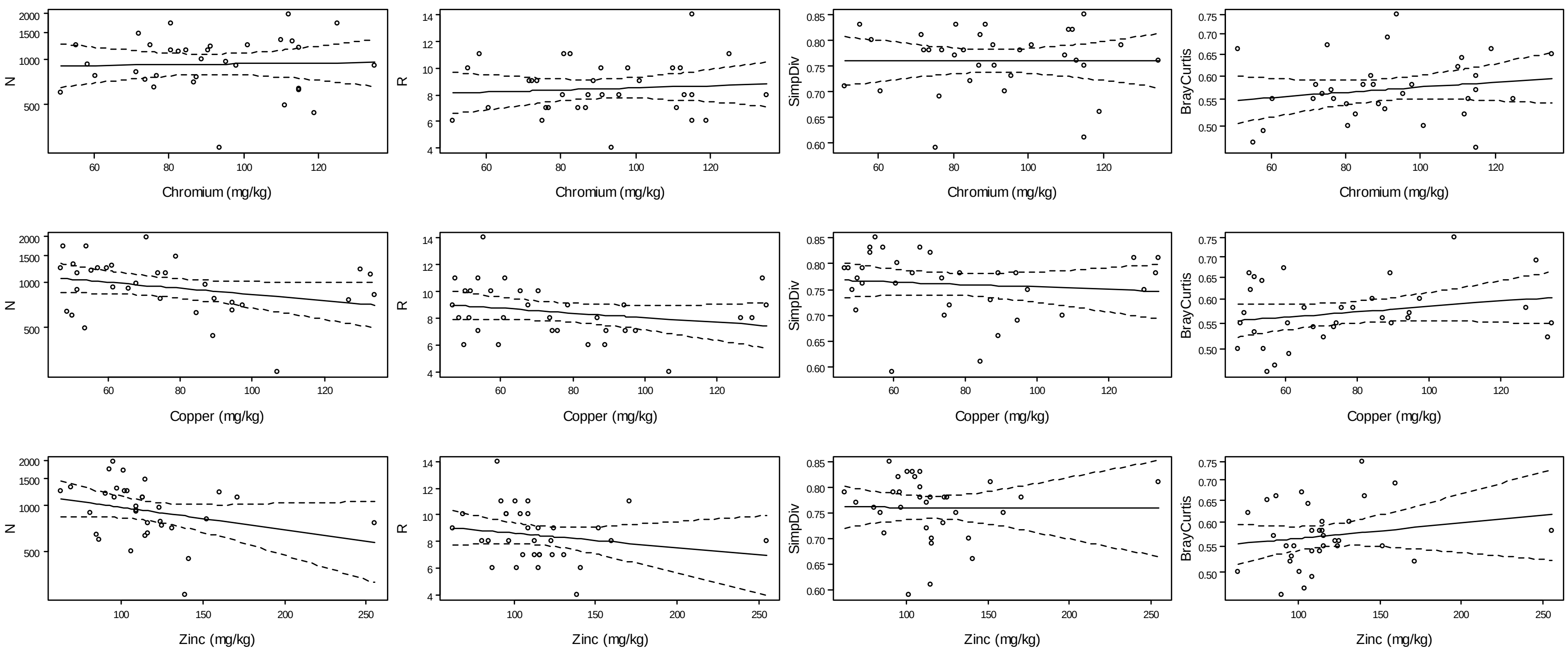


Figure A3-17. Key benthic community descriptors (abundance, richness, Simpson's Diversity, and Bray Curtis distance) as a function of key physical variables (chromium, copper and zinc) for 2009 and 2010 CREMP and EAS datasets.



4. PERIPHYTON COMMUNITY

4.1. Study Design Overview

This study component was conducted to address concerns regarding potential impacts to the periphyton community in Second Portage Lake stemming from construction of the East Dike in 2008. The 2010 EAS study had the following study design elements:

- *Area* – Six different areas were sampled (see main document for maps) along a gradient of TSS exposure during the 2008 construction event (from none to high): SP-REF (control in Drilltrail Arm), SP-CREMP (very low exposure), SP-ISLA (low exposure), SP-AZI (low-moderate exposure), SP-GSM (moderate exposure), and SP-BL (high exposure) (**Figure A4-1**). Five replicate samples were collected at each area.

Visual examination of the 2010 periphyton data set (see main EAS report for figures and discussion) clearly bounded the zone of impact to SP-BL. While there was a general decrease in periphyton biomass at all stations in 2010 relative to 2009 (based on SP-BL, SP-CREMP and SP-REF, it was noted that SP-BL may have decreased proportionately less from year x to year y than the other areas (i.e., indicating a potential improvement, or recovery, relative to the other two areas). This question is further explored here using Model 2.

4.2. Results

The response variable assessed in this analysis was:

- Total periphyton biomass (µg/cm^2 ww)

Raw data and box plots for total biomass are shown in **Figure A4-2** (the raw data file is provided in **Appendix A2**). Results by Area and Date are shown in **Figure A4-2**.

A variation of Model 2 was used to analyze this data set (R code: lmer(y ~ Effect*Year[7] + (1|Area) + (1|Area:Year))). In this model, Effect was a dummy variable coded with two levels: control (SP-DT and SP-CREMP[8]) and impact (SP-BL); Year is a factor with levels 2009 and 2010; and the other two are random effects terms characterizing variability associated with Area (i.e., differences related to Area, regardless of Year) and Area:Year (i.e., differences related to specific Area/Year combinations). The interaction

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[7] Note that “Effect*Year” in R code actually refers to “Effect + Year + Effect*Year”. Most references to Effect*Year in the rest of the text refers to the interaction term only.

[8] This area would have been exposed to low concentrations of TSS in 2008. Given that the area has had higher periphyton biomass than the SP-DT no exposure control, it was categorized as a control station to facilitate model analysis.

term Effect*Year is of particular interest to test for differential changes at impact (I) areas over time relative to control (C) areas (e.g., as would occur if a recovery were occurring).

Results of statistical analyses are presented in **Table A4-1**. Key results[9] from **Table A4-1** are as follows:

- The control-impact (CI) Effect variable showed a 57% difference (marginally significant) between control and impact area means in 2009.
- The Year variable showed a 39% drop between 2009 and 2010 at the control areas (marginally significant), suggesting a broader trend of lower productivity that may be related to that seen for the benthic invertebrate studies (see **Section 3.2** for details).
- The Effect*Year interaction term, which was used to test for possible signs of recovery at SP-BL, did show a 25% "recovery" relative to the predicted "no effect" mean from the model. However, variability was high and the result was not statistically significant.

[9] Magnitude of response for Effect and Year are shown relative to Control areas in 2009.

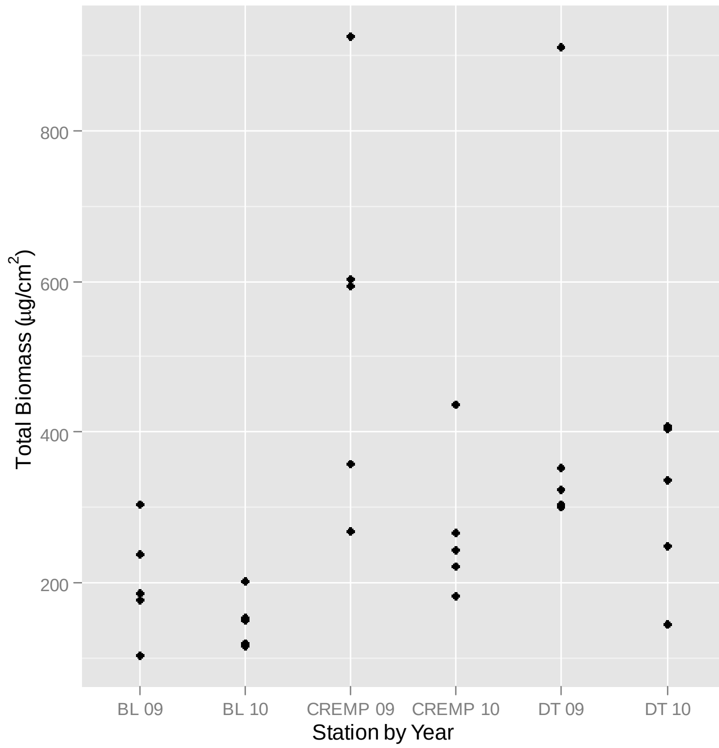
Table A4-1. Statistical model results for tests of significance of "Effect" on primary and secondary productivity for the 2009 Bay-Goose Dike EAS.

	Total Abundance ($\#/m^2$)
Data Transformation[1]	Log10
Advanced Transformation[2]	NA
Model Results	
C-I Effect Difference?	Marginal
p-value	0.059
Magnitude	-57%
Year Difference	Marginal
p-value	0.109
Magnitude	-39%
Effect*Year Difference?	No
p-value	0.545
"No Effect" Mean	116
Actual Mean	145
"Recovery" Size	29
"Recovery" Magnitude	25%
95% Lower CI[3] of Recovery Size	-77
95% Upper CI[3] of Recovery Size	424

Notes:

1. Initial transformation options discussed in **Section 2**.
2. Advanced transformations determined using Box-Cox method (Venables & Ripley 2002).
3. Confidence intervals estimated using 2 * Std. Error of Effect Size estimate.

Figure A4-1. Comparison of total periphyton biomass (raw data in top plot; box plots in bottom plot) at SP-BL, SP-CREMP and SP-DT stations in Second Portage Lake, 2009 and 2010.



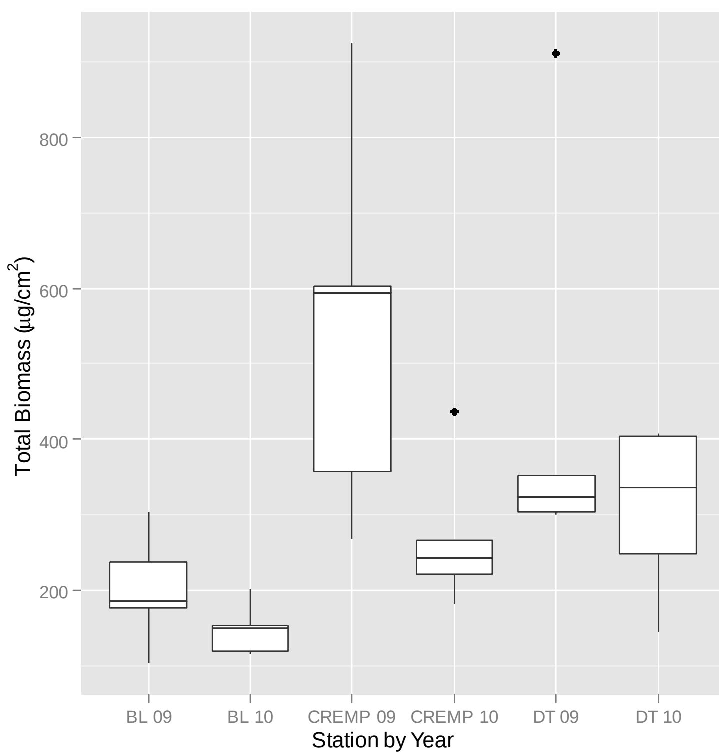
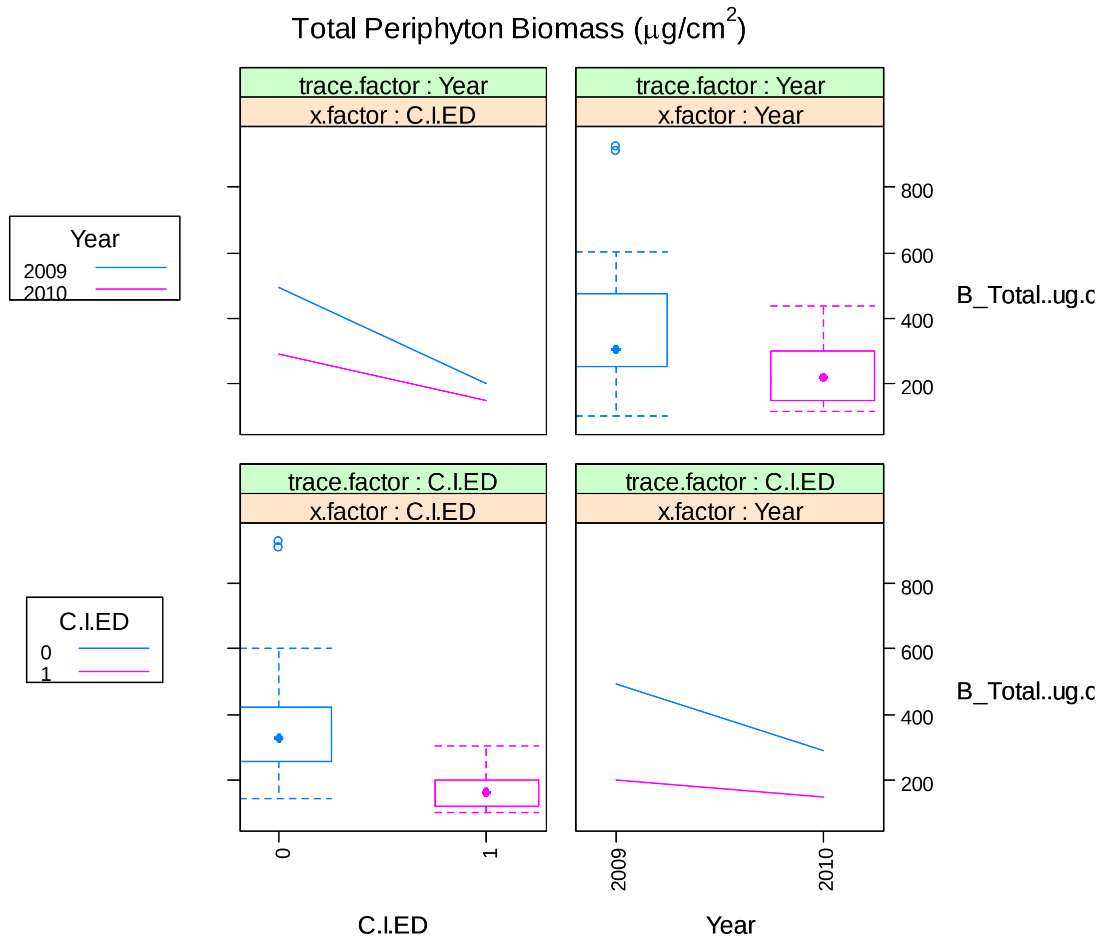


Figure A4-2. Interaction plots for Control-Impact and Year for total periphyton biomass at Second Portage Lake stations with 2009 and 2010 data.



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APPENDIX A1

RAW DATA FOR ANALYSIS OF BENTHIC INVERTEBRATES – REPS AND MEANS

Appendix A1: Benthic Invertebrate Reps.

Program	Date	Year	CREMP.ST	CREMP.LT	C.I.ED	C.I.ED2	C.I.BG	AEM.AZI	Repeat	Station	Replicate	Depth.m	N.Tot.m2	N.Olig.m2	N.Insect.m2	N.Moll.m2	N.Other.m2	R.Tot	R.Olig	R.Insect	R.Moll	R.Other	Simp.D	Bray.Cur
CREMP	20-Aug-09	2009	0	0	0	0	0	1	1	INUG	1	7.6	1130.43	108.7	521.74	434.78	65.22	15	2	7	3	3	0.85	0.43
CREMP	20-Aug-09	2009	0	0	0	0	0	1	1	INUG	2	7.9	1543.48	65.22	934.78	456.52	86.96	15	1	9	3	2	0.88	0.49
CREMP	20-Aug-09	2009	0	0	0	0	0	1	1	INUG	3	7	1630.43	0	1086.96	456.52	86.96	15	0	10	3	2	0.88	0.43
CREMP	20-Aug-09	2009	0	0	0	0	0	1	1	INUG	4	6.9	630.43	0	304.35	326.09	0	8	0	6	2	0	0.74	0.49
CREMP	20-Aug-09	2009	0	0	0	0	0	1	1	INUG	5	6.9	1021.74	43.48	521.74	369.57	86.96	15	2	8	3	2	0.9	0.48
CREMP	17-Aug-09	2009	0	0	0	0	0	1	1	PDL	1	7.2	2000	0	1347.83	630.43	21.74	10	0	8	1	1	0.8	0.52
CREMP	17-Aug-09	2009	0	0	0	0	0	1	1	PDL	2	8	1195.65	21.74	695.65	456.52	21.74	12	1	9	1	1	0.81	0.41
CREMP	17-Aug-09	2009	0	0	0	0	0	1	1	PDL	3	8.3	760.87	21.74	500	195.65	43.48	11	1	7	1	2	0.88	0.48
CREMP	17-Aug-09	2009	0	0	0	0	0	1	1	PDL	4	7.3	3326.09	195.65	2478.26	543.48	108.7	10	0	8	1	1	0.61	0.69
CREMP	17-Aug-09	2009	0	0	0	0	0	1	1	PDL	5	7.5	1347.83	326.09	847.83	152.17	21.74	11	2	7	1	1	0.82	0.62
CREMP	12-Aug-09	2009	2	1	1	2		1	1	SP	1	7.5	804.35	65.22	347.83	260.87	130.43	5	1	2	1	1	0.74	0.66
CREMP	12-Aug-09	2009	2	1	1	2		1	1	SP	2	7.7	695.65	21.74	391.3	260.87	21.74	7	1	4	1	1	0.77	0.57
CREMP	12-Aug-09	2009	2	1	1	2		1	1	SP	3	6.8	913.04	65.22	413.04	326.09	108.7	8	0	5	2	1	0.83	0.48
CREMP	12-Aug-09	2009	2	1	1	2		1	1	SP	4	7.1	847.83	43.48	434.78	326.09	43.48	8	0	6	1	1	0.77	0.48
CREMP	12-Aug-09	2009	2	1	1	2		1	1	SP	5	8.1	630.43	21.74	369.57	239.13	0	6	0	5	1	0	0.8	0.56
CREMP	14-Aug-09	2009	5	2	1	2		1	1	TE	1	7	847.83	21.74	152.17	586.96	86.96	7	1	4	1	1	0.51	0.62
CREMP	14-Aug-09	2009	5	2	1	2		1	1	TE	2	7.4	760.87	108.7	391.3	195.65	65.22	7	0	5	1	1	0.87	0.57
CREMP	14-Aug-09	2009	5	2	1	2		1	1	TE	3	6.9	521.74	0	130.43	391.3	0	5	0	3	2	0	0.49	0.6
CREMP	14-Aug-09	2009	5	2	1	2		1	1	TE	4	8.2	869.57	0	391.3	347.83	130.43	8	0	5	1	2	0.79	0.49
CREMP	14-Aug-09	2009	5	2	1	2		1	1	TE	5	7.9	847.83	0	413.04	304.35	130.43	8	0	6	1	1	0.81	0.46
CREMP	14-Aug-09	2009	0	0	0	0	0	1	1	TEFF	1	6.9	1021.74	0	586.96	239.13	195.65	11	0	9	1	1	0.86	0.45
CREMP	14-Aug-09	2009	0	0	0	0	0	1	1	TEFF	2	6.6	1543.48	21.74	1347.83	130.43	43.48	12	1	9	1	1	0.78	0.52
CREMP	14-Aug-09	2009	0	0	0	0	0	1	1	TEFF	3	7.8	1434.78	0	1108.7	326.09	0	8	0	7	1	0	0.83	0.45
CREMP	14-Aug-09	2009	0	0	0	0	0	1	1	TEFF	4	7.2	978.26	0	608.7	326.09	43.48	12	0	10	1	1	0.84	0.43
CREMP	14-Aug-09	2009	0	0	0	0	0	1	1	TEFF	5	6.9	1195.65	0	934.78	217.39	43.48	9	0	7	1	1	0.88	0.48
CREMP	13-Aug-09	2009	7	3				1	1	TPE	1	6.9	1543.48	108.7	1130.43	217.39	86.96	12	2	8	1	1	0.89	0.42
CREMP	13-Aug-09	2009	7	3				1	1	TPE	2	7.7	1891.3	0	1195.65	695.65	0	11	0	10	1	0	0.82	0.47
CREMP	14-Aug-09	2009	7	3				1	1	TPE	3	7.8	1065.22	0	586.96	456.52	21.74	9	0	7	1	1	0.77	0.49
CREMP	14-Aug-09	2009	7	3				1	1	TPE	4	6.5	1826.09	173.91	869.57	586.96	195.65	12	0	10	1	1	0.84	0.57
CREMP	14-Aug-09	2009	7	3				1	1	TPE	5	6.5	2239.13	108.7	1326.09	717.39	86.96	12	2	8	1	1	0.83	0.55
CREMP	21-Aug-09	2009	9	4				1	1	TPN	1	8.7	1565.22	21.74	1021.74	521.74	0	11	1	9	1	0	0.83	0.51
CREMP	21-Aug-09	2009	9	4				1	1	TPN	2	7.1	1173.91	0	673.91	456.52	43.48	9	0	7	1	1	0.77	0.51
CREMP	21-Aug-09	2009	9	4				1	1	TPN	3	8.5	1478.26	0	826.09	608.7	43.48	8	0	6	1	1	0.78	0.5
CREMP	21-Aug-09	2009	9	4				1	1	TPN	4	7.8	1086.96	0	652.17	413.04	21.74	7	0	5	1	1	0.79	0.51
CREMP	21-Aug-09	2009	9	4				1	1	TPN	5	8.8	891.3	0	478.26	391.3	21.74	11	0	9	1	1	0.77	0.47
CREMP	21-Aug-09	2009	0	0	0	0	0	1	1	TPS	1	8	1217.39	86.96	956.52	173.91	0	11	1	9	1	0	0.92	0.4
CREMP	21-Aug-09	2009	0	0	0	0	0	1	1	TPS	2	6.8	2521.74	21.74	2000	500	0	11	1	9	1	0	0.86	0.56
CREMP	21-Aug-09	2009	0	0	0	0	0	1	1	TPS	3	7.3	3326.09	282.61	2130.43	913.04	0	11	1	9	1	0	0.84	0.6
CREMP	21-Aug-09	2009	0	0	0	0	0	1	1	TPS	4	7.3	2021.74	0	1717.39	304.35	0	11	0	10	1	0	0.76	0.52
CREMP	21-Aug-09	2009	0	0	0	0	0	1	1	TPS	5	9.7	717.39	43.48	304.35	369.57	0	8	1	6	1	0	0.72	0.51
CREMP	25-Aug-10	2010	0	0	0	1	0	1	1	INUG	1	6.8	478.26	86.96	130.43	260.87	0	6	1	3	2	0	0.76	0.63
CREMP	25-Aug-10	2010	0	0	0	1	0	1	1	INUG	2	6.7	543.48	21.74	391.3	108.7	21.74	7	1	4	1	1	0.77	0.72
CREMP	25-Aug-10	2010	0	0	0	1	0	1	1	INUG	3	8	760.87	0	239.13	456.52	65.22	12	0	7	3	2	0.78	0.45
CREMP	25-Aug-10	2010	0	0	0	1	0	1	1	INUG	4	8.3	630.43	0	173.91	413.04	43.48	7	0	4	2	1	0.64	0.54
CREMP	25-Aug-10	2010	0	0	0	1	0	1	1	INUG	5	8.7	782.61	21.74	456.52	282.61	21.74	10	1	6	2	1	0.81	0.54
CREMP	24-Aug-10	2010	0	0	0	1	0	1	1	PDL	1	6.6	1130.43	43.48	891.3	195.65	0	8	0	6	2	0	0.58	0.67
CREMP	24-Aug-10	2010	0	0	0	1	0	1	1	PDL	2	6.9	1043.48	65.22	695.65	260.87	21.74	8	0	5	2	1	0.74	0.61
CREMP	24-Aug-10	2010	0	0	0	1	0	1	1	PDL	3	6.5	1500	86.96	695.65	717.39	0	9	1	6	2	0	0.77	0.63
CREMP	24-Aug-10	2010	0	0	0	1	0	1	1	PDL	4	6.8	456.52	21.74	260.87	152.17	21.74	9	1	6	1	1	0.8	0.65
CREMP	24-Aug-10	2010	0	0	0	1	0	1	1	PDL	5	7.7	347.83	0	239.13	108.7	0	8	0	7	1	0	0.88	0.71
CREMP	21-Aug-10	2010	3	1	1	3		1	1	SP	1	8.9	217.39	0	108.7	86.96	21.74	5	0	3	1	1	0.82	0.8
CREMP	21-Aug-10	2010	3	1	1	3		1	1	SP	2	6.8	217.39	0	65.22	130.43	21.74	3	0	1	1	1	0.6	0.78
CREMP	21-Aug-10	2010	3	1	1	3		1	1	SP	3	8.8	173.91	0	65.22	108.7	0	2	0	1	1	0	0.54	0.82
CREMP	21-Aug-10	2010	3	1	1	3		1	1	SP	4	7.4	217.39	0	86.96	108.7	21.74	5	0	3	1	1	0.76	0.78
CREMP	21-Aug-10	2010	3	1	1	3		1	1	SP	5	8	456.52	43.48	152.17	217.39	43.48	7	1	4	1	1	0.76	0.59
CREMP	27-Aug-10	2010	6	2	1	3		1	1	TE	1	7.7	1021.74	21.74	282.61	673.91	43.48	10	1	7	1	1	0.56	0.56
CREMP	27-Aug-10	2010	6	2	1	3		1	1	TE	2	9.6	347.83	0	108.7	130.43	108.7	4	0	2	1	1	0.74	0.77
CREMP	27-Aug-10	2010	6	2	1	3		1	1	TE	3	8.2	217.39	0	65.22	108.7	43.48	3	0	1	1	1	0.69	0.78
CREMP	27-Aug-10	2010	6	2	1	3		1	1	TE	4	7.5	760.87	0	326.09	239.13	195.65	7	0	5	1	1	0.75	0.64
CREMP	27-Aug-10	2010	6	2	1	3		1	1	TE	5	6.9	630.43	43.48	304.35	239.13	43.48	8	1	5	1	1	0.8	0.56
CREMP	27-Aug-10	2010	0	0	0	1	0	1	1	TEFF	1	7.4	652.17	0	369.57	260.87	21.74	9	0	7	1	1	0.81	0.51
CREMP	27-Aug-10	2010	0	0	0	1	0	1	1	TEFF	2	7.2	1391.3	0	978.26	391.3	21.74	14	0	12	1	1	0.79	0.49
CREMP	27-Aug-10	2010	0	0	0	1	0	1	1	TEFF	3	7.4	673.91	0	282.61	369.57	21.74	8	0	6	1	1	0.69	0.52
CREMP	27-Aug-10	2010	0	0	0	1	0	1	1	TEFF	4	6.6	956.52	21.74	608.7	282.61	43.48	12	1	9	1	1	0.85	0.42
CREMP	27-Aug-10	2010	0	0	0	1	0	1	1	TEFF	5	8	934.78	43.48	478.26	282.61	130.43	11	1	8	1	1	0.84	0.53
CREMP	19-Aug-10	2010	8	3			1	1	1	TPE	1	8.3	847.83	43.48	413.04	369.57	21.74	9	2	5	1	1	0.75	0.53
CREMP	19-Aug-10	2010	8	3			1	1	1	TPE	2	7.5	1152.17	21.74	434.78	543.48	152.17	8	1	5	1	1	0.74	0.57
CREMP	19-Aug-10	2010	8	3			1	1	1	TPE	3	6.8	1195.65	43.48	760.87	369.57	21.74	10	1	7	1	1	0.81	0.5
CREMP	19-Aug-10	2010	8	3			1	1	1	TPE	4	8.4	1152.17	108.7	652.17	326.09	65.22	11	2	7	1	1	0.82	0.54
CREMP	19-Aug-10	2010	8	3			1	1	1	TPE	5	6.5	1347.83	86.96	673.91	434.78	152.17	11	2	7	1	1	0.83	0.51
CREMP	19-Aug-10	2010	10	4				1	1	TPN	1	7.5	1434.78	86.96	1043.48	260.87	43.48	11	2	7	1	1	0.69	0.58
CREMP	19-Aug-10	2010	10	4				1	1	TPN	2	8.8	2108.7	43.48	1739.13	282.61	43.48	11	1	8	1	1	0.64	0.57
CREMP	19-Aug-10	2010	10	4				1	1	TPN	3	9.5	1760.87	86.96	1173.91	478.26	21.74	12	2	8	1	1	0.75	0.57
CREMP	19-Aug-10	2010	10	4				1	1	TPN	4	9.5	1108.7	0	913.04	152.17	43.48	10	0	8	1	1	0.81	0.59
CREMP	19-Aug-10	2010	10	4				1	1	TPN	5	8.4	195.65	0	152.17	43.48	0	8	0	7	1	0	0.97	0.8
CREMP	20-Aug-10	2010	0	0	0	1	0	1	1	TPS	1	7.2	1869.57	86.96	1195.65	586.96	0	9	0	8	1	0	0.84	0.47
CREMP	20-Aug-10	2010	0	0	0	1	0	1	1	TPS	2	8.1	1869.57	43.48	739.13	978.26	108.7	12	0	9	2	1	0.77	0.48
CREMP	20-Aug-10	2010	0	0	0	1	0	1	1	TPS	3	8.4	1586.96	0	1326.09	260.87	0	9	0	8	1	0	0.81	0.57
CREMP	20-Aug-10	2010	0	0	0	1	0	1	1	TPS	4	6.7	586.96	21.74	369.57	195.65	0	5	1	3	1	0	0.75	0.63
CREMP	20-Aug-10	2010	0	0	0	1	0	1	1	TPS	5	7.6	565.22	0	239.13	326.09	0	6	0	5	1	0	0.63	0.59
ED EAS	19-Aug-09	2009			0	0	0	1	1	SP-DT	1	6.5	1173.91	0	326.09	739.13	108.7	11	0	8	2	1	0.69	0.55
ED EAS	19-Aug-09	2009			0	0	0	1	1	SP-DT	2	7.5	978.26	0	434.78	456.52	86.96	9	0	6	2	1	0.77	0.52
ED EAS	19-Aug-09	2009			0	0	0	1	1	SP-DT	3	7.3	1304.35	86.96	543.48	630.43	43.48	12	1	9	1	1	0.73	0.52
ED EAS	19-Aug-09	2009			0	0	0	1	1	SP-DT	4	7.6	1217.39	152.17	652.17	413.04	0	11	1	8	2	0	0.84	0.5
ED EAS	19-Aug-09	2009			0	0	0	1	1	SP-DT	5	7.6	934.78	86.96	456.52	239.13	152.17	11	2	6	2	1	0.87	0.51
ED EAS	23-Aug-09	2009			1	2		1	1	SP-F1	1	7	1108.7	108.7	565.22	347.83	86.96	8	1	5	1	1	0.8	0.53
ED EAS	23-Aug-09	2009			1	2		1	1	SP-F1	2	7.2	1391.3	0	630.43	630.43	130.43	7	0	5	1	1	0.73	0.61
ED EAS	23-Aug-09	2009			1	2		1	1	SP-F1	3	6.8	2369.57	21.74	1347.83	869.57	130.43	11	1	8	1	1	0.77	0.64
ED EAS	23-Aug-09	2009			1	2		1	1	SP-F1	4	6.8	1043.48	0	673.91	282.61	86.96	9	0	7	1	1	0.81	0.53
ED EAS	23-Aug-09	2009			1	2		1	1	SP-F1	5	7.3	1456.52	0	826.09	478.26	152.17	8	0	6	1	1	0.8	0.58
ED EAS	18-Aug-09	2009			1	2		1	1	SP-F2	1	7.6	934.78	0	326.09	543.48	65.22	5	0	2	2	1	0.74	0.58
ED EAS	18-Aug-09	2009			1	2		1	1	SP-F2	2	6.9	978.26	21.74	500	413.04	43.48	14	1	9	3	1	0.88	0.51
ED EAS	18-Aug-09	2009			1	2		1	1	SP-F2	3	7.6	934.78	0	456.52	456.52	21.74	7	0	4	2	1	0.76	0.6
ED EAS	18-Aug-09	2009			1	2		1	1	SP-F2	4	7.1	565.22	0	260.87	260.87	43.48	7	0	4	2	1	0.79	0.57
ED EAS	18-Aug-09	2009			1	2		1	1	SP-F2	5	7.1	369.57	65.22	130.43	108.7	65.22	7	1	3	2	1	0.9	0.67
ED EAS	15-Aug-09	2009			1	2		1	1	SP-N1	1	6.5	1021.74	21.74	369.57	478.26	152.17	5	0	3	1	1	0.71	0.59
ED EAS	15-Aug-09	2009			1	2		1	1	SP-N1	2	7	1000	0	521.74	456.52	21.74	7	0	4	2	1	0.74	0.54
ED EAS	15-Aug-09	2009			1	2		1	1	SP-N1	3	7.4	1021.74	21.74	347.83	565.22	86.96	6	1	3	1	1	0.62	0.64
ED EAS	15-Aug-09	2009			1	2		1	1	SP-N1	4	7.7	1739.13	0	804.35	804.35	130.43	8	0	5	2	1	0.73	0.61
ED EAS	15-Aug-09	2009			1	2		1	1	SP-N1	5	7.2	891.3	86.96	347.83	369.57	86.96	7	0	4	2	1	0.81	0.49
ED EAS	17-Aug-09	2009			1	2		1	1	SP-N2	1	6.9	869.57	21.74	565.22	282.61	0	8	1	6	1	0	0.77	0.57
ED EAS	17-Aug-09	2009			1	2		1	1	SP-N2	2	7.4	608.7	21.74	195.65	347.83	43.48	10	1	7	1	1	0.67	0.52
ED EAS	17-Aug-09	2009			1	2		1	1	SP-N2	3	8.9	456.52	21.74	65.22	347.83	21.74	5	1	2	1	1	0.42	0.63
ED EAS	17-Aug-09	2009			1	2		1	1	SP-N2	4	7.5	543.48	43.48	260.87	217.39	21.74	6	1	3	1	1	0.76	0.58
ED EAS	17-Aug-09	2009			1	2		1	1	SP-N2	5	7.4	782.61	21.74	434.78	239.13	86.96	8	0	6	1	1	0.83	0.55
ED EAS	23-Aug-09	2009			1	2		1	1	SP-N3	1	6.9	913.04	43.48	413.04	413.04	43.48	11	1	7	2	1	0.79	0.49
ED EAS	23-Aug-09	2009			1	2		1	1	SP-N3	2	8	565.22	0	304.35	217.39	43.48	7	0	4	2	1	0.79	0.59
ED EAS	23-Aug-09	2009			1	2		1	1	SP-N3	3	7.5	695.65	21.74	369.57	173.91	130.43	11	1	7	2	1	0.88	0.56
ED EAS	23-Aug-09	2009			1	2		1	1	SP-N3	4	7.3	782.61	0	369.57	239.13	173.91	8	0	6	1	1	0.79	0.61
ED EAS	23-Aug-09	2009			1	2		1	1	SP-N3	5		695.65	0	260.87	391.3	43.48	7	0	5	1	1	0.63	0.57
ED EAS	23-Aug-09	2009						1	1	HVH-4	1	7.1	1000	43.48	521.74	239.13	195.65	10	1	6	2	1	0.84	0.57
ED EAS	23-Aug-09	2009						1	1	HVH-4	2	6.9	1086.96	108.7	695.65	195.65	86.96	9	2	5	1	1	0.74	0.63
ED EAS	23-Aug-09	2009						1	1	HVH-4	3	7.5	847.83	21.74	521.74	260.87	43.48	9	0	7	1	1	0.85	0.48
ED EAS	23-Aug-09	2009						1	1	HVH-4	4	7.7	1065.22	0	673.91	282.61	108.7	7	0	5	1	1	0.82	0.54
ED EAS	23-Aug-09	2009						1	1	HVH-4	5	7.3	934.78	65.22	630.43	173.91	65.22	11	1	8	1	1	0.88	0.5
ED EAS	22-Aug-09	2009						0	1	TRB-1	1	8.2	456.52	0	173.91	173.91	108.7	7	0	5	1	1	0.79	0.65
ED EAS	22-Aug-09	2009						0	1	TRB-1	2	7.5	1065.22	108.7	326.09	608.7	21.74	9	1	6	1	1	0.66	0.52
ED EAS	22-Aug-09	2009						0	1	TRB-1	3	6.9	847.83	43.48	434.78	282.61	86.96	6	0	4	1	1	0.8	0.55
ED EAS	22-Aug-09	2009						0	1	TRB-1	4	7.2	739.13	21.74	282.61	347.83	86.96	8	0	6	1	1	0.75	0.51
ED EAS	22-Aug-09	2009						0	1	TRB-1	5	8.5	978.26	43.48	391.3	521.74	21.74	9	0	7	1	1	0.69	0.51
ED EAS	22-Aug-09	2009						0	1	TRB-2	1	6.1	391.3	86.96	86.96	108.7	108.7	5	1	2	1	1	0.83	0.78
ED EAS	22-Aug-09	2009						0	1	TRB-2	2	6	500	173.91	86.96	173.91	65.22	6	1	3	1	1	0.79	0.67
ED EAS	22-Aug-09	2009						0	1	TRB-2	3	6.2	717.39	217.39	43.48	326.09	130.43	6	1	2	2	1	0.74	0.84
ED EAS	22-Aug-09	2009						0	1	TRB-2	4	6.4	347.83	65.22	21.74	173.91	86.96	5	1	1	2	1	0.79	0.83
ED EAS	22-Aug-09	2009						0	1	TRB-2	5	6.5	43.48	0	21.74	0	21.74	2	0	1	0	1	1	0.95
ED EAS	24-Aug-10	2010					1	1	1	HVH-4	1	7.5	282.61	21.74	86.96	173.91	0	4	1	2	1	0	0.6	0.72
ED EAS	24-Aug-10	2010					1	1	1	HVH-4	2	7.8	369.57	0	86.96	217.39	65.22	7	0	4	1	2	0.66	0.69
ED EAS	24-Aug-10	2010					1	1	1	HVH-4	3	7	586.96	0	304.35	282.61	0	7	0	5	2	0	0.74	0.57
ED EAS	24-Aug-10	2010					1	1	1	HVH-4	4	7.2	847.83	43.48	500	239.13	65.22	12	2	7	2	1	0.89	0.43
ED EAS	24-Aug-10	2010					1	1	1	HVH-4	5	8	108.7	0	0	108.7	0	2	0	0	2	0	0.4	0.88
ED EAS	23-Aug-10	2010			0	1	0	1	1	SP-DT	1	7.4	1086.96	43.48	478.26	521.74	43.48	10	0	7	2	1	0.77	0.46
ED EAS	23-Aug-10	2010			0	1	0	1	1	SP-DT	2	8.5	652.17	65.22	326.09	152.17	108.7	10	1	5	3	1	0.91	0.57
ED EAS	23-Aug-10	2010			0	1	0	1	1	SP-DT	3	8.7	847.83	43.48	260.87	434.78	108.7	8	1	5	1	1	0.71	0.55
ED EAS	23-Aug-10	2010			0	1	0	1	1	SP-DT	4	7.3	869.57	86.96	282.61	369.57	130.43	10	1	5	3	1	0.81	0.5
ED EAS	23-Aug-10	2010			0	1	0	1	1	SP-DT	5	9.8	630.43	0	391.3	130.43	108.7	8	0	6	1	1	0.85	0.65
ED EAS	20-Aug-10	2010			1	3		1	1	SP-F1	1	7.7	1347.83	43.48	695.65	434.78	173.91	8	0	6	1	1	0.82	0.54
ED EAS	20-Aug-10	2010			1	3		1	1	SP-F1	2	9.6	1304.35	21.74	500	586.96	195.65	9	1	6	1	1	0.74	0.54
ED EAS	20-Aug-10	2010			1	3		1	1	SP-F1	3	8.5	760.87	0	456.52	239.13	65.22	5	0	3	1	1	0.71	0.62
ED EAS	20-Aug-10	2010			1	3		1	1	SP-F1	4	9.7	1239.13	0	760.87	413.04	65.22	8	0	6	1	1	0.75	0.52
ED EAS	20-Aug-10	2010			1	3		1	1	SP-F1	5	9.9	1021.74	0	543.48	347.83	130.43	10	0	8	1	1	0.83	0.5

Program	Date	Year	CREMP.ST	CREMP.LT	C.I.ED	C.I.ED2	C.I.BG	AEM.AZI	Repeat	Station	Replicate	Depth.m	N.Tot.m2	N.Olig.m2	N.Insect.m2	N.Moll.m2	N.Other.m2	R.Tot	R.Olig	R.Insect	R.Moll	R.Other	Simp.D	Bray.Cur
ED EAS	20-Aug-10	2010			1	3		1	1	SP-N1	1	8	1521.74	21.74	847.83	500	152.17	8	0	5	2	1	0.8	0.57
ED EAS	20-Aug-10	2010			1	3		1	1	SP-N1	2	7.5	1217.39	0	847.83	304.35	65.22	6	0	4	1	1	0.57	0.65
ED EAS	20-Aug-10	2010			1	3		1	1	SP-N1	3	7.1	152.17	0	0	130.43	21.74	2	0	0	1	1	0.29	0.84
ED EAS	20-Aug-10	2010			1	3		1	1	SP-N1	4	10	2608.7	0	2000	521.74	86.96	10	0	7	2	1	0.74	0.69
ED EAS	20-Aug-10	2010			1	3		1	1	SP-N1	5	7.2	695.65	0	130.43	456.52	108.7	6	0	4	1	1	0.55	0.61
ED EAS	20-Aug-10	2010			1	3		1	1	SP-N2	1	8.2	695.65	21.74	260.87	369.57	43.48	8	1	5	1	1	0.69	0.5
ED EAS	20-Aug-10	2010			1	3		1	1	SP-N2	2	7.5	1065.22	0	760.87	304.35	0	7	0	5	2	0	0.78	0.58
ED EAS	20-Aug-10	2010			1	3		1	1	SP-N2	3	8.7	1434.78	108.7	869.57	391.3	65.22	6	0	3	2	1	0.66	0.6
ED EAS	20-Aug-10	2010			1	3		1	1	SP-N2	4	9.3	652.17	21.74	239.13	369.57	21.74	9	1	6	1	1	0.67	0.53
ED EAS	20-Aug-10	2010			1	3		1	1	SP-N2	5	8.3	934.78	86.96	565.22	195.65	86.96	8	0	5	2	1	0.86	0.58
ED EAS	19-Aug-10	2010			1	3		1	1	SP-N3	1	7.4	304.35	0	130.43	108.7	65.22	5	0	2	2	1	0.79	0.75
ED EAS	19-Aug-10	2010			1	3		1	1	SP-N3	2	8.9	413.04	21.74	195.65	152.17	43.48	8	0	6	1	1	0.84	0.62
ED EAS	19-Aug-10	2010			1	3		1	1	SP-N3	3	9.2	913.04	65.22	217.39	521.74	108.7	8	1	4	2	1	0.82	0.51
ED EAS	19-Aug-10	2010			1	3		1	1	SP-N3	4	8.7	934.78	0	195.65	673.91	65.22	7	0	4	2	1	0.56	0.61
ED EAS	19-Aug-10	2010			1	3		1	1	SP-N3	5	7.3	934.78	43.48	456.52	434.78	0	9	1	6	2	0	0.76	0.5
BG EAS	25-Aug-10	2010					1	1	0	TP-E1	1	7.4	391.3	0	195.65	173.91	21.74	7	0	4	2	1	0.81	0.65
BG EAS	25-Aug-10	2010					1	1	0	TP-E1	2	7.5	652.17	21.74	369.57	260.87	0	8	1	5	2	0	0.87	0.57
BG EAS	25-Aug-10	2010					1	1	0	TP-E1	3	8	608.7	21.74	152.17	391.3	43.48	9	1	5	2	1	0.76	0.54
BG EAS	25-Aug-10	2010					1	1	0	TP-E1	4	8	608.7	0	260.87	326.09	21.74	6	0	3	2	1	0.8	0.65
BG EAS	25-Aug-10	2010					1	1	0	TP-E1	5	8.5	217.39	0	86.96	130.43	0	6	0	4	2	0	0.87	0.8
BG EAS	27-Aug-10	2010					1	1	0	TP-E2	1	9.5	891.3	0	586.96	260.87	43.48	12	0	9	2	1	0.88	0.52
BG EAS	27-Aug-10	2010					1	1	0	TP-E2	2	10	717.39	21.74	304.35	391.3	0	8	1	6	1	0	0.66	0.61
BG EAS	27-Aug-10	2010					1	1	0	TP-E2	3	9.9	1652.17	65.22	934.78	630.43	21.74	11	1	7	2	1	0.82	0.57
BG EAS	27-Aug-10	2010					1	1	0	TP-E2	4	9	913.04	21.74	326.09	500	65.22	8	1	5	1	1	0.68	0.54
BG EAS	27-Aug-10	2010					1	1	0	TP-E2	5	8.9	369.57	21.74	217.39	130.43	0	9	1	7	1	0	0.87	0.65
BG EAS	25-Aug-10	2010			0	1	0	1	0	TP-E3	1	11	913.04	0	260.87	652.17	0	5	0	3	2	0	0.53	0.59
BG EAS	25-Aug-10	2010			0	1	0	1	0	TP-E3	2	12	565.22	0	152.17	369.57	43.48	7	0	5	1	1	0.58	0.57
BG EAS	28-Aug-10	2010			0	1	0	1	0	TP-E3	3	10	217.39	0	43.48	173.91	0	4	0	2	2	0	0.53	0.78
BG EAS	28-Aug-10	2010			0	1	0	1	0	TP-E3	4	10	760.87	21.74	260.87	456.52	21.74	7	1	4	1	1	0.61	0.57
BG EAS	28-Aug-10	2010			0	1	0	1	0	TP-E3	5	10	673.91	0	239.13	347.83	86.96	9	0	6	2	1	0.78	0.5
ED EAS	19-Aug-10	2010						1	1	TRB-2	1	6.9	695.65	0	173.91	347.83	173.91	3	0	1	1	1	0.65	0.91
ED EAS	19-Aug-10	2010						1	1	TRB-2	2	6.8	282.61	43.48	173.91	65.22	0	5	1	2	2	0	0.72	0.85
ED EAS	19-Aug-10	2010						1	1	TRB-2	3	6.9	413.04	43.48	108.7	217.39	43.48	7	0	4	2	1	0.87	0.68
ED EAS	19-Aug-10	2010						1	1	TRB-2	4	6.5	347.83	0	108.7	173.91	65.22	6	0	3	2	1	0.85	0.73
ED EAS	19-Aug-10	2010						1	1	TRB-2	5	6.6	478.26	43.48	304.35	65.22	65.22	10	1	6	2	1	0.92	0.63
ED EAS	23-Aug-10	2010			1	3		1	1	SP-F2	1	7.4	717.39	0	347.83	326.09	43.48	7	0	4	2	1	0.8	0.67
ED EAS	23-Aug-10	2010			1	3		1	1	SP-F2	2	7.8	478.26	21.74	217.39	239.13	0	7	1	4	2	0	0.79	0.75
ED EAS	23-Aug-10	2010			1	3		1	1	SP-F2	3	7.2	2347.83	21.74	1695.65	608.7	21.74	9	0	6	2	1	0.64	0.68
ED EAS	23-Aug-10	2010			1	3		1	1	SP-F2	4	7.2	1826.09	0	1456.52	347.83	21.74	10	0	7	2	1	0.74	0.66
ED EAS	23-Aug-10	2010			1	3		1	1	SP-F2	5	7.8	695.65	0	130.43	456.52	108.7	7	0	4	2	1	0.76	0.68
ED EAS	19-Aug-10	2010						0	1	TRB-1	1	7.4	1000	21.74	543.48	369.57	65.22	9	0	6	2	1	0.86	0.46
ED EAS	19-Aug-10	2010						0	1	TRB-1	2	7.2	1065.22	130.43	369.57	434.78	130.43	8	0	5	2	1	0.84	0.51
ED EAS	19-Aug-10	2010						0	1	TRB-1	3	9.2	782.61	86.96	326.09	326.09	43.48	8	2	4	1	1	0.79	0.5
ED EAS	19-Aug-10	2010						0	1	TRB-1	4	9.4	782.61	86.96	282.61	260.87	152.17	12	1	8	2	1	0.9	0.62
ED EAS	19-Aug-10	2010						0	1	TRB-1	5	7.1	1086.96	65.22	521.74	500	0	9	0	7	2	0	0.78	0.49
BG EAS	18-Aug-10	2010						0	0	TRB-3	1	7.8	586.96	43.48	282.61	260.87	0	4	0	3	1	0	0.74	0.57
BG EAS	22-Aug-10	2010						0	0	TRB-3	2	7.8	413.04	43.48	304.35	21.74	43.48	5	1	2	1	1	0.65	0.76
BG EAS	22-Aug-10	2010						0	0	TRB-3	3	7.7	65.22	21.74	0	21.74	21.74	3	1	0	1	1	1	0.93
BG EAS	22-Aug-10	2010						0	0	TRB-3	4	9.6	86.96	21.74	43.48	21.74	0	3	0	2	1	0	1	0.93
BG EAS	22-Aug-10	2010						0	0	TRB-3	5	10	173.91	65.22	86.96	0	21.74	5	1	3	0	1	0.86	0.86
BG EAS	22-Aug-10	2010						0	0	TRB-4	1	7.5	152.17	21.74	108.7	21.74	0	4	1	2	1	0	0.71	0.84
BG EAS	22-Aug-10	2010						0	0	TRB-4	2	7	500	65.22	43.48	391.3	0	6	2	2	2	0	0.57	0.61
BG EAS	22-Aug-10	2010						0	0	TRB-4	3	6.8	152.17	43.48	86.96	21.74	0	3	1	1	1	0	0.71	0.84
BG EAS	24-Aug-10	2010						0	0	TRB-4	4	7.4	1000	673.91	239.13	65.22	21.74	9	2	4	2	1	0.69	0.76
BG EAS	24-Aug-10	2010						0	0	TRB-4	5	7.2	652.17	86.96	173.91	391.3	0	5	1	2	2	0	0.68	0.57
CREMP	17-Aug-06	2006	0	0			0	1	1	TPE	1	8	2565.22	0	1869.57	673.91	21.74	7	0	5	1	1	0.74	0.63
CREMP	17-Aug-06	2006	0	0			0	1	1	TPE	2	8	3673.91	0	3260.87	413.04	0	8	0	7	1	0	0.59	0.71
CREMP	17-Aug-06	2006	0	0			0	1	1	TPE	3	8	3543.48	86.96	2739.13	673.91	43.48	10	2	6	1	1	0.76	0.65
CREMP	18-Aug-06	2006	0	0			0	1	1	SP	1	7.8	521.74	0	108.7	347.83	65.22	4	0	2	1	1	0.53	0.69
CREMP	18-Aug-06	2006	0	0			0	1	1	SP	2	7.8	695.65	21.74	347.83	239.13	86.96	8	1	5	1	1	0.74	0.65
CREMP	18-Aug-06	2006	0	0			0	1	1	SP	3	7.8	652.17	0	326.09	239.13	86.96	7	0	5	1	1	0.75	0.65
CREMP	19-Aug-06	2006	0	0			0	1	1	INUG	1	8	521.74	0	239.13	217.39	65.22	8	0	5	2	1	0.82	0.66
CREMP	19-Aug-06	2006	0	0			0	1	1	INUG	2	8	717.39	43.48	347.83	282.61	43.48	10	2	5	2	1	0.81	0.61
CREMP	19-Aug-06	2006	0	0			0	1	1	INUG	3	8	1043.48	65.22	630.43	326.09	21.74	13	1	9	2	1	0.84	0.54
CREMP	21-Aug-06	2006	0	0			0	1	1	TPS	1	8.7	1217.39	0	717.39	456.52	43.48	11	0	9	1	1	0.81	0.49
CREMP	21-Aug-06	2006	0	0			0	1	1	TPS	2	8.7	1065.22	0	782.61	282.61	0	12	0	11	1	0	0.87	0.46
CREMP	21-Aug-06	2006	0	0			0	1	1	TPS	3	8.7	630.43	0	478.26	152.17	0	9	0	8	1	0	0.89	0.57
CREMP	18-Aug-07	2007	0	0			0	1	1	TPS	1	8.4	978.26	0	782.61	195.65	0	7	0	6	1	0	0.83	0.61
CREMP	18-Aug-07	2007	0	0			0	1	1	TPS	2	11.4	1130.43	0	826.09	304.35	0	7	0	6	1	0	0.66	0.61
CREMP	18-Aug-07	2007	0	0			0	1	1	TPS	3	8.3	826.09	0	652.17	173.91	0	9	0	8	1	0	0.85	0.56
CREMP	18-Aug-07	2007	0	0			0	1	1	TPS	4	9.3	2065.22	282.61	1000	739.13	43.48	12	2	8	1	1	0.78	0.55
CREMP	18-Aug-07	2007	0	0			0	1	1	TPS	5	8.3	5500	695.65	3456.52	1282.61	65.22	14	1	11	1	1	0.86	0.66
CREMP	19-Aug-07	2007	0	0			0	1	1	TPN	1	9.4	1326.09	0	978.26	326.09	21.74	11	0	9	1	1	0.86	0.46
CREMP	19-Aug-07	2007	0	0			0	1	1	TPN	2	9.2	1934.78	282.61	1108.7	521.74	21.74	14	2	10	1	1	0.88	0.46
CREMP	19-Aug-07	2007	0	0			0	1	1	TPN	3	8.6	1891.3	0	1173.91	695.65	21.74	11	0	9	1	1	0.81	0.54
CREMP	19-Aug-07	2007	0	0			0	1	1	TPN	4	8	978.26	0	695.65	195.65	86.96	7	0	5	1	1	0.81	0.58
CREMP	19-Aug-07	2007	0	0			0	1	1	TPN	5	9.4	978.26	0	456.52	500	21.74	6	0	4	1	1	0.68	0.59
CREMP	21-Aug-07	2007	0	0			0	1	1	TPE	1	9.5	1608.7	0	869.57	673.91	65.22	10	0	8	1	1	0.78	0.51
CREMP	21-Aug-07	2007	0	0			0	1	1	TPE	2	8.7	1217.39	21.74	760.87	413.04	21.74	10	1	7	1	1	0.84	0.41
CREMP	21-Aug-07	2007	0	0			0	1	1	TPE	3	7.8	1565.22	0	1152.17	413.04	0	12	0	11	1	0	0.81	0.48
CREMP	21-Aug-07	2007	0	0			0	1	1	TPE	4	7.6	1608.7	0	978.26	500	130.43	9	0	7	1	1	0.83	0.49
CREMP	21-Aug-07	2007	0	0			0	1	1	TPE	5	8.8	1891.3	86.96	782.61	978.26	43.48	12	1	9	1	1	0.7	0.54
CREMP	25-Aug-07	2007	0	0			0	1	1	TE	1	8.9	869.57	43.48	456.52	369.57	0	4	1	2	1	0	0.58	0.66
CREMP	25-Aug-07	2007	0	0			0	1	1	TE	2	7.1	1391.3	43.48	630.43	543.48	173.91	10	0	8	1	1	0.77	0.6
CREMP	25-Aug-07	2007	0	0			0	1	1	TE	3	10.7	782.61	21.74	347.83	217.39	195.65	9	1	4	1	3	0.81	0.66
CREMP	25-Aug-07	2007	0	0			0	1	1	TE	4	9.9	913.04	43.48	391.3	369.57	108.7	10	1	6	1	2	0.78	0.58
CREMP	25-Aug-07	2007	0	0			0	1	1	TE	5	9.1	804.35	21.74	500	260.87	21.74	10	1	7	1	1	0.76	0.6
CREMP	27-Aug-07	2007	0	0			0	1	1	SP	1	9.6	608.7	43.48	282.61	173.91	108.7	5	0	3	1	1	0.75	0.75
CREMP	27-Aug-07	2007	0	0			0	1	1	SP	2	10.6	1434.78	86.96	456.52	760.87	130.43	11	1	8	1	1	0.69	0.57
CREMP	27-Aug-07	2007	0	0			0	1	1	SP	3	8	978.26	21.74	608.7	260.87	86.96	11	1	8	1	1	0.85	0.57
CREMP	27-Aug-07	2007	0	0			0	1	1	SP	4	9.1	456.52	65.22	239.13	21.74	130.43	9	1	5	1	2	0.9	0.76
CREMP	27-Aug-07	2007	0	0			0	1	1	SP	5	8.4	1086.96	65.22	543.48	347.83	130.43	10	2	6	1	1	0.82	0.55
CREMP	28-Aug-07	2007	0	0			0	1	1	INUG	1	9.8	847.83	21.74	608.7	217.39	0	12	1	9	2	0	0.87	0.57
CREMP	28-Aug-07	2007	0	0			0	1	1	INUG	2	7.8	1717.39	130.43	1130.43	369.57	86.96	13	2	8	1	2	0.87	0.47
CREMP	28-Aug-07	2007	0	0			0	1	1	INUG	3	10.1	826.09	21.74	282.61	391.3	130.43	11	1	6	2	2	0.79	0.51
CREMP	28-Aug-07	2007	0	0			0	1	1	INUG	4	9.6	782.61	65.22	565.22	108.7	43.48	11	1	7	1	2	0.86	0.63
CREMP	28-Aug-07	2007	0	0			0	1	1	INUG	5	8	934.78	21.74	369.57	326.09	217.39	12	1	7	2	2	0.85	0.56
CREMP	16-Aug-08	2008	0	0			0	1	1	TPE	1	8.7	6021.74	108.7	5369.57	239.13	304.35	16	1	13	1	1	0.69	0.73
CREMP	16-Aug-08	2008	0	0			0	1	1	TPE	2	7.8	5217.39	0	4652.17	565.22	0	10	0	9	1	0	0.72	0.74
CREMP	16-Aug-08	2008	0	0			0	1	1	TPE	3	11.5	7152.17	0	6326.09	695.65	130.43	14	0	11	1	2	0.57	0.74
CREMP	16-Aug-08	2008	0	0			0	1	1	TPE	4	11.2	4478.26	21.74	4065.22	86.96	304.35	16	1	11	1	3	0.79	0.7
CREMP	16-Aug-08	2008	0	0			0	1	1	TPE	5	8.9	5260.87	86.96	4434.78	195.65	543.48	15	2	10	1	2	0.8	0.72
CREMP	17-Aug-08	2008	0	0			0	1	1	TPS	1	9.1	2043.48	21.74	1934.78	86.96	0	13	1	11	1	0	0.82	0.65
CREMP	17-Aug-08	2008	0	0			0	1	1	TPS	2	9.7	695.65	21.74	478.26	195.65	0	10	1	7	2	0	0.88	0.56
CREMP	17-Aug-08	2008	0	0			0	1	1	TPS	3	11.7	2043.48	43.48	1630.43	369.57	0	10	1	8	1	0	0.72	0.59
CREMP	17-Aug-08	2008	0	0			0	1	1	TPS	4	9.9	1565.22	0	1130.43	413.04	21.74	11	0	9	1	1	0.78	0.52
CREMP	17-Aug-08	2008	0	0			0	1	1	TPS	5	10	1673.91	0	1304.35	369.57	0	9	0	8	1	0	0.62	0.6
CREMP	18-Aug-08	2008	0	0			0	1	1	TPN	1	7.8	1391.3	0	1326.09	65.22	0	8	0	7	1	0	0.66	0.79
CREMP	18-Aug-08	2008	0	0			0	1	1	TPN	2	9.2	717.39	0	652.17	65.22	0	10	0	9	1	0	0.81	0.73
CREMP	18-Aug-08	2008	0	0			0	1	1	TPN	3	8.4	1326.09	21.74	1021.74	260.87	21.74	11	1	8	1	1	0.64	0.64
CREMP	18-Aug-08	2008	0	0			0	1	1	TPN	4	8.4	260.87	0	173.91	86.96	0	3	0	2	1	0	0.59	0.83
CREMP	18-Aug-08	2008	0	0			0	1	1	TPN	5	7.8	1391.3	0	1260.87	130.43	0	9	0	8	1	0	0.71	0.65
CREMP	19-Aug-08	2008	4	2				1	1	TE	1	7.5	804.35	0	500	282.61	21.74	12	0	9	2	1	0.83	0.55
CREMP	19-Aug-08	2008	4	2				1	1	TE	2	9.4	978.26	21.74	413.04	500	43.48	11	1	8	1	1	0.71	0.53
CREMP	19-Aug-08	2008	4	2				1	1	TE	3	11.7	543.48	0	260.87	282.61	0	8	0	7	1	0	0.71	0.63
CREMP	19-Aug-08	2008	4	2				1	1	TE	4	13.1	695.65	21.74	456.52	173.91	43.48	10	1	7	1	1	0.86	0.65
CREMP	19-Aug-08	2008	4	2				1	1	TE	5	12.6	760.87	0	565.22	195.65	0	9	0	8	1	0	0.86	0.6
CREMP	20-Aug-08	2008	0	0			0	1	1	INUG	1	8.1	847.83	0	500	326.09	21.74	14	0	11	2	1	0.79	0.57
CREMP	20-Aug-08	2008	0	0			0	1	1	INUG	2	8.7	1695.65	43.48	1260.87	326.09	65.22	13	1	9	1	2	0.86	0.49
CREMP	20-Aug-08	2008	0	0			0	1	1	INUG	3	9.8	1239.13	21.74	1021.74	152.17	43.48	17	1	12	2	2	0.92	0.5
CREMP	20-Aug-08	2008	0	0			0	1	1	INUG	4	12.6	5326.09	43.48	4565.22	652.17	65.22	17	1	12	3	1	0.9	0.65
CREMP	20-Aug-08	2008	0	0			0	1	1	INUG	5	8	391.3	0	239.13	130.43	21.74	8	0	6	1	1	0.86	0.77
CREMP	23-Aug-08	2008	1	1				1	1	SP	1	9.9	239.13	0	130.43	108.7	0	5	0	4	1	0	0.78	0.81
CREMP	23-Aug-08	2008	1	1				1	1	SP	2	7	478.26	0	304.35	130.43	43.48	8	0	6	1	1	0.81	0.73
CREMP	23-Aug-08	2008	1	1				1	1	SP	3	13.2	565.22	0	326.09	195.65	43.48	11	0	9	1	1	0.86	0.67
CREMP	23-Aug-08	2008	1	1				1	1	SP	4	7.8	456.52	0	326.09	130.43	0	7	0	6	1	0	0.86	0.72
CREMP	23-Aug-08	2008	1	1				1	1	SP	5	10.1	326.09	0	195.65	108.7	21.74	6	0	4	1	1	0.8	0.78

Appendix A1: Benthic Invertebrate Means

Program	Date	Year	C.I.ED	C.I.BG	AEM.AZI	Repeat	Station	Depth.m	N.Tot.m2	N.Olig.m2	N.Insect.m2	N.Moll.m2	N.Other.m2	R.Tot.m2	R.Olig.m2	R.Insect.m2	R.Moll.m2	R.Other.m2	Simp.D	Bray.Cur	TOC
CREMP	20-Aug-09	2009	0	0	1	1	INUG	7.26	1191.3	43.48	673.91	408.7	65.22	14	1	8	3	2	0.85	0.46	3.52
CREMP	17-Aug-09	2009	0	0	1	1	PDL	7.66	1726.09	113.04	1173.91	395.65	43.48	11	1	8	1	1	0.79	0.55	0.72
CREMP	12-Aug-09	2009	1	2	1	1	SP	7.44	778.26	43.48	391.3	282.61	60.87	7	0	4	1	1	0.78	0.55	3.74
CREMP	14-Aug-09	2009	1	2	1	1	TE	7.48	769.57	26.09	295.65	365.22	82.61	7	0	5	1	1	0.7	0.55	2.49
CREMP	14-Aug-09	2009	0	0	1	1	TEFF	7.08	1234.78	4.35	917.39	247.83	65.22	10	0	8	1	1	0.83	0.47	2.87
CREMP	14-Aug-09	2009	2	2	1	1	TPE	7.08	1713.04	78.26	1021.74	534.78	78.26	11	1	9	1	1	0.83	0.5	3.41
CREMP	21-Aug-09	2009	2	2	1	1	TPN	8.18	1239.13	4.35	730.43	478.26	26.09	9	0	7	1	1	0.79	0.5	2.86
CREMP	21-Aug-09	2009	0	0	1	1	TPS	7.82	1960.87	86.96	1421.74	452.17	0	10	1	9	1	0	0.82	0.52	4.22
CREMP	25-Aug-10	2010	0	0	1	1	INUG	7.7	639.13	26.09	278.26	304.35	30.43	8	1	5	2	1	0.75	0.57	2.66
CREMP	24-Aug-10	2010	0	0	1	1	PDL	6.9	895.65	43.48	556.52	286.96	8.7	8	0	6	2	0	0.76	0.65	2.65
CREMP	21-Aug-10	2010	1	2	1	1	SP	7.98	256.52	8.7	95.65	130.43	21.74	4	0	2	1	1	0.7	0.75	3.91
CREMP	27-Aug-10	2010	1	2	1	1	TE	7.98	595.65	13.04	217.39	278.26	86.96	6	0	4	1	1	0.71	0.66	2.49
CREMP	27-Aug-10	2010	0	0	1	1	TEFF	7.32	921.74	13.04	543.48	317.39	47.83	11	0	8	1	1	0.8	0.49	3.38
CREMP	19-Aug-10	2010	2	1	1	1	TPE	7.5	1139.13	60.87	586.96	408.7	82.61	10	2	6	1	1	0.79	0.53	3.02
CREMP	19-Aug-10	2010	2	2	1	1	TPN	8.74	1321.74	43.48	1004.35	243.48	30.43	10	1	8	1	1	0.77	0.62	3.11
CREMP	20-Aug-10	2010	0	0	1	1	TPS	7.6	1295.65	30.43	773.91	469.57	21.74	8	0	7	1	0	0.76	0.55	4.1
ED EAS	19-Aug-09	2009	0	0	1	1	SP-DT	7.3	1121.74	65.22	482.61	495.65	78.26	11	1	7	2	1	0.78	0.52	4.17
ED EAS	23-Aug-09	2009	1	2	1	1	SP-F1	7.02	1473.91	26.09	808.7	521.74	117.39	9	0	6	1	1	0.78	0.58	3.16
ED EAS	18-Aug-09	2009	1	2	1	1	SP-F2	7.26	756.52	17.39	334.78	356.52	47.83	8	0	4	2	1	0.81	0.58	5.51
ED EAS	15-Aug-09	2009	1	2	1	1	SP-N1	7.17	1134.78	26.09	478.26	534.78	95.65	7	0	4	2	1	0.72	0.58	3.56
ED EAS	17-Aug-09	2009	1	2	1	1	SP-N2	7.62	652.17	26.09	304.35	286.96	34.78	7	1	5	1	1	0.69	0.57	3.63
ED EAS	23-Aug-09	2009	1	2	1	1	SP-N3	7.43	730.43	13.04	343.48	286.96	86.96	9	0	6	2	1	0.78	0.56	4.75
ED EAS	22-Aug-09	2009	1	2	0	1	TRB-1	7.66	817.39	43.48	321.74	386.96	65.22	8	0	6	1	1	0.74	0.55	3.91
ED EAS	22-Aug-09	2009	1	2	0	1	TRB-2	6.24	400	108.7	52.17	156.52	82.61	5	1	2	1	1	0.83	0.82	1.09
ED EAS	23-Aug-09	2009	2	2	1	1	HVH-4	7.3	986.96	47.83	608.7	230.43	100	9	1	6	1	1	0.83	0.54	3.26
ED EAS	19-Aug-10	2010	1	2	0	1	TRB-2	6.74	443.48	26.09	173.91	173.91	69.57	6	0	3	2	1	0.8	0.76	0.52
ED EAS	23-Aug-10	2010	0	0	1	1	SP-DT	8.34	817.39	47.83	347.83	321.74	100	9	1	6	2	1	0.81	0.55	4.96
ED EAS	20-Aug-10	2010	1	2	1	1	SP-F1	9.08	1134.78	13.04	591.3	404.35	126.09	8	0	6	1	1	0.77	0.54	4.1
ED EAS	20-Aug-10	2010	1	2	1	1	SP-N1	7.96	1239.13	4.35	765.22	382.61	86.96	6	0	4	1	1	0.59	0.67	2.88
ED EAS	20-Aug-10	2010	1	2	1	1	SP-N2	8.4	956.52	47.83	539.13	326.09	43.48	8	0	5	2	1	0.73	0.56	4.4
ED EAS	19-Aug-10	2010	1	2	1	1	SP-N3	8.3	700	26.09	239.13	378.26	56.52	7	0	4	2	1	0.75	0.6	4.22
BG EAS	25-Aug-10	2010	2	1	1	0	TP-E1	7.88	495.65	8.7	213.04	256.52	17.39	7	0	4	2	1	0.82	0.64	2.86
BG EAS	27-Aug-10	2010	2	1	1	0	TP-E2	9.46	908.7	26.09	473.91	382.61	26.09	10	1	7	1	1	0.78	0.58	3.18
BG EAS	28-Aug-10	2010	0	0	1	0	TP-E3	10.6	626.09	4.35	191.3	400	30.43	6	0	4	2	1	0.61	0.6	3.12
ED EAS	24-Aug-10	2010	2	1	1	1	HVH-4	7.5	439.13	13.04	195.65	204.35	26.09	6	1	4	2	1	0.66	0.66	2.77
ED EAS	19-Aug-10	2010	1	2	0	1	TRB-1	8.06	943.48	78.26	408.7	378.26	78.26	9	1	6	2	1	0.83	0.52	3.72
BG EAS	22-Aug-10	2010	2	1	0	0	TRB-3	8.58	265.22	39.13	143.48	65.22	17.39	4	1	2	1	1	0.85	0.81	2.98
BG EAS	24-Aug-10	2010	2	1	0	0	TRB-4	7.18	491.3	178.26	130.43	178.26	4.35	5	1	2	2	0	0.67	0.72	3.45
ED EAS	23-Aug-10	2010	1	2	1	1	SP-F2	7.48	1213.04	8.7	769.57	395.65	39.13	8	0	5	2	1	0.75	0.69	6.7

Gravel	Sand	Silt	Clay	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenur	Nickel	Selenium	Silver	Thallium	Tin	Vanadium	Zinc
<1.0	7	69	24	25800	<10	16.3	139	1.59	<0.50	115	12.1	55.2	<30	0.0236	<4.0	79.8	<2.0	<2.0	<1.0	<5.0	39.6	90
<1.0	20	46	33	27400	<10	23.1	133	1.18	<0.50	125	22	47.5	<30	0.007	4.7	103	<2.0	<2.0	<1.0	<5.0	45.9	92.6
<1.0	2	68	30	28300	<10	42.5	143	2.4	<0.50	76.9	17.6	89.5	<30	0.0861	8.1	72.4	<2.0	<2.0	<1.0	<5.0	42.6	124
<1.0	5	66	29	27700	<10	23.5	136	2.52	<0.50	60.5	13.2	74.4	<30	0.0275	6.9	48.7	<2.0	<2.0	<1.0	<5.0	42.7	116
<1.0	5	61	34	25400	<10	12.7	124	2.15	<0.50	55.2	12.3	57.2	<30	0.0555	5.1	38.7	<2.0	<2.0	<1.0	<5.0	39.2	104
<1.0	6	58	36	23800	<10	18.1	124	1.88	<0.50	80.7	16.1	53.8	<30	0.0679	5.4	65	<2.0	<2.0	<1.0	<5.0	38	101
<1.0	25	54	21	16700	<10	9.8	66.5	0.97	<0.50	101	8.8	46.7	<30	0.0116	<4.0	49.7	<2.0	<2.0	<1.0	<5.0	29.2	62.8
<1.0	5	62	33	25100	<10	18	108	1.5	<0.50	112	13.4	70.6	<30	0.0208	<4.0	71.9	<2.0	<2.0	<1.0	<5.0	39.3	95.3
<0.10	13	63	24	23600	<10	16.8	99.3	1.53	<0.50	115	9.3	48.6	<30	0.0154	<4.0	67.7	<0.50	<2.0	<1.0	<5.0	38.2	84.7
<0.10	11	73	16	20400	<10	13	82.5	1.02	<0.50	135	10.9	51.4	<30	0.0098	<4.0	81.6	<2.0	<2.0	<1.0	<5.0	36.7	80.9
<0.10	2	66	32	33600	<10	36.2	148	2.52	0.72	93.7	17.8	107	<30	0.0326	7.9	76.9	<2.0	<2.0	<1.0	<5.0	46.6	139
<0.10	26	57	17	20100	<10	15.7	80.2	1.78	<0.50	51.1	8	49.9	<30	0.0171	<4.0	32.6	<0.50	<2.0	<1.0	<5.0	32.5	86.7
<0.10	6	76	18	25500	<10	13.1	119	1.97	1.47	58.2	13.6	61.2	<30	0.016	4.6	35.4	<2.0	<2.0	<1.0	<5.0	38.6	109
<0.10	4	72	24	25300	<10	38.1	125	1.81	0.56	90.7	16.4	51.5	<30	0.0158	5.4	64.9	<2.0	<2.0	<1.0	<5.0	37.3	95.9
<0.10	23	72	5	16900	<10	9.8	64.5	0.99	<0.50	110	8.4	50.3	<30	0.0483	<4.0	54.1	<2.0	<2.0	<1.0	<5.0	30.6	69.3
<0.10	14	78	9	23600	<10	15.8	106	1.47	<0.50	113	15.4	60.9	<30	0.025	<4.0	75.7	<2.0	<2.0	<1.0	<5.0	38.6	97.3
<1.0	9	68	23	40100	<10	12.3	205	3.03	0.83	82.7	11.6	133	35	0.0292	4.6	71.4	<2.0	<2.0	<1.0	<5.0	50.2	171
<1.0	7	67	26	27600	<10	54	116	2.21	<0.50	72.2	11.4	78.8	<30	0.0244	10.6	46.1	<2.0	<2.0	<1.0	<5.0	37.9	115
<1.0	6	65	30	35100	<10	17.7	233	2.69	0.96	87.4	13.1	127	<30	0.0249	8.4	83	<2.0	<2.0	<1.0	<5.0	48.5	255
<1.0	16	64	20	27900	<10	15	125	1.87	<0.50	84.7	12.9	75.8	<30	0.0219	6.1	58.5	<2.0	<2.0	<1.0	<5.0	44.9	113
<1.0	5	71	23	28700	<10	41.3	134	2.23	<0.50	76.2	21.1	94.6	<30	0.024	7.3	71.3	<2.0	<2.0	<1.0	<5.0	40.4	116
<1.0	1	64	34	27900	<10	60.9	138	2.03	0.57	73.7	17.6	94.4	<30	0.0318	8.1	71.7	<2.0	<2.0	<1.0	<5.0	40.3	125
<1.0	2	74	25	27600	<10	30.8	135	1.97	0.55	80	18.3	82.5	<30	0.0297	8.1	75.3	<2.0	<2.0	<1.0	<5.0	39.9	117
<1.0	1	77	23	26700	<10	9.8	147	0.81	<0.50	126	17.9	45.1	<30	0.0084	<4.0	84	<2.0	<2.0	<1.0	<5.0	49.7	85.7
<1.0	1	65	34	29000	<10	25.6	130	2.07	<0.50	88.8	17.2	67.7	<30	0.0155	6.1	60.8	<2.0	<2.0	<1.0	<5.0	46.4	109
<0.10	0.68	80.7	18.6	28000	<10	11.1	149	0.61	<0.50	156	21.2	39.6	<30	<0.0050	<4.0	102	<2.0	<2.0	<1.0	<5.0	54.7	86.3
<0.10	5.83	67.9	26.3	29400	17	59.2	145	2.81	2.6	71.5	12.2	134	33	0.0392	13.4	54.5	<2.0	<2.0	<1.0	<5.0	40.4	152
<0.10	7.31	66.1	26.5	25400	<10	50.2	98	2.06	<0.50	80.5	13.3	73.7	<30	0.027	9	54.9	0.62	<2.0	<1.0	<5.0	40.6	113
0.29	17.3	61	21.4	22500	<10	10.8	102	1.59	<0.50	75.2	9.5	59.6	<30	0.021	<4.0	52.8	<2.0	<2.0	<1.0	<5.0	37.3	102
<0.10	2.98	69.6	27.5	28100	<10	35.5	123	2.2	<0.50	95.5	18	87.1	<30	0.0274	7	70.9	0.73	<2.0	<1.0	<5.0	44.3	123
<0.10	1.95	70.8	27.2	27600	<10	104	119	2.12	<0.50	86.8	13.6	97.5	<30	0.0244	10.3	67.2	0.88	<2.0	<1.0	<5.0	43.1	131
<0.10	2.59	64.1	33.3	25400	<10	23.2	103	1.91	<0.50	111	17.5	53.7	<30	0.0102	5.2	73	0.7	<2.0	<1.0	<5.0	42.3	106
<0.10	3.66	63.3	33	26200	<10	32.4	104	1.88	<0.50	97.9	17.2	65.5	<30	0.0149	7.3	62	<2.0	<2.0	<1.0	<5.0	42.8	109
<0.10	3.34	70.1	26.5	26500	<10	24.6	131	1.66	<0.50	115	23.7	84.4	<30	0.0235	5.7	142	0.86	<2.0	<1.0	<5.0	43.4	115
1.09	2.89	48.4	47.6	36100	<10	26.6	139	2.55	<0.50	119	20.1	89.2	33	0.0133	7.2	80.1	<2.0	<2.0	<1.0	<5.0	57.7	141
<0.10	8.79	74.9	16.3	21100	<10	67.8	169	1.3	<0.50	130	26.5	63.4	<30	0.0269	10.8	136	0.71	<2.0	<1.0	<5.0	38.6	99
<0.10	3.06	73.3	23.7	25400	<10	33.3	96.4	1.69	<0.50	183	20.7	62.2	<30	0.017	6.8	89.3	0.95	<2.0	<1.0	<5.0	45.7	107
<0.10	1.75	69	29.2	28400	<10	21.1	114	2.01	<0.50	179	13.8	67.2	<30	0.0138	5.9	85.1	0.74	<2.0	<1.0	<5.0	49.1	120
<0.10	2.73	73.5	23.8	29900	<10	15.2	163	2.48	0.8	91.2	10.6	130	<30	0.029	6.2	85.6	<2.0	<2.0	<1.0	<5.0	45.1	160

APPENDIX A2

RAW DATA FOR ANALYSIS OF PERIPHYTON – REPS

Appendix A2: Periphyton Station Reps.

Program	Date	Year	Stn.Year	C.I.ED	Repeat	Station	Replicate	B_Cyano (ug/cm2)	B_Chloro (ug/cm2)	B_Chryso (ug/cm2)	B_Diatom (ug/cm2)	B_Dino (ug/cm2)	B_Total (ug/cm2)	D_Cyano (cells/cm2)	D_Chloro (cells/cm2)	D_Chryso (cells/cm2)	D_Diatom (cells/cm2)	D_Dino (cells/cm2)	D_Total (cells/cm2)	Dry Weight (g)	Ash Weight (g)	Ash Free Dry Weight (g)
ED EAS	21-Aug-10	2010		1	0	SP-ISLA	1	73.5	7.8	0	246.6	0	327.9	857738	3589	0	165088	0	1026414	0.867	0.77	0.0967
ED EAS	21-Aug-10	2010		1	0	SP-ISLA	2	83.5	0	0	181.2	0	264.7	613695	0	0	226098	0	839793	1.59	1.47	0.116
ED EAS	21-Aug-10	2010		1	0	SP-ISLA	3	38.9	14.5	0	154.4	0	207.8	531600	6729	0	213089	0	751418	0.591	0.517	0.0743
ED EAS	21-Aug-10	2010		1	0	SP-ISLA	4	69.4	29.1	0	87.7	0	186.2	385803	6729	0	159256	0	551787	0.854	0.736	0.118
ED EAS	21-Aug-10	2010		1	0	SP-ISLA	5	21.8	10.1	0	70	0	101.9	170471	7851	0	116638	0	294959	0.308	0.237	0.0711
ED EAS	22-Aug-10	2010	2	1	1	SP-BL	1	16.5	0	0	133.7	0	150.1	239257	0	0	436645	0	675902	1.44	1.32	0.127
ED EAS	22-Aug-10	2010	2	1	1	SP-BL	2	77.9	4.2	0	119.5	0	201.5	481505	2991	0	496459	0	980955	0.829	0.773	0.0564
ED EAS	22-Aug-10	2010	2	1	1	SP-BL	3	21.4	0	0	131.6	0	153	345428	0	0	412719	0	758147	3.04	2.88	0.163
ED EAS	22-Aug-10	2010	2	1	1	SP-BL	4	11.7	0	0	104	0	115.6	174316	0	0	430663	0	604979	2.92	2.79	0.134
ED EAS	22-Aug-10	2010	2	1	1	SP-BL	5	19.3	0	0	100.2	0	119.5	190658	0	0	372344	0	563002	1.81	1.72	0.0957
ED EAS	22-Aug-10	2010		1	0	SP-GSM	1	86.7	16.4	0	130.7	0	233.8	915159	13458	0	260192	0	1188810	1.32	1.17	0.145
ED EAS	22-Aug-10	2010		1	0	SP-GSM	2	111.5	63.9	3.2	217.6	0	396.2	724950	21533	14355	376830	0	1137669	0.483	0.418	0.0645
ED EAS	22-Aug-10	2010		1	0	SP-GSM	3	89.2	30.3	0	271.1	0	390.6	852354	8972	0	358886	0	1220213	0.928	0.783	0.146
ED EAS	22-Aug-10	2010		1	0	SP-GSM	4	83.1	14.5	0	153.9	0	251.5	493468	8972	0	195144	0	697585	0.62	0.532	0.0875
ED EAS	22-Aug-10	2010		1	0	SP-GSM	5	113.3	41.5	0	108.9	0	263.7	354400	11215	0	139068	0	504684	0.712	0.553	0.159
ED EAS	22-Aug-10	2010		1	0	SP-AZI	1	244.1	85.7	0	304.3	0	634.1	580199	14954	0	352905	0	948057	0.406	0.367	0.0395
ED EAS	22-Aug-10	2010		1	0	SP-AZI	2	24.6	23.5	0	156.6	0	204.7	376830	15951	0	303059	0	695840	0.48	0.379	0.101
ED EAS	22-Aug-10	2010		1	0	SP-AZI	3	44.1	38.2	0	263.8	0	346.1	287109	17944	0	311035	0	616088	0.659	0.57	0.0888
ED EAS	22-Aug-10	2010		1	0	SP-AZI	4	133.6	186	0	119.1	0	438.7	520385	17944	0	155517	0	693846	0.548	0.428	0.121
ED EAS	22-Aug-10	2010		1	0	SP-AZI	5	44.4	217.6	0	167.2	0	429.3	287109	42618	0	293838	0	623565	0.478	0.402	0.0765
ED EAS	23-Aug-10	2010	4	0	1	SP-CREMP	1	75.6	73.7	0	286.3	1.3	436.9	1073069	21533	0	254809	3589	1353000	0.791	0.521	0.27
ED EAS	23-Aug-10	2010	4	0	1	SP-CREMP	2	138.5	0	0	127.7	0	266.2	888243	0	0	191406	0	1079649	0.417	0.369	0.0485
ED EAS	23-Aug-10	2010	4	0	1	SP-CREMP	3	40.7	16.1	0	185.2	0	242.1	882860	10767	0	276342	0	1169968	0.248	0.198	0.0498
ED EAS	23-Aug-10	2010	4	0	1	SP-CREMP	4	79.6	0	0	102.5	0	182.1	720336	0	0	151245	0	871580	0.712	0.393	0.318
ED EAS	23-Aug-10	2010	4	0	1	SP-CREMP	5	107.1	43.1	0	71.3	0	221.5	741698	29907	0	101684	0	873289	0.607	0.48	0.127
ED EAS	23-Aug-10	2010	6	0	1	SP-DT	1	234.6	0	0	170.1	0	404.7	1143949	0	0	287109	0	1431058	0.319	0.177	0.142
ED EAS	23-Aug-10	2010	6	0	1	SP-DT	2	167.7	0.7	0	79.2	0	247.7	968992	26917	0	130096	0	1126005	0.201	0.102	0.0991
ED EAS	24-Aug-10	2010	6	0	1	SP-DT	3	86.9	179.1	0	141.1	0	407	815184	20508	0	156372	0	992064	0.224	0.115	0.109
ED EAS	24-Aug-10	2010	6	0	1	SP-DT	4	25.8	31.4	0	86.5	0	143.6	720763	14954	0	155517	0	891234	0.258	0.149	0.109
ED EAS	24-Aug-10	2010	6	0	1	SP-DT	5	64.5	78.9	0	193.5	0	336.9	674193	25635	0	274292	0	974119	0.66	0.327	0.333
ED EAS	27-Aug-09	2009	1	1	1	SP-BL	1	44.8	12.5	0	127.5	0	184.8	568236	5981	0	278137	0	852354	0.437	0.398	0.0393
ED EAS	27-Aug-09	2009	1	1	1	SP-BL	2	63	8	0	233.1	0	304.1	714781	2991	0	328979	0	1046751	0.814	0.63	0.184
ED EAS	27-Aug-09	2009	1	1	1	SP-BL	3	18.4	0.2	0	84.9	0	103.5	634032	5981	0	139567	0	779580	0.952	0.889	0.0629
ED EAS	27-Aug-09	2009	1	1	1	SP-BL	4	4.7	0	0	172.4	0	177.1	46143	0	0	307617	0	353759	1.21	1.13	0.0776
ED EAS	27-Aug-09	2009	1	1	1	SP-BL	5	123	11.7	0	103	0	237.7	486739	8972	0	181686	0	677397	0.71	0.677	0.0328
ED EAS	28-Aug-09	2009	3	0	1	SP-CREMP	1	212.3	494.7	0	218.7	0	925.7	744689	49347	0	192901	0	986937	0.559	0.299	0.26
ED EAS	28-Aug-09	2009	3	0	1	SP-CREMP	2	318.3	71.2	0	213.1	0	602.6	724950	21533	0	154321	0	900804	0.839	0.417	0.422
ED EAS	28-Aug-09	2009	3	0	1	SP-CREMP	3	179.6	10.9	0	77.8	0	268.3	610106	29907	0	116638	0	756651	0.354	0.225	0.129
ED EAS	28-Aug-09	2009	3	0	1	SP-CREMP	4	160	88.3	0	345.5	0	593.8	850560	50244	0	222509	0	1123313	0.341	0.232	0.11
ED EAS	28-Aug-09	2009	3	0	1	SP-CREMP	5	123.6	84.6	0	148.7	0	356.9	829027	17944	0	236865	0	1083836	0.575	0.315	0.26
ED EAS	30-Aug-09	2009	5	0	1	SP-DT	1	478.1	297.3	0	134.5	0	909.9	645995	71777	0	269165	0	986937	0.205	0.0747	0.13
ED EAS	30-Aug-09	2009	5	0	1	SP-DT	2	230.5	6	0	116.1	0	352.6	628051	2991	0	152527	0	783568	0.433	0.19	0.243
ED EAS	30-Aug-09	2009	5	0	1	SP-DT	3	148.1	72.7	0	78.6	0	299.5	520385	38879	0	122619	0	681883	0.205	0.072	0.133
ED EAS	30-Aug-09	2009	5	0	1	SP-DT	4	170.1	70.4	0	63.3	0	303.8	658812	35889	0	112793	0	807494	0.319	0.136	0.183
ED EAS	30-Aug-09	2009	5	0	1	SP-DT	5	117.9	0	0	206.2	0	324.2	476806	0	0	225586	0	702391	0.33	0.15	0.179

APPENDIX B

SEDIMENT TOXICITY TEST RESULTS – MAXXAM ANALYTICS

FRESHWATER SEDIMENT TOXICITY TESTS USING *HYALELLA AZTECA* AND *CHIRONOMUS TENTANS*

Prepared for:

Azimuth Consulting Group
218 – 2902 West Broadway
Vancouver, BC
V6K 2G8

Prepared by:

Ecotoxicology Group
Maxxam Analytics

Azimuth Project No.: AEM-10-02.2

Maxxam Project No.: 2-11-0691

October 2010

CALA
Testing
Accreditation No. A 2168

EXECUTIVE SUMMARY

Four sediment samples were collected by Azimuth Consulting Group on August 22, 25 and 27, 2010 and submitted to Maxxam Analytics for 10-d *Chironomus tentans* Survival and Growth and 14-d *Hyalella azteca* Survival and Growth sediment toxicity tests.

There was no statistically significant difference in any of the samples when compared to the lab controls for both endpoints, growth and survival, in either test, *Hyalella* or *Chironomid.*

The Chironomid and *Hyalella* tests performed on the sediment samples were initiated on September 17, 2010. The Chironomid tests performed met the survival and dry weight validity criteria. However, the average head capsule width of the larvae before test initiation was 0.53 mm, greater than the Environment Canada recommended range of 0.33 – 0.45 mm. This does not invalidate a test, since the larvae are still considered third instar at this size. However, it does account for the number of pupae and midges recovered at test completion. Statistical and raw data for these tests are included in this report, with supporting data provided in Appendix B. The *Hyalella* tests performed met the survival and dry weight validity criteria. All statistical and raw data for these tests are included in this report, with supporting data provided in Appendix C.

In addition to the sediment toxicity tests performed, physical and chemical analyses were performed on the whole sediment, the sediment porewater and the overlying water from the Chironomid and *Hyalella* sediment tests. The results for these analyses are provided in Appendix D.

Test Data Summary sheets of all test results are also provided and can be found in each individual test section.

TEST METHODS, STATISTICS AND VALIDITY CRITERIA

The Chironomid tests were conducted using the test method EPS 1/RM/32 Environment Canada Method (1997) Biological Test Method: Test for Survival and Growth in Sediment Using the Larvae of Freshwater Midges (*Chironomus tentans* or *Chironomus riparius*). This test provides survival and growth data for chironomids when exposed to whole sediment. The Chironomid test is a static, non-renewal test using 3rd instar larvae exposed to sediment for 10-days. This test is conducted at 23°C, using 5 replicates per treatment including a laboratory control, with 10 organisms per replicate. A detailed list of test conditions is included in the Test Data Summary sheet.

The *Hyalella* sediment tests were conducted using the test method EPS 1/RM/33 Environment Canada Method (1997) Biological Test Method: Test for Survival and Growth in Sediment Using the Freshwater Amphipod *Hyalella azteca*. This test provides survival and growth data for *Hyalella* when exposed to whole sediment. The Hyalella test is a static, non-renewal test using juvenile (2-9 days old) amphipods, exposed to sediment for 14-days. This test is conducted at 23°C, using 5 replicates per treatment including a laboratory control, with 10 organisms per replicate. A detailed list of test conditions is included in the Test Data Summary sheet.

The Chironomid sediment test is considered valid if the mean survival in the controls is ≥70% and the average dry weight is ≥0.6 mg/larvae.

The *Hyalella* sediment test is considered valid if the mean survival in the controls is ≥80% and the average dry weight is ≥0.1 mg/amphipod.

Statistical analyses for survival and growth comparisons were calculated using CETIS™ (Version 1.7.0.3), an Access based software application (Tidepool Scientific Software). Details on analyses used are provided in Test Data Summary sheets.

Reference Toxicant tests for each organism were run concurrently with the toxicity tests, using the same batch of organisms used in each test. Their respective LC50 and 95% confidence limits for each reference toxicant test were calculated using CETIS™ and are included in the Test Data Summary sheets. A control chart was prepared for each reference toxicant test, and is included in their respective appendices.

10-D CHIRONOMID GROWTH AND SURVIVAL TEST

Summary of 10-d Chironomid Test Results for Azimuth Sediment Samples

Test Date: September 17, 2010

Sample	Mean Survival (%) ÑSD	Mean Dry Weight (mg) ÑSD
Control	94 ± 9	1.71 ± 0.35
SP-TRB-2	80 ± 10	1.83 ± 0.29
SP-N1	94 ± 5	2.08 ± 0.15
INUG	84 ± 15	2.13 ± 0.42
TEFF	88 ± 8	1.86 ± 0.23

SD=Standard Deviation. *=Statistically significant difference compared to the Control

Maxxam

10-d Chironomid Survival and Growth Sediment Test

Client Name/Location	Azimuth Consulting Group / Vancouver, BC
Testing Lab/Location	Maxxam Analytics / Burnaby, BC
Sample Information	
Sample Names	SP-TRB-2, SP-N1, INUG, TEFF
Type of Sample	Field collected sediments
Method of Collection	See Chain of Custody form
Sample Collector	See Chain of Custody form
Sample Volume	4 L
Sample Containers	4-L white food grade plastic buckets
Sample Collection Date	2010 August 22, 25, 27
Date & Time of Sample Receipt	2010 September 03 @ 08:25
Sample Temperature upon Arrival	10 - 13°C
Sediment and Pore Water Characterisation	See Sediment Sample Descriptions sheet (Appendix A) and analytical chemistry reports (Appendix D)
Sample Preparation	
Homogenisation	Samples were individually mixed until homogenised at ambient laboratory temperature; large debris and indigenous macro-organisms were removed during homogenisation (see Sediment Sample Descriptions sheet, Appendix A)
Date of Homogenisation	2010 September 16
Sediment – Physical Analyses	Each homogenised sediment was analysed for grain size, TOC and moisture content. See chemical analysis reports, Appendix D.
Sediment Porewater – Chemical Analyses	Samples of homogenised sediment were centrifuged to produce porewater. The porewater was then analysed for Ammonia and Sulfides. See chemical analysis report, Appendix D.
Test Organisms	
Species	*Chironomus tentans*
Source	Aquatic Bio Systems, Fort Collins, CO
Age at Start of Test	3rd Instar
Water quality parameters of shipping water before shipment and after arrival	See Organism History Sheet See Acclimation and Holding Conditions sheets
Acclimation rate and procedure	See Acclimation and Holding Conditions sheets
Mortality upon arrival and preceding test	See Acclimation and Holding Conditions sheets

Laboratory Control Sediment and Test Water	
Laboratory Control Sediment Source	Mackenzie Beach, Tofino, BC; Collected by Seacology (North Vancouver, BC)
Laboratory Control Sediment Storage	Stored in a cold room that was at 4 ± 2°C
Laboratory Control Sediment Preparation Procedure	Sediment was sieved (0.5 mm) before use and rinsed thoroughly with control water
Control Water	Reconstituted water (EC 1997)
Test Conditions & Facilities	
Test Method	Environment Canada Biological Test Method: Test for Survival and Growth in Sediment Using the Larvae of Freshwater Midges (*Chironomus tentans* or *Chironomus riparius)*EPS 1/RM/32 (1997)
Test Type	Static, no water renewal
Test Temperature	23°C ± 1°C. See the Test Measurement and Survival Data sheets
Light levels and photoperiod	Overhead full spectrum (fluorescent or equivalent); 607 – 763 lux, 16-h light:8-h dark
Aeration	Continuous and minimal in each test vessel; checked 3 times daily. Compressed oil-free air delivered through microbore airline tubing
Test Start Date	2010 September 17
Test Completion Date	2010 September 27
Test Duration	10 days
Test Vessels	300 mL glass jars; covered
Volume of Sediment	100 mL
Volume of Test Water	175 mL
Analysts	M. Grey, K. Tamaki, L. Stavroff, R. Masson, K. Melling, J. Laroulandie, D. Greschner, K. Pomeroy
Water Renewal	None
# Organisms / Vessel	10
Number of Replicates	5 (plus one measurement beaker) for each sediment sample
Feeding Regime	3.75 mL Tetrafin slurry, 4 times/10days
Dissolved Oxygen Concentrations (DO) and Temperature	In overlying water, at the start and end of the test and ~3 times/week in the measurement beakers. See Test Conditions and Survival Data sheets
pH, Conductivity and Hardness	In overlying water, at the start and end of the test in the measurement beakers. See Test Conditions and Survival Data sheets
Sediment Appearance During Test	See Aeration Checks and Test Observations sheets
Test Observations	Organism behaviour during the test, visible mortalities and/or abnormal behaviour was recorded on Test Observations sheet
Overlying Water – Chemical Analysis	Samples of the overlying water were analysed for Ammonia and Alkalinity on Day 0 (start) and Day 10 (end) of the test. See chemical analysis reports, Appendix D.

Anything Unusual about the Test, Deviation from Test Method, other Problems	By test completion, many larvae had begun to pupate, with some already developed into midges. Observed pupae and midges were included in the survival counts, but were excluded from final dry weight measurements. Initial head capsule width measurements were larger than the recommended with range of 0.33 – 0.45 mm (Average: 0.53mm)
Results	
Endpoints	Survival, Mean Dry Weight
Survival Endpoint Results	There was no statistically significant difference in survival between the test sediments and the laboratory control.
Name and citation of program and methods used for calculating statistical endpoint	CETIS v1.7.0.3 – Parametric; Dunnett's Multiple Comparisons Test Data was tested for normality using Shapiro-Wilk's test and homogeneity of variance using Bartlett's test
Growth Endpoint Results	There was no statistically significant difference in dry weight between the test sediments and the laboratory control.
Name and citation of program and methods used for calculating statistical endpoint	CETIS v1.7.0.3 – Parametric; Dunnett's Multiple Comparisons Test Data was tested for normality using Shapiro-Wilk's test and homogeneity of variance using Bartlett's test
QA	
Test Validity Criteria • Mean survival in the test controls for *C. tentans* must be ≥70% • Average Dry Weight ≥0.6mg	• Mean survival in the control was 94% • Mean Dry Weight was 1.71 mg
Reference Toxicant Test: LC50 (95% CL) (mg Cu^{2+}/L) for Survival	0.38 (0.29, 0.47)
Ref Tox Test Historic Mean and 2SD Range (mg Cu^{2+}/L)	0.41; 2SD range: (0.17, 0.97)
Invalid Ref Tox Test?	No
Date of Ref Tox Test	2010 September 17
Organisms Batch and Condition of Ref Tox Test	Static 96-h water-only test. Same batch of organisms used

CETIS Analytical Report

Chironomus 10-d Survival and Growth Sediment Test — **Maxxam**

Analysis ID:	15-0113-4222	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.7.0
Analyzed:	30 Sep-10 16:55	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	09-4886-5450	**Test Type:**	Survival-AF Growth	**Analyst:**	K. Melling
Start Date:	17 Sep-10 17:38	**Protocol:**	EC/EPS 1/RM/32	**Diluent:**	Reconstituted Water
Ending Date:	27 Sep-10 16:00	**Species:**	Chironomus tentans	**Brine:**	Not Applicable
Duration:	9d 22h	**Source:**	Aquatic Biosystems, CO	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
CTRL2010Sept17	10-7548-6371	17 Sep-10 09:00		9h	Azimuth Consulting Group In	General Misc. Bioassays
SP-TRB-2	02-9973-0060	22 Aug-10 09:00	03 Sep-10 08:25	26d 9h		
SP-N1	02-4340-9088	22 Aug-10 09:00	03 Sep-10 08:25	26d 9h		
INUG	09-3052-7692	25 Aug-10 09:00	03 Sep-10 08:25	23d 9h		
TEFF	20-8508-6076	27 Aug-10 09:00	03 Sep-10 08:25	21d 9h		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
CTRL2010Sept17	Freshwater Sediment	Azimuth Consulting Group	Lab Control		
SP-TRB-2	Freshwater Sediment	Azimuth Consulting Group	SP-TRB-2		
SP-N1	Freshwater Sediment	Azimuth Consulting Group	SP-N1		
INUG	Freshwater Sediment	Azimuth Consulting Group	INUG		
TEFF	Freshwater Sediment	Azimuth Consulting Group	TEFF		

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	0	C > T	Not Run					14.31%

Dunnett's Multiple Comparison Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	P-Value	Decision(5%)
CTRL2010Sept17		SP-TRB-2	2.266	2.305	0.2044	0.0538	Non-Significant Effect
		SP-N1	0.04753	2.305	0.2044	0.7842	Non-Significant Effect
		INUG	1.554	2.305	0.2044	0.1838	Non-Significant Effect
		TEFF	1.055	2.305	0.2044	0.3577	Non-Significant Effect

Auxiliary Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision
Extreme Value	Grubbs Single Outlier	2.301	2.822	0.3824	No Outliers Detected

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	0.1501287	0.03753217	4	1.909	0.1483	Non-Significant Effect
Error	0.3932123	0.01966062	20			
Total	0.543341	0.05719278	24			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	2.309	13.28	0.6791	Equal Variances
Distribution	Shapiro-Wilk Normality	0.9643		0.5067	Normal Distribution

2010Sept30 2010Oct4

Analyst: LS QA: PH

Chironomus 10-d Survival and Growth Sediment Test — **Maxxam**

Analysis ID:	15-0113-4222	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.7.0
Analyzed:	30 Sep-10 16:55	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
CTRL2010Sept17	5	0.94	0.906	0.974	0.8	1	0.04	0.08944	9.52%	0.0%
SP-TRB-2	5	0.8	0.762	0.838	0.7	0.9	0.04472	0.1	12.5%	14.89%
SP-N1	5	0.94	0.9192	0.9608	0.9	1	0.02449	0.05477	5.83%	0.0%
INUG	5	0.84	0.7823	0.8977	0.6	1	0.06782	0.1517	18.05%	10.64%
TEFF	5	0.88	0.8482	0.9118	0.8	1	0.03742	0.08367	9.51%	6.38%

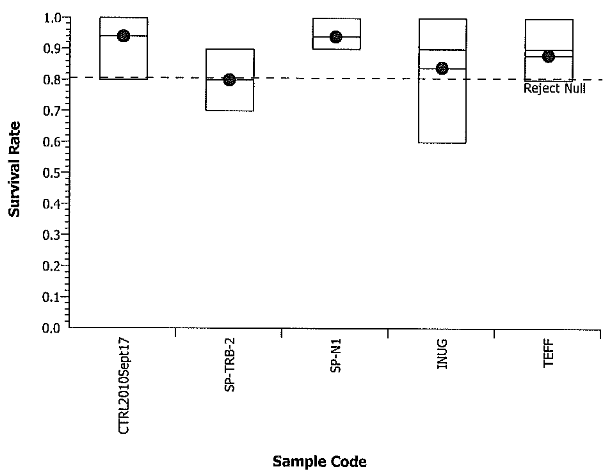
Angular (Corrected) Transformed Summary

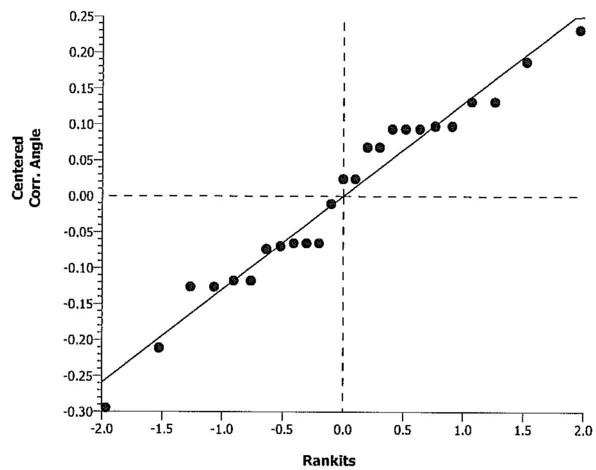
Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
CTRL2010Sept17	5	1.318	1.266	1.371	1.107	1.412	0.06153	0.1376	10.44%	0.0%
SP-TRB-2	5	1.118	1.068	1.167	0.9912	1.249	0.05772	0.1291	11.55%	15.24%
SP-N1	5	1.314	1.28	1.348	1.249	1.412	0.03992	0.08926	6.79%	0.32%
INUG	5	1.181	1.106	1.256	0.8861	1.412	0.08805	0.1969	16.68%	10.45%
TEFF	5	1.225	1.177	1.273	1.107	1.412	0.05653	0.1264	10.32%	7.1%

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
CTRL2010Sept17	1	1	1	0.9	0.8
SP-TRB-2	0.9	0.9	0.7	0.8	0.7
SP-N1	1	0.9	0.9	0.9	1
INUG	1	0.6	0.8	0.9	0.9
TEFF	0.9	0.9	0.8	1	0.8

Graphics





2010Sept30 2010Oct4
Analyst: LS QA: PH

Chironomus 10-d Survival and Growth Sediment Test

Maxxam

Analysis ID:	14-2354-7105	**Endpoint:**	Mean Dry Weight	**CETIS Version:**	CETISv1.7.0
Analyzed:	30 Sep-10 16:55	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	09-4886-5450	**Test Type:**	Survival-AF Growth	**Analyst:**	K. Melling
Start Date:	17 Sep-10 17:38	**Protocol:**	EC/EPS 1/RM/32	**Diluent:**	Reconstituted Water
Ending Date:	27 Sep-10 16:00	**Species:**	Chironomus tentans	**Brine:**	Not Applicable
Duration:	9d 22h	**Source:**	Aquatic Biosystems, CO	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
CTRL2010Sept17	10-7548-6371	17 Sep-10 09:00		9h	Azimuth Consulting Group In	General Misc. Bioassays
SP-TRB-2	02-9973-0060	22 Aug-10 09:00	03 Sep-10 08:25	26d 9h		
SP-N1	02-4340-9088	22 Aug-10 09:00	03 Sep-10 08:25	26d 9h		
INUG	09-3052-7692	25 Aug-10 09:00	03 Sep-10 08:25	23d 9h		
TEFF	20-8508-6076	27 Aug-10 09:00	03 Sep-10 08:25	21d 9h		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
CTRL2010Sept17	Freshwater Sediment	Azimuth Consulting Group	Lab Control		
SP-TRB-2	Freshwater Sediment	Azimuth Consulting Group	SP-TRB-2		
SP-N1	Freshwater Sediment	Azimuth Consulting Group	SP-N1		
INUG	Freshwater Sediment	Azimuth Consulting Group	INUG		
TEFF	Freshwater Sediment	Azimuth Consulting Group	TEFF		

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed	0	C > T	Not Run					25.8%

Dunnett's Multiple Comparison Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	P-Value	Decision(5%)
CTRL2010Sept17		SP-TRB-2	-0.6334	2.305	0.4414	0.9417	Non-Significant Effect
		SP-N1	-1.948	2.305	0.4414	0.9984	Non-Significant Effect
		INUG	-2.205	2.305	0.4414	0.9993	Non-Significant Effect
		TEFF	-0.793	2.305	0.4414	0.9598	Non-Significant Effect

Auxiliary Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision
Extreme Value	Grubbs Single Outlier	2.45	2.822	0.2283	No Outliers Detected

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	0.6347302	0.1586826	4	1.73	0.1828	Non-Significant Effect
Error	1.833966	0.0916983	20			
Total	2.468696	0.2503809	24			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	3.918	13.28	0.4172	Equal Variances
Distribution	Shapiro-Wilk Normality	0.9699		0.6421	Normal Distribution

Mean Dry Weight Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
CTRL2010Sept17	5	1.71	1.578	1.843	1.256	2.054	0.156	0.3489	20.4%	0.0%
SP-TRB-2	5	1.832	1.72	1.943	1.546	2.16	0.1311	0.2932	16.01%	-7.09%
SP-N1	5	2.084	2.027	2.141	1.847	2.226	0.06693	0.1497	7.18%	-21.82%
INUG	5	2.133	1.974	2.292	1.739	2.81	0.1868	0.4176	19.58%	-24.69%
TEFF	5	1.862	1.774	1.951	1.489	2.038	0.1039	0.2324	12.48%	-8.88%

2010Sept30 2010Oct4

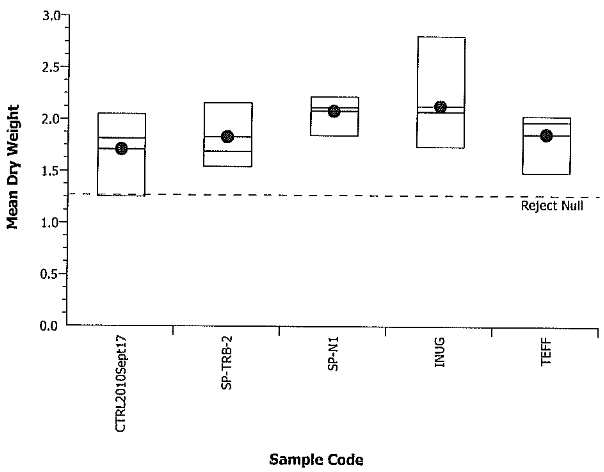
Chironomus 10-d Survival and Growth Sediment Test **Maxxam**

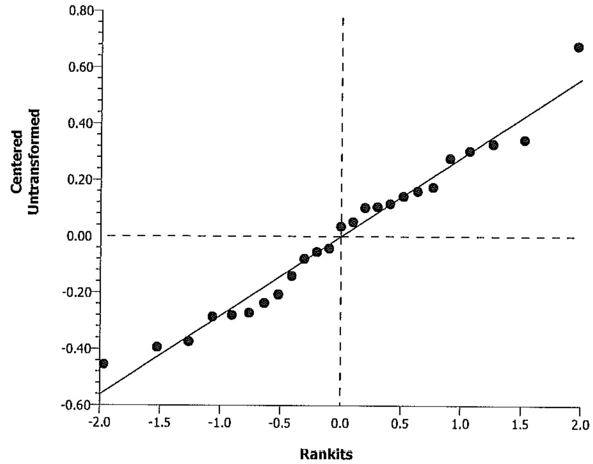
Analysis ID:	14-2354-7105	**Endpoint:**	Mean Dry Weight	**CETIS Version:**	CETISv1.7.0
Analyzed:	30 Sep-10 16:55	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Mean Dry Weight Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
CTRL2010Sept17	1.439	1.816	2.054	1.988	1.256
SP-TRB-2	1.691	1.546	2.136	2.16	1.626
SP-N1	1.847	2.041	2.226	2.186	2.119
INUG	1.739	2.81	2.184	1.853	2.078
TEFF	1.489	2.038	2.023	1.783	1.979

Graphics





2010Sept30 2010Oct4

Analyst: CS QA: PH

Maxxam

Chironomus tentans Survival and Growth Test
Survival of Larvae

Client # & Name: #4954 Azimuth

Sample ID: Various

Sample # Various

Organism Lot #: AB100915CT

Analysts: M. Grey, J. Laroulandie

Start Date and Time: 2010Sept17 @ 17:38

End Date: 2010Sept27

Sample Date: 2010 Aug 22, 25, 27

Stats File ID: CT-4954-0110

Sample ID	Client ID	Rep	# Surviving Chironomids	% Survived	Survival Mean	Survival SD
Control	-	A	10	100	94	9
		B	10	100		
		C	10	100		
		D	9	90		
		E	8	80		
AZ101	SP-TRB-2	A	9	90	80	10
		B	9	90		
		C	7	70		
		D	8	80		
		E	7	70		
AZ102	SP-N1	A	10	100	94	5
		B	9	90		
		C	9	90		
		D	9	90		
		E	10	100		
AZ103	INUG	A	10	100	84	15
		B	6	60		
		C	8	80		
		D	9	90		
		E	9	90		
AZ104	TEFF	A	9	90	88	8
		B	9	90		
		C	8	80		
		D	10	100		
		E	8	80		

PHawes
2010 Oct 04

Maxxam

Chironomid Survival and Growth Test
Dry Weights of Larvae

Client # & Name: #4954 Azimuth
Start Date and Time: 2010 Sept 17 @ 17:38
Organism Lot #: AB100915CT
End Date: 2010 Sept 27
Weighing Dates: 2010 Sep 24, 2010 Sep 29
Drying Temp (°C): 60°C
Drying Time (h): >24
Stats File ID: CT-4954-0110
Analysts: K. Tamaki

Boat #	Sample	Rep	# Worms	Boat Wt. (g)	Boat & Worms Wt. (g)	Worm Wt. (mg)	Mean Wt./worm (mg)	Mean Wt./ Worm (mg)	SD	% CV
1	Control	A	8	1.13279	1.14430	11.51	1.44	1.71	0.35	0.20
2		B	7	1.13875	1.15146	12.71	1.82			
3		C	9	1.17470	1.19319	18.49	2.05			
4		D	9	1.17125	1.18914	17.89	1.99			
5		E	7	1.17636	1.18515	8.79	1.26			
6	SP-TRB-2	A	8	1.17904	1.19257	13.53	1.69	1.83	0.29	0.16
7		B	8	1.16225	1.17462	12.37	1.55			
8		C	7	1.15958	1.17453	14.95	2.14			
9		D	8	1.15129	1.16857	17.28	2.16			
10		E	7	1.14548	1.15686	11.38	1.63			
11	SP-N1	A	10	1.17851	1.19698	18.47	1.85	2.08	0.15	0.07
12		B	9	1.18150	1.19987	18.37	2.04			
13		C	9	1.14042	1.16045	20.03	2.23			
14		D	9	1.15010	1.16977	19.67	2.19			
15		E	10	1.14312	1.16431	21.19	2.12			
16	INUG	A	8	1.14476	1.15867	13.91	1.74	2.13	0.42	0.20
17		B	5	1.17092	1.18497	14.05	2.81			
18		C	8	1.16226	1.17973	17.47	2.18			
19		D	9	1.17473	1.19141	16.68	1.85			
20		E	9	1.17657	1.19527	18.70	2.08			
21	TEFF	A	9	1.17734	1.19074	13.40	1.49	1.86	0.23	0.12
22		B	9	1.17180	1.19014	18.34	2.04			
23		C	6	1.14978	1.16192	12.14	2.02			
24		D	10	1.15918	1.17701	17.83	1.78			
25		E	8	1.14465	1.16048	15.83	1.98			
26		QA/QC		1.15671	1.15665	-0.06				
27		QA/QC		1.15855	1.15857	0.02				
1		0 - A	8	1.13282	1.14439	11.57				
Analyst			KT	KT	KT					

The average dry weight for the replicate controls must be >0.6 mg, for the test to be valid.

LStanoff
2010 Sept 30

Maxxam Analytics

Chironomid Survival and Growth Test
Dry Weights of Larvae

Client # & Name: #4954 Azimoth
Sample ID: Various
Sample # Various
Drying Temperature (°C): 60°C
Analysts: K.Tamaki

Start Date and Time: 2010Sep17@1738
End Date: 2010Sept27
Weighing Dates: 2010Sep24, 2010Sep29
Drying Time (h): >24hours

Boat #	Sample	Rep	# Worms	Boat Wt. (g)	Boat & Worms Wt. (g)	Worm Wt. (mg)	Mean Wt./worm (mg)	Mean Wt. /Sample (mg)	SD	% CV
1	Control	A	Ⓡ 108	1.13279	1.14430	0.00	#DIV/0!	#DIV/0!	#####	#####
2		B	Ⓡ 107	1.13875	1.15146	0.00	#DIV/0!			
3		C	Ⓡ 109	1.17470	1.19319	0.00	#DIV/0!			
4		D	Ⓡ 99	1.17125	1.18914	0.00	#DIV/0!			
5		E	Ⓡ 87	1.17636	1.18525	0.00	#DIV/0!			
6	AZ101 SP-TRB-2	A	Ⓡ 98	1.17404	1.19257	0.00	#DIV/0!	#DIV/0!	#####	#####
7		B	Ⓡ 98	1.16225	1.17462	0.00	#DIV/0!			
8		C	Ⓡ 77	1.15958	1.17453	0.00	#DIV/0!			
9		D	Ⓡ 88	1.15129	1.16857	0.00	#DIV/0!			
10		E	Ⓡ 77	1.14548	1.15686	0.00	#DIV/0!			
11	AZ102 SP-N1	A	10	1.17851	1.19698	0.00	#DIV/0!	#DIV/0!	#####	#####
12		B	9	1.18150	1.19987	0.00	#DIV/0!			
13		C	9	1.14042	1.16045	0.00	#DIV/0!			
14		D	9	1.15010	1.16977	0.00	#DIV/0!			
15		E	10	1.14312	1.16431	0.00	#DIV/0!			
16	AZ103 INUG	A	Ⓡ 108	1.14476	1.15867	0.00	#DIV/0!	#DIV/0!	#####	#####
17		B	Ⓡ 65	1.17092	1.18497	0.00	#DIV/0!			
18		C	8	1.16226	1.17973	0.00	#DIV/0!			
19		D	9	1.17473	1.19141	0.00	#DIV/0!			
20		E	9	1.17657	1.19527	0.00	#DIV/0!			
21	AZ104 TEFF	A	9	1.17734	1.19074	0.00	#DIV/0!	#DIV/0!	#####	#####
22		B	9	1.17180	1.19014	0.00	#DIV/0!			
23		C	Ⓡ 86	1.14978	1.16192	0.00	#DIV/0!			
24		D	10	1.15918	1.17701	0.00	#DIV/0!			
25		E	8	1.14465	1.16048	0.00	#DIV/0!			
26		A				0.00	#DIV/0!	#DIV/0!	#####	#####
27		B				0.00	#DIV/0!			
28		C				0.00	#DIV/0!			
29		D				0.00	#DIV/0!			
30		E				0.00	#DIV/0!			
31		A				0.00	#DIV/0!	#DIV/0!	#####	#####
32		B				0.00	#DIV/0!			
33		C				0.00	#DIV/0!			
34		D				0.00	#DIV/0!			
35		E				0.00	#DIV/0!			
~~36~~ 26		QA/QC	—	1.15671	1.15605					
~~37~~ 27		QA/QC	—	1.15855	1.15857					
1		0 - A	8	1.13282	1.14429					
Analyst			KT	KT	KT					

K.Tamaki 2010 Sep 24

The average dry weight for the replicate controls must be >0.6 mg, for the test to be valid.

Ⓡ weight 2010 Sep 29

Maxxam

Chironomus tentans
Environment Canada Test Data Sheet

Sample ID: Control
Sample Date: n/a
Sample Received: n/a
Start Date: 2010Sept17
End Date: 2010Sept27
Sample #: n/a

Measurements						Samples Taken			
pH		Hardness (mg/L $CaCO_3$)		Conductance (μS/cm)		Alkalinity (mg/L $CaCO_3$)		Ammonia (mg/L)	
Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
8.1	8.4	104	80	368	508	✓64	120	✓<0.05	6.8

Initial overlying WQ measurements:
Analyst KM rm | Date 2010Sep17

Final overlying WQ measurements:
Analyst SJ | Date 27Sept2010

Day	Friday Day 0	Monday Day 3	Wednesday Day 5	Friday Day 7	Monday Day 10
Temp. (°C)	23.1	21.4	22.0	22.0	23.0
D.O. (mg/L)	8.6	8.7	8.6	8.7	8.4
Feeding	✓	✓	✓	✓	no
Analyst	KM	KC	KT	KT	SJ MG

Feed 3.75mL Tetrafin

Replicate	A	B	C	D	E
# Surviving	10	10	10	9	8
Analyst	MG	MG	MG	MG	MG

Date	Replicate	Comments	Analyst
2010Sept27	B	one pupal casing found - hatched midge. counted as survived	MG
2010Sept27	A	two pupated counted as survived, not weighed	MG
2010Sept27	B	two pupated, counted as survived, not weighed.	MG
2010Sept27	C	one pupated counted as survived, not weighed	MG
2010Sept27	E	one pupated, counted as survived, not weighed	MG
		WStaff 2010Oct04	

Maxxam

Chironomus tentans
Environment Canada Test Data Sheet

Sample ID: AZ101 (SP-TRB-2)
Sample Date: 2010Aug22
Sample Received: 2010Sept03
Start Date: 2010Sept17
End Date: 2010Sept27
Sample #: W72035-01

Measurements						Samples Taken			
pH		Hardness (mg/L $CaCO_3$)		Conductance (µS/cm)		Alkalinity (mg/L $CaCO_3$)		Ammonia (mg/L)	
Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
8.2	8.4	128	180	379	482	82	130	0.18	27

Initial overlying WQ measurements:	
Analyst KM Rm	Date 2010Sept17

Final overlying WQ measurements:	
Analyst JL	Date 27 Sept 2010

Day	Friday Day 0	Monday Day 3	Wednesday Day 5	Friday Day 7	Monday Day 10
Temp. (°C)	23.2	21.9	22.2	22.7	22.8
D.O. (mg/L)	8.6	8.6	8.6	8.6	8.6
Feeding	✓	✓	✓	✓	No
Analyst	KM	KP	KF	KF	JL

Feed 3.75mL Tetrafin

Replicate	A	B	C	D	E
# Surviving	9	9	7	8	7
Analyst	MG	MG	MG	MG	MG

Date	Replicate	Comments	Analyst
2010Sept18	all	cloudy	Rm
2010 Sept27	B	one hatched midge, survived, not weighed	MG
2010 Sept27	A	one pupated, survived, not weighed	MG

LStaceroff 2010Oct04

Maxxam

Chironomus tentans
Environment Canada Test Data Sheet

Sample ID: AZ102 (SP-N1)
Sample Date: 2010Aug22
Sample Received: 2010Sept03

Start Date: 2010Sept17
End Date: 2010Sept27
Sample #: W72036-01

Measurements						Samples Taken			
pH		Hardness (mg/L $CaCO_3$)		Conductance (µS/cm)		Alkalinity (mg/L $CaCO_3$)		Ammonia (mg/L)	
Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
8.0	7.9	128	64	311	272	43	35	0.06	7.0

Initial overlying WQ measurements:	
Analyst KM Rm	Date 2010Sept17

Final overlying WQ measurements:	
Analyst JL	Date 27 Sept 2010

Day	Friday	Monday	Wednesday	Friday	Monday
	Day 0	Day 3	Day 5	Day 7	Day 10
Temp. (°C)	23.2	21.9	22.2	22.1	22.9
D.O. (mg/L)	8.6	8.6	8.6	8.7	8.6
Feeding	✓	✓	✓	✓	No
Analyst	KM	KP	KT	KT	JL

Feed 3.75 mL Tetrafin

Replicate	A	B	C	D	E
# Surviving	10	9	9	9	10
Analyst	JL	JL	JL	JL	JL

Date	Replicate	Comments	Analyst
		JL 27 Sept 2010	

Maxxam

Chironomus tentans
Environment Canada Test Data Sheet

Sample ID:	AZ103 (INUG)	**Start Date:**	2010Sept17
Sample Date:	2010Aug25	**End Date:**	2010Sept27
Sample Received:	2010Sept03	**Sample #:**	W72037-01

Measurements						Samples Taken			
pH		Hardness (mg/L $CaCO_3$)		Conductance (μS/cm)		Alkalinity (mg/L $CaCO_3$)		Ammonia (mg/L)	
Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
7.7	7.6	80	56	247	261	~38	~~40.65~~ 22 LS 2010Oct04	~~2~~ <0.05 LS 2010Oct04	6.8

Initial overlying WQ measurements:	
Analyst KM RM	Date 2010Sep17

Final overlying WQ measurements:	
Analyst JZ	Date 27Sept2010

Day	Friday Day 0	Monday Day 3	Wednesday Day 5	Friday Day 7	Monday Day 10
Temp. (°C)	23.2	21.6	22.0	22.0	22.9
D.O. (mg/L)	8.5	8.6	8.2	8.6	8.6
Feeding	✓	✓	✓	✓	No
Analyst	KM	WP	KT	KT	JZ

Feed 3.75 mL tetrafin

Replicate	A	B	C	D	E
# Surviving	10	6	8	9	9
Analyst	MG	MG	MG	MG	MG

Date	Replicate	Comments	Analyst
2010Sept18	D	One emerged	RM
2010Sept27	B	one pupated.	MG
2010Sept27	A	one midge hatched, one pupated counted as	MG
2010Sept27	A	survived not weighed.	MG

LStew 2010Oct04

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Chironomus tentans
Environment Canada Test Data Sheet

Sample ID: AZ104 (TEFF)
Sample Date: 2010Aug27
Sample Received: 2010Sept03

Start Date: 2010Sept17
End Date: 2010Sept27
Sample #: W72038-01

Measurements						Samples Taken			
pH		Hardness (mg/L $CaCO_3$)		Conductance (µS/cm)		Alkalinity (mg/L $CaCO_3$)		Ammonia (mg/L)	
Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
7.7	8.0	80	64	293	325	39	56	0.13	6.9

Initial overlying WQ measurements:	
Analyst KM Km	Date 2010Sept17

Final overlying WQ measurements:	
Analyst JL	Date 27 Sept 2010

Day	Friday Day 0	Monday Day 3	Wednesday Day 5	Friday Day 7	Monday Day 10
Temp. (°C)	23.2	21.6	22.0	22.0	23.1
D.O. (mg/L)	8.5	8.7	8.6	8.6	8.5
Feeding	✓	–	✓	✓	No
Analyst	KM	KP	KA	KA	JL

Feed 3.75 mL Tetrafin

Replicate	A	B	C	D	E
# Surviving	9	9	~~7~~ 8 (wrong number)	10	8
Analyst	MG	JL	MG	JL	MG

Date	Replicate	Comments	Analyst
2010Sept18	C	One floating - dead.	
2010 Sept 27	C	one pupal casing, counted as survived, not weighed	MG
2010 Sept 27	C	one pupated, counted as survived, not weighed	MG

LStanoff 2010Oct04

FORM: 1601F9V1

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Chironomid Survival Growth Test
Aeration Checks

Client # & Name: #4954 Azimuth

Start Date & Time: 2010Sept17@ 1738

Initial when aeration is checked. If air is off record DO and note which replicate(s) in comments section.

	Day -1	Day 0	1	2	3	4	5	6	7	8	9	10
Date	2010 Sept16	2010 Sept17	2010 Sept 18	2010 Sept19	2010 Sept 20	2010 Sep21	2010 Sep22	2010 Sep23	2010 Sep24	2010 Sep 25	2010 Sep 26	2010 Sept 27
Early AM	n/a (A)	LS	RM	DJ	WP	WP	KT	KT	KT	DJ	DJ	MF
Mid-day	n/a 2010 Sept16 RM	LS	RM	DJ	KA	KT	KT	KT	KT	DJ	DJ	MF 2010 Sept 27
Late PM	2010 Sept 16 RM	LS	KM	DJ	KP	KT	KT	KT	KT	DJ	DJ	

Comments:

(A) WS RM 2010 Sept 16

LStaw?? 2010 Oct 04

Randomization Chart for Chironomid Tests

Back Wall

Position Map

6	12	18	24	30
5	11	17	23	29
4	10	16	22	28
3	9	15	21	27
2	8	14	20	26
1	7	13	19	25

Front of Counter

Position #	Colour Code	Treatment	Replicate
8	Red	Control	A
29	Red	Control	B
30	Red	Control	C
16	Red	Control	D
23	Red	Control	E
20	Red	Control	Measure
19	Green	AZ101	A
7	Green	AZ101	B
12	Green	AZ101	C
26	Green	AZ101	D
21	Green	AZ101	E
24	Green	AZ101	Measure
9	Blue	AZ102	A
6	Blue	AZ102	B
28	Blue	AZ102	C
2	Blue	AZ102	D
15	Blue	AZ102	E
5	Blue	AZ102	Measure
3	Yellow	AZ103	A
18	Yellow	AZ103	B
10	Yellow	AZ103	C
11	Yellow	AZ103	D
14	Yellow	AZ103	E
27	Yellow	AZ103	Measure
22	Orange	AZ104	A
4	Orange	AZ104	B
1	Orange	AZ104	C
17	Orange	AZ104	D
25	Orange	AZ104	E
13	Orange	AZ104	Measure

14-D *HYALELLA* GROWTH AND SURVIVAL TEST

Summary of 14-d *Hyalella* Test Results for Azimuth Sediment Samples Test Date: September 17, 2010

Sample	Mean Survival (%) ÑSD	Mean Dry Weight (mg) ÑSD
Control	98 ± 4	0.11 ± 0.02
SP-TRB-2	88 ± 13	0.17 ± 0.03
SP-N1	90 ± 12	0.11 ± 0.02
INUG	100 ± 0	0.15 ± 0.04
TEFF	88 ± 16	0.11 ± 0.02

SD=Standard Deviation. *=Statistically significant difference compared to the Control

14-d *Hyalella azteca* Survival and Growth Sediment Test

Client Name/Location	Azimuth Consulting Group / Vancouver, BC
Testing Lab/Location	Maxxam Analytics / Burnaby, BC
Sample Information	
Sample Names	SP-TRB-2, SP-N1, INUG, TEFF
Type of Sample	Field collected sediments
Method of Collection	See Chain of Custody form
Sample Collector	See Chain of Custody form
Sample Volume	4 L
Sample Containers	4-L white food grade plastic buckets
Sample Collection Date	2010 August 22, 25, 27
Date & Time of Sample Receipt	2010 September 03 @ 08:25
Sample Temperature upon Arrival	10 - 13°C
Sediment and Pore Water Characterisation	See Sediment Sample Descriptions sheet (Appendix A) and analytical chemistry reports (Appendix D)
Sample Preparation	
Homogenisation	Samples were individually mixed until homogenised at ambient laboratory temperature; large debris and indigenous macro-organisms were removed during homogenisation (see Sediment Sample Descriptions sheet, Appendix A)
Date of Homogenisation	2010 September 16
Sediment – Physical Analyses	Each homogenised sediment was analysed for grain size, TOC and moisture content. See chemical analysis reports, Appendix D.
Sediment Porewater – Chemical Analyses	Samples of homogenised sediment were centrifuged to produce porewater. The porewater was then analysed for Ammonia and Sulfides. See chemical analysis report, Appendix D.
Test Organisms	
Species	*Hyalella azteca*
Source	Aquatic Bio Systems, Fort Collins, CO
Age at Start of Test	Juveniles, between 7-9 days old
Water quality parameters of shipping water before shipment and after arrival	See Organism History Sheet See Acclimation and Holding Conditions sheets
Acclimation rate and procedure	See Acclimation and Holding Conditions sheets
Mortality upon arrival and preceding test	See Acclimation and Holding Conditions sheets

Laboratory Control Sediment and Test Water	
Laboratory Control Sediment Source	Mackenzie Beach, Tofino, BC; Collected by Seacology (North Vancouver, BC)
Laboratory Control Sediment Storage	Stored in a cold room that was at 4 ± 2°C
Laboratory Control Sediment Preparation Procedure	Sediment was sieved (0.5 mm) before use and rinsed thoroughly with control water
Control Water	Sam-5S reconstituted water (Borgmann 1996)
Test Conditions & Facilities	
Test Method	Environment Canada Biological Test Method: Test for Survival and Growth in Sediment Using the Freshwater Amphipod *Hyalella azteca*, EPS 1/RM/33 (1997)
Test Type	Static, no water renewal
Test Temperature	23°C ± 1°C. See the Test Measurement and Survival Data sheets
Light levels and photoperiod	Overhead full spectrum (fluorescent or equivalent); 607 – 763 lux, 16-h light:8-h dark
Aeration	Continuous and minimal in each test vessel; checked 3 times daily. Compressed oil-free air delivered through microbore airline tubing
Test Start Date	2010 September 17
Test Completion Date	2010 October 01
Test Duration	14 days
Test Vessels	300 mL glass jars; covered
Volume of Sediment	100 mL
Volume of Test Water	175 mL
Analysts	L. Stavroff, K. Melling, K. Pomeroy, R. Masson, D. Greschner, K. Tamaki, J. Laroulandie, M. Brassil, D. Lee, M. Grey
Water Renewal	None
# Organisms / Vessel	10
Number of Replicates	5 (plus one measurement beaker) for each sediment sample
Feeding Regime	1.5 mL YCT three times/week (Yeast, Cerophyll, Trout Chow)
Dissolved Oxygen Concentrations (DO) and Temperature	In overlying water, at the start and end of the test and ~3 times/week in the measurement beakers. See Test Conditions and Survival Data sheets
pH, Conductivity and Hardness	In overlying water, at the start and end of the test in the measurement beakers. See Test Conditions and Survival Data sheets
Sediment Appearance During Test	See Aeration Checks and Test Observations sheets
Test Observations	Organism behaviour during the test, visible mortalities and/or abnormal behaviour was recorded on Test Observations sheet
Overlying Water – Chemical Analysis	Samples of the overlying water were analysed for Ammonia and Alkalinity on Day 0 (start) and Day 14 (end) of the test. See chemical analysis reports, Appendix D.

Anything Unusual about the Test, Deviation from Test Method, other Problems	There were no deviations or problems with the test, except control replicates A & C were accidentally switched when placed into the drying pans. This would not affect the tests.
Results	
Endpoints	Survival, Mean Dry Weight
Survival Endpoint Results	There was no statistically significant difference in survival between the test sediments and the laboratory control.
Name and citation of program and methods used for calculating statistical endpoint	CETIS v1.7.0.3 – Parametric; Dunnett's Multiple Comparisons Test Data was tested for normality using Shapiro-Wilk's test and homogeneity of variance using Modified Levene's test
Growth Endpoint Results	There was no statistically significant difference in dry weight between the test sediments and the laboratory control.
Name and citation of program and methods used for calculating statistical endpoint	CETIS v1.7.0.3 – Parametric; Dunnett's Multiple Comparisons Test Data was tested for normality using Shapiro-Wilk's test and homogeneity of variance using Bartlett's test
QA	
Test Validity Criteria • Mean survival in the test controls for *H. azteca* must be ≥80% • Average Dry Weight ≥0.1mg	• Mean survival in the control was 98% • Mean Dry Weight was 0.11 mg
Reference Toxicant Test: LC50 (95% CL) (mg Cu^{2+}/L) for Survival	237.8 (201.7, 274.4)
Ref Tox Test Historic Mean and 2SD Range (mg Cu^{2+}/L)	232.16; 2SD range: (136.33, 395.34)
Invalid Ref Tox Test?	No
Date of Ref Tox Test	2010 September 17
Organisms Batch and Condition of Ref Tox Test	Static 96-h water-only test. Same batch of organisms used

CETIS Analytical Report

Report Date:	04 Oct-10 12:44 (p 1 of 2)
Test Code:	17-9357-7133/HA-4954-0110

Hyalella 10-d Survival and Growth Sediment Test — **Maxxam**

Analysis ID:	16-8917-7667	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.7.0
Analyzed:	04 Oct-10 12:39	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	11-3654-9454	**Test Type:**	Survival-Growth	**Analyst:**	L. Stavroff
Start Date:	17 Sep-10 15:43	**Protocol:**	EC/EPS 1/RM/33	**Diluent:**	Reconstituted Water
Ending Date:	01 Oct-10 14:00	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	13d 22h	**Source:**	Aquatic Biosystems, CO	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
CTRL2010Sept17	16-5515-3910	17 Sep-10 09:00		7h	Azimuth Consulting Group In	General Misc. Bioassays
SP-TRB-2	02-9973-0060	22 Aug-10 09:00	03 Sep-10 08:25	26d 7h		
SP-N1	02-4340-9088	22 Aug-10 09:00	03 Sep-10 08:25	26d 7h		
INUG	09-3052-7692	25 Aug-10 09:00	03 Sep-10 08:25	23d 7h		
TEFF	20-8508-6076	27 Aug-10 09:00	03 Sep-10 08:25	21d 7h		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
CTRL2010Sept17	Freshwater Sediment	Azimuth Consulting Group	Lab Control		
SP-TRB-2	Freshwater Sediment	Azimuth Consulting Group	SP-TRB-2		
SP-N1	Freshwater Sediment	Azimuth Consulting Group	SP-N1		
INUG	Freshwater Sediment	Azimuth Consulting Group	INUG		
TEFF	Freshwater Sediment	Azimuth Consulting Group	TEFF		

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	0	C > T	Not Run					14.41%

Dunnett's Multiple Comparison Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	P-Value	Decision(5%)
CTRL2010Sept17		SP-TRB-2	1.508	2.305	0.2218	0.1968	Non-Significant Effect
		SP-N1	1.213	2.305	0.2218	0.2953	Non-Significant Effect
		INUG	-0.3386	2.305	0.2218	0.8912	Non-Significant Effect
		TEFF	1.431	2.305	0.2218	0.2199	Non-Significant Effect

Auxiliary Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision
Extreme Value	Grubbs Single Outlier	2.559	2.822	0.1515	No Outliers Detected

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	0.1389767	0.03474417	4	1.5	0.2399	Non-Significant Effect
Error	0.4632071	0.02316036	20			
Total	0.6021838	0.05790452	24			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Mod Levene Equality of Variance	3.165	4.893	0.0450	Equal Variances
Distribution	Shapiro-Wilk Normality	0.872		0.0047	Non-normal Distribution

20100ct04 20100ct04

Analyst: LS QA: PH

Hyalella 10-d Survival and Growth Sediment Test — Maxxam

Analysis ID:	16-8917-7667	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.7.0
Analyzed:	04 Oct-10 12:39	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
CTRL2010Sept17	5	0.98	0.963	0.997	0.9	1	0.02	0.04472	4.56%	0.0%
SP-TRB-2	5	0.88	0.8304	0.9296	0.7	1	0.05831	0.1304	14.82%	10.2%
SP-N1	5	0.9	0.8534	0.9466	0.7	1	0.05477	0.1225	13.61%	8.16%
INUG	5	1	1	1	1	1	0	0	0.0%	-2.04%
TEFF	5	0.88	0.8175	0.9425	0.6	1	0.07348	0.1643	18.67%	10.2%

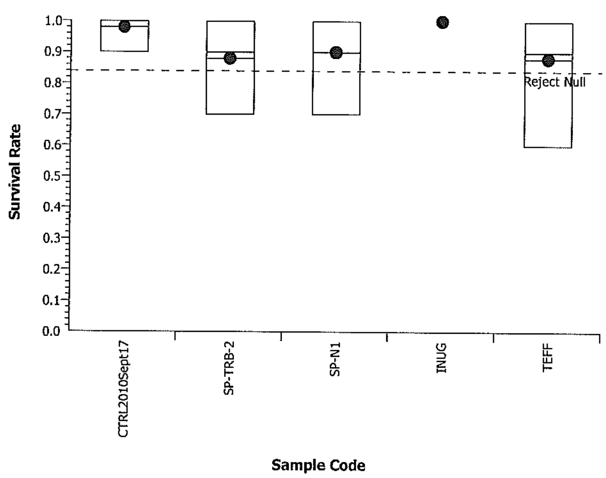
Angular (Corrected) Transformed Summary

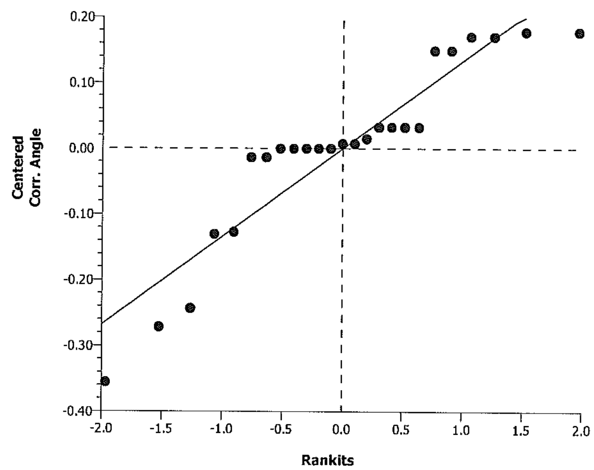
Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
CTRL2010Sept17	5	1.379	1.352	1.407	1.249	1.412	0.03259	0.07288	5.28%	0.0%
SP-TRB-2	5	1.234	1.163	1.305	0.9912	1.412	0.08327	0.1862	15.09%	10.52%
SP-N1	5	1.263	1.197	1.328	0.9912	1.412	0.07704	0.1723	13.64%	8.47%
INUG	5	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	-2.36%
TEFF	5	1.242	1.16	1.323	0.8861	1.412	0.09607	0.2148	17.3%	9.99%

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
CTRL2010Sept17	0.9	1	1	1	1
SP-TRB-2	1	1	0.8	0.7	0.9
SP-N1	1	0.9	0.7	0.9	1
INUG	1	1	1	1	1
TEFF	0.6	0.9	1	1	0.9

Graphics





2010Oct04 2010Oct04

Hyalella 10-d Survival and Growth Sediment Test — Maxxam

Analysis ID:	19-3965-0690	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.7.0
Analyzed:	04 Oct-10 14:30	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	11-3654-9454	**Test Type:**	Survival-Growth	**Analyst:**	L. Stavroff
Start Date:	17 Sep-10 15:43	**Protocol:**	EC/EPS 1/RM/33	**Diluent:**	Reconstituted Water
Ending Date:	01 Oct-10 14:00	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	13d 22h	**Source:**	Aquatic Biosystems, CO	**Age:**	

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
CTRL2010Sept17	16-5515-3910	17 Sep-10 09:00		7h	Azimuth Consulting Group In	General Misc. Bioassays
SP-TRB-2	02-9973-0060	22 Aug-10 09:00	03 Sep-10 08:25	26d 7h		
SP-N1	02-4340-9088	22 Aug-10 09:00	03 Sep-10 08:25	26d 7h		
INUG	09-3052-7692	25 Aug-10 09:00	03 Sep-10 08:25	23d 7h		
TEFF	20-8508-6076	27 Aug-10 09:00	03 Sep-10 08:25	21d 7h		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
CTRL2010Sept17	Freshwater Sediment	Azimuth Consulting Group	Lab Control		
SP-TRB-2	Freshwater Sediment	Azimuth Consulting Group	SP-TRB-2		
SP-N1	Freshwater Sediment	Azimuth Consulting Group	SP-N1		
INUG	Freshwater Sediment	Azimuth Consulting Group	INUG		
TEFF	Freshwater Sediment	Azimuth Consulting Group	TEFF		

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed	0	C > T	Not Run					34.67%

Dunnett's Multiple Comparison Test

Sample Code	vs Sample Code	Test Stat	Critical	MSD	P-Value	Decision(5%)
CTRL2010Sept17	SP-TRB-2	-3.292	2.305	0.03916	1.0000	Non-Significant Effect
	SP-N1	0.1844	2.305	0.03916	0.7349	Non-Significant Effect
	INUG	-2.185	2.305	0.03916	0.9992	Non-Significant Effect
	TEFF	0.4106	2.305	0.03916	0.6427	Non-Significant Effect

Auxiliary Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision
Extreme Value	Grubbs Single Outlier	2.605	2.822	0.1268	No Outliers Detected

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	0.01595208	0.003988021	4	5.523	0.0037	Significant Effect
Error	0.01444125	0.0007220624	20			
Total	0.03039333	0.004710083	24			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	4.422	13.28	0.3519	Equal Variances
Distribution	Shapiro-Wilk Normality	0.9538		0.3047	Normal Distribution

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
CTRL2010Sept17	5	0.113	0.1051	0.1208	0.08	0.13	0.009226	0.02063	18.26%	0.0%
SP-TRB-2	5	0.1689	0.1571	0.1807	0.1429	0.2188	0.01386	0.031	18.35%	-49.52%
SP-N1	5	0.1098	0.1027	0.117	0.084	0.132	0.008397	0.01878	17.09%	2.77%
INUG	5	0.1501	0.1348	0.1654	0.11	0.214	0.01801	0.04028	26.83%	-32.87%
TEFF	5	0.106	0.1	0.112	0.096	0.134	0.007051	0.01577	14.88%	6.18%

20100ct04 20100ct04

Analyst: LS QA: PH

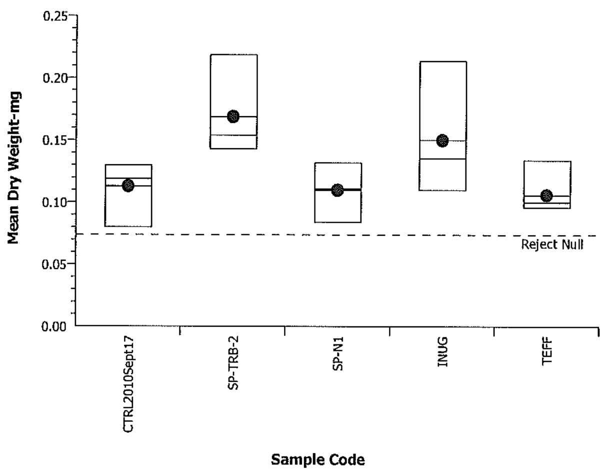
Hyalella 10-d Survival and Growth Sediment Test | **Maxxam**

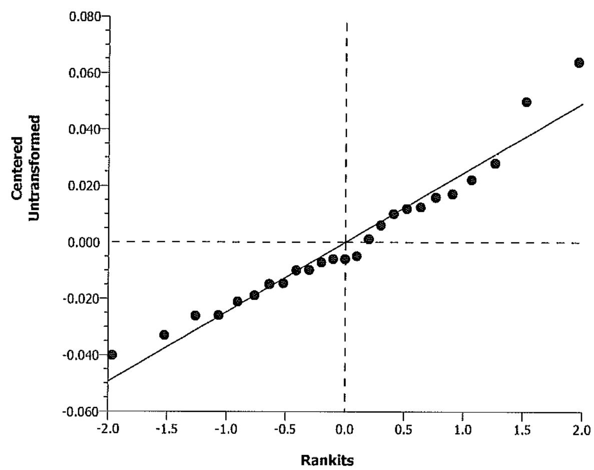
Analysis ID:	19-3965-0690	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.7.0
Analyzed:	04 Oct-10 14:30	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Mean Dry Weight-mg Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
CTRL2010Sept17	0.08	0.119	0.1289	0.107	0.13
SP-TRB-2	0.154	0.179	0.2188	0.1429	0.15
SP-N1	0.111	0.084	0.1	0.1222	0.132
INUG	0.1356	0.214	0.11	0.162	0.129
TEFF	0.1	0.1011	0.096	0.134	0.09889

Graphics





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Hyalella azteca Survival and Growth Test
Survival of Amphipods

Client # & Name: #4954 Azimuth
Start Date and Time: 2010 Sept 17 @ 15:43
Sample ID: Various
End Date: 2010 Oct 01
Sample # Various
Sample Date: 2010 Aug 22, 25, 27
Organism Lot #: AB100915HA
Stats File ID: HA-4954-0110
Analysts: M. Grey, R. Masson

Sample ID	Client ID	Rep	# Surviving Hyalella	% Survived	Survival	
					Mean	SD
Control	-	A	9	90	98	4
		B	10	100		
		C	10	100		
		D	10	100		
		E	10	100		
AZ101	SP-TRB-2	A	10	100	88	13
		B	10	100		
		C	8	80		
		D	7	70		
		E	9	90		
AZ102	SP-N1	A	10	100	90	12
		B	9	90		
		C	7	70		
		D	9	90		
		E	10	100		
AZ103	INUG	A	10	100	100	0
		B	10	100		
		C	10	100		
		D	10	100		
		E	10	100		
AZ104	TEFF	A	6	60	88	16
		B	9	90		
		C	10	100		
		D	10	100		
		E	9	90		

P. Hawes
2010 Oct 04

Maxxam

Hyalella azteca Survival and Growth Test
Dry Weights of Larvae

Client # & Name: #4954 Azimuth
Start Date and Time: 2010 Sept 17 @ 15:43
Organism Lot #: AB100915HA
End Date: 2010 Oct 01
Weighing Dates: 2010 Oct 04
Drying Temperature (°C): 60°C
Drying Time (h): >24 hrs
Stats File ID: HA-4954-0110
Analysts: R. Masson

Boat #	Sample	Rep	# *Hyalella*	*Hyalella* Wt.(g)	*Hyalella* Wt. (mg)	Mean Wt./*Hyalella* (mg)	Mean Wt./Sample (mg)	SD	% CV
1	Control	A	10	0.00080	0.80	0.08	0.11	0.02	0.18
2		B	10	0.00119	1.19	0.12			
3		C	9	0.00116	1.16	0.13			
4		D	10	0.00107	1.07	0.11			
5		E	10	0.00130	1.30	0.13			
6	SP-TRB-2	A	10	0.00154	1.54	0.15	0.17	0.03	0.18
7		B	10	0.00179	1.79	0.18			
8		C	8	0.00175	1.75	0.22			
9		D	7	0.00100	1.00	0.14			
10		E	9	0.00135	1.35	0.15			
11	SP-N1	A	10	0.00111	1.11	0.11	0.11	0.02	0.17
12		B	10	0.00084	0.84	0.08			
13		C	7	0.00070	0.70	0.10			
14		D	9	0.00110	1.10	0.12			
15		E	10	0.00132	1.32	0.13			
16	INUG	A	9	0.00122	1.22	0.14	0.15	0.04	0.27
17		B	10	0.00214	2.14	0.21			
18		C	10	0.00110	1.10	0.11			
19		D	10	0.00162	1.62	0.16			
20		E	10	0.00129	1.29	0.13			
21	TEFF	A	6	0.00060	0.60	0.10	0.11	0.02	0.15
22		B	9	0.00091	0.91	0.10			
23		C	10	0.00096	0.96	0.10			
24		D	10	0.00134	1.34	0.13			
25		E	9	0.00089	0.89	0.10			
1		QA/QC	10	0.00081	0.81	0.08			
8		QA/QC	8	0.00172	1.72	0.22			
19		QA/QC	10	0.00163	1.63	0.16			
Analyst			RM	RM					

The average dry weight for the replicate controls must be >0.1 mg, for the test to be valid.

JP
2010 Oct 7

Maxxam Analytics

Hyalella azteca Survival and Growth Test
Dry Weights of Larvae

Client # & Name: 4954 Azimuth
Sample ID: Meadow Bank East
Sample Date: 2010 Aug 22, 25, 27
Sample Received: 2010 Sept 3
Sample #: B080482
Organism Lot #: AB100915HA
Analysts: R. Masson

Start Date and Time: 2010 Sept 17 @ 1543
End Date: 2010 Oct 01
Weighing Dates: 2010 Oct 04
Drying Temperature (°C): 60°
Drying Time (~~h~~): 3 days
Statistics File ID: HA-4954-0110

Boat #	Sample	Rep	# *Hyalella*	Boat Wt. (g)	Boat & *Hyalella* Wt. (g)	*Hyalella* Wt. (mg)	Mean Wt./*Hyalella* (mg)	Mean Wt./Sample (mg)	SD	% CV
1	Control	A	10		(~~0.00070~~) Ⓐ	0.00	#DIV/0!	#DIV/0!	#####	#####
2	Control	B	10		0.00119	0.00	#DIV/0!			
3	Control	C	Ⓓ 9 Ⓑ		0.00116	0.00	#DIV/0!			
4	Control	D	10		0.00107	0.00	#DIV/0!			
5	Control	E	10		0.00130	0.00	#DIV/0!			
6		A	10		0.00154	0.00	#DIV/0!	#DIV/0!	#####	#####
7		B	10		0.00179	0.00	#DIV/0!			
8		C	8		0.00175	0.00	#DIV/0!			
9		D	7		0.00100	0.00	#DIV/0!			
10		E	9		0.00135	0.00	#DIV/0!			
11		A	Ⓒ 10		0.00111	0.00	#DIV/0!	#DIV/0!	#####	#####
12		B	Ⓒ 10		0.00084	0.00	#DIV/0!			
13		C	7		0.00070	0.00	#DIV/0!			
14		D	9		0.00110	0.00	#DIV/0!			
15		E	10		0.00132	0.00	#DIV/0!			
16		A	9		0.00122	0.00	#DIV/0!	#DIV/0!	#####	#####
17		B	10		0.00214	0.00	#DIV/0!			
18		C	10		0.00110	0.00	#DIV/0!			
19		D	10		0.00162	0.00	#DIV/0!			
20		E	10		0.00129	0.00	#DIV/0!			
21		A	6		0.00060	0.00	#DIV/0!	#DIV/0!	#####	#####
22		B	Ⓒ 9		0.00091	0.00	#DIV/0!			
23		C	Ⓒ 10		0.00096	0.00	#DIV/0!			
24		D	10		0.00134	0.00	#DIV/0!			
25		E	9		0.00089	0.00	#DIV/0!			
1		QA/QC	10		0.00081					
8		QA/QC	8		0.00172					
19		QA/QC	10		0.00163					
Analyst			RM		RM					

The average dry weight for the replicate controls must be >0.1 mg, for the test to be valid.

Ⓐ RM @ E 2010 Oct 04 - 0.00080 - Possible damage to Hyalella
Ⓑ One Hyalella possibly lost. RM 2010 Oct 04
Ⓒ Damage to organisms RM 2010 Oct 04
Ⓓ CTRL A & CTRL D possibly switched RM 2010 Oct 07

Maxxam — *Hyalella azteca* Canada Survival and Growth Test Measurement and Survival Data Sheet

Sample ID: Control
Start Date: 2010Sept17 @ 1543
Sample Date: n/a
End Date: 2010Oct01
Sample Received: n/a
Sample #: n/a

Measurements						Samples Taken			
pH		Hardness (mg/L $CaCO_3$)		Conductance (µS/cm)		Alkalinity (mg/L $CaCO_3$)		Ammonia (mg/L)	
Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
8.1	8.0	112	128	410	533	~60	78	<0.05	0.33

Initial overlying WQ measurements:	
Analyst KM Rm	Date 2010Sep17

Final overlying WQ measurements:	
Analyst Rm	Date 2010Oct01

Day	Friday Day 0	Monday Day 3	Wednesday Day 5	Friday Day 7	Monday Day 10	Wednesday Day 12	Friday Day 14
Temp. (°C)	22.8	22.0	22.2	22.1	22.9	22.3	22.8
D.O. (mg/L)	8.8	8.6	8.7	8.7	8.5	8.6	8.6
Feeding	✓	✓	✓	✓	✓	✓	✓
Analyst	KM LS	KP	KT	KT	SL	KT	Rm

Feed 3.5mL YCT.

Replicate	A	B	C	D	E
# Surviving	9	10	10	10	10
Analyst	MG	MG	MG	MG	MG

Date	Replicate	Comments	Analyst

M.Gy. 2010 Oct 18

Maxxam *Hyalella azteca* **Canada Survival and Growth Test Measurement and Survival Data Sheet**

Sample ID: AZ101 (SP-TRB-2) **Start Date:** 2010Sept17
Sample Date: 2010Aug22 **End Date:** 2010Oct01
Sample Received: 2010Sept03 **Sample #:** W72035-01

Measurements						Samples Taken			
pH		Hardness (mg/L $CaCO_3$)		Conductance (µS/cm)		Alkalinity (mg/L $CaCO_3$)		Ammonia (mg/L)	
Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
8.1	8.1	140	180	413	508	✓ 68	110	✓ 0.20	<0.05

Initial overlying WQ measurements:	
Analyst KM Rm	Date 2010Sept17

Final overlying WQ measurements:	
Analyst Rm	Date 2010Oct01

Day	Friday Day 0	Monday Day 3	Wednesday Day 5	Friday Day 7	Monday Day 10	Wednesday Day 12	Friday Day 14
Temp. (°C)	22.7	22.0	22.3	22.3	22.7	22.3	22.7
D.O. (mg/L)	8.7	8.6	8.6	8.6	8.5	8.7	8.5
Feeding	✓	✓	✓	✓	✓	✓	✓
Analyst	KM LS	WP	KH	KH	JL	KH	Rm

Feed 3.5ml YCT

Replicate	A	B	C	D	E
# Surviving	~~7~~ 10 (WE Rm 2010Oct01)	10	8	7	9
Analyst	RM	RM	Rm	Rm	Rm

Date	Replicate	Comments	Analyst
2010Sept18	all	cloudy	Rm

M.Gray 2010 Oct 18

FORM:1602F4V1
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Maxxam

Hyalella azteca Canada Survival and Growth Test
Measurement and Survival Data Sheet

Sample ID: AZ102 (SP-NI)
Sample Date: ~~2010Sept01~~ Aug22 (2010Sep20 SUE)
Sample Received: 2010Sept03

Start Date: 2010Sept17
End Date: 2010Oct01
Sample #: W72036-01

Measurements						Samples Taken			
pH		Hardness (mg/L $CaCO_3$)		Conductance (µS/cm)		Alkalinity (mg/L $CaCO_3$)		Ammonia (mg/L)	
Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
8.0	7.6	108	72	332	305	39	33	0.07	4.8

Initial overlying WQ measurements:	
Analyst KM Rm	Date 2010Sep17

Final overlying WQ measurements:	
Analyst RM	Date 2010Oct01

Day	Friday Day 0	Monday Day 3	Wednesday Day 5	Friday Day 7	Monday Day 10	Wednesday Day 12	Friday Day 14
Temp. (°C)	22.7	22.1	22.3	22.5	22.8	22.5	22.5
D.O. (mg/L)	8.6	8.5	8.5	8.5	8.5 ~~8.0~~ ①	8.6	8.6
Feeding	✓	✓	✓	✓	✓	✓	✓
Analyst	KM LS	WP	KF	KF	JL	KF	Rm

Feed 3.5ml YCT

① 2010 Sep 27 W.E JL

Replicate	A	B	C	D	E
# Surviving	10	9	7	9	10
Analyst	MG	MG	MG	MG	MG

Date	Replicate	Comments	Analyst

M.Gy 2010 Oct 18

FORM:1602F4V1
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Maxxam

***Hyalella azteca* Canada Survival and Growth Test**
Measurement and Survival Data Sheet

Sample ID: AZ 103 (INUG)
Sample Date: 2010Aug25
Sample Received: 2010Sept03
Start Date: 2010Sept17
End Date: 2010Oct01
Sample #: W72037-01

Measurements						Samples Taken			
pH		Hardness (mg/L $CaCO_3$)		Conductance (µS/cm)		Alkalinity (mg/L $CaCO_3$)		Ammonia (mg/L)	
Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
7.7	7.4	100	60	323	293	✓ 31	23	✓ 0.06	5.0

Initial overlying WQ measurements:	
Analyst KM Rm	Date 2010Sept17

Final overlying WQ measurements:	
Analyst Rm	Date 2010Oct01

Day	Friday Day 0	Monday Day 3	Wednesday Day 5	Friday Day 7	Monday Day 10	Wednesday Day 12	Friday Day 14
Temp. (°C)	22.8	21.8	22.4	22.4	22.8	22.4	22.5
D.O. (mg/L)	8.6	8.6	8.6	8.7	8.5	8.6	8.6
Feeding	✓	✓	✓	✓	JL	✓	✓
Analyst	KM LS	WP	KT	KT	JL	KT	Rm

Feed 3.5mL YCT

Replicate	A	B	C	D	E
# Surviving	10	10	10	10	10
Analyst	MG	MG	MG	MG	MG

Date	Replicate	Comments	Analyst
~~2010Sept18~~	~~D~~	~~One emerged.~~ 2010Sept18-WE Rm	Rm

M. Gay 2010 Oct 18

Maxxam

Hyalella azteca Canada Survival and Growth Test
Measurement and Survival Data Sheet

Sample ID: AZ104 (TEFF)
Sample Date: 2010Aug27
Sample Received: 2010Sept03

Start Date: 2010Sept17
End Date: 2010Oct01
Sample #: W72038-01

Measurements						Samples Taken			
pH		Hardness (mg/L $CaCO_3$)		Conductance (µS/cm)		Alkalinity (mg/L $CaCO_3$)		Ammonia (mg/L)	
Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
7.6	7.5	104	64	324	282	✓34	32	✓<0.05	4.4

Initial overlying WQ measurements:	
Analyst KM Rm	Date 2010Sep17

Final overlying WQ measurements:	
Analyst Rm	Date 2010Oct01

Day	Friday Day 0	Monday Day 3	Wednesday Day 5	Friday Day 7	Monday Day 10	Wednesday Day 12	Friday Day 14
Temp. (°C)	22.9	22.1	22.3	22.3	22.7	22.3	22.6
D.O. (mg/L)	8.6	8.5	8.6	8.7	8.6	8.7	8.6
Feeding	✓	✓	✓	✓	✓	✓	—
Analyst	KM 15	NP	KF	KF	JL	KF	Rm

Feed 3.5mL YCT

Replicate	A	B	C	D	E
# Surviving	6	9	10	10	9
Analyst	Rm	Rm	MG	MG	MG

Date	Replicate	Comments	Analyst
~~2010Sep18~~	~~104-C~~	~~One dead - floating~~ WE Rm 2010Sept18	Rm

M.Gay 2010Oct18

Maxxam

Hyalella Survival Growth Test
Aeration Checks

Client # & Name: #4954 Azimuth   Start Date: 2010 Sept 17

Initial when aeration is checked. If air is off record DO and note which replicate(s) in comments section.

	Day -1	Day 0	1	2	3	4	5	6
Date	2010 Sept 16	2010 Sept 17	2010 Sept 18	2010 Sept 19	2010 SEP 20	2010 Sep 21	2010 Sep 22	2010 Sep 23
Early AM	n/a	LS	RM	DJ	WP	WP	Kt	Kt
Mid-day	(A) ~~Rm~~ n/a	LS	RM	DJ	WP	Kt	Kt	Kt
Late PM	Rm	LS	RM	DJ	WP	Kt	Kt	Kt

	Day 7	8	9	10	11	12	13	14
Date	2010 Sep 24	2010 Sep 25	2010 Sep 26	2010 Sep 27	2010 Sep 28	2010 Sep 29	2010 Sept 30	2010 Oct 01
Early AM	Kt	DJ	DJ	SZ	Kt	Kt	DL	MG
Mid-day	Kt	DJ	DJ	MG	KM	Kt	DL	~~MG 2010 Oct 01~~
Late PM	Kt	DJ	DJ	MG	Kt	Kt	AB	

Comments:

(A) CWE Rm 2010 Sept 18

~~LStaw AP 2010 Oct 04~~

FORM:1602F2V1
2006/11/01

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Randomization Chart for *Hyalella* Tests

Position Map

	Back Wall				
	6	12	18	24	30
	5	11	17	23	29
	4	10	16	22	28
	3	9	15	21	27
	2	8	14	20	26
	1	7	13	19	25
	Front of Counter				

Position #	Colour Code	Treatment	Replicate
30	Red	Control	A
18	Red	Control	B
15	Red	Control	C
2	Red	Control	D
1	Red	Control	E
11	Red	Control	Measure
9	Green	AZ101	A
22	Green	AZ101	B
28	Green	AZ101	C
6	Green	AZ101	D
16	Green	AZ101	E
21	Green	AZ101	Measure
29	Blue	AZ102	A
3	Blue	AZ102	B
10	Blue	AZ102	C
12	Blue	AZ102	D
23	Blue	AZ102	E
24	Blue	AZ102	Measure
20	Yellow	AZ103	A
27	Yellow	AZ103	B
4	Yellow	AZ103	C
14	Yellow	AZ103	D
26	Yellow	AZ103	E
19	Yellow	AZ103	Measure
25	Orange	AZ104	A
5	Orange	AZ104	B
7	Orange	AZ104	C
13	Orange	AZ104	D
8	Orange	AZ104	E
17	Orange	AZ104	Measure

LIST OF APPENDICES

APPENDIX

A SAMPLE INFORMATION

Chain of Custody Forms

Supporting Sample Information

Client: AZIMUTH CONSULTING GROUP
218 - 2902 WEST BROADWAY
VANCOUVER BC
CANADA V6K 2G8

Inv Attn: Gary Mann

Task Order:
Line Item:

Printed: 2010/09/13 Version 5
Reception Date: 2010/09/03
Reception Time: 08:25
Login Date: 2010/09/03
REQUIRED DATE: 2010/09/13, 18:00
Quote Number: A90744

Report: same

Attention: Gary Mann
PHONE: (604) 730 - 1220Ext:
FAX: (604) 739 - 8511
EMAIL: gmann@azimuthgroup.ca

P.O. Number:
PROJECT NUMBER:
AEM-10-02.2 MEADOWBANK EAS
Site Location:
Site #:
Client Number: 4954
Rpt Address #:
Q.C. Samples: No

Project Coordinator: RM1

Accounting Information
Desc. Code

Report Copies

Attention	# cop. Fax	EMAIL
Maggie McConnell	1	mmcconnell@azimuthgroup.ca

Maxxam Number	Client Sample ID/Report ID	Cont's	Store Code	Recd. OK	Sampling Date	MATRIX	Test Codes
W72035-01R	SP-TRB-2 SP-TRB-2	1-4PAL	N/A-VBG-0	Yes	2010/08/22	SED	CHIROV-SD, DISPOSAL, ECOATTACHS HYALELV-SD
W72035-02R	SP-TRB-2 SP-TRB-2	1-120P	N/A-VBG-0	Yes	2010/08/22	SED	ARCHIVE, SUB2002
W72035-03R	SP-TRB-2 SP-TRB-2	1-120P	N/A-VBG-0	Yes	2010/08/22	SED	ARCHIVE2
W72036-01R	SP-N1 SP-N1	1-4PAL	N/A-VBG-0	Yes	2010/08/22	SED	CHIROV-SD, DISPOSAL, ECOATTACHS HYALELV-SD
W72036-02R	SP-N1 SP-N1	1-120P	N/A-VBG-0	Yes	2010/08/22	SED	ARCHIVE
W72036-03R	SP-N1 SP-N1	1-120P	N/A-VBG-0	Yes	2010/08/22	SED	ARCHIVE2
W72037-01R	INUG INUG	1-4PAL	N/A-VBG-0	Yes	2010/08/25	SED	CHIROV-SD, DISPOSAL, ECOATTACHS HYALELV-SD
W72037-02R	INUG INUG	1-120P	N/A-VBG-0	Yes	2010/08/25	SED	ARCHIVE
W72037-03R	INUG INUG	1-120P	N/A-VBG-0	Yes	2010/08/25	SED	ARCHIVE2
W72038-01R	TEFF TEFF	1-4PAL	N/A-VBG-0	Yes	2010/08/27	SED	CHIROV-SD, DISPOSAL, ECOATTACHS HYALELV-SD
W72038-02R	TEFF TEFF	1-120P	N/A-VBG-0	Yes	2010/08/27	SED	ARCHIVE
W72038-03R	TEFF TEFF	1-120P	N/A-VBG-0	Yes	2010/08/27	SED	ARCHIVE2

Remarks: ml4

Quote Remarks:
single metal: $28 - soil

Inspected by: MBO
Date: 2010/09/03
Time: 17:47

Approved by: ML4
Date: 2010/09/08
Time: 14:57

Date of Sample Disposal:
Disposal by:

Maxxam Analytics Inc

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Ph: (604) 734-7... x (604) 731-2386, Toll Free: (800) 665-8566

COC# B086482

ANALYTICAL REQUEST FORM

Invoice To: Require Report? Yes [x] No [ ]

Company Name:	Azimuth Consulting Group Inc.
Contact Name:	Gary Mann & Maggie McConnell
Address:	218-2902 W. Broadway
	Vancouver, BC PC: V2K 2G8
Phone / Fax#:	Ph: 804.730.1220 Fax:

Report To: same as invoice

PC:

Ph: Fax:

PO# / AFE#:	
Quotation #:	
Project #:	AEM-10-02.2
Proj. Name:	Meadowbank EAS
Location:	Meadowbank Mine, Nunavut
Sampler's Initials:	

REGULATORY REQUIREMENTS:

- [ ] CSR
- [ ] CCME
- [ ] CCME FWAL
- [ ] PST
- [ ] CDWQG
- [ ] G50

REPORT DISTRIBUTION:

- [ ] Mail
- [ ] Fax
- [x] PDF
- [x] Excel
- [ ] Other
- [x] Email: mmcconnell@azimuthgroup.ca, gmann@azimuthgroup.ca

SERVICE REQUESTED:

- [ ] RUSH (Please ensure you contact the lab)
  Date Required:
- [x] REGULAR Turnaround

METALS: (WATERS)

- [ ] Total
- [ ] Extractable
- [ ] Dissolved

ANALYSIS REQUESTED (lab use only)

	Sample Identification	Matrix	Date/Time Sampled	Sample Type Grab/Comp	Hold > 60 Days	Sample Container #	Hyalella azteca 14-day	Chironomus tentans 10-d		Sequential Extraction
1	SP-TRB-2	sediment	22-Aug-10	Comp.Sed Grabs		3	X	X		X
2	SP-N1	sediment	22-Aug-10	Comp.Sed Grabs		3	X	X		X
3	INUG	sediment	25-Aug-10	Comp.Sed Grabs		3	X	X		X
4	TEFF	sediment	27-Aug-10	Comp.Sed Grabs		3	X	X		X
5										
6										
7										
8										
9										
10										
11										
12										

** For water samples: please indicate if sample container has been preserved (P) and/or filtered (F).

Relinquished By: Maggie McConnell

Signature:

Date/Time: Aug 29, 2010

Received: Nick Sandor Sept 3/10 @ 8:25 Temp 12/12/13 10/10/10

Temperature:

COMMENTS/SPECIAL INSTRUCTIONS:

1. 4-L containers for toxicity testing. Contact Curtis Eickhoff if you have any questions
2. 125-ml jars are for sequential extraction analysis. Contact Tim O'Hearn.

08321919

Maxxam

Sediment Sample Descriptions

Client # / Name: #4954 Azimuth **Project #:** 2-11-691

Maxxam Sample Name	Sample #	Client Sample Name	Date Homogenised / Subsampled	Grain Size & Colour	Type of Debris Removed	Endemic Animals Removed	Odour	Centrifuged for porewater? Y/N	Purged with N_2?	Analyst
AZ101	WEMG-2010 Sept 16 ~~W72035~~ W72035	~~A~~ WEMG-2010 Sept 16 SP-TRB-2	2010 Sept 16	clay - grey	none	few chironomids + oligochaetes	none	Y	Y	MG
AZ102	W72036	SP-N1	2010 Sept 16	Grey silt/clay.	none	none	none	Y	Y	Rm
AZ103	W72037	INUG	2010 Sep 16	Brown silt/clay	none	chironomids sieved	none	yes	yes	KT
AZ104	W72038	TEFF	2010 Sept 16	Brown silt/mud	none	none	none	Y	Y	Rm

Maxxam

Freshwater Sediment Tests
Porewater Measurements

Client # & Name: #4954 Azimuth Date Measured: 2010 SEP 16

Method for Porewater Collection:

Sample ID	Temperature (°C)	pH	Ammonia Sample?	Analyst
Control		7.8	✓	UP
AZ101		8.0	✓	UP
AZ102		7.8	✓	UP
AZ103		7.1	✓	UP
AZ104		7.0	✓	UP

Comments

APPENDIX

B CHIRONOMID CULTURE DATA

Organism History

Head Capsule Width Measurements

Acclimation and Holding Conditions Record

Water Preparation Data Sheets

Reference Toxicant Control Chart

AB100915CT
Ustawoff

1300 Blue Spruce Drive, Suite C
Fort Collins, Colorado 80524

AQUATIC BIO SYSTEMS ABS INC.

Toll Free: 800/331-5916
Tel:970/484-5091 Fax:970/484-2514

ORGANISM HISTORY

DATE: 9/14/10

SPECIES: *Chironomus dilutus (formerly C. tentans)*

AGE: Deposited on 9/3/2010

LIFE STAGE: Second Instar 9/14/2010

HATCH DATE: Emergent date 9/27/2010

BEGAN FEEDING: Immediately

FOOD: *Selenastrum* sp., Flake slurry

Water Chemistry Record:	**Current**	**Range**
TEMPERATURE:	25°C	22-26°C
SALINITY/CONDUCTIVITY:	--	--
TOTAL HARDNESS (as $CaCO_3$):	150 mg/l	100-190 mg/l
TOTAL ALKALINITY (as $CaCO_3$):	75 mg/l	50-110 mg/l
pH:	7.78	7.53-8.31

Comments:

Facility Supervisor

Maxxam

Chironomus tentans
Measurements of Head Capsule Widths

Client # & Name: #4954 Azimuth

Start Date and Time: 2010 Sept 17 @ 17:38

End Date: 2010 Sept 27

Organism Lot #: AB100915CT

Head Widths at Beginning of Test

Chironomid #	Head Width (um)	Head Width (mm)
1	358	0.36
2	333	0.33
3	394	0.39
4	393	0.39
5	364	0.36
6	621	0.62
7	610	0.61
8	618	0.62
9	603	0.60
10	652	0.65
11	624	0.62
12	663	0.66
13	589	0.59
14	567	0.57
15	684	0.68
16	661	0.66
17	530	0.53
18	377	0.38
19	552	0.55
20	362	0.36
Average	528	0.53
SD	125.7	0.13
Analyst	MB	

Average must be 0.33-0.45 mm (Environment Canada 1998)

Note: Head widths were measured using Motic camera attached to a microscope. Measured widths are in um

Maxxam

Chironomus tentans
Measurements of Head Capsule Widths

Client # & Name: #4954 Azimuth

Start Date and Time: 2010Sept 17 @1738

End Date: 2010Sept27

Organism Lot #: AB100915CT

Head Widths at Beginning of Test

Chironomid #	(A) Head Width ~~(Micrometer)~~	Head Width (mm)
1	358	
2	333	
3	394	
4	393	
5	364	
6	621	
7	610	
8	618	
9	603	
10	652	
11	624	
12	663	
13	589	
14	567	
15	684	
16	661	
17	530	
18	377	
19	552	
20	362	
Average	#DIV/0!	#DIV/0!
SD	#DIV/0!	#DIV/0!
Analyst	WB	

Average must be 0.33-0.45 mm (Environment Canada 1998)

(A) ~~1 mm=40 units on micrometer~~

(A) Measured in microns w Motic camera
WB 2010 Sep 17

ECOTOXICOLOGY
ACCLIMATION AND HOLDING CONDITIONS

Maxxam

Organism: Chironomus tentans
Organism Lot #:
Supplier: ABS
Customer #: #4954
Arrival Date & Time:
Age upon Arrival:
 # Ordered: 630
Study/Project # : 2-11-691

Arrival Conditions

Bag ID	# Dead	# Inactive	Salinity (‰) OR Conductivity (µS/cm)	Temperature (°C)	pH	DO (mg/L)	Feeding	Analyst
1 / 2			375 / 379	23.8 / 23.7	6.6 / 6.6	10.7 / 10.8	✓	WO
3			378	23.7	6.6	8.5		

Container ID:

Daily Conditions During Holding/Acclimation

	Observations		Water Quality					
Date	# Dead	# Inactive	Salinity (‰) OR Conductivity (µS/cm)	Temperature (°C)	pH	DO (mg/L)	Feeding	Analyst
2010Sep16	0	0	366	23.9	7.5	7.4	✓	KT

Comments (e.g., feeding times and quantities, behaviour, acclimation conditions):	Analyst	Date
2010Sep16 - 50% H2O Δ @ 10:15 Fed 10ml Tetramin©	KT	2010Sep16

Revision: 01
Revision Date: March 25, 2010
Document Control Number: 80-F-089-01

Form approved by: Janet Pickard
Effective date: Apr 01, 2010

ECOTOXICOLOGY
ACCLIMATION AND HOLDING CONDITIONS

Maxxam

Organism: Chironomus tentans
Organism Lot #:
Supplier: ABS
Customer #: #4954
Arrival Date & Time:
Age upon Arrival:
 # Ordered: 630
Study/Project # : 2-1-691

Arrival Conditions

Bag ID	# Dead	# Inactive	Salinity (‰) OR Conductivity (µS/cm)	Temperature (°C)	pH	DO (mg/L)	Feeding	Analyst
4/5			381/389	23.9/23.8	6.5/6.5	12.4/10.3	✓	LP

Container ID:

Daily Conditions During Holding/Acclimation

	Observations		Water Quality					
Date	# Dead	# Inactive	Salinity (‰) OR Conductivity (µS/cm)	Temperature (°C)	pH	DO (mg/L)	Feeding	Analyst
2010Sep16	0	0	366	23.4	7.4	6.6		Kt
2010Sep17	6	13	n/a	n/a	n/a	n/a	n/a	KM

Comments (e.g., feeding times and quantities, behaviour, acclimation conditions):	Analyst	Date
2010Sep16 - 50% H2OΔ @ 10:15 Fed 10ml tetramin @	Kt	2010Sep16

Revision: 01
Revision Date: March 25, 2010
Document Control Number: 80-F-089-01

Form approved by: Janet Pickard
Effective date: Apr 01, 2010

Maxxam

BATCH ID : 2010 SEP 13
(Date Hardened)

Chironomus tentans **H_2O Hardness Adjustment (Environment Canada 1997)**
(For water hardness 90 - 100 mg/L)

Chemical Weights	$CaCl_2X2H_2O$	$MgSO_4$ (g)	$CaSO_4$ (g)	$NaHCO_3$ (g)	KCl (g)
Brand	EMD	EMD	EMD	EMD	EMD
Lot #	47171751	48317907	48226934	2260C307	48221842
Calculated	3.98	1.80	3.00	5.76	0.24
Actual	3.9808	1.8002	3.0001	5.7660	0.2400

Balance: 3536

Analyst: K. Pomeroy

Date: 2010 SEP 13

Add to 60 litres DI water

Water Use: #4954 Azimuth (i.e. Client #, Ref Tox, Holding, etc...)

Date Hardened: 2010 SEP 13 Analyst: K. Pomeroy

Water Quality:

Temp: 23.2 pH: 7.8 Hardness 96

Cond.: 363 DO: 8.5 Alkalinity: ______

Analyst: K. Tamaki Date: 2010SEP16

Comments:

NaHCO3 (Sodium Bicarbonate)

CaSO4 (Calcium Sulfate - anhydrous)

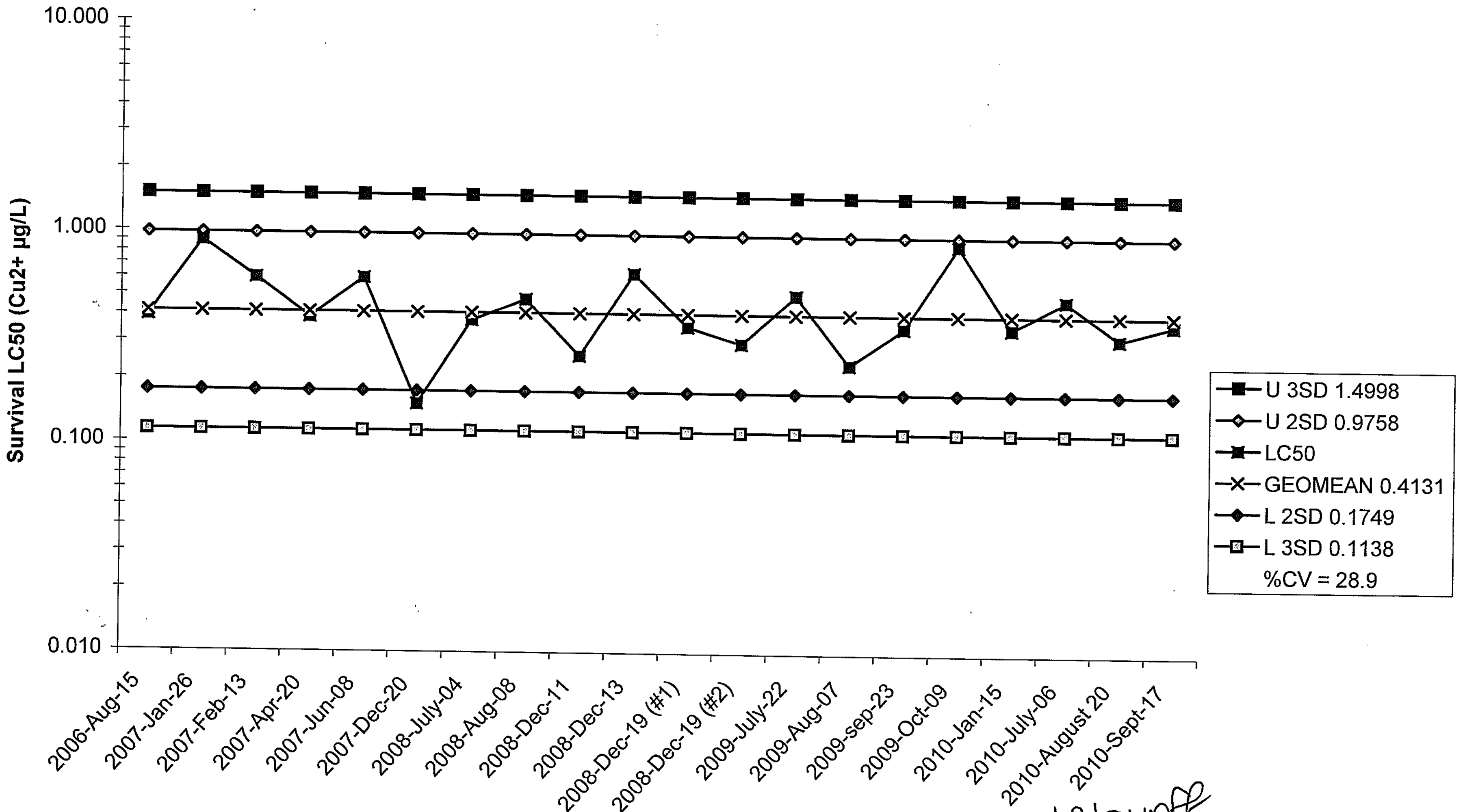
CaCl2 x 2H2O (Calcium Chloride - dihydrous)

MgSO4 (Magnesium Sulfate - anhydrous)

KCl (Potassium Chloride)

Maxxam

Chironomus tentans
96 hour Reference Toxicant Control Chart for Copper



LStavroff
2010Sept22

APPENDIX

C *HYALELLA* CULTURE DATA

Organism History

Acclimation and Holding Conditions Record

Water Preparation Data Sheets

Reference Toxicant Control Chart

1300 Blue Spruce Drive, Suite C
Fort Collins, Colorado 80524

AQUATIC BIO SYSTEMS ABS INC.

AB100915HA
LStdwoff

Toll Free: 800/331-5916
Tel: 970/484-5091 Fax:970/484-2514

ORGANISM HISTORY

DATE:	9/14/2010
SPECIES:	*Hyalella azteca*
AGE:	4-6 day
LIFE STAGE:	Juvenile
HATCH DATE:	Variable
BEGAN FEEDING:	Immediately
FOOD:	Flake slurry

Water Chemistry Record:	Current	Range
TEMPERATURE:	25°C	22-25°C
SALINITY/CONDUCTIVITY:	--	--
TOTAL HARDNESS (as $CaCO_3$):	100 mg/l	100-204 mg/l
TOTAL ALKALINITY (as $CaCO_3$):	75 mg/l	50-100 mg/l
pH:	7.81	7.26-8.26

Comments:

Facility Supervisor

ECOTOXICOLOGY
ACCLIMATION AND HOLDING CONDITIONS

Maxxam

Organism: Hyalella azteca
Organism Lot #: AB100915HA
Supplier: ABS
Customer #: #4954, #11233, #4388
Arrival Date & Time: 2010Sept15@10:30
Age upon Arrival: 5-7days
 # Ordered: 1900
Study/Project # : Various

Arrival Conditions

Bag ID	# Dead	# Inactive	Salinity (‰) OR Conductivity (µS/cm)	Temperature (°C)	pH	DO (mg/L)	Feeding	Analyst
6/7	0	0	731 / 728	23.7 / 23.6	7.7/7.7	7.8/7.6	✓	KP

Container ID: Pan A

Daily Conditions During Holding/Acclimation

	Observations		Water Quality					
Date	# Dead	# Inactive	Salinity (‰) OR Conductivity (µS/cm)	Temperature (°C)	pH	DO (mg/L)	Feeding	Analyst
2010Sep16	0	0	738	23.9	8.2	8.1	✓	Kt

LStauffer 2010Sept22

Comments (e.g., feeding times and quantities, behaviour, acclimation conditions):	Analyst	Date
50% H2O Δ @ 11:26 Fed 5ml tetramin +	Kt	2010Sep16
5ml YCT @ 11:30	Kt	2010Sep16

LStauffer 2010Sept22

Revision: 01
Revision Date: March 25, 2010
Document Control Number: 80-F-089-01

Form approved by: Janet Pickard
Effective date: Apr 01, 2010

ECOTOXICOLOGY
ACCLIMATION AND HOLDING CONDITIONS

Maxxam

Organism: Hyalella azteca
Organism Lot #: AB100915HA
Supplier: ABS
Customer #: #4954, #11233, #4388

Arrival Date & Time: 2010Sept15@10:30
Age upon Arrival: 5-7 days
Ordered: 1900
Study/Project # : Various

Arrival Conditions

Bag ID	# Dead	# Inactive	Salinity (‰) OR Conductivity (µS/cm)	Temperature (°C)	pH	DO (mg/L)	Feeding	Analyst
8/9	0	0	738/748	23.6/23.7	7.7/7.7	7.6/7.7	/	KP

Container ID: Pan B

Daily Conditions During Holding/Acclimation

Date	Observations: # Dead	Observations: # Inactive	Water Quality: Salinity (‰) OR Conductivity (µS/cm)	Water Quality: Temperature (°C)	Water Quality: pH	Water Quality: DO (mg/L)	Water Quality: Feeding	Analyst
2010Sept16	0	0	754	23.6	8.2	8.2	✓	KT

(crossed out) LStauoff 2010Sept22

Comments (e.g., feeding times and quantities, behaviour, acclimation conditions):	Analyst	Date
50% H2OΔ @11:26. Fed 5ml YCT+5ml	KT	2010Sept16
tetramin @ 11:30	KT	2010Sept16

(crossed out) LStauoff 2010Sept22

Revision: 01
Revision Date: March 25, 2010
Document Control Number: 80-F-089-01

Form approved by: Janet Pickard
Effective date: Apr 01, 2010

BATCH ID: 2010 SEP 13
(Date Hardened)

Maxxam

SAM-5S Reconstituted Water Recipe for *Hyalella azteca* as per Borgmann 1996
(For water hardness ~125 mg/L)

Chemical Weights	$CaCl_2X2H_2O$	$MgSO_4$ (g)	NaBr (g)	$NaHCO_3$ (g)	KCl (g)
Brand	EMD	EMD	EMD	EMD	EMD
Lot #	47171751	48317907	47355846	2260C307	48221842
Calculated	8.82	1.81	0.06	5.04	0.22
Actual	8.8208	1.8102	0.0602	5.0399	0.2204

Balance: 3536

Analyst: K. Pomeroy

Date: 2010 SEP 13

Add to Type 2 DI (L): 60

Water Use: 4954, 11233, 4388, RT (i.e., Client #, Ref Tox, Holding, etc...)

Date Hardened: 2010 SEP 13 Analyst: K. Pomeroy

Water Quality:

Temp: 23.7 pH: 7.6 Hardness ~~80~~ 122 LS we 2010Sep17

Cond.: 397 DO: 8.3 Alkalinity:

Analyst: KiTamaki Date: 2010Sep16

Comments:

NaHCO3 (Sodium Bicarbonate)

NaBr (Sodium Bromide)

CaCl2 x 2H2O (Calcium Chloride - dihydrous)

MgSO4 (Magnesium Sulfate - anhydrous)

KCl (Potassium Chloride)

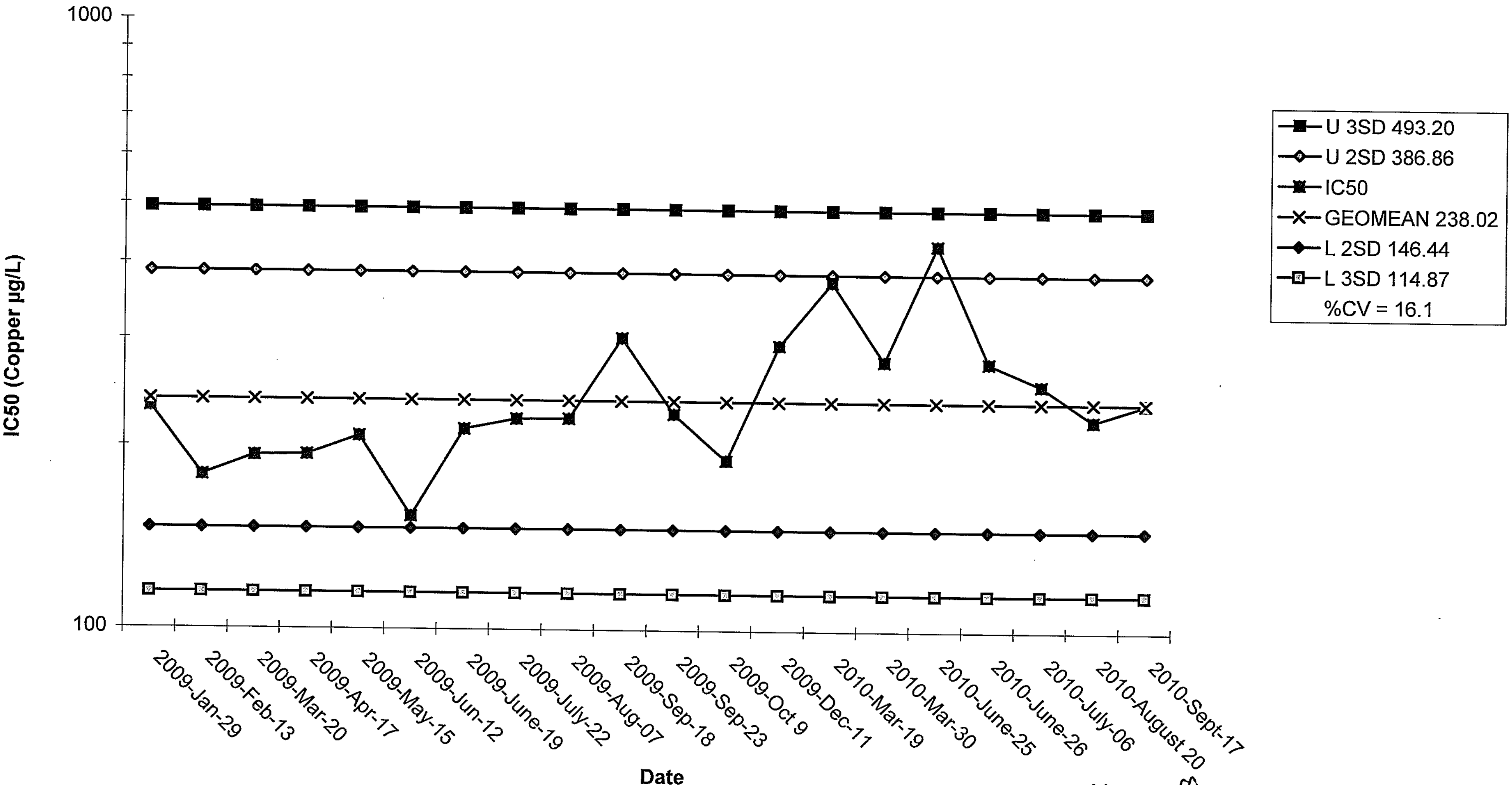
SAM-5S Recipe = 1 mM CaCl2, 1 mM NaHCO3, 0.01 mM NaBr, 0.05 mM KCl, and 0.25 mM MgSO4

Borgmann, U. 1996. Systematic analysis of aqueous ion requirements of *Hyalella azteca*: A standard artificial medium including the essential bromide ion. *Archives of Environmental Contamination and Toxicology*. 30: 356-363.

Maxxam

Hyalella azteca

Control Chart for 96 Hour Water Only Reference Toxicant Test using Cu^{2+}



LStaurroff
2010Sept22

APPENDIX

D SEDIMENT TEST CHEMISTRY

Sediment Chemistry and Physical Analyses

Sediment Porewater Chemistry

Day 0 Chironomid Test Overlying Water

Day 10 Chironomid Test Overlying Water

Day 0 *Hyalella* Test Overlying Water

Day 14 *Hyalella* Test Overlying Water

Maxxam Job #: B087774
Report Date: 2010/10/05

Maxxam Analytics (TOX Internal)
Client Project #: 2-11-691 HY+CH SEDS (AZIMUTH)

Sediment Chemistry p.1

RESULTS OF CHEMICAL ANALYSES OF SEDIMENT

Maxxam ID		X04085	X04086	X04087	X04088	X04089	
Sampling Date		2010/09/16	2010/09/16	2010/09/16	2010/09/16	2010/09/16	
COC#		G035559	G035559	G035559	G035559	G035559	
	Units	**CONTROL SEDIMENT**	**AZ101 SEDIMENT**	**AZ102 SEDIMENT**	**AZ103 SEDIMENT**	**AZ104 SEDIMENT**	**RDL**
Physical Properties							
Texture	N/A	SAND	SILT LOAM	CLAY LOAM	SILTY CLAY	CLAY	N/A

PARTICLE SIZE DISTRIBUTION ANALYSIS (SEDIMENT)

Maxxam ID		X04085	X04086	X04087	X04088	X04089	
Sampling Date		2010/09/16	2010/09/16	2010/09/16	2010/09/16	2010/09/16	
COC#		G035559	G035559	G035559	G035559	G035559	
	Units	**CONTROL SEDIMENT**	**AZ101 SEDIMENT**	**AZ102 SEDIMENT**	**AZ103 SEDIMENT**	**AZ104 SEDIMENT**	**RDL**
Percent Passing							
<0.002mm Pipette	%	2.41	13.99	33.72	41.87	53.70	0.01
<0.053mm Pipette	%	2.29	98.76	72.72	84.72	92.63	0.01
<0.125mm, Sieve #120	%	9.01	99.69	76.37	94.95	98.57	0.01
<0.250mm, Sieve #60	%	99.26	99.92	81.37	97.79	99.57	0.01
<2.00mm, Sieve #10	%	100.0	100.0	97.14	100.0	100.0	0.01
Percent of Entire Sample							
<0.002mm	%	2.41	13.99	33.72	41.87	53.70	0.01
<0.053mm & >0.002mm	%	<0.01	84.78	39.00	42.85	38.93	0.01
<2.00mm & >0.053mm	%	97.71	1.24	24.42	15.28	7.37	0.01
>2.00mm	%	<0.01	<0.01	2.86	<0.01	<0.01	0.01
% of the <2mm Fraction							
% Clay <0.002mm	%	2.41	13.99	34.71	41.87	53.70	0.01
% Sand <2.00mm & >0.053mm	%	97.71	1.24	25.14	15.28	7.37	0.01
% Silt <0.053mm & >0.002mm	%	<0.01	84.78	40.15	42.85	38.93	0.01

N/A = Not Applicable
RDL = Reportable Detection Limit

Maxxam Job #: B087774
Report Date: 2010/10/05

Maxxam Analytics (TOX Internal)
Client Project #: 2-11-691 HY+CH SEDS (AZIMUTH)

MISCELLANEOUS (SEDIMENT)

Maxxam ID		X04085	X04086	X04087	X04088	X04089	
Sampling Date		2010/09/16	2010/09/16	2010/09/16	2010/09/16	2010/09/16	
COC#		G035559	G035559	G035559	G035559	G035559	
	Units	**CONTROL SEDIMENT**	**AZ101 SEDIMENT**	**AZ102 SEDIMENT**	**AZ103 SEDIMENT**	**AZ104 SEDIMENT**	**RDL**
Misc. Inorganics							
Total Organic Carbon (C)	%	0.13	0.51	1.9	2.6	2.5	0.02

Sediment Chemistry p-2

RDL = Reportable Detection Limit

Maxxam Job #: B087317
Report Date: 2010/09/24

Maxxam Analytics (TOX Internal)
Client Project #: 2-11-691
Site Reference: HY + CH SED(AZIMUTH)POREWATER

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		X01943	X01944	X01945	X01946	X01947	
Sampling Date		2010/09/16	2010/09/16	2010/09/16	2010/09/16	2010/09/16	
COC#		G035560	G035560	G035560	G035560	G035560	
	Units	**CONTROL POREWATER**	**AZ101**	**AZ102**	**AZ103**	**AZ104**	**RDL**
MISCELLANEOUS							
Sulphide	mg/L	<0.005	0.007	0.006	0.010	0.007	0.005
Nutrients							
Ammonia (N)	mg/L	0.20(1)	1.6	0.26(1)	0.26(1)	0.22(1)	0.05

Sediment Porewater

RDL = Reportable Detection Limit
(1) - RDL raised due to sample matrix interference.

Maxxam Job #: B088206
Report Date: 2010/09/24

Maxxam Analytics (TOX Internal)
Client Project #: 2-11-691
Site Reference: CHRON DAY 0 (AZIMUTH SEDS)

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		X06739	X06740	X06741	X06742	X06743	
Sampling Date		2010/09/17	2010/09/17	2010/09/17	2010/09/17	2010/09/17	
COC#		G035562	G035562	G035562	G035562	G035562	
	Units	**CRTL OVERLY H20 DAY 0**	**AZ101 OVERLY H20 DAY 0**	**AZ102 OVERLY H20 DAY 0**	**AZ103 OVERLY H20 DAY 0**	**AZ104 OVERLY H20 DAY 0**	**RDL**
Misc. Inorganics							
Alkalinity (Total as CaCO3)	mg/L	64	82	43	38	39	0.5
Alkalinity (PP as CaCO3)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Bicarbonate (HCO3)	mg/L	78	100	53	46	47	0.5
Carbonate (CO3)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Nutrients							
Ammonia (N)	mg/L	<0.05(1)	0.18(1)	0.06(1)	<0.05(1)	0.13(1)	0.05

Chironomids - Day 0 overlying test water

RDL = Reportable Detection Limit
(1) - RDL raised due to sample matrix interference.

Maxxam Job #: B092237
Report Date: 2010/10/01

Maxxam Analytics (TOX Internal)
Client Project #: 2-11-691 CHIR DAY 10 (AZ. SEDS

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		X25503		X25504		X25505	X25506	X25507	
Sampling Date		2010/09/27		2010/09/27		2010/09/27	2010/09/27	2010/09/27	
COC#		G035563		G035563		G035563	G035563	G035563	
	Units	**CTRL OVERLY H2O DAY 10**	**RDL**	**AZ101 OVERLY H2O DAY 10**	**RDL**	**AZ102 OVERLY H2O DAY 10**	**AZ103 OVERLY H2O DAY 10**	**AZ104 OVERLY H2O DAY 10**	**RDL**
Misc. Inorganics									
Alkalinity (Total as CaCO3)	mg/L	120	0.5	130	0.5	35	22	56	0.5
Alkalinity (PP as CaCO3)	mg/L	<0.5	0.5	<0.5	0.5	<0.5	<0.5	<0.5	0.5
Bicarbonate (HCO3)	mg/L	150	0.5	160	0.5	42	27	69	0.5
Carbonate (CO3)	mg/L	<0.5	0.5	<0.5	0.5	<0.5	<0.5	<0.5	0.5
Hydroxide (OH)	mg/L	<0.5	0.5	<0.5	0.5	<0.5	<0.5	<0.5	0.5
Nutrients									
Ammonia (N)	mg/L	6.8	0.1	2.7	0.05	7.0	6.8	6.9	0.1

Day 10 overlying test water - Chironomids.

RDL = Reportable Detection Limit

Maxxam Job #: B088207
Report Date: 2010/09/24

Maxxam Analytics (TOX Internal)
Client Project #: 2-11-691
Site Reference: HYALELLA DAY 0 (AZIMUTH SEDS)

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		X06744	X06745	X06746	X06747	X06748	
Sampling Date		2010/09/17	2010/09/17	2010/09/17	2010/09/17	2010/09/17	
COC#		G035561	G035561	G035561	G035561	G035561	
	Units	**CRTL OVERLY H20 DAY 0**	**AZ101 OVERLY H20 DAY 0**	**AZ102 OVERLY H20 DAY 0**	**AZ103 OVERLY H20 DAY 0**	**AZ104 OVERLY H20 DAY 0**	**RDL**
Misc. Inorganics							
Alkalinity (Total as CaCO3)	mg/L	60	68	39	31	34	0.5
Alkalinity (PP as CaCO3)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Bicarbonate (HCO3)	mg/L	73	82	47	38	42	0.5
Carbonate (CO3)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Nutrients							
Ammonia (N)	mg/L	<0.05(1)	0.20(1)	0.07(1)	0.06(1)	<0.05(1)	0.05

Hyalella - Day 0 overlying test water.

RDL = Reportable Detection Limit
(1) - RDL raised due to sample matrix interference.

Maxxam Job #: B094477
Report Date: 2010/10/07

Maxxam Analytics (TOX Internal)
Client Project #: 2-11-691 HYALELLA DAY 14 (AZIM

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		X39864		X39865		X39866	X39867	X39868	
Sampling Date		2010/10/01		2010/10/01		2010/10/01	2010/10/01	2010/10/01	
COC#		G035564		G035564		G035564	G035564	G035564	
	Units	**CTRL OVERLY.H2O DAY 14**	**RDL**	**AZ101 OVERLY H2O DAY 14**	**RDL**	**AZ102 OVERLY H2O DAY 14**	**AZ103 OVERLY H2O DAY 14**	**AZ104 OVERLY H2O DAY 14**	**RDL**
Misc. Inorganics									
Alkalinity (Total as CaCO3)	mg/L	78	0.5	110	0.5	33	23	32	0.5
Alkalinity (PP as CaCO3)	mg/L	<0.5	0.5	<0.5	0.5	<0.5	<0.5	<0.5	0.5
Bicarbonate (HCO3)	mg/L	95	0.5	130	0.5	40	28	39	0.5
Carbonate (CO3)	mg/L	<0.5	0.5	<0.5	0.5	<0.5	<0.5	<0.5	0.5
Hydroxide (OH)	mg/L	<0.5	0.5	<0.5	0.5	<0.5	<0.5	<0.5	0.5
Nutrients									
Ammonia (N)	mg/L	0.33	0.005	<0.05(1)	0.05	4.8	5.0	4.4	0.1

Hyalella - Day 14 overlying test water

RDL = Reportable Detection Limit
(1) - RDL raised due to sample matrix interference.

APPENDIX C

SEDIMENT CHEMISTRY LABORATORY DATA ï ALS ENVIRONMENTAL

AZIMUTH CONSULTING GROUP INC.
ATTN: MAGGIE McCONNELL
218 - 2902 WEST BROADWAY
VANCOUVER BC V6K 2G8
Phone: 604-730-1220

Date Received: 03-SEP-10
Report Date: 27-SEP-10 17:10 (MT)
Version: FINAL

Certificate of Analysis

Lab Work Order #: L928158
Project P.O. #: NOT SUBMITTED
Job Reference: MEADOWBANK MINE CREMP
Legal Site Desc:
C of C Numbers:

Natasha Markovic-Mirovic
Account Manager

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	L928158-1	L928158-2	L928158-3	L928158-4	L928158-5
	Sample ID	L928158-1	L928158-2	L928158-3	L928158-4	L928158-5
	Description					
	Sampled Date	23-AUG-10	23-AUG-10	23-AUG-10	24-AUG-10	24-AUG-10
	Sampled Time					
	Client ID	WAL-1	WAL-2	WAL-3	PDL-1	PDL-2
SOIL						
Physical Tests	Moisture (%)	88.4	88.7	89.2	74.1	75.0
	pH (pH)	6.84	6.22	6.33	5.90	5.96
Particle Size	% Gravel (>2mm) (%)	<0.10	<0.10	<0.10	<0.10	<0.10
	% Sand (2.0mm - 0.063mm) (%)	2.57	0.27	1.49	11.4	13.0
	% Silt (0.063mm - 4um) (%)	87.4	95.2	81.9	72.8	74.4
	% Clay (<4um) (%)	10.0	4.56	16.6	15.8	12.6
Organic / Inorganic Carbon	Total Organic Carbon (%)	6.04	8.94	10.1	2.65	2.79
Metals	Aluminum (Al) (mg/kg)	22200	22700	23100	20400	21200
	Antimony (Sb) (mg/kg)	<10	<10	10	<10	<10
	Arsenic (As) (mg/kg)	20.6	29.6	60.5	13.0	12.0
	Barium (Ba) (mg/kg)	115	140	121	82.5	92.8
	Beryllium (Be) (mg/kg)	1.66	1.66	1.74	1.02	1.03
	Cadmium (Cd) (mg/kg)	0.66	1.47	1.74	<0.50	<0.50
	Chromium (Cr) (mg/kg)	61.4	62.5	63.8	135	138
	Cobalt (Co) (mg/kg)	9.4	11.5	10.0	10.9	11.5
	Copper (Cu) (mg/kg)	163	163	190	51.4	50.7
	Lead (Pb) (mg/kg)	38	40	40	<30	<30
	Mercury (Hg) (mg/kg)	0.0384	0.0612	0.0672	0.0098	0.0099
	Molybdenum (Mo) (mg/kg)	7.2	7.9	13.1	<4.0	<4.0
	Nickel (Ni) (mg/kg)	57.4	55.6	53.7	81.6	90.9
	Selenium (Se) (mg/kg)	<2.4 DLM	<2.0	<2.0	<2.0	<2.0
	Silver (Ag) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Thallium (Tl) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Tin (Sn) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Uranium (U) (mg/kg)	17.3	17.1	19.2	8.62	8.35
	Vanadium (V) (mg/kg)	32.3	30.9	32.2	36.7	36.3
	Zinc (Zn) (mg/kg)	132	158	135	80.9	87.3
Aggregate Organics	Oil and Grease (mg/kg)	1030	1520	2030	<500	<500
Hydrocarbons	EPH10-19 (mg/kg)	<800 DLHM	<820 DLHM	<840 DLHM	<360 DLHM	<400 DLHM
	EPH19-32 (mg/kg)	<800 DLHM	<820 DLHM	<840 DLHM	<360 DLHM	<400 DLHM
	LEPH (mg/kg)	<800	<820	<840	<360	<400
	HEPH (mg/kg)	<800	<820	<840	<360	<400
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Acenaphthylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		L928158-6	L928158-7	L928158-8	L928158-9	L928158-10
	Sample ID	L928158-6	L928158-7	L928158-8	L928158-9	L928158-10
	Description					
	Sampled Date	24-AUG-10	25-AUG-10	25-AUG-10	25-AUG-10	27-AUG-10
	Sampled Time					
	Client ID	PDL-3	INUG-1	INUG-2	INUG-3	TE-1
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	68.2	75.5	47.7	82.6	74.7
	pH (pH)	5.95	5.91	6.02	5.90	6.14
Particle Size	% Gravel (>2mm) (%)	<0.10	<0.10	0.88	<0.10	<0.10
	% Sand (2.0mm - 0.063mm) (%)	20.5	13.4	16.4	3.08	26.4
	% Silt (0.063mm - 4um) (%)	70.7	62.8	52.5	79.2	56.5
	% Clay (<4um) (%)	8.78	23.9	30.3	17.8	17.1
Organic / Inorganic Carbon	Total Organic Carbon (%)	2.44	2.66	0.59	4.28	2.49
Metals	Aluminum (Al) (mg/kg)	17200	23600	24400	24200	20100
	Antimony (Sb) (mg/kg)	<10	<10	<10	<10	<10
	Arsenic (As) (mg/kg)	11.5	16.8	12.6	18.6	15.7
	Barium (Ba) (mg/kg)	60.6	99.3	101	120	80.2
	Beryllium (Be) (mg/kg)	0.80	1.53	1.04	1.56	1.78
	Cadmium (Cd) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Chromium (Cr) (mg/kg)	115	115	111	119	51.1
	Cobalt (Co) (mg/kg)	10.7	9.3	14.3	12.1	8.0
	Copper (Cu) (mg/kg)	34.9	48.6	31.3	54.1	49.9
	Lead (Pb) (mg/kg)	<30	<30	<30	<30	<30
	Mercury (Hg) (mg/kg)	0.0112	0.0154	0.0066	0.0261	0.0171
	Molybdenum (Mo) (mg/kg)	<4.0	<4.0	4.1	4.2	<4.0
	Nickel (Ni) (mg/kg)	70.3	67.7	75.3	90.9	32.6
	Selenium (Se) (mg/kg)	<2.2 DLM	<0.50	<0.50	<2.6 DLM	<0.50
	Silver (Ag) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Thallium (Tl) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Tin (Sn) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Uranium (U) (mg/kg)	5.83	15.9	11.4	17.1	16.0
	Vanadium (V) (mg/kg)	32.1	38.2	41.5	38.7	32.5
	Zinc (Zn) (mg/kg)	72.7	84.7	80.0	100	86.7
Aggregate Organics	Oil and Grease (mg/kg)	790	<500	<500	<500	<500
Hydrocarbons	EPH10-19 (mg/kg)	<300 DLHM	<400 DLHM	<200	<560 DLHM	<400 DLHM
	EPH19-32 (mg/kg)	<300 DLHM	<400 DLHM	<200	<560 DLHM	<400 DLHM
	LEPH (mg/kg)	<300	<400	<200	<560	<400
	HEPH (mg/kg)	<300	<400	<200	<560	<400
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Acenaphthylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L928158-11	L928158-12	L928158-13	L928158-14	L928158-15
	Description					
	Sampled Date	27-AUG-10	27-AUG-10	27-AUG-10	27-AUG-10	27-AUG-10
	Sampled Time					
	Client ID	TE-2	TE-3	TEFF-1	TEFF-2	TEFF-3
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	76.9	76.6	81.1	78.6	77.0
	pH (pH)	5.51	5.99	5.87	5.79	5.80
Particle Size	% Gravel (>2mm) (%)	<0.10	<0.10	<0.10	<0.10	1.84
	% Sand (2.0mm - 0.063mm) (%)	10.4	7.84	5.80	9.30	6.49
	% Silt (0.063mm - 4um) (%)	67.1	71.9	75.9	71.8	55.4
	% Clay (<4um) (%)	22.6	20.3	18.3	18.9	36.2
Organic / Inorganic Carbon	Total Organic Carbon (%)	2.90	2.60	3.38	2.60	2.79
Metals	Aluminum (Al) (mg/kg)	20500	25500	25500	27700	29100
	Antimony (Sb) (mg/kg)	19	14	<10	<10	<10
	Arsenic (As) (mg/kg)	35.9	21.3	13.1	11.3	13.1
	Barium (Ba) (mg/kg)	109	126	119	124	136
	Beryllium (Be) (mg/kg)	1.79	2.08	1.97	2.04	2.15
	Cadmium (Cd) (mg/kg)	2.51	2.04	1.47	1.35	1.53
	Chromium (Cr) (mg/kg)	50.7	60.4	58.2	64.6	64.2
	Cobalt (Co) (mg/kg)	11.4	14.7	13.6	12.7	14.6
	Copper (Cu) (mg/kg)	57.6	65.4	61.2	62.3	62.2
	Lead (Pb) (mg/kg)	<30	<30	<30	<30	<30
	Mercury (Hg) (mg/kg)	0.0239	0.0187	0.0160	0.0124	0.0127
	Molybdenum (Mo) (mg/kg)	13.0	7.0	4.6	4.5	5.0
	Nickel (Ni) (mg/kg)	31.4	48.6	35.4	35.8	35.9
	Selenium (Se) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Silver (Ag) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Thallium (Tl) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Tin (Sn) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Uranium (U) (mg/kg)	18.0	16.4	24.3	26.0	25.2
	Vanadium (V) (mg/kg)	30.2	37.2	38.6	41.6	43.0
	Zinc (Zn) (mg/kg)	93.6	109	109	115	117
Aggregate Organics	Oil and Grease (mg/kg)	<500	<500	<500	<500	<500
Hydrocarbons	EPH10-19 (mg/kg)	<400 DLHM	<400 DLHM	<460 DLHM	<400 DLHM	<400 DLHM
	EPH19-32 (mg/kg)	<400 DLHM	<400 DLHM	<460 DLHM	<400 DLHM	<400 DLHM
	LEPH (mg/kg)	<400	<400	<460	<400	<400
	HEPH (mg/kg)	<400	<400	<460	<400	<400
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Acenaphthylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		L928158-16	L928158-29	L928158-30	L928158-31	L928158-32
	Sample ID	L928158-16	L928158-29	L928158-30	L928158-31	L928158-32
	Description					
	Sampled Date	23-AUG-10	19-AUG-10	23-AUG-10	20-AUG-10	20-AUG-10
	Sampled Time		14:00	15:36	08:58	16:50
	Client ID	DUP-2	TRB-2	SP-DT	SP-F1	SP-N1
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	88.9				
	pH (pH)	6.23	8.26	5.83	6.38	6.20
Particle Size	% Gravel (>2mm) (%)	<0.10	<0.10	<0.10	<0.10	0.29
	% Sand (2.0mm - 0.063mm) (%)	2.87	0.68	5.83	7.31	17.3
	% Silt (0.063mm - 4um) (%)	88.7	80.7	67.9	66.1	61.0
	% Clay (<4um) (%)	8.48	18.6	26.3	26.5	21.4
Organic / Inorganic Carbon	Total Organic Carbon (%)	9.34	0.52	4.96	4.10	2.88
Metals	Aluminum (Al) (mg/kg)	22100	28000	29400	25400	22500
	Antimony (Sb) (mg/kg)	<10	<10	17	<10	<10
	Arsenic (As) (mg/kg)	29.3	11.1	59.2	50.2	10.8
	Barium (Ba) (mg/kg)	136	149	145	98.0	102
	Beryllium (Be) (mg/kg)	1.64	0.61	2.81	2.06	1.59
	Cadmium (Cd) (mg/kg)	1.47	<0.50	2.60	<0.50	<0.50
	Chromium (Cr) (mg/kg)	61.7	156	71.5	80.5	75.2
	Cobalt (Co) (mg/kg)	11.4	21.2	12.2	13.3	9.5
	Copper (Cu) (mg/kg)	158	39.6	134	73.7	59.6
	Lead (Pb) (mg/kg)	41	<30	33	<30	<30
	Mercury (Hg) (mg/kg)	0.0603	<0.0050	0.0392	0.0270	0.0210
	Molybdenum (Mo) (mg/kg)	7.7	<4.0	13.4	9.0	<4.0
	Nickel (Ni) (mg/kg)	54.6	102	54.5	54.9	52.8
	Selenium (Se) (mg/kg)	<2.0	<2.0	<2.0	0.62	<2.0
	Silver (Ag) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Thallium (Tl) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Tin (Sn) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Uranium (U) (mg/kg)	18.1	3.12	26.2	17.6	14.5
	Vanadium (V) (mg/kg)	30.5	54.7	40.4	40.6	37.3
	Zinc (Zn) (mg/kg)	157	86.3	152	113	102
Aggregate Organics	Oil and Grease (mg/kg)	2290				
Hydrocarbons	EPH10-19 (mg/kg)	<840 DLHM				
	EPH19-32 (mg/kg)	<840 DLHM				
	LEPH (mg/kg)	<840				
	HEPH (mg/kg)	<840				
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050				
	Acenaphthylene (mg/kg)	<0.050				
	Anthracene (mg/kg)	<0.050				

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

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	L928158-33	L928158-34	L928158-35	L928158-36	L928158-37
	Description					
	Sampled Date	20-AUG-10	19-AUG-10	25-AUG-10	27-AUG-10	25-AUG-10
	Sampled Time	11:40	16:00	14:00	16:45	15:30
	Client ID	SP-N2	SP-N3	TP-E1	TP-E2	TP-E3
SOIL						
Physical Tests	Moisture (%)					
	pH (pH)	6.40	5.78	5.88	5.50	5.86
Particle Size	% Gravel (>2mm) (%)	<0.10	<0.10	<0.10	<0.10	<0.10
	% Sand (2.0mm - 0.063mm) (%)	2.98	1.95	2.59	3.66	3.34
	% Silt (0.063mm - 4um) (%)	69.6	70.8	64.1	63.3	70.1
	% Clay (<4um) (%)	27.5	27.2	33.3	33.0	26.5
Organic / Inorganic Carbon	Total Organic Carbon (%)	4.40	4.22	2.86	3.18	3.12
Metals	Aluminum (Al) (mg/kg)	28100	27600	25400	26200	26500
	Antimony (Sb) (mg/kg)	<10	<10	<10	<10	<10
	Arsenic (As) (mg/kg)	35.5	104	23.2	32.4	24.6
	Barium (Ba) (mg/kg)	123	119	103	104	131
	Beryllium (Be) (mg/kg)	2.20	2.12	1.91	1.88	1.66
	Cadmium (Cd) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Chromium (Cr) (mg/kg)	95.5	86.8	111	97.9	115
	Cobalt (Co) (mg/kg)	18.0	13.6	17.5	17.2	23.7
	Copper (Cu) (mg/kg)	87.1	97.5	53.7	65.5	84.4
	Lead (Pb) (mg/kg)	<30	<30	<30	<30	<30
	Mercury (Hg) (mg/kg)	0.0274	0.0244	0.0102	0.0149	0.0235
	Molybdenum (Mo) (mg/kg)	7.0	10.3	5.2	7.3	5.7
	Nickel (Ni) (mg/kg)	70.9	67.2	73.0	62.0	142
	Selenium (Se) (mg/kg)	0.73	0.88	0.70	<2.0	0.86
	Silver (Ag) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Thallium (Tl) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Tin (Sn) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Uranium (U) (mg/kg)	18.7	22.2	16.7	19.0	15.4
	Vanadium (V) (mg/kg)	44.3	43.1	42.3	42.8	43.4
	Zinc (Zn) (mg/kg)	123	131	106	109	115
Aggregate Organics	Oil and Grease (mg/kg)					
Hydrocarbons	EPH10-19 (mg/kg)					
	EPH19-32 (mg/kg)					
	LEPH (mg/kg)					
	HEPH (mg/kg)					
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)					
	Acenaphthylene (mg/kg)					
	Anthracene (mg/kg)					

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L928158-38 24-AUG-10 13:43 HVH-4	L928158-39 19-AUG-10 14:00 TRB-1	L928158-40 23-AUG-10 15:36 TRB-3	L928158-41 20-AUG-10 08:58 TRB-4	L928158-42 20-AUG-10 16:50 SP-F2
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)					
	pH (pH)	6.00	6.58	6.38	6.01	6.40
Particle Size	% Gravel (>2mm) (%)	1.09	<0.10	<0.10	<0.10	<0.10
	% Sand (2.0mm - 0.063mm) (%)	2.89	8.79	3.06	1.75	2.73
	% Silt (0.063mm - 4um) (%)	48.4	74.9	73.3	69.0	73.5
	% Clay (<4um) (%)	47.6	16.3	23.7	29.2	23.8
Organic / Inorganic Carbon	Total Organic Carbon (%)	2.77	3.72	2.98	3.45	6.70
Metals	Aluminum (Al) (mg/kg)	36100	21100	25400	28400	29900
	Antimony (Sb) (mg/kg)	<10	<10	<10	<10	<10
	Arsenic (As) (mg/kg)	26.6	67.8	33.3	21.1	15.2
	Barium (Ba) (mg/kg)	139	169	96.4	114	163
	Beryllium (Be) (mg/kg)	2.55	1.30	1.69	2.01	2.48
	Cadmium (Cd) (mg/kg)	<0.50	<0.50	<0.50	<0.50	0.80
	Chromium (Cr) (mg/kg)	119	130	183	179	91.2
	Cobalt (Co) (mg/kg)	20.1	26.5	20.7	13.8	10.6
	Copper (Cu) (mg/kg)	89.2	63.4	62.2	67.2	130
	Lead (Pb) (mg/kg)	33	<30	<30	<30	<30
	Mercury (Hg) (mg/kg)	0.0133	0.0269	0.0170	0.0138	0.0290
	Molybdenum (Mo) (mg/kg)	7.2	10.8	6.8	5.9	6.2
	Nickel (Ni) (mg/kg)	80.1	136	89.3	85.1	85.6
	Selenium (Se) (mg/kg)	<2.0	0.71	0.95	0.74	<2.0
	Silver (Ag) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Thallium (Tl) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Tin (Sn) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Uranium (U) (mg/kg)	27.9	11.9	16.3	18.4	25.9
	Vanadium (V) (mg/kg)	57.7	38.6	45.7	49.1	45.1
	Zinc (Zn) (mg/kg)	141	99.0	107	120	160
Aggregate Organics	Oil and Grease (mg/kg)					
Hydrocarbons	EPH10-19 (mg/kg)					
	EPH19-32 (mg/kg)					
	LEPH (mg/kg)					
	HEPH (mg/kg)					
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)					
	Acenaphthylene (mg/kg)					
	Anthracene (mg/kg)					

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L928158-1 23-AUG-10 WAL-1	L928158-2 23-AUG-10 WAL-2	L928158-3 23-AUG-10 WAL-3	L928158-4 24-AUG-10 PDL-1	L928158-5 24-AUG-10 PDL-2
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Benz(a)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(a)pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(b)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(g,h,i)perylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(k)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chrysene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibenz(a,h)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluorene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	2-Methylnaphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Naphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Phenanthrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: d10-Acenaphthene (SS) (%)	85	92	87	85	83
	Surrogate: d12-Chrysene (SS) (%)	78	80	76	75	80
	Surrogate: d8-Naphthalene (SS) (%)	87	89	85	83	81
	Surrogate: d10-Phenanthrene (SS) (%)	83	89	83	81	80

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L928158-6	L928158-7	L928158-8	L928158-9	L928158-10
	Description					
	Sampled Date	24-AUG-10	25-AUG-10	25-AUG-10	25-AUG-10	27-AUG-10
	Sampled Time					
	Client ID	PDL-3	INUG-1	INUG-2	INUG-3	TE-1
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Benz(a)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(a)pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(b)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(g,h,i)perylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(k)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chrysene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibenz(a,h)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluorene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	2-Methylnaphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Naphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Phenanthrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: d10-Acenaphthene (SS) (%)	87	95	88	84	90
	Surrogate: d12-Chrysene (SS) (%)	75	71	72	72	70
	Surrogate: d8-Naphthalene (SS) (%)	83	92	82	76	90
	Surrogate: d10-Phenanthrene (SS) (%)	82	84	81	71	82

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L928158-11	L928158-12	L928158-13	L928158-14	L928158-15
	Description					
	Sampled Date	27-AUG-10	27-AUG-10	27-AUG-10	27-AUG-10	27-AUG-10
	Sampled Time					
	Client ID	TE-2	TE-3	TEFF-1	TEFF-2	TEFF-3
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Benz(a)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(a)pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(b)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(g,h,i)perylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(k)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chrysene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibenz(a,h)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluorene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	2-Methylnaphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Naphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Phenanthrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: d10-Acenaphthene (SS) (%)	82	89	94	93	92
	Surrogate: d12-Chrysene (SS) (%)	67	70	85	74	70
	Surrogate: d8-Naphthalene (SS) (%)	79	88	95	87	91
	Surrogate: d10-Phenanthrene (SS) (%)	76	80	90	84	83

ALS LABORATORY GROUP ANALYTICAL REPORT

		L928158-16	L928158-29	L928158-30	L928158-31	L928158-32
	Sample ID	L928158-16	L928158-29	L928158-30	L928158-31	L928158-32
	Description					
	Sampled Date	23-AUG-10	19-AUG-10	23-AUG-10	20-AUG-10	20-AUG-10
	Sampled Time		14:00	15:36	08:58	16:50
	Client ID	DUP-2	TRB-2	SP-DT	SP-F1	SP-N1
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Benz(a)anthracene (mg/kg)	<0.050				
	Benzo(a)pyrene (mg/kg)	<0.050				
	Benzo(b)fluoranthene (mg/kg)	<0.050				
	Benzo(g,h,i)perylene (mg/kg)	<0.050				
	Benzo(k)fluoranthene (mg/kg)	<0.050				
	Chrysene (mg/kg)	<0.050				
	Dibenz(a,h)anthracene (mg/kg)	<0.050				
	Fluoranthene (mg/kg)	<0.050				
	Fluorene (mg/kg)	<0.050				
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.050				
	2-Methylnaphthalene (mg/kg)	<0.050				
	Naphthalene (mg/kg)	<0.050				
	Phenanthrene (mg/kg)	<0.050				
	Pyrene (mg/kg)	<0.050				
	Surrogate: d10-Acenaphthene (SS) (%)	91				
	Surrogate: d12-Chrysene (SS) (%)	68				
	Surrogate: d8-Naphthalene (SS) (%)	86				
	Surrogate: d10-Phenanthrene (SS) (%)	79				

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L928158-33	L928158-34	L928158-35	L928158-36	L928158-37
	Description					
	Sampled Date	20-AUG-10	19-AUG-10	25-AUG-10	27-AUG-10	25-AUG-10
	Sampled Time	11:40	16:00	14:00	16:45	15:30
	Client ID	SP-N2	SP-N3	TP-E1	TP-E2	TP-E3
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Benz(a)anthracene (mg/kg)					
	Benzo(a)pyrene (mg/kg)					
	Benzo(b)fluoranthene (mg/kg)					
	Benzo(g,h,i)perylene (mg/kg)					
	Benzo(k)fluoranthene (mg/kg)					
	Chrysene (mg/kg)					
	Dibenz(a,h)anthracene (mg/kg)					
	Fluoranthene (mg/kg)					
	Fluorene (mg/kg)					
	Indeno(1,2,3-c,d)pyrene (mg/kg)					
	2-Methylnaphthalene (mg/kg)					
	Naphthalene (mg/kg)					
	Phenanthrene (mg/kg)					
	Pyrene (mg/kg)					
	Surrogate: d10-Acenaphthene (SS) (%)					
	Surrogate: d12-Chrysene (SS) (%)					
	Surrogate: d8-Naphthalene (SS) (%)					
	Surrogate: d10-Phenanthrene (SS) (%)					

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L928158-38 24-AUG-10 13:43 HVH-4	L928158-39 19-AUG-10 14:00 TRB-1	L928158-40 23-AUG-10 15:36 TRB-3	L928158-41 20-AUG-10 08:58 TRB-4	L928158-42 20-AUG-10 16:50 SP-F2
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Benz(a)anthracene (mg/kg)					
	Benzo(a)pyrene (mg/kg)					
	Benzo(b)fluoranthene (mg/kg)					
	Benzo(g,h,i)perylene (mg/kg)					
	Benzo(k)fluoranthene (mg/kg)					
	Chrysene (mg/kg)					
	Dibenz(a,h)anthracene (mg/kg)					
	Fluoranthene (mg/kg)					
	Fluorene (mg/kg)					
	Indeno(1,2,3-c,d)pyrene (mg/kg)					
	2-Methylnaphthalene (mg/kg)					
	Naphthalene (mg/kg)					
	Phenanthrene (mg/kg)					
	Pyrene (mg/kg)					
	Surrogate: d10-Acenaphthene (SS) (%)					
	Surrogate: d12-Chrysene (SS) (%)					
	Surrogate: d8-Naphthalene (SS) (%)					
	Surrogate: d10-Phenanthrene (SS) (%)					

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		Sample ID	L928158-17				
		Description					
		Sampled Date	23-AUG-10				
		Sampled Time					
		Client ID	SWIPE-2				
Grouping	**Analyte**						
SWAB							
Metals	Aluminum (Al)-Total (ug)		41				
	Antimony (Sb)-Total (ug)		<20				
	Arsenic (As)-Total (ug)		<20				
	Barium (Ba)-Total (ug)		<1.0				
	Beryllium (Be)-Total (ug)		<0.50				
	Bismuth (Bi)-Total (ug)		<20				
	Cadmium (Cd)-Total (ug)		<1.0				
	Calcium (Ca)-Total (ug)		40.7				
	Chromium (Cr)-Total (ug)		<2.0				
	Cobalt (Co)-Total (ug)		<1.0				
	Copper (Cu)-Total (ug)		<1.0				
	Iron (Fe)-Total (ug)		46.1				
	Lead (Pb)-Total (ug)		<5.0				
	Lithium (Li)-Total (ug)		<1.0				
	Magnesium (Mg)-Total (ug)		18				
	Manganese (Mn)-Total (ug)		0.59				
	Molybdenum (Mo)-Total (ug)		<3.0				
	Nickel (Ni)-Total (ug)		<5.0				
	Phosphorus (P)-Total (ug)		<30				
	Potassium (K)-Total (ug)		<200				
	Selenium (Se)-Total (ug)		<20				
	Silver (Ag)-Total (ug)		<1.0				
	Sodium (Na)-Total (ug)		<200				
	Strontium (Sr)-Total (ug)		<0.50				
	Thallium (Tl)-Total (ug)		<20				
	Tin (Sn)-Total (ug)		<3.0				
	Titanium (Ti)-Total (ug)		1.5				
	Vanadium (V)-Total (ug)		<3.0				
	Zinc (Zn)-Total (ug)		1.04				

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L928158-18	L928158-19	L928158-20	L928158-21	L928158-22
	Description					
	Sampled Date	23-AUG-10	24-AUG-10	25-AUG-10	25-AUG-10	25-AUG-10
	Sampled Time					
	Client ID	WAL-11-S	PDL-11-S	INUG-17-S	INUG-17-INT	INUG-17-D
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	28.9	20.6	14.6	14.6	14.0
	Hardness (as CaCO3) (mg/L)	12.2	8.20	5.12	5.10	5.15
	pH (pH)	7.44	7.35	6.99	7.01	6.98
	Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Dissolved Solids (mg/L)	18	14	10	13	<10
	Turbidity (NTU)	0.46	0.24	0.46	0.39	0.39
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	10.2	6.9	4.4	4.6	4.5
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	10.2	6.9	4.4	4.6	4.5
	Ammonia-N (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	0.51	0.52	0.60	0.59
	Fluoride (F) (mg/L)	0.034	0.030	0.042	0.049	0.049
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	<0.050	<0.050	<0.050	0.128	0.092
	Ortho Phosphate as P (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Phosphate as P (mg/L)	0.0028	<0.0020	0.0104	0.0031	0.0029
	Silicate (as SIO2) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Sulfate (SO4) (mg/L)	2.06	1.38	0.63	0.71	0.71
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.16	1.90	2.08	2.12	2.09
	Total Organic Carbon (mg/L)	2.16	1.90	2.06	2.01	2.11
Total Metals	Aluminum (Al)-Total (mg/L)	0.0076	0.0058	0.0114	0.0126	0.0107
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Barium (Ba)-Total (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Total (mg/L)	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017
	Calcium (Ca)-Total (mg/L)	3.27	2.12	1.02	1.05	1.02
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Copper (Cu)-Total (mg/L)	0.0011	<0.0010	<0.0010	<0.0010	<0.0010
	Iron (Fe)-Total (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L928158-23	L928158-24	L928158-25	L928158-26	L928158-27
	Description					
	Sampled Date	28-AUG-10	28-AUG-10	28-AUG-10	28-AUG-10	28-AUG-10
	Sampled Time					
	Client ID	TE-29-S	TE-29-INT	TE-29-D	TEFF-11-S	AUG EB-2
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	18.1	15.9	15.0	12.6	<2.0
	Hardness (as CaCO3) (mg/L)	6.56	6.56	6.67	5.36	<0.50
	pH (pH)	7.02	7.00	7.00	6.97	5.53
	Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Dissolved Solids (mg/L)	10	11	<10	<10	<10
	Turbidity (NTU)	0.43	0.40	0.36	0.37	0.24
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	5.3	5.3	5.3	4.4	<2.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	5.3	5.3	5.3	4.4	<2.0
	Ammonia-N (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	0.0299 RRV
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Fluoride (F) (mg/L)	0.049	0.049	0.048	0.045	<0.020
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.101	0.110	<0.050	<0.050	<0.050
	Ortho Phosphate as P (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Phosphate as P (mg/L)	0.0044	<0.0020	<0.0020	<0.0020	<0.0020
	Silicate (as SIO2) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Sulfate (SO4) (mg/L)	1.63	1.62	1.65	1.53	<0.50
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.67	1.66	1.70	1.54	0.85
	Total Organic Carbon (mg/L)	1.68	1.65	1.63	1.60	0.81
Total Metals	Aluminum (Al)-Total (mg/L)	0.0112	0.0127	0.0109	0.0068	<0.0050
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Barium (Ba)-Total (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Total (mg/L)	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017
	Calcium (Ca)-Total (mg/L)	1.60	1.63	1.65	1.30	<0.10
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Copper (Cu)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	0.0011
	Iron (Fe)-Total (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	0.00085

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L928158-28				
	Description					
	Sampled Date	27-AUG-10				
	Sampled Time					
	Client ID	AUG EB-3				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	<2.0				
	Hardness (as CaCO3) (mg/L)					
	pH (pH)	5.78				
	Total Suspended Solids (mg/L)	<1.0				
	Total Dissolved Solids (mg/L)	<10				
	Turbidity (NTU)	0.21				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	<2.0				
	Ammonia-N (mg/L)	0.0214 RRV				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	<0.50				
	Fluoride (F) (mg/L)	<0.020				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	<0.050				
	Ortho Phosphate as P (mg/L)	<0.0010				
	Total Phosphate as P (mg/L)	<0.0020				
	Silicate (as SIO2) (mg/L)	<1.0				
	Sulfate (SO4) (mg/L)	<0.50				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
	Total Organic Carbon (mg/L)	0.70 RRV				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0050				
	Antimony (Sb)-Total (mg/L)	<0.00050				
	Arsenic (As)-Total (mg/L)	<0.00050				
	Barium (Ba)-Total (mg/L)	<0.020				
	Beryllium (Be)-Total (mg/L)	<0.0010				
	Boron (B)-Total (mg/L)	<0.10				
	Cadmium (Cd)-Total (mg/L)	<0.000017				
	Calcium (Ca)-Total (mg/L)	<0.10				
	Chromium (Cr)-Total (mg/L)	<0.0010				
	Cobalt (Co)-Total (mg/L)	<0.00030				
	Copper (Cu)-Total (mg/L)	0.0019				
	Iron (Fe)-Total (mg/L)	<0.030				
	Lead (Pb)-Total (mg/L)	0.00135				

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

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	L928158-18	L928158-19	L928158-20	L928158-21	L928158-22
	Sample ID	L928158-18	L928158-19	L928158-20	L928158-21	L928158-22
	Description					
	Sampled Date	23-AUG-10	24-AUG-10	25-AUG-10	25-AUG-10	25-AUG-10
	Sampled Time					
	Client ID	WAL-11-S	PDL-11-S	INUG-17-S	INUG-17-INT	INUG-17-D
WATER						
Total Metals	Lithium (Li)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium (Mg)-Total (mg/L)	0.97	0.73	0.62	0.63	0.63
	Manganese (Mn)-Total (mg/L)	0.00182	0.00126	0.00204	0.00195	0.00193
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	0.000014	0.000013	0.000012
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Selenium (Se)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silver (Ag)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Sodium (Na)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Vanadium (V)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Barium (Ba)-Dissolved (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Beryllium (Be)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017
	Calcium (Ca)-Dissolved (mg/L)	3.27	2.09	1.02	1.01	1.02
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Copper (Cu)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Lithium (Li)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium (Mg)-Dissolved (mg/L)	0.97	0.73	0.63	0.62	0.63
	Manganese (Mn)-Dissolved (mg/L)	0.00035	0.00038	0.00032	0.00035	<0.00030
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	0.000011	<0.000010	0.000017	0.000012
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Potassium (K)-Dissolved (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Selenium (Se)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L928158-23	L928158-24	L928158-25	L928158-26	L928158-27
	Description					
	Sampled Date	28-AUG-10	28-AUG-10	28-AUG-10	28-AUG-10	28-AUG-10
	Sampled Time					
	Client ID	TE-29-S	TE-29-INT	TE-29-D	TEFF-11-S	AUG EB-2
Grouping	**Analyte**					
WATER						
Total Metals	Lithium (Li)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium (Mg)-Total (mg/L)	0.60	0.61	0.62	0.53	<0.10
	Manganese (Mn)-Total (mg/L)	0.00159	0.00167	0.00159	0.00147	<0.00030
	Mercury (Hg)-Total (mg/L)	0.000011	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Selenium (Se)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silver (Ag)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Sodium (Na)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Vanadium (V)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Barium (Ba)-Dissolved (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Beryllium (Be)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017
	Calcium (Ca)-Dissolved (mg/L)	1.63	1.62	1.65	1.28	<0.10
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Copper (Cu)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Lithium (Li)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium (Mg)-Dissolved (mg/L)	0.61	0.61	0.62	0.53	<0.10
	Manganese (Mn)-Dissolved (mg/L)	0.00057	0.00062	0.00060	0.00053	<0.00030
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Potassium (K)-Dissolved (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Selenium (Se)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L928158-28 27-AUG-10 AUG EB-3				
Grouping	**Analyte**						
WATER							
Total Metals	Lithium (Li)-Total (mg/L)		<0.0050				
	Magnesium (Mg)-Total (mg/L)		<0.10				
	Manganese (Mn)-Total (mg/L)		<0.00030				
	Mercury (Hg)-Total (mg/L)		<0.000010				
	Molybdenum (Mo)-Total (mg/L)		<0.0010				
	Nickel (Ni)-Total (mg/L)		<0.0010				
	Potassium (K)-Total (mg/L)		<2.0				
	Selenium (Se)-Total (mg/L)		<0.0010				
	Silver (Ag)-Total (mg/L)		<0.000020				
	Sodium (Na)-Total (mg/L)		<2.0				
	Thallium (Tl)-Total (mg/L)		<0.00020				
	Tin (Sn)-Total (mg/L)		<0.00050				
	Titanium (Ti)-Total (mg/L)		<0.010				
	Uranium (U)-Total (mg/L)		<0.00020				
	Vanadium (V)-Total (mg/L)		<0.0010				
	Zinc (Zn)-Total (mg/L)		<0.0050				
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)						
	Antimony (Sb)-Dissolved (mg/L)						
	Arsenic (As)-Dissolved (mg/L)						
	Barium (Ba)-Dissolved (mg/L)						
	Beryllium (Be)-Dissolved (mg/L)						
	Boron (B)-Dissolved (mg/L)						
	Cadmium (Cd)-Dissolved (mg/L)						
	Calcium (Ca)-Dissolved (mg/L)						
	Chromium (Cr)-Dissolved (mg/L)						
	Cobalt (Co)-Dissolved (mg/L)						
	Copper (Cu)-Dissolved (mg/L)						
	Iron (Fe)-Dissolved (mg/L)						
	Lead (Pb)-Dissolved (mg/L)						
	Lithium (Li)-Dissolved (mg/L)						
	Magnesium (Mg)-Dissolved (mg/L)						
	Manganese (Mn)-Dissolved (mg/L)						
	Mercury (Hg)-Dissolved (mg/L)						
	Molybdenum (Mo)-Dissolved (mg/L)						
	Nickel (Ni)-Dissolved (mg/L)						
	Potassium (K)-Dissolved (mg/L)						
	Selenium (Se)-Dissolved (mg/L)						

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L928158-18	L928158-19	L928158-20	L928158-21	L928158-22
	Description					
	Sampled Date	23-AUG-10	24-AUG-10	25-AUG-10	25-AUG-10	25-AUG-10
	Sampled Time					
	Client ID	WAL-11-S	PDL-11-S	INUG-17-S	INUG-17-INT	INUG-17-D
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Sodium (Na)-Dissolved (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Plant Pigments	Chlorophyll a (ug)	0.484	0.368	0.285	0.287	0.299

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		L928158-23	L928158-24	L928158-25	L928158-26	L928158-27
	Sample ID	L928158-23	L928158-24	L928158-25	L928158-26	L928158-27
	Description					
	Sampled Date	28-AUG-10	28-AUG-10	28-AUG-10	28-AUG-10	28-AUG-10
	Sampled Time					
	Client ID	TE-29-S	TE-29-INT	TE-29-D	TEFF-11-S	AUG EB-2
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Sodium (Na)-Dissolved (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Plant Pigments	Chlorophyll a (ug)	0.390	0.192	0.207	0.191	

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L928158-28				
	Description					
	Sampled Date	27-AUG-10				
	Sampled Time					
	Client ID	AUG EB-3				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					
	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					
Plant Pigments	Chlorophyll a (ug)					

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

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
RRV	Reported Result Verified By Repeat Analysis
DLM	Detection Limit Adjusted For Sample Matrix Effects
DLHM	Detection Limit Adjusted: Sample has High Moisture Content

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AL-CSR-ICP-VA	Soil	Al in Soil by ICPOES (CSR SALM)	BCMELP CSR SALM Method 8

This analysis is carried out using procedures from CSR Analytical Method 8 "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, Lands and Parks, 26 June 2001, and procedures adapted from "Test Methods for Evaluating Solid Waste", SW-846 Method 3050B United States Environmental Protection Agency (EPA). The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 90 degrees Celsius for 2 hours by block digester using a 1:1 ratio of concentrated nitric and hydrochloric acids. Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-NO2-IC-VA	Water	Nitrite by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Specifically, the nitrite detection is by UV absorbance and not conductivity.

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-NO3-IC-VA	Water	Nitrate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Specifically, the nitrate detection is by UV absorance and not conductivity.

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ALS Test Code	Matrix	Test Description	Method Reference**
C-DIS-ORG-LOW-CL	Water	Dissolved Organic Carbon	APHA 5310 C-Instrumental
C-TOT-ORG-LECO-SK	Soil	Organic Carbon by combustion method	SSSA (1996) p. 973

Total Organic Carbon (C-TOT-ORG-LECO-SK, C-TOT-ORG-SK)

Total C and inorganic C are determined on separate samples. The total C is determined by combustion and thermal conductivity detection, while inorganic C is determined by weight lass after addition of hydrochloric acid. Organic C is calculated by the difference between these two determinations.

Reference for Total C:
Nelson, D.W. and Sommers, L.E. 1996. Total Carbon, organic carbon and organic matter. P. 961-1010 In: J.M. Bartels et al. (ed.) Methods of soil analysis: Part 3 Chemical methods. (3rd ed.) ASA and SSSA, Madison, WI. Book series no. 5

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

ALS Test Code	Matrix	Test Description	Method Reference**
C-TOT-ORG-LOW-CL	Water	Total Organic Carbon	APHA 5310 C-Instrumental

Reference Information

CHLOROA-VA Water Chlorophyll a by Fluorometer EPA 445.0

Chlorophyll and Pheopigments by Fluorometry analysis is carried out using procedures adapted from USEPA Method 445.0. The sample is filtered using either a glass fiber filter or a 0.45 micron Membrane filter. The pigments are extracted from the filter with 90% aqueuos acetone. For chlorophyll-a analysis the extract is read using a fluorometer. For pheopigments the extract is first acidified then read. This method is not subject to interferences from chlorophyll b.

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

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

EPH-TUMB-FID-VA Soil EPH in Solids by Tumbler and GCFID BCMELP CSR

Extractable Hydrocarbons in Sediment/Soil
This analysis is carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Extractable Petroleum Hydrocarbons in Solids by GC/FID, Version 2.1 July 1999". The procedure, based on EPA 3570, uses a rotary extraction technique to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene or kept in hexane/acetone and analyzed by capillary column gas chromatography with flame ionization detection (GC/FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

Accuracy target values for Reference Materials used in this method are derived from averages of long-term method performance, as certified values do not exist for the reported parameters.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness is calculated from Calcium and Magnesium concentrations, and is expressed as calcium carbonate equivalents.

HG-CCME-CVAFS-VA Soil CVAFS Hg in Soil (CCME) BCMELP CSR SALM METHOD 8/EPA 245.7

This analysis is carried out using procedures from CSR Analytical Method 8 "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, Lands and Parks, 26 June 2001, and procedures adapted from "Test Methods for Evaluating Solid Waste", SW-846 Method 3050B United States Environmental Protection Agency (EPA). The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 90 degrees Celsius for 2 hours by block digester using a 1:1 ratio of concentrated nitric and hydrochloric acids. Instrumental analysis is by atomic fluorescence spectrophotometry (EPA Method 7000 series).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA Soil LEPHs and HEPHs BC MOE LABORATORY MANUAL (2005)

Light and Heavy Extractable Petroleum Hydrocarbons in Solids. These results are determined according to the British Columbia Ministry of Environment, Lands, and Parks Analytical Method for Contaminated Sites "Calculation of Light and Heavy Extractable Petroleum Hydrocarbons in Solids or Water". According to this method, LEPH and HEPH are calculated
by subtracting selected Polycyclic Aromatic Hydrocarbon results from Extractable Petroleum Hydrocarbon results. To calculate LEPH, the individual results for Naphthalene and Phenanthrene are subtracted from EPH(C10-19). To calculate HEPH, the individual results for Benz(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene, Indeno(1,2,3-c,d)pyrene, and Pyrene
are subtracted from EPH(C19-32). Analysis of Extractable Petroleum Hydrocarbons adheres to all prescribed elements of the BCMELP method "Extractable Petroleum Hydrocarbons in Solids by GC/FID" (Version 2.1, July 20, 1999).

MET-200.2-CCMS-VA Soil Metals in Soil by CRC ICPMS EPA 200.2/6020A

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

Reference Information

MET-CSR-FULL-ICP-VA Soil Metals in Soil by ICPOES (CSR SALM) BCMELP CSR SALM METHOD 8

This analysis is carried out using procedures from CSR Analytical Method 8 "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, Lands and Parks, 26 June 2001, and procedures adapted from "Test Methods for Evaluating Solid Waste", SW-846 Method 3050B United States Environmental Protection Agency (EPA). The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 90 degrees Celsius for 2 hours by block digester using a 1:1 ratio of concentrated nitric and hydrochloric acids. Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

MET-DIS-CCME-ICP-VA Water Diss. Metals in Water by ICPOES (CCME) EPA SW-846 3005A/6010B

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

MET-DIS-CCME-MS-VA Water Diss. Metals in Water by ICPMS (CCME) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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

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

MET-TOT-CCME-MS-VA Water Total Metals in Water by ICPMS (CCME) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-UG-ICP-VA Swab Metals in Swab by ICPOES NIOSH 7303/EPA 6010B

This analysis is carried out using procedures adapted from Method 7303 in the NIOSH Manual of Analytcial Methods (NMAM). The procedure involves a hot block digestion of the swab material, using a combination of nitric acid and hydrochloric acid. Instrumental analysis of the swab extract is by inductively coupled plasma - optical emission spectrophotometry (EPA 6010B).

MOISTURE-VA Soil Moisture content ASTM METHOD D2974-00

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

N-TOTKJ-LOW-ED Water Total Kjeldahl Nitrogen- Low Level APHA 4500Norg C-Dig.-Auto-Colorimetry

NH4-LOW-ED Water Ammonia-N Low Level APHA 4500 NH3F-Colorimetry

OG-TMB-VA Soil Oil & Grease in Soils by Tumbler NATM1100 V03 CCME PHC F2-F4G

A subsample of the sediment/soil is extracted with 1:1 hexane:acetone using a rotary extraction apparatus. The extract is analyzed gravimetrically.

Accuracy target values for Reference Materials used in this method are derived from averages of long-term method performance, as certified values do not exist for the reported parameters.

PAH-SURR-MS-VA Soil PAH Surrogates for Soils EPA METHODS 3570, 3545A & 8270

PAH-TUMB-H/A-MS-VA Soil PAH by Tumbler HEX/ACE with GCMS EPA METHODS 3570 & 8270.

Polycyclic Aromatic Hydrocarbons in Sediment/Soil
This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation.

PH-1:2-VA Soil CSR pH by 1:2 Water Leach BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

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

PH-MAN-VA Water pH by Manual Meter APHA 4500-H "pH Value"

Reference Information

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

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

PH-MAN-VA	Water	pH by Manual Meter	APHA 4500-H pH Value

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

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

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

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

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

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

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

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

PO4-DO-COL-VA	Water	Dissolved ortho Phosphate by Colour	APHA 4500-P "Phosphorous"

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". All forms of phosphate are determined by the ascorbic acid colourimetric method. Dissolved ortho-phosphate (dissolved reactive phosphorous) is determined by direct measurement. Total phosphate (total phosphorous) is determined after persulphate digestion of a sample. Total dissolved phosphate (total dissolved phosphorous) is determined by filtering a sample through a 0.45 micron membrane filter followed by persulfate digestion of the filtrate.

PO4-DO-COL-VA	Water	Dissolved ortho Phosphate by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". All forms of phosphate are determined by the ascorbic acid colourimetric method. Dissolved ortho-phosphate (dissolved reactive phosphorous) is determined by direct measurement. Total phosphate (total phosphorous) is determined after persulphate digestion of a sample. Total dissolved phosphate (total dissolved phosphorous) is determined by filtering a sample through a 0.45 micron membrane filter followed by persulfate digestion of the filtrate.

PO4-T-COL-VA	Water	Total Phosphate P by Color	APHA 4500-P "Phosphorous"

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". All forms of phosphate are determined by the ascorbic acid colourimetric method. Dissolved ortho-phosphate (dissolved reactive phosphorous) is determined by direct measurement. Total phosphate (total phosphorous) is determined after persulphate digestion of a sample. Total dissolved phosphate (total dissolved phosphorous) is determined by filtering a sample through a 0.45 micron membrane filter followed by persulfate digestion of the filtrate.

PO4-T-COL-VA	Water	Total Phosphate P by Color	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". All forms of phosphate are determined by the ascorbic acid colourimetric method. Dissolved ortho-phosphate (dissolved reactive phosphorous) is determined by direct measurement. Total phosphate (total phosphorous) is determined after persulphate digestion of a sample. Total dissolved phosphate (total dissolved phosphorous) is determined by filtering a sample through a 0.45 micron membrane filter followed by persulfate digestion of the filtrate.

PSA-PIPET+GRAVEL-SK	Soil	Particle size - Sieve and Pipette	FORESTRY CANADA (1991) P. 46-48 MOD

Particle size analysis involves the measurement of the proportions of the various primary soil particle sizes (ie. clay < 0.004 mm, silt 0.004-0.063 mm, sand 0.063-2.0 mm and gravel > 2.0 mm). In this method, the gravel and sand portions are determined by sieving, while the clay portion is determined by sedimentation using Stokes Law, which relates the radius of the particles to the velocity of the sedimentation in water. Silt is calculated as 100% - (sand% + clay%)
Pretreatment of the soil with Calgon (sodium hexametaphosphate) is used to ensure the complete dispersion of the primary soil particles. Additional pretreatment may be necessary to remove cementing materials such as CaCO3 and organic matter.

Reference
Y.P. Kalra, and D.G. Maynard, 1991. Methods Manual For Forest Soil and Plant Analysis,Northwest Region. Forestry Canada (modified sand, silt and clay size ranges)

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SIO2 D.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 D. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

TL-CSR-MS-VA	Soil	ICPMS Tl in Soil by CSR SALM	BCMELP CSR SALM Method 8

This analysis is carried out using procedures from CSR Analytical Method 8 "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, Lands and Parks, 26 June 2001, and procedures adapted from "Test Methods for Evaluating Solid Waste", SW-846 Method 3050B United States Environmental Protection Agency (EPA). The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm

Reference Information

(10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 90 degrees Celsius for 2 hours by either hotplate or block digester using a 1:1 ratio of concentrated nitric and hydrochloric acids. Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

TSS-LOW-VA	Water	Total Suspended Solids by Grav. (1 mg/L)	APHA 2540 Gravimetric

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

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

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

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

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

U-200.2-MS-VA	Soil	Uranium in Soil by ICPMS	EPA 200.2/6020A

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

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

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

Laboratory Definition Code	Laboratory Location
ED	ALS LABORATORY GROUP - EDMONTON, ALBERTA, CANADA
CL	ALS LABORATORY GROUP - CALGARY, ALBERTA, CANADA
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA
SK	ALS LABORATORY GROUP - SASKATOON, SASKATCHEWAN, CANADA

Chain of Custody Numbers:

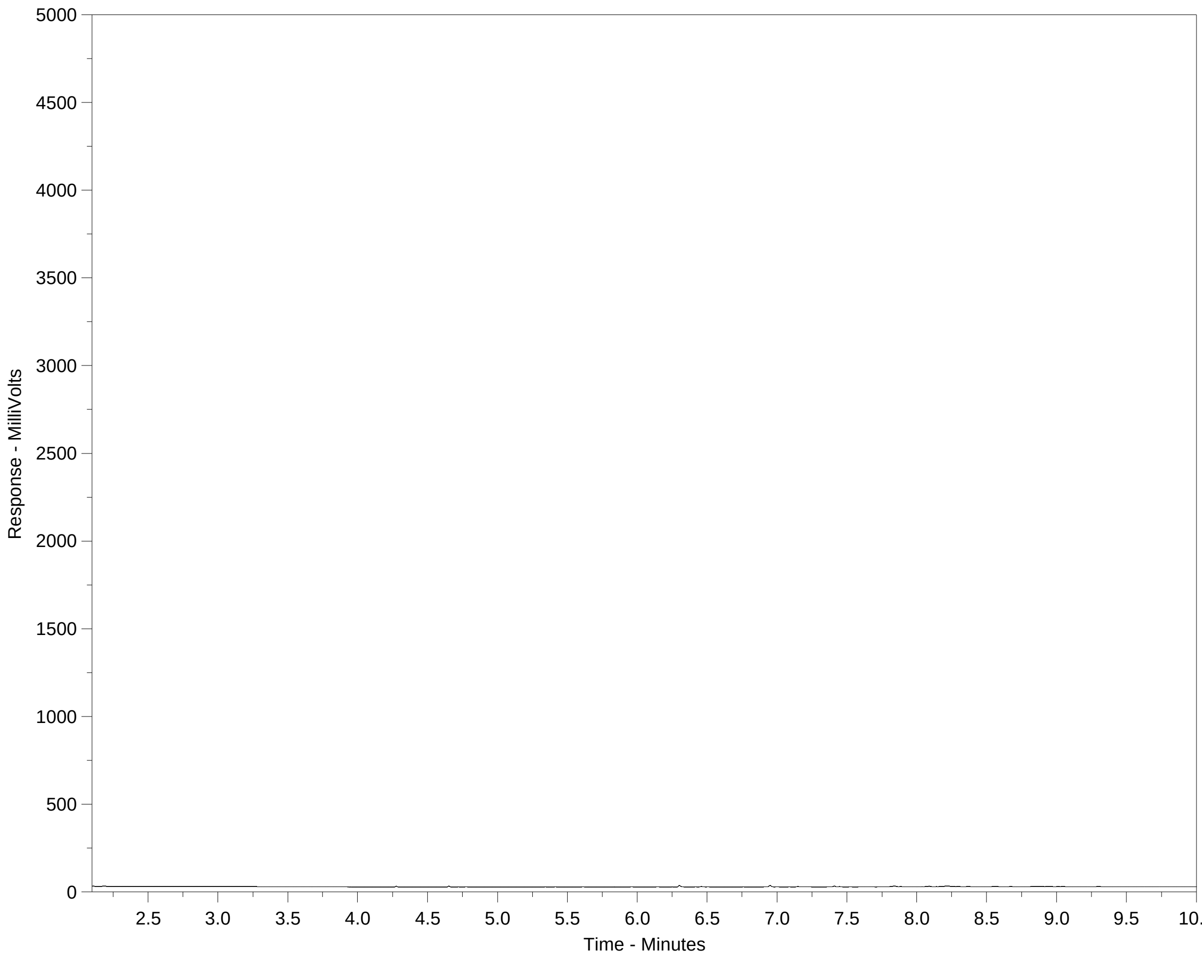
GLOSSARY OF REPORT TERMS

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

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

Hydrocarbon Distribution Report

ALS Sample ID: L928158-1
Client ID: WAL-1



nC10	nC19	nC32	Surrogate	nC40
174°C 346°F	330°C 626°F	467°C 873°F		522°C 972°F

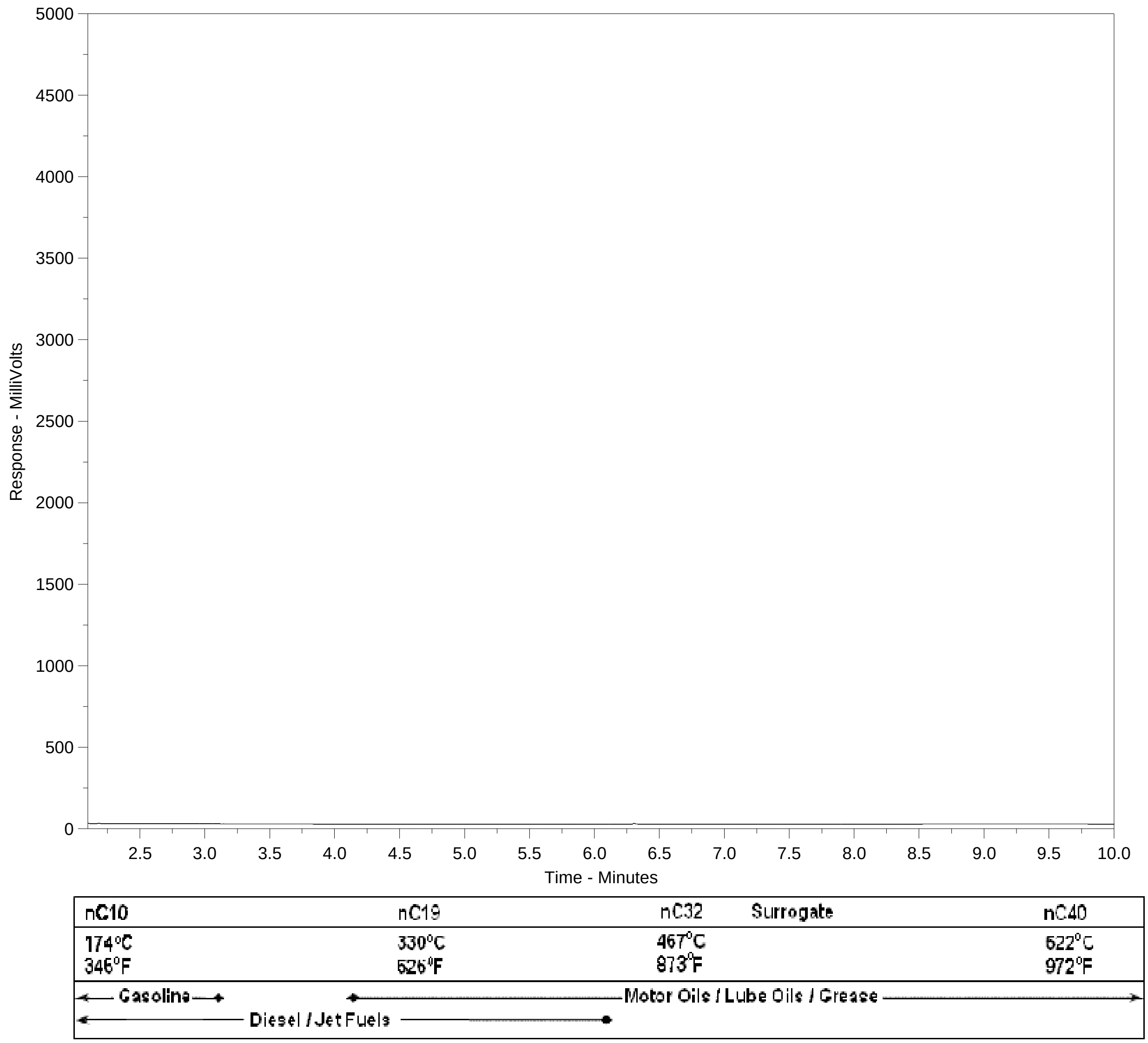
← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

Chromatograms from the ALS HDR Reference Library indicate the patterns of hydrocarbon compounds found in petroleum products, reference standards, and some examples of natural plant and organic materials. The chromatogram from left to right roughly corresponds to increasing boiling point from approximately 174°C to 522°C, a range encompassing most middle distillate and residual petroleum products (diesel, fuel oils, lubricating oils, etc). Comparison of library chromatograms with those of unknown samples may aid in the identification of contaminants. Surrogate compounds, which are added to samples by the laboratory, are not present in HDR library chromatograms.

Please note that retention times may vary between samples by as much as 0.5 minutes.
Lxxxxxx-L-x denotes low level samples, Lxxxxxx-S-x denotes SG cleaned samples.

Hydrocarbon Distribution Report

ALS Sample ID: L928158-8
Client ID: INUG-2



Chromatograms from the ALS HDR Reference Library indicate the patterns of hydrocarbon compounds found in petroleum products, reference standards, and some examples of natural plant and organic materials. The chromatogram from left to right roughly corresponds to increasing boiling point from approximately 174°C to 522°C, a range encompassing most middle distillate and residual petroleum products (diesel, fuel oils, lubricating oils, etc). Comparison of library chromatograms with those of unknown samples may aid in the identification of contaminants. Surrogate compounds, which are added to samples by the laboratory, are not present in HDR library chromatograms.

Please note that retention times may vary between samples by as much as 0.5 minutes.
Lxxxxxx-L-x denotes low level samples, Lxxxxxx-S-x denotes SG cleaned samples.

L928158

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ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

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Report to:		**Report Format / Distribution**		**Service Requested:**
Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other		☑ Regular Service (Default)
Contact:	Maggie McConnell	☑ PDF ☑ Excel ☐ Fax		☐ Rush Service (2-3 Days)
Address:	218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1:	mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2:	gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone:	604-730-1220 Fax:			**Analysis Request**
Invoice To:	☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →→		
Company:		**Client / Project Information:**		
Contact:		Job #:	Meadowbank Mine CREMP	
Address:		PO/AFE:		
Sample		Legal Site Description:		
Phone:	Fax:	Quote #:	Q24230	
Lab Work Order # (lab use only)	L928158	ALS Contact:	Natasha MM	Sampler (Initials): MLM, MF

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	T-Metals (incl. Al, Ph) (CCME)	pH	Moisture	TOC	PSA	PAH	Oil&Grease	LEPH&HEPH			Hazardous?	Highly Contaminated?	Number of Containers
1	WAL-1	23-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
2	WAL-2	23-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
3	WAL-3	23-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
4	PDL-1	24-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
5	PDL-2	24-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
6	PDL-3	24-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
7	INUG-1	25-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
8	INUG-2	25-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
9	INUG-3	25-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
10	TE-1	27-Aug-10		Sediment	X	X	X	X	X	X	X	X					3

Guidelines / Regulations	**Special Instructions / Hazardous Details**

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.

								Sample Condition (lab use only)	
Relinquished By:	Maggie McConnell	Date & Time:	29-Aug-10	Received By:		Date & Time:		Temperature	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By:	[signature]	Date & Time:		Received By:	RC	Date & Time:	03-SEP-10 10:35am	15.2	

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Report to:	**Report Format / Distribution**	**Service Requested:**
Company: Azimuth Consulting Group Inc.	☑ Standard ☐ Other	☑ Regular Service (Default)
Contact: Maggie McConnell	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address: 218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1: mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
	Email 2: gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone: 604-730-1220 Fax:		**Analysis Request**
Invoice To: ☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →→	
Company:	**Client / Project Information:**	
Contact:	Job #: Meadowbank Mine CREMP	
Address:	PO/AFE:	
Sample	Legal Site Description:	
Phone: Fax:	Quote #: Q24230	
Lab Work Order # (lab use only)	**ALS Contact:** Natasha MM; **Sampler** (Initials): MLM, MF	

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	T-Metals (incl. Al, Ph) (CCME)	pH	Moisture	TOC	PSA	PAH	Oil&Grease	LEPH&HEPH			Hazardous?	Highly Contaminated?	Number of Containers
11	TE-2	27-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
12	TE-3	27-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
13	TEFF-1	27-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
14	TEFF-2	27-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
15	TEFF-3	27-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
16	DUP-2	23-Aug-10		Sediment	X	X	X	X	X	X	X	X					3
17	Swipe-2	23-Aug-10		Other	X												1

Guidelines / Regulations	Special Instructions / Hazardous Details
	"Swipe-2" is a filter.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
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Relinquished By:	Date & Time:	Received By:	Date & Time:	Sample Condition (lab use only)	
Maggie McConnell	29-Aug-10			Temperature	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By: [illegible signature]	Date & Time:	Received By: RC	Date & Time: 30/09 10:35	15.2	

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Page 3 of 6

Report to:
Company: Azimuth Consulting Group Inc.
Contact: Maggie McConnell
Address: 218 - 2902 West Broadway, Vancouver, BC, V6K 2G8
Phone: 604-730-1220 Fax:

Invoice To: ☑ Same as Report
Company:
Contact:
Address:
Sample
Phone: Fax:

Report Format / Distribution
☑ Standard ☐ Other
☑ PDF ☑ Excel ☐ Fax
Email 1: mmcconnell@azimuthgroup.ca
Email 2: gmann@azimuthgroup.ca

Client / Project Information:
Job #: Meadowbank Mine CREMP
PO/AFE:
Legal Site Description:
Quote #: Q24230
ALS Contact: Natasha MM
Sampler (Initials): MLM, MF

Service Requested:
☑ Regular Service (Default)
☐ Rush Service (2-3 Days)
☐ Priority Service (1 Day or ASAP)
☐ Emergency Service (<1 Day / Wkend) - Contact ALS

Lab Work Order # (lab use only)

Indicate Bottles: Filtered / Preserved (F/P) →

Analysis Request

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	T-Metals (incl. Ph) (CCME)	D-Metals (incl. Ph) (CCME)	TOC, DOC (F)	TKN, Ammonia	TDS, TSS-low	Alk (SPECIATED)	Anion Scan, Si, pH, EC	T-PO4, ortho-PO4	Chlorophyll-a	Turbididty	Hazardous?	Highly Contaminated?	Number of Containers
				F/P	P	F/P	P	P					P				
18	WAL-11-S	23-Aug-10		Water	X	X	X	X	X	X	X	X	X	X			7 + 1 filter
19	PDL-11-S	24-Aug-10		Water	X	X	X	X	X	X	X	X	X	X			7 + "
20	INUG-17-S	25-Aug-10		Water	X	X	X	X	X	X	X	X	X	X			7 + "
21	INUG-17-INT	25-Aug-10		Water	X	X	X	X	X	X	X	X	X	X			7 + "
22	INUG-17-D	25-Aug-10		Water	X	X	X	X	X	X	X	X	X	X			7 + "
23	TE-29-S	28-Aug-10		Water	X	X	X	X	X	X	X	X	X	X			7 + "
24	TE-29-INT	28-Aug-10		Water	X	X	X	X	X	X	X	X	X	X			7 + "
25	TE-29-D	28-Aug-10		Water	X	X	X	X	X	X	X	X	X	X			7 + "
26	TEFF-11-S	28-Aug-10		Water	X	X	X	X	X	X	X	X	X	X			7 + "

Guidelines / Regulations

Special Instructions / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.

Relinquished By:	Maggie McConnell	Date & Time:	29-Aug-10	Received By:		Date & Time:	
Relinquished By:	[signature]	Date & Time:		Received By:	RC	Date & Time:	08/09 10:35

Sample Condition (lab use only)
Temperature: 15.2
Samples Received in Good Condition? Y / N (if no provided details)

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Report to:		Report Format / Distribution		Service Requested:
Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other		☑ Regular Service (Default)
Contact:	Maggie McConnell	☑ PDF ☑ Excel ☐ Fax		☐ Rush Service (2-3 Days)
Address:	218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1:	mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2:	gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone:	604-730-1220 Fax:			**Analysis Request**
Invoice To:	☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →		
Company:		**Client / Project Information:**		
Contact:		Job #:	Meadowbank Mine CREMP	
Address:		PO/AFE:		
Sample		Legal Site Description:		
Phone:	Fax:	Quote #:	Q24230	
Lab Work Order # (lab use only)		ALS Contact:	Natasha MM	Sampler (Initials): MLM, MF

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	T-Metals (incl. Ph) (CCME)	D-Metals (incl. Ph) (CCME)	TOC, DOC (F)	TKN, Ammonia	TDS, TSS-low	Alk (SPECIATED)	Anion Scan, Si, pH, EC	T-PO4, ortho-PO4	Chlorophyll-a	Turbididty	Hazardous?	Highly Contaminated?	Number of Containers
F/P					P	F/P	P	P					P				
27	Aug EB-2	28-Aug-10		Water	X	X	X	X	X	X	X	X	X	X			6
28	Aug EB-3	27-Aug-10		Water	X		X	X	X	X	X	X	X	X			4

Guidelines / Regulations	Special Instructions / Hazardous Details
	"Aug EB-2" and "Aug EB-3" should be analysed for TSS but not TSS-low.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.

Relinquished By:	Date & Time:	Received By:	Date & Time:	Sample Condition (lab use only)	
Maggie McConnell	29-Aug-10			Temperature	Samples Received in Good Condition? Y / N (if no provided details)
[signature]		RC	30/09 10:35	15.2	

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # ____________

Report to:	Report Format / Distribution	Service Requested:
Company: Azimuth Consulting Group Inc.	☑ Standard ☐ Other	☑ Regular Service (Default)
Contact: Maggie McConnell	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address: 218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1: mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
	Email 2: gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone: 604-730-1220 Fax:		Analysis Request
Invoice To: ☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →	
Company:	Client / Project Information:	
Contact:	Job #: Meadowbank Mine EAS	
Address:	PO/AFE:	
Sample	Legal Site Description:	
Phone: Fax:	Quote #: Q24230	
Lab Work Order # (lab use only)	ALS Contact: Natasha MM / Sampler (Initials):	

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	T-Metals (incl. Al, Ph) (CCME)	pH	Moisture	TOC	PSA							Hazardous?	Highly Contaminated?	Number of Containers
29	TRB-2	19/08/10	14:00	Sediment	X	X	X	X	X									2
30	SP-DT	23/08/10	15:36	Sediment	X	X	X	X	X									2
31	SP-F1	20/08/10	8:58	Sediment	X	X	X	X	X									2
32	SP-N1	20/08/10	16:50	Sediment	X	X	X	X	X									2
33	SP-N2	20/08/10	11:40	Sediment	X	X	X	X	X									2
34	SP-N3	19/08/10	16:00	Sediment	X	X	X	X	X									2
35	TP-E1	25/08/10	14:00	Sediment	X	X	X	X	X									2
36	TP-E2	27/08/10	16:45	Sediment	X	X	X	X	X									2
37	TP-E3	25/08/10	15:30	Sediment	X	X	X	X	X									2
38	HVH-4	24/08/10	13:43	Sediment	X	X	X	X	X									2

Guidelines / Regulations	Special Instructions / Hazardous Details

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

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.

Relinquished By:	Date & Time:	Received By:	Date & Time:	Sample Condition (lab use only)	
Jessica Fang	August 29.2010			Temperature	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By: [signature]	Date & Time:	Received By: RC	Date & Time: 3/9 1035	15.2	

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

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

COC # ____________

Page 6 of 6

Report to:		Report Format / Distribution	Service Requested:
Company:	Agnico-Eagle Mines Ltd	☑ Standard ☐ Other	☑ Regular Service (Default)
Contact:	Ryan VanEngen	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address:	Meadowbank Camp Baker Lake Nunavut	Email 1: rvanengen@agnico-eagle.com	☐ Priority Service (1 Day or ASAP)
		Email 2: mmcconnell@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone:	8677934100 x6759 Fax:		Analysis Request
Invoice To:	☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →	
Company:		**Client / Project Information:**	
Contact:		Job #: Meadowbank Mine EAS	
Address:		PO/AFE:	
Sample		Legal Site Description:	
Phone:	Fax:	Quote #: Q24230	
Lab Work Order # (lab use only)		ALS Contact: Natasha MM	Sampler (Initials):

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	T-Metals (incl. Al, Ph) (CCME)	pH	Moisture	TOC	PSA						Hazardous?	Highly Contaminated?	Number of Containers
39	TRB-1	19/08/10	14:00	Sediment	X	X	X	X	X								2
40	TRB-3	23/08/10	15:36	Sediment	X	X	X	X	X								2
41	TRB-4	20/08/10	8:58	Sediment	X	X	X	X	X								
42	SP-F2	20/08/10	16:50	Sediment	X	X	X	X	X								

Guidelines / Regulations	Special Instructions / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.

Relinquished By:	Date & Time:		Received By:		Date & Time:		Sample Condition (lab use only)	
Jessica Fang		29-Aug-10					Temperature	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By: [signature]	Date & Time:		Received By:	RC	Date & Time:	3/9 1035	15.2	

APPENDIX D

SEQUENTIAL EXTRACTION LABORATORY DATA – MAXXAM ANALYTICS

Maxxam Analytics 4606 Canada Way, Burnaby, BC Canada V5G 1K5 Tel: 604 734 7276 Fax: 604 731 2386 www.maxxam.ca

Table 1: Results for Harmonized Procedure of BCR Sequential Extraction Protocol
for 4 Meadowbank Samples - Nov 2010

		STEP 1						
Dissolved Metals by ICPMS	**Units**	**SP-TRP-2 Step 1**	**SP-TRP-2 DUP Step 1**	**SP-N1 Step 1**	**INUG Step 1**	**TEFF Step 1**	**BCR-701 Step 1**	**Method Blank Step 1**
Dissolved Hardness (CaCO3)	mg/kg	15000	15240	2988	2202	3024	21480	<30
Dissolved Aluminum (Al)	mg/kg	161.4	149.4	201	478.2	475.2	191.4	0.72
Dissolved Antimony (Sb)	mg/kg	<0.006	<0.006	<0.006	<0.006	<0.006	0.102	<0.006
Dissolved Arsenic (As)	mg/kg	0.516	0.516	0.672	1.026	0.45	2.208	<0.006
Dissolved Barium (Ba)	mg/kg	39.54	35.82	32.82	28.26	23.88	22.32	0.054
Dissolved Beryllium (Be)	mg/kg	0.0876	0.0876	0.26400	0.2898	0.4542	0.1164	<0.003
Dissolved Bismuth (Bi)	mg/kg	0.0048	0.0042	0.0024	0.003	0.0018	0.00600	<0.0018
Dissolved Boron (B)	mg/kg	<18	<18	<18	<18	<18	<18	<18
Dissolved Cadmium (Cd)	mg/kg	0.0402	0.0408	0.1062	0.0528	0.0792	7.68	0.00600
Dissolved Cesium (Cs)	mg/kg	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018
Dissolved Chromium (Cr)	mg/kg	0.588	0.5400	0.228	0.876	0.354	2.616	<0.03
Dissolved Cobalt (Co)	mg/kg	1.218	1.194	0.2634	0.654	2.982	2.166	0.0144
Dissolved Copper (Cu)	mg/kg	7.5	7.32	8.58	8.46	8.64	50.7	0.552
Dissolved Iron (Fe)	mg/kg	1116	1128	163.2	258.6	217.8	89.4	0.54
Dissolved Lanthanum (La)	mg/kg	1.806	1.788	8.22	8.16	19.44	0.21	<0.018
Dissolved Lead (Pb)	mg/kg	0.642	0.624	1.158	0.57600	0.5442	3.054	1.074
Dissolved Lithium (Li)	mg/kg	0.3	0.36	0.48	0.3	0.36	<0.18	<0.18
Dissolved Manganese (Mn)	mg/kg	188.4	189	36.72	108.6	876	193.2	0.144
Dissolved Molybdenum (Mo)	mg/kg	<0.018	<0.018	<0.018	<0.018	<0.018	0.018	<0.018
Dissolved Nickel (Ni)	mg/kg	2.412	2.328	3.498	5.61	6.12	15.66	0.042
Dissolved Phosphorus (P)	mg/kg	3	3	22.2	2.4	<0.6	406.8	<0.6
Dissolved Rubidium (Rb)	mg/kg	0.852	0.864	0.462	0.516	0.768	0.318	<0.018
Dissolved Selenium (Se)	mg/kg	<0.012	<0.012	0.012	0.012	0.036	0.03	<0.012
Dissolved Silicon (Si)	mg/kg	264	240.0	180.0	192	306	342	<30
Dissolved Silver (Ag)	mg/kg	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018	0.0228	<0.0018
Dissolved Strontium (Sr)	mg/kg	25.26	25.62	5.43	4.7400	6.36	45.24	<0.018
Dissolved Tellurium (Te)	mg/kg	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Dissolved Thallium (Tl)	mg/kg	0.0042	0.0042	0.0036	0.0024	0.0054	0.015	0.0018
Dissolved Thorium (Th)	mg/kg	0.0108 (1)	0.009	0.00600	0.0066	0.0024	0.0114	<0.0018
Dissolved Tin (Sn)	mg/kg	<0.003	<0.003	<0.003	0.0036	<0.003	0.0168	<0.003
Dissolved Titanium (Ti)	mg/kg	1.74	1.14	0.42	0.36	<0.18	0.78	<0.18
Dissolved Tungsten (W)	mg/kg	<0.003	<0.003	<0.003	<0.003	<0.003	0.0072	<0.003
Dissolved Uranium (U)	mg/kg	0.375	0.381	0.4698	0.8400	1.452	0.0714	0.0024
Dissolved Vanadium (V)	mg/kg	0.3	0.24	1.56	<0.06	<0.06	0.54	<0.06
Dissolved Zinc (Zn)	mg/kg	2.334	2.208	4.974	6.72	7.68	206.4	0.51
Dissolved Zirconium (Zr)	mg/kg	0.102	0.09	<0.03	<0.03	<0.03	<0.03	<0.03
Dissolved Calcium (Ca)	mg/kg	5442	5556	972	618	906	7200	<18
Dissolved Magnesium (Mg)	mg/kg	348	330	132	162	186	840.0	<18
Dissolved Potassium (K)	mg/kg	222	216	108	126	126	120.0	<18
Dissolved Sodium (Na)	mg/kg	24	18	30	30	36	54	<18
Dissolved Sulphur (S)	mg/kg	<3000	<3000	<3000	<3000	<3000	<3000	<3000

Maxxam ID		Y34587	Y34591	Y34588	Y34589	Y34590	Y34592	Y34593
Sampling Date		11/10/2010	11/10/2010	11/10/2010	11/10/2010	11/10/2010	11/10/2010	11/10/2010
COC Number		8324434	8324434	8324434	8324434	8324434	8324434	8324434

RDL = Reportable Detection Limit
EDL = Estimated Detection Limit
(1) Duplicate RPD for Th exceeds acceptance criteria. 10% of analytes failure in multielement scan is allowed.

Maxxam Analytics 4606 Canada Way, Burnaby, BC Canada V5G 1K5 Tel: 604 734 7276 Fax: 604 731 2386 www.maxxam.ca

Table 1: Results for Harmonized Procedure of BCR Sequential Extraction Protocol
for 4 Meadowbank Samples - Nov 2010

		STEP 2						
Dissolved Metals by ICPMS	**Units**	**SP-TRB-2 Step 2**	**SP-TRB-2 DUP Step 2**	**SP-N1 Step 2**	**INUG Step 2**	**TEFF Step 2**	**BCR 701 Step 2**	**Method Blank Step 2**
Dissolved Hardness (CaCO3)	mg/kg	5238	4986	1152	702	930	6480	<30
Dissolved Aluminum (Al)	mg/kg	1080.0	1164	1272	1644	1848	3012	0.96
Dissolved Antimony (Sb)	mg/kg	<0.012	0.012	0.012	<0.012	0.018	0.186	<0.012
Dissolved Arsenic (As)	mg/kg	1.842	1.884	1.326	2.106	1.452	18.96	<0.012
Dissolved Barium (Ba)	mg/kg	17.52	18.24	21.12	18.600	19.800	103.2	0.078
Dissolved Beryllium (Be)	mg/kg	0.102	0.108	0.192	0.264	0.366	0.498	<0.006
Dissolved Bismuth (Bi)	mg/kg	0.2838	0.31200	0.2802	0.2736	0.3126	0.597	<0.003
Dissolved Boron (B)	mg/kg	<30	<30	<30	<30	<30	<30	<30
Dissolved Cadmium (Cd)	mg/kg	0.01200	0.0138	0.111	0.0294	0.0504	3.744	<0.003
Dissolved Cesium (Cs)	mg/kg	0.15	0.144	0.15	0.096	0.21	0.174	<0.03
Dissolved Chromium (Cr)	mg/kg	2.94	2.94	1.02	3.42	1.74	40.62	0.12
Dissolved Cobalt (Co)	mg/kg	1.038	1.074	0.2394	0.3942	1.176	2.724	0.0114
Dissolved Copper (Cu)	mg/kg	7.92	8.16	19.5	15.54	17.52	119.4	0.222
Dissolved Iron (Fe)	mg/kg	1914	1782	630	2670	4098	6360	1.2
Dissolved Lanthanum (La)	mg/kg	21.9	22.62	52.02	54.12	76.8	5.658	<0.03
Dissolved Lead (Pb)	mg/kg	5.682	6.06	9.48	8.400	12.96	117	0.0138
Dissolved Lithium (Li)	mg/kg	1.02	1.14	0.36	<0.3	0.3	0.66	<0.3
Dissolved Manganese (Mn)	mg/kg	36.36	37.44	9.12	16.38	151.2	129	0.036
Dissolved Molybdenum (Mo)	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	0.096	<0.03
Dissolved Nickel (Ni)	mg/kg	2.988	2.898	1.854	2.586	2.052	22.62	0.0600
Dissolved Phosphorus (P)	mg/kg	500.4	507	103.2	143.4	6.6	1488	<1.2
Dissolved Rubidium (Rb)	mg/kg	1.212	1.2600	1.3800	1.302	2.466	1.056	<0.03
Dissolved Selenium (Se)	mg/kg	<0.024	<0.024	0.066	0.066	0.1200	0.072	<0.024
Dissolved Silicon (Si)	mg/kg	720	660	300	360	420	1620	<60
Dissolved Silver (Ag)	mg/kg	0.03600	0.0366	0.0546	0.0378	0.0138	3.87	<0.003
Dissolved Strontium (Sr)	mg/kg	7.02	7.5	1.53	1.236	1.722	13.44	0.09
Dissolved Tellurium (Te)	mg/kg	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012
Dissolved Thallium (Tl)	mg/kg	0.0144	0.015	0.0162	0.0096	0.0288	0.0876	<0.0012
Dissolved Thorium (Th)	mg/kg	0.0258	0.0222	0.021	0.0132	0.0102	0.0228	<0.003
Dissolved Tin (Sn)	mg/kg	0.006	<0.006	<0.006	<0.006	<0.006	0.294	0.018
Dissolved Titanium (Ti)	mg/kg	11.400	11.16	4.14	3.54	5.76	6.96	<0.3
Dissolved Tungsten (W)	mg/kg	0.006	0.012	0.012	0.012	0.018	0.084	<0.006
Dissolved Uranium (U)	mg/kg	1.29	1.3800	2.484	3.156	5.172	0.756	<0.0012
Dissolved Vanadium (V)	mg/kg	2.58	2.76	3.78	5.46	3.72	10.800	<0.12
Dissolved Zinc (Zn)	mg/kg	7.98	7.68	11.04	8.400	8.76	103.8	2.88
Dissolved Zirconium (Zr)	mg/kg	0.24	0.24	0.12	0.24	0.12	0.12	<0.06
Dissolved Calcium (Ca)	mg/kg	1344	1242	300.0	174	216	1848	<30
Dissolved Magnesium (Mg)	mg/kg	456	462	96	66	96	450	<30
Dissolved Potassium (K)	mg/kg	84	90	72	78	90	90	<30
Dissolved Sodium (Na)	mg/kg	<30	<30	<30	<30	<30	<30	<30
Dissolved Sulphur (S)	mg/kg	<6000	<6000	<6000	<6000	<6000	<6000	<6000

Maxxam ID		Y37366	Y37370	Y37367	Y37368	Y37369	Y37371	Y37372
Sampling Date		11/11/2010	11/11/2010	11/11/2010	11/11/2010	11/11/2010	11/11/2010	11/11/2010
COC Number		8324442	8324442	8324442	8324442	8324442	8324442	8324442

RDL = Reportable Detection Limit
EDL = Estimated Detection Limit
(1) Duplicate RPD for Th exceeds acceptance criteria. 10% of analytes failure in multielement scan is allowed.

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Table 1: Results for Harmonized Procedure of BCR Sequential Extraction Protocol
for 4 Meadowbank Samples - Nov 2010

		STEP 3						
Dissolved Metals by ICPMS	**Units**	**SP-TRB-2 Step 3**	**SP-TRB-2 DUP Step 3**	**SP-N1 Step 3**	**INUG Step 3**	**TEFF Step 3**	**BCR 701 Step 3**	**Method Blank Step 3**
Dissolved Hardness (CaCO3)	mg/kg	2646.9	2718.3	1795.2	2126.7	2269.5	2657.1	<25.5
Dissolved Aluminum (Al)	mg/kg	354.96	340.17	1591.2	1810.5	2432.7	1009.8	1.173
Dissolved Antimony (Sb)	mg/kg	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	0.0459	<0.0102
Dissolved Arsenic (As)	mg/kg	0.2652	0.2805	0.6477	0.3417	0.4641	3.1416	0.0153
Dissolved Barium (Ba)	mg/kg	8.415	8.466	12.393	13.209	13.719	20.145	2.8713
Dissolved Beryllium (Be)	mg/kg	0.0408	0.0408	0.2448	0.2091	0.4182	0.1224	<0.0051
Dissolved Bismuth (Bi)	mg/kg	0.02346	0.02244	0.23562	0.07854	0.15351	0.32691	<0.00255
Dissolved Boron (B)	mg/kg	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5
Dissolved Cadmium (Cd)	mg/kg	0.00918	0.00816	0.04794	0.01071	0.02703	0.33048	<0.00255
Dissolved Cesium (Cs)	mg/kg	0.0459	0.0408	0.2550	0.1428	0.4029	0.0816	<0.0255
Dissolved Chromium (Cr)	mg/kg	3.672	3.825	9.129	17.340	9.078	138.21	0.357
Dissolved Cobalt (Co)	mg/kg	0.8670	0.8976	0.7548	0.8670	1.2444	1.5402	0.00408
Dissolved Copper (Cu)	mg/kg	2.0400	38.913	9.333	4.8552	9.792	48.246	0.3060
Dissolved Iron (Fe)	mg/kg	423.81	400.86	744.6	1101.6	2198.1	1382.1	5.10
Dissolved Lanthanum (La)	mg/kg	5.967	5.661	10.149	8.517	16.575	1.2138	<0.0255
Dissolved Lead (Pb)	mg/kg	0.6681	0.6681	2.0706	1.4943	3.0753	8.874	0.05151
Dissolved Lithium (Li)	mg/kg	1.836	1.785	4.590	3.009	6.069	1.632	<0.255
Dissolved Manganese (Mn)	mg/kg	17.442	18.003	16.320	20.961	91.29	24.480	0.3213
Dissolved Molybdenum (Mo)	mg/kg	0.7854	0.8109	1.2291	1.3821	0.0561	0.7293	<0.0255
Dissolved Nickel (Ni)	mg/kg	3.3303	3.1926	10.404	9.894	5.661	15.045	0.1020
Dissolved Phosphorus (P)	mg/kg	35.19	34.17	199.92	109.65	37.74	244.80	3.57
Dissolved Rubidium (Rb)	mg/kg	0.9945	0.9384	2.0196	1.6830	2.9937	1.2546	<0.0255
Dissolved Selenium (Se)	mg/kg	0.0459	0.0459	0.3978	0.4335	0.4233	0.6324	<0.0204
Dissolved Silicon (Si)	mg/kg	408	357	816	816	1122	714	<51
Dissolved Silver (Ag)	mg/kg	0.03366	0.03927	0.11832	0.09384	0.08619	1.2648	0.02907
Dissolved Strontium (Sr)	mg/kg	1.4994	1.5147	1.3260	1.3515	1.7136	2.3817	0.4896
Dissolved Tellurium (Te)	mg/kg	<0.0102	<0.0102	0.0102	<0.0102	<0.0102	<0.0102	<0.0102
Dissolved Thallium (Tl)	mg/kg	0.00867	0.00816	0.01428	0.01020	0.01632	0.03366	<0.00102
Dissolved Thorium (Th)	mg/kg	0.11730	0.13005	1.2393	0.6885	2.7234	0.24531	0.00306
Dissolved Tin (Sn)	mg/kg	0.0357	0.0357	0.0306	0.0357	0.0357	0.1377	0.1785
Dissolved Titanium (Ti)	mg/kg	217.77	216.24	168.81	123.42	6.528	38.760	0.510
Dissolved Tungsten (W)	mg/kg	0.2295	0.2397	0.2805	0.0867	0.0153	0.1122	<0.0051
Dissolved Uranium (U)	mg/kg	0.7038	0.6885	9.078	7.497	13.617	1.8768	0.00408
Dissolved Vanadium (V)	mg/kg	3.774	3.825	3.366	3.774	0.408	3.825	<0.102
Dissolved Zinc (Zn)	mg/kg	3.825	3.774	15.657	10.455	16.371	48.144	1.020
Dissolved Zirconium (Zr)	mg/kg	0.153	0.153	1.428	1.275	1.173	0.612	<0.051
Dissolved Calcium (Ca)	mg/kg	428.4	453.9	168.3	234.6	147.9	234.6	<25.5
Dissolved Magnesium (Mg)	mg/kg	382.5	382.5	336.6	372.3	464.1	504.9	<25.5
Dissolved Potassium (K)	mg/kg	168.3	163.2	147.9	158.1	198.9	107.1	<25.5
Dissolved Sodium (Na)	mg/kg	91.8	91.8	91.8	91.8	112.2	91.8	71.4
Dissolved Sulphur (S)	mg/kg	<5100	<5100	<5100	<5100	<5100	<5100	<5100

Maxxam ID		Y37373	Y37377	Y37374	Y37375	Y37376	Y37378	Y37379
Sampling Date		11/11/2010	11/11/2010	11/11/2010	11/11/2010	11/11/2010	11/11/2010	11/11/2010
COC Number		8324442	8324442	8324442	8324442	8324442	8324442	8324442

RDL = Reportable Detection Limit
EDL = Estimated Detection Limit
(1) Duplicate RPD for Th exceeds acceptance criteria. 10% of analytes failure in multielement scan is allowed.

APPENDIX E

SEDIMENT TRAP CHEMISTRY LABORATORY DATA – ALS ENVIRONMENTAL

AZIMUTH CONSULTING GROUP INC.
ATTN: MAGGIE McCONNELL
218 - 2902 WEST BROADWAY
VANCOUVER BC V6K 2G8
Phone: 604-730-1220

Date Received: 03-AUG-10
Report Date: 09-MAR-11 14:10 (MT)
Version: FINAL REV. 2

Certificate of Analysis

Lab Work Order #: L915449
Project P.O. #: NOT SUBMITTED
Job Reference: MEADOWBANK MINE EAS
Legal Site Desc:
C of C Numbers:

Comments: ADDITIONAL 21-FEB-11 09:34
ADDITIONAL 21-FEB-11 09:34
ADDITIONAL 21-FEB-11 09:27
ADDITIONAL 21-FEB-11 09:27
Water samples containing algae and sediment were submitted to ALS for analysis. Originally, only determination of dry weight for all samples was requested. Subsequently, total metals analysis was requested on ten samples and ash free dry weight analysis was requested for the remainder of the samples.

In order to determine dry weight of the samples, they were filtered through pre-weighed glass fibre filters. Algae and sediment found on the filter and the filter itself were then dried at 105 degrees Celcius. The dry weight of the sample was determined by subtracting the weight of the filter from the total dry weight.
Ash free dry weight was determined by ashing the dry sample at 550 degrees Celcius and subtracting the ash weight from the dry weight of the sample.
Total metals were analysed by digesting the dry sample (including the filter) using the regular CSP digestion procedure.
Please note that the filter blanks, treated in the same manner as the samples, were digested and analysed for total metals. The weight used in the calculation of the metals concentrations for these samples was 0.50 g. Levels of some of the metals found in the filter blanks are quite high and this should be considered when reviewing the metals data.
09-MAR-11: Please note that the Dry Weight result for sample"SP ST1 R4" was incorrectly reported in the original report. The dry weight result has now been corrected in the following data tables.

Heather Easton
Account Manager

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	L915449-4	L915449-6	L915449-10	L915449-16	L915449-25
	Sample ID	L915449-4	L915449-6	L915449-10	L915449-16	L915449-25
	Description					
	Sampled Date	16-JUL-10	16-JUL-10	17-JUL-10	17-JUL-10	18-JUL-10
	Sampled Time					
	Client ID	BG ST1 R4	BG ST2 R2	SP ST6 R2	SP ST8 R4	SP ST1 R1
SOIL						
Metals	Aluminum (Al) (mg/kg)	36900	40500	41400	41300	41200
	Antimony (Sb) (mg/kg)	0.24	0.39	0.49	0.36	0.28
	Arsenic (As) (mg/kg)	37.0	38.4	51.6	55.3	41.1
	Barium (Ba) (mg/kg)	6540	11700	17500	16900	15200
	Beryllium (Be) (mg/kg)	1.39	1.77	1.71	1.26	1.20
	Bismuth (Bi) (mg/kg)	4.13	6.21	7.48	6.64	6.42
	Cadmium (Cd) (mg/kg)	1.43	1.73	2.26	2.02	3.29
	Calcium (Ca) (mg/kg)	7840	11800	17600	17200	14800
	Chromium (Cr) (mg/kg)	674	423	332	521	638
	Cobalt (Co) (mg/kg)	32.3	28.3	28.6	27.9	29.9
	Copper (Cu) (mg/kg)	68.2	56.8	70.4	49.2	49.9
	Iron (Fe) (mg/kg)	63500	64100	69600	73000	69800
	Lead (Pb) (mg/kg)	27.1	42.7	53.2	44.3	36.8
	Lithium (Li) (mg/kg)	43.7	60.3	53.2	46.3	44.7
	Magnesium (Mg) (mg/kg)	28900	24600	22500	27300	30500
	Manganese (Mn) (mg/kg)	783	1200	2240	758	877
	Mercury (Hg) (mg/kg)	0.0220	0.0282	0.0472	0.0240	0.0253
	Molybdenum (Mo) (mg/kg)	3.79	4.19	5.66	4.21	3.94
	Nickel (Ni) (mg/kg)	252	158	147	175	208
	Phosphorus (P) (mg/kg)	606	631	1740	1170	1090
	Potassium (K) (mg/kg)	6440	10900	13500	11700	9700
	Selenium (Se) (mg/kg)	0.68	0.60	0.85	0.49	0.40
	Silver (Ag) (mg/kg)	1.45	0.81	0.94	0.81	0.82
	Sodium (Na) (mg/kg)	12400	22200	33300	32500	28100
	Strontium (Sr) (mg/kg)	54.6	127	214	204	99.7
	Thallium (Tl) (mg/kg)	0.281	0.430	0.458	0.312	0.275
	Tin (Sn) (mg/kg)	2.6	6.1	4.5	4.7	4.5
	Titanium (Ti) (mg/kg)	873	1200	1010	772	695
	Uranium (U) (mg/kg)	13.0	16.6	12.7	7.09	6.65
	Vanadium (V) (mg/kg)	87.5	72.8	63.6	71.9	79.4
	Zinc (Zn) (mg/kg)	4670	8340	12600	12200	11000

ALS LABORATORY GROUP ANALYTICAL REPORT

		Sample ID	L915449-34	L915449-39	L915449-44	L915449-45	L915449-52
		Description					
		Sampled Date	20-JUL-10	20-JUL-10	23-JUL-10	23-JUL-10	23-JUL-10
		Sampled Time					
		Client ID	TE ST4 R2	TE ST1 R3	TPS ST2 R4	TPE ST1 R1	BG ST6 R4
Grouping	**Analyte**						
SOIL							
Metals	Aluminum (Al) (mg/kg)		32600	45300	32800	42400	30200
	Antimony (Sb) (mg/kg)		0.36	0.50	0.36	0.15	0.21
	Arsenic (As) (mg/kg)		13.1	28.9	28.2	37.4	48.2
	Barium (Ba) (mg/kg)		17700	30200	19000	4060	2470
	Beryllium (Be) (mg/kg)		2.02	2.34	1.18	2.05	0.98
	Bismuth (Bi) (mg/kg)		8.10	13.2	7.82	4.35	1.88
	Cadmium (Cd) (mg/kg)		4.18	6.54	4.06	0.99	0.69
	Calcium (Ca) (mg/kg)		16800	25000	18900	5960	7550
	Chromium (Cr) (mg/kg)		73.9	152	299	755	447
	Cobalt (Co) (mg/kg)		9.99	17.5	21.5	42.2	29.9
	Copper (Cu) (mg/kg)		53.4	67.8	47.7	97.9	50.1
	Iron (Fe) (mg/kg)		31800	57600	43200	70500	72100
	Lead (Pb) (mg/kg)		54.7	72.7	45.9	35.2	19.8
	Lithium (Li) (mg/kg)		54.6	64.0	36.4	60.4	36.5
	Magnesium (Mg) (mg/kg)		11900	18400	18700	31900	23000
	Manganese (Mn) (mg/kg)		623	1050	1460	1130	664
	Mercury (Hg) (mg/kg)		0.0287	0.0470	0.0278	0.0214	0.0125
	Molybdenum (Mo) (mg/kg)		4.24	6.41	3.70	4.29	3.82
	Nickel (Ni) (mg/kg)		46.6	86.3	131	281	174
	Phosphorus (P) (mg/kg)		1410	1600	1330	683	1210
	Potassium (K) (mg/kg)		12300	19000	11200	7050	4200
	Selenium (Se) (mg/kg)		0.97	1.01	0.76	0.68	0.41
	Silver (Ag) (mg/kg)		0.70	1.12	0.71	0.98	0.35
	Sodium (Na) (mg/kg)		33000	56600	34700	7310	4760
	Strontium (Sr) (mg/kg)		115	180	122	51.4	37.9
	Thallium (Tl) (mg/kg)		0.493	0.593	0.346	0.393	0.208
	Tin (Sn) (mg/kg)		4.5	8.0	4.1	2.9	<2.0
	Titanium (Ti) (mg/kg)		963	1200	660	945	591
	Uranium (U) (mg/kg)		24.9	19.1	10.9	24.7	8.45
	Vanadium (V) (mg/kg)		38.1	51.7	48.0	101	71.1
	Zinc (Zn) (mg/kg)		13000	22300	14600	2780	1810

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L915449-53
	Description	
	Sampled Date	
	Sampled Time	
	Client ID	FILTER BLANK
Grouping	**Analyte**	
SOIL		
Metals	Aluminum (Al) (mg/kg)	29900
	Antimony (Sb) (mg/kg)	0.57
	Arsenic (As) (mg/kg)	3.15
	Barium (Ba) (mg/kg)	52300
	Beryllium (Be) (mg/kg)	0.44
	Bismuth (Bi) (mg/kg)	5.98
	Cadmium (Cd) (mg/kg)	7.20
	Calcium (Ca) (mg/kg)	23300
	Chromium (Cr) (mg/kg)	5.17
	Cobalt (Co) (mg/kg)	0.47
	Copper (Cu) (mg/kg)	10.0
	Iron (Fe) (mg/kg)	939
	Lead (Pb) (mg/kg)	68.6
	Lithium (Li) (mg/kg)	17.5
	Magnesium (Mg) (mg/kg)	3650
	Manganese (Mn) (mg/kg)	31.0
	Mercury (Hg) (mg/kg)	<0.0050
	Molybdenum (Mo) (mg/kg)	0.84
	Nickel (Ni) (mg/kg)	1.74
	Phosphorus (P) (mg/kg)	214
	Potassium (K) (mg/kg)	25200
	Selenium (Se) (mg/kg)	<0.20
	Silver (Ag) (mg/kg)	0.59
	Sodium (Na) (mg/kg)	71000
	Strontium (Sr) (mg/kg)	542
	Thallium (Tl) (mg/kg)	0.276
	Tin (Sn) (mg/kg)	6.0
	Titanium (Ti) (mg/kg)	32.9
	Uranium (U) (mg/kg)	0.536
	Vanadium (V) (mg/kg)	2.11
	Zinc (Zn) (mg/kg)	37700

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L915449-1	L915449-2	L915449-3	L915449-4	L915449-5
	Description					
	Sampled Date	16-JUL-10	16-JUL-10	16-JUL-10	16-JUL-10	16-JUL-10
	Sampled Time					
	Client ID	BG ST1 R1	BG ST1 R2	BG ST1 R3	BG ST1 R4	BG ST2 R1
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	1.71	1.67	1.58	1.77	0.839
	Ash Weight (g)	1.52	1.48	1.41		0.752
	Ash Free Dry Weight (g)	0.184	0.186	0.170		0.0867

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		L915449-6	L915449-7	L915449-8	L915449-9	L915449-10
	Sample ID	L915449-6	L915449-7	L915449-8	L915449-9	L915449-10
	Description					
	Sampled Date	16-JUL-10	16-JUL-10	16-JUL-10	17-JUL-10	17-JUL-10
	Sampled Time					
	Client ID	BG ST2 R2	BG ST2 R3	BG ST2 R4	SP ST6 R1	SP ST6 R2
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	1.04	0.796	1.01	0.515	0.681
	Ash Weight (g)		0.718	0.905	0.433	
	Ash Free Dry Weight (g)		0.0766	0.107	0.0825	

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L915449-11	L915449-12	L915449-13	L915449-14	L915449-15
	Description					
	Sampled Date	17-JUL-10	17-JUL-10	17-JUL-10	17-JUL-10	17-JUL-10
	Sampled Time					
	Client ID	SP ST6 R3	SP ST6 R4	SP ST8 R1	SP ST8 R2	SP ST8 R3
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.584	0.659	0.849	0.810	0.804
	Ash Weight (g)	0.490	0.546	0.779	0.728	0.738
	Ash Free Dry Weight (g)	0.0937	0.114	0.0699	0.0826	0.0661

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		Sample ID	L915449-16	L915449-17	L915449-18	L915449-19	L915449-20
		Description					
		Sampled Date	17-JUL-10	18-JUL-10	18-JUL-10	18-JUL-10	18-JUL-10
		Sampled Time					
		Client ID	SP ST8 R4	TPS ST1 R1	TPS ST1 R2	TPS ST1 R3	TPS ST1 R4
Grouping	**Analyte**						
TISSUE							
Physical Tests	Dry Weight (g)		0.858	0.318	0.284	0.327	0.284
	Ash Weight (g)			0.234	0.212	0.243	0.209
	Ash Free Dry Weight (g)			0.0847	0.0715	0.0836	0.0749

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		L915449-21	L915449-22	L915449-23	L915449-24	L915449-25
	Sample ID	L915449-21	L915449-22	L915449-23	L915449-24	L915449-25
	Description					
	Sampled Date	18-JUL-10	18-JUL-10	18-JUL-10	18-JUL-10	18-JUL-10
	Sampled Time					
	Client ID	SP ST7 R1	SP ST7 R2	SP ST7 R3	SP ST7 R4	SP ST1 R1
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.255	0.240	0.229	0.233	0.916
	Ash Weight (g)	0.168	0.154	0.148	0.147	
	Ash Free Dry Weight (g)	0.0869	0.0860	0.0811	0.0853	

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L915449-26	L915449-27	L915449-28	L915449-29	L915449-30
	Description					
	Sampled Date	18-JUL-10	18-JUL-10	18-JUL-10	20-JUL-10	20-JUL-10
	Sampled Time					
	Client ID	SP ST1 R2	SP ST1 R3	SP ST1 R4	TE ST5 R1	TE ST5 R2
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.841	0.884	0.851	0.422	0.403
	Ash Weight (g)	0.776	0.819	0.782	0.288	0.269
	Ash Free Dry Weight (g)	0.0650	0.0658	0.0688	0.134	0.134

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L915449-31	L915449-32	L915449-33	L915449-34	L915449-35
	Description					
	Sampled Date	20-JUL-10	20-JUL-10	20-JUL-10	20-JUL-10	20-JUL-10
	Sampled Time					
	Client ID	TE ST5 R3	TE ST5 R4	TE ST4 R1	TE ST4 R2	TE ST4 R3
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.405	0.386	0.993	0.993	0.960
	Ash Weight (g)	0.273	0.267	0.746		0.731
	Ash Free Dry Weight (g)	0.131	0.119	0.247		0.229

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L915449-36	L915449-37	L915449-38	L915449-39	L915449-40
	Description					
	Sampled Date	20-JUL-10	20-JUL-10	20-JUL-10	20-JUL-10	20-JUL-10
	Sampled Time					
	Client ID	TE ST4 R4	TE ST1 R1	TE ST1 R2	TE ST1 R3	TE ST1 R4
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.913	0.518	0.511	0.538	0.500
	Ash Weight (g)	0.694	0.408	0.442		0.390
	Ash Free Dry Weight (g)	0.219	0.110	0.109		0.110

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		L915449-41	L915449-42	L915449-43	L915449-44	L915449-45
	Sample ID	L915449-41	L915449-42	L915449-43	L915449-44	L915449-45
	Description					
	Sampled Date	23-JUL-10	23-JUL-10	23-JUL-10	23-JUL-10	23-JUL-10
	Sampled Time					
	Client ID	TPS ST2 R1	TPS ST2 R2	TPS ST2 R3	TPS ST2 R4	TPE ST1 R1
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.546	0.465	0.485	0.743	3.28
	Ash Weight (g)	0.413	0.357	0.366		
	Ash Free Dry Weight (g)	0.133	0.108	0.119		

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

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample ID		L915449-46	L915449-47	L915449-48	L915449-49	L915449-50
Description						
Sampled Date		23-JUL-10	23-JUL-10	23-JUL-10	23-JUL-10	23-JUL-10
Sampled Time						
Client ID		TPE ST1 R2	TPE ST1 R3	TPE ST1 R4	BG ST6 R1	BG ST6 R2
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	2.96	2.50	2.77	3.07	2.88
	Ash Weight (g)	2.66	2.25	2.48	2.81	2.68
	Ash Free Dry Weight (g)	0.298	0.247	0.284	0.254	0.198

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L915449-51	L915449-52			
	Description					
	Sampled Date	23-JUL-10	23-JUL-10			
	Sampled Time					
	Client ID	BG ST6 R3	BG ST6 R4			
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	2.91	3.09			
	Ash Weight (g)	2.66				
	Ash Free Dry Weight (g)	0.246				

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

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
RM-H	Reference Material recovery was above ALS DQO. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ASHFREE-DRY-VA	Tissue	Ash Free Dry Weight	44.3 ASH CONTENT & ORG. MATTER CONTENT

This analysis is carried out using procedures adapted from the Canadian Society of Soil Science method "44.3 Ash Content and Organic Matter Content", (1993). Ash Free Dry Weight is determined by the difference between 'Dry Weight' and 'Ash Weight' which are both determined gravimetrically. Dry Weight is determined by drying the sample at 105 ”C and the Ash Weight is subsequently determined by ashing the dried sample at 550 ”C.

ALS Test Code	Matrix	Test Description	Method Reference**
HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/245.7

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis is by atomic fluorescence spectrophotometry (EPA Method 245.7).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

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

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is dried at 40 C, then ground to < 2 mm particle size using a stainless steel flail grinder. A representative portion is digested with concentrated nitric and hydrochloric acids for 2 hours in an open vessel digestor at 95 degrees. Instrumental analysis of the digested exttract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

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

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

Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

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

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

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

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

COC #

Report to:		Report Format / Distribution		Service Requested:
Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other		☑ Regular Service (Default)
Contact:	Maggie McConnell	☑ PDF ☑ Excel ☐ Fax		☐ Rush Service (2-3 Days)
Address:	218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1:	mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2:	gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone:	604-730-1220 Fax:			Analysis Request
Invoice To:	☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →→		
Company:		Client / Project Information:		
Contact:		Job #:	Meadowbank Mine EAS	
Address:		PO/AFE:		
Sample		Legal Site Description:		
Phone:	Fax:	Quote #:	Q24230	
Lab Work Order # (lab use only)	L915449.	ALS Contact:	Natasha MM	Sampler (Initials): MDF, MLM

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight	Hazardous?	Highly Contaminated?	Number of Containers
1	BG ST1 R1	16-Jul-10		Other	X			1
2	BG ST1 R2	16-Jul-10		Other	X			1
3	BG ST1 R3	16-Jul-10		Other	X			1
4	BG ST1 R4	16-Jul-10		Other	X			1
5	BG ST2 R1	16-Jul-10		Other	X			1
6	BG ST2 R2	16-Jul-10		Other	X			1
7	BG ST2 R3	16-Jul-10		Other	X			1
8	BG ST2 R4	16-Jul-10		Other	X			1

Guidelines / Regulations	Special Instructions / Hazardous Details
	** Samples are a mix of water and sediments; please contact us regarding other analyses (e.g., ash-free DW) **

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Relinquished By:	Date & Time:	Received By:	Date & Time:	Sample Condition (lab use only)	
Relinquished By: [signature]	Date & Time: 25-Jul-10	Received By:	Date & Time:	Temperature	Samples Received in Good Condition? (Y) N (if no provide details)
Relinquished By:	Date & Time:	Received By: [signature]	Date & Time: 8/3 10:50	21	

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

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

COC # ____

Report to:
Company: Azimuth Consulting Group Inc.
Contact: Maggie McConnell
Address: 218 - 2902 West Broadway, Vancouver, BC, V6K 2G8
Phone: 604-730-1220 Fax:

Invoice To: ☑ Same as Report
Company:
Contact:
Address:
Sample
Phone: Fax:

Report Format / Distribution
☑ Standard ☐ Other
☑ PDF ☑ Excel ☐ Fax
Email 1: mmcconnell@azimuthgroup.ca
Email 2: gmann@azimuthgroup.ca

Indicate Bottles: Filtered / Preserved (F/P) →

Client / Project Information:
Job #: Meadowbank Mine EAS
PO/AFE:
Legal Site Description:
Quote #: Q24230
ALS Contact: Natasha MM
Sampler (Initials): MDF, MLM

Service Requested:
☑ Regular Service (Default)
☐ Rush Service (2-3 Days)
☐ Priority Service (1 Day or ASAP)
☐ Emergency Service (<1 Day / Wkend) - Contact ALS

Lab Work Order # (lab use only)

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight	Hazardous?	Highly Contaminated?	Number of Containers
9	SP ST6 R1	17-Jul-10		Other	X			1
10	SP ST6 R2	17-Jul-10		Other	X			1
11	SP ST6 R3	17-Jul-10		Other	X			1
12	SP ST6 R4	17-Jul-10		Other	X			1
13	SP ST8 R1	17-Jul-10		Other	X			1
14	SP ST8 R2	17-Jul-10		Other	X			1
15	SP ST8 R3	17-Jul-10		Other	X			1
16	SP ST8 R4	17-Jul-10		Other	X			1

Guidelines / Regulations

Special Instructions / Hazardous Details
** Samples are a mix of water and sediments; please contact us regarding other analyses (e.g., ash-free DW) **

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Relinquished By:	[signature]	Date & Time:	25-Jul-10	Received By:		Date & Time:		Sample Condition (lab use only)	
Relinquished By:		Date & Time:		Received By:	[signature]	Date & Time:	8/3 10:50	Temperature 21	Samples Received in Good Condition? Y / N (if no provided details)

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Environmental Division

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

COC # ____________

Report to:		Report Format / Distribution		Service Requested:
Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other		☑ Regular Service (Default)
Contact:	Maggie McConnell	☑ PDF ☑ Excel ☐ Fax		☐ Rush Service (2-3 Days)
Address:	218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1:	mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2:	gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone:	604-730-1220 Fax:			Analysis Request
Invoice To:	☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →→		
Company:		Client / Project Information:		
Contact:		Job #:	Meadowbank Mine EAS	
Address:		PO/AFE:		
Sample		Legal Site Description:		
Phone:	Fax:	Quote #:	Q24230	
Lab Work Order # (lab use only)		ALS Contact:	Natasha MM	Sampler (Initials): MDF, MLM

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight	Hazardous?	Highly Contaminated?	Number of Containers
17	TPS ST1 R1	18-Jul-10		Other	X			1
18	TPS ST1 R2	18-Jul-10		Other	X			1
19	TPS ST1 R3	18-Jul-10		Other	X			1
20	TPS ST1 R4	18-Jul-10		Other	X			1
21	SP ST7 R1	18-Jul-10		Other	X			1
22	SP ST7 R2	18-Jul-10		Other	X			1
23	SP ST7 R3	18-Jul-10		Other	X			1
24	SP ST7 R4	18-Jul-10		Other	X			1

Guidelines / Regulations	Special Instructions / Hazardous Details
	** Samples are a mix of water and sediments; please contact us regarding other analyses (e.g., ash-free DW) **

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Relinquished By:	Date & Time:		Received By:		Date & Time:		Sample Condition (lab use only)	
[signature]		25-Jul-10					Temperature	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By:	Date & Time:		Received By:	[signature]	Date & Time:	8/3 10:50	21	Y

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COC #

Report to:	Report Format / Distribution	Service Requested:
Company: Azimuth Consulting Group Inc.	☑ Standard ☐ Other	☑ Regular Service (Default)
Contact: Maggie McConnell	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address: 218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1: mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
	Email 2: gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone: 604-730-1220 Fax:		Analysis Request
Invoice To: ☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →→	
Company:	**Client / Project Information:**	
Contact:	Job #: Meadowbank Mine EAS	
Address:	PO/AFE:	
Sample	Legal Site Description:	
Phone: Fax:	Quote #: Q24230	
Lab Work Order # (lab use only)	ALS Contact: Natasha MM — Sampler (Initials): MDF, MLM	

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight										Hazardous?	Highly Contaminated?	Number of Containers
25	SP ST1 R1	18-Jul-10		Other	X												1
26	SP ST1 R2	18-Jul-10		Other	X												1
27	SP ST1 R3	18-Jul-10		Other	X												1
28	SP ST1 R4	18-Jul-10		Other	X												1
29	TE ST5 R1	20-Jul-10		Other	X												1
30	TE ST5 R2	20-Jul-10		Other	X												1
31	TE ST5 R3	20-Jul-10		Other	X												1
32	TE ST5 R4	20-Jul-10		Other	X												1

Guidelines / Regulations	Special Instructions / Hazardous Details
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								Sample Condition (lab use only)	
Relinquished By:	[signature]	Date & Time:	25-Jul-10	Received By:		Date & Time:		Temperature	Samples Received in Good Condition? Y N (if no provided details)
Relinquished By:		Date & Time:		Received By:	[signature]	Date & Time:	8/3 10:50	21	

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www.alsglobal.com

COC # ____

Report to:		**Report Format / Distribution**	**Service Requested:**
Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other	☑ Regular Service (Default)
Contact:	Maggie McConnell	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address:	218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1: mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2: gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone:	604-730-1220 Fax:		**Analysis Request**
Invoice To:	☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →→	
Company:		**Client / Project Information:**	
Contact:		Job #: Meadowbank Mine EAS	
Address:		PO/AFE:	
Sample		Legal Site Description:	
Phone:	Fax:	Quote #: Q24230	
Lab Work Order # (lab use only)		ALS Contact: Natasha MM; Sampler (Initials): MDF, MLM	

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight	Hazardous?	Highly Contaminated?	Number of Containers
33	TE ST4 R1	20-Jul-10		Other	X			1
34	TE ST4 R2	20-Jul-10		Other	X			1
35	TE ST4 R3	20-Jul-10		Other	X			1
36	TE ST4 R4	20-Jul-10		Other	X			1
37	TE ST1 R1	20-Jul-10		Other	X			1
38	TE ST1 R2	20-Jul-10		Other	X			1
39	TE ST1 R3	20-Jul-10		Other	X			1
40	TE ST1 R4	20-Jul-10		Other	X			1

Guidelines / Regulations	Special Instructions / Hazardous Details
	** Samples are a mix of water and sediments; please contact us regarding other analyses (e.g., ash-free DW) **

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Relinquished By:	[signature]	Date & Time:	25-Jul-10	Received By:		Date & Time:		Sample Condition (lab use only)
Relinquished By:		Date & Time:		Received By:	[signature]	Date & Time:	8/3 10:50	Temperature: 21; Samples Received in Good Condition? (Y) N (if no provided details)

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

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

COC # ______

Report to:		Report Format / Distribution		Service Requested:
Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other		☑ Regular Service (Default)
Contact:	Maggie McConnell	☑ PDF ☑ Excel ☐ Fax		☐ Rush Service (2-3 Days)
Address:	218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1:	mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2:	gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone:	604-730-1220 Fax:			Analysis Request
Invoice To:	☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →→		
Company:		Client / Project Information:		
Contact:		Job #:	Meadowbank Mine EAS	
Address:		PO/AFE:		
Sample		Legal Site Description:		
Phone:	Fax:	Quote #:	Q24230	
Lab Work Order # (lab use only)		ALS Contact:	Natasha MM	Sampler (Initials): MDF, MLM

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight										Hazardous?	Highly Contaminated?	Number of Containers
41	TPS ST2 R1	23-Jul-10		Other	X												1
42	TPS ST2 R2	23-Jul-10		Other	X												1
43	TPS ST2 R3	23-Jul-10		Other	X												1
44	TPS ST2 R4	23-Jul-10		Other	X												1
45	TPE ST1 R1	23-Jul-10		Other	X												1
46	TPE ST1 R2	23-Jul-10		Other	X												1
47	TPE ST1 R3	23-Jul-10		Other	X												1
48	TPE ST1 R4	23-Jul-10		Other	X												1

Guidelines / Regulations	Special Instructions / Hazardous Details
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								Sample Condition (lab use only)	
Relinquished By:	[signature]	Date & Time:	25-Jul-10	Received By:		Date & Time:		Temperature	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By:		Date & Time:		Received By:	[signature]	Date & Time:	8/3 10:50	21	

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

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www.alsglobal.com

COC # ______

Report to:
Company: Azimuth Consulting Group Inc.
Contact: Maggie McConnell
Address: 218 - 2902 West Broadway, Vancouver, BC, V6K 2G8
Phone: 604-730-1220 Fax:

Invoice To: ☑ Same as Report
Company:
Contact:
Address:
Sample
Phone: Fax:

Report Format / Distribution
☑ Standard ☐ Other
☑ PDF ☑ Excel ☐ Fax
Email 1: mmcconnell@azimuthgroup.ca
Email 2: gmann@azimuthgroup.ca

Indicate Bottles: Filtered / Preserved (F/P) →

Client / Project Information:
Job #: Meadowbank Mine EAS
PO/AFE:
Legal Site Description:
Quote #: Q24230
ALS Contact: Natasha MM
Sampler (Initials): MDF, MLM

Service Requested:
☑ Regular Service (Default)
☐ Rush Service (2-3 Days)
☐ Priority Service (1 Day or ASAP)
☐ Emergency Service (<1 Day / Wkend) - Contact ALS

Analysis Request

Lab Work Order # (lab use only)

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight	Hazardous?	Highly Contaminated?	Number of Containers
49	BG ST6 R1	23-Jul-10		Other	X			1
50	BG ST6 R2	23-Jul-10		Other	X			1
51	BG ST6 R3	23-Jul-10		Other	X			1
52	BG ST6 R4	23-Jul-10		Other	X			1

Guidelines / Regulations

Special Instructions / Hazardous Details
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Relinquished By:	[signature]	Date & Time:	25-Jul-10	Received By:		Date & Time:		Sample Condition (lab use only)	
Relinquished By:		Date & Time:		Received By:	[signature]	Date & Time:	8/3 10:50	Temperature: 21	Samples Received in Good Condition? Y / N (if no provided details)

AZIMUTH CONSULTING GROUP INC.
ATTN: MAGGIE McCONNELL
218 - 2902 WEST BROADWAY
VANCOUVER BC V6K 2G8
Phone: 604-730-1220

Date Received: 30-AUG-10
Report Date: 08-MAR-11 10:27 (MT)
Version: FINAL REV. 2

Certificate of Analysis

Lab Work Order #: L925853
Project P.O. #: NOT SUBMITTED
Job Reference: MEADOWBANK MINE EAS
Legal Site Desc:
C of C Numbers:

Comments: ADDITIONAL 21-FEB-11 09:51
ADDITIONAL 21-FEB-11 09:51

08-MAR-11: The additional analyses, Ash free dry weight and metals, were requested by the client on Feb. 17, 2011. Please note that this request was past the recommended holding time for mercury and metals. The filter blank reported with the metals was an acid washed blank filter used to filter the biomass. The weight used to calculate the results for this sample was 0.50 g.

Heather Easton
Account Manager

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L925853-1	L925853-7	L925853-9		
	Description					
	Sampled Date	27-JUL-10	27-JUL-10			
	Sampled Time					
	Client ID	BG-ST3-R1	BG-ST5-R3	FILTER BLANK		
Grouping	**Analyte**					
SOIL						
Metals	Aluminum (Al) (mg/kg)	38500	44900	772		
	Antimony (Sb) (mg/kg)	0.24	0.37	0.30		
	Arsenic (As) (mg/kg)	46.9	49.8	0.164		
	Barium (Ba) (mg/kg)	4280	9810	1800		
	Beryllium (Be) (mg/kg)	1.75	2.13	<0.20		
	Bismuth (Bi) (mg/kg)	3.77	6.11	0.45		
	Cadmium (Cd) (mg/kg)	1.08	2.08	0.13		
	Calcium (Ca) (mg/kg)	6950	10100	1140		
	Chromium (Cr) (mg/kg)	584	471	1.92		
	Cobalt (Co) (mg/kg)	34.5	30.5	<0.10		
	Copper (Cu) (mg/kg)	71.3	69.0	13.6		
	Iron (Fe) (mg/kg)	69600	73400	80		
	Lead (Pb) (mg/kg)	32.7	44.7	7.80		
	Lithium (Li) (mg/kg)	56.5	68.7	1.1		
	Magnesium (Mg) (mg/kg)	27300	26800	268		
	Manganese (Mn) (mg/kg)	1050	939	2.9		
	Mercury (Hg) (mg/kg)	0.0213	0.0241	<0.0050		
	Molybdenum (Mo) (mg/kg)	4.25	4.97	<0.50		
	Nickel (Ni) (mg/kg)	215	192	0.70		
	Phosphorus (P) (mg/kg)	833	732	<50		
	Potassium (K) (mg/kg)	6990	11100	1600		
	Selenium (Se) (mg/kg)	0.55	0.56	<0.20		
	Silver (Ag) (mg/kg)	0.60	1.07	0.24		
	Sodium (Na) (mg/kg)	7760	17900	6280		
	Strontium (Sr) (mg/kg)	47.8	78.0	13.0		
	Thallium (Tl) (mg/kg)	0.357	0.473	<0.050		
	Tin (Sn) (mg/kg)	2.7	4.5	<2.0		
	Titanium (Ti) (mg/kg)	1040	1340	3.9		
	Uranium (U) (mg/kg)	15.4	19.4	<0.050		
	Vanadium (V) (mg/kg)	89.3	84.2	<0.20		
	Zinc (Zn) (mg/kg)	4000	7020	1520		

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		L925853-1	L925853-2	L925853-3	L925853-4	L925853-5
	Sample ID	L925853-1	L925853-2	L925853-3	L925853-4	L925853-5
	Description					
	Sampled Date	27-JUL-10	27-JUL-10	27-JUL-10	27-JUL-10	27-JUL-10
	Sampled Time					
	Client ID	BG-ST3-R1	BG-ST3-R2	BG-ST3-R3	BG-ST3-R4	BG-ST5-R1
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	2.51	2.38	2.42	2.45	1.29
	Ash Weight (g)		2.19	2.25	2.27	1.18
	Ash Free Dry Weight (g)		0.194	0.169	0.182	0.111

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L925853-6	L925853-7	L925853-8		
	Description					
	Sampled Date	27-JUL-10	27-JUL-10	27-JUL-10		
	Sampled Time					
	Client ID	BG-ST5-R2	BG-ST5-R3	BG-ST5-R4		
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	1.18	1.40	1.32		
	Ash Weight (g)	1.07		1.21		
	Ash Free Dry Weight (g)	0.102		0.117		

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

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
RM-H	Reference Material recovery was above ALS DQO. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ASHFREE-DRY-VA	Tissue	Ash Free Dry Weight	44.3 ASH CONTENT & ORG. MATTER CONTENT

This analysis is carried out using procedures adapted from the Canadian Society of Soil Science method "44.3 Ash Content and Organic Matter Content", (1993). Ash Free Dry Weight is determined by the difference between 'Dry Weight' and 'Ash Weight' which are both determined gravimetrically. Dry Weight is determined by drying the sample at 105 ”C and the Ash Weight is subsequently determined by ashing the dried sample at 550 ”C.

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/245.7

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis is by atomic fluorescence spectrophotometry (EPA Method 245.7).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is dried at 40 C, then ground to < 2 mm particle size using a stainless steel flail grinder. A representative portion is digested with concentrated nitric and hydrochloric acids for 2 hours in an open vessel digestor at 95 degrees. Instrumental analysis of the digested exttract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

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

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

Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

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

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

ALS Laboratory Group

Environmental Division

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

COC # ____________

Page 1 of 1

Report to:		Report Format / Distribution		Service Requested:
Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other		☑ Regular Service (Default)
Contact:	Maggie McConnell	☑ PDF ☑ Excel ☐ Fax		☐ Rush Service (2-3 Days)
Address:	218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1:	mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2:	gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone:	604-730-1220 Fax:			Analysis Request
Invoice To:	☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →→		
Company:		Client / Project Information:		
Contact:		Job #:	Meadowbank Mine EAS	
Address:		PO/AFE:		
Sample		Legal Site Description:		
Phone:	Fax:	Quote #:	Q24230	
Lab Work Order # (lab use only)	L925853	ALS Contact: Natasha MM	Sampler (Initials): MF	

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight	Hazardous?	Highly Contaminated?	Number of Containers
	BG-ST3-R1	27-Jul-10		Other	X			1
	BG-ST3-R2	27-Jul-10		Other	X			1
	BG-ST3-R3	27-Jul-10		Other	X			1
	BG-ST3-R4	27-Jul-10		Other	X			1
	BG-ST5-R1	27-Jul-10		Other	X			1
	BG-ST5-R2	27-Jul-10		Other	X			1
	BG-ST5-R3	27-Jul-10		Other	X			1
	BG-ST5-R4	27-Jul-10		Other	X			1

Guidelines / Regulations	Special Instructions / Hazardous Details
	** Samples are a mix of water and sediments; please contact us regarding other analyses (e.g., ash-free DW) **

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

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.

Relinquished By:	~~G. Mann~~ MF	Date & Time:	~~26-Sep-09~~ Aug 22, 2010	Received By		Date & Time:		Sample Condition (lab use only)	
Relinquished By:	[signature]	Date & Time:		Received By	LC	Date & Time	30/03 9:30am	Temperature 14.4	Samples Received in Good Condition? Y / N (if no provided details)

AZIMUTH CONSULTING GROUP INC.
ATTN: MAGGIE McCONNELL
218 - 2902 WEST BROADWAY
VANCOUVER BC V6K 2G8

Phone: 604-730-1220

Date Received: 04-OCT-10
Report Date: 08-MAR-11 10:50 (MT)
Version: FINAL REV. 2

Certificate of Analysis

Lab Work Order #: L938889
Project P.O. #: NOT SUBMITTED
Job Reference:
Legal Site Desc:
C of C Numbers: 1, 2, 3, 4, 5, 6, 7, 8

Comments: ADDITIONAL 21-FEB-11 10:01
ADDITIONAL 21-FEB-11 10:01

08-MAR-11: Samples containing algae and sediment were submitted to ALS for analysis of Dry Weight. Subsequently, on February 17, 2011, total metals analysis was requested on some of the samples and Ash free dry weight was requested on the remainder.
In order to determine dry weight of the algae and sediment, samples were filtered through pre-weighed glass fibre filters. Algae and sediment found on the filter and the filter itself were then dried at 105 degrees Celcius. The dry weight of the sample was determined by subtracting the weight of the filter from the total dry weight.
Ash free dry weight was determined by ashing the dry sample at 550 degrees Celcius and subtracting the ash weight from the dry weight of the sample.
Total metals were analysed by digesting the dry sample (including the filter) using regular CSR digestion procedures and subsequently analysing the digest using ICPOES, ICPMS and CVAFS.
Please note that filter blanks, treated in the same manner as the samples, were digested and analysed for total metals. Levels of some of the metals found in the filter blank sample are quite high and this should be considered wihen reviewing the metals data for the samples.

Heather Easton
Account Manager

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	L938889-4	L938889-7	L938889-10	L938889-16	L938889-19
	Sample ID	L938889-4	L938889-7	L938889-10	L938889-16	L938889-19
	Description					
	Sampled Date	18-SEP-10	20-SEP-10	20-SEP-10	20-SEP-10	20-SEP-10
	Sampled Time					
	Client ID	BG ST2 R4	BG ST4 R3	TPE ST1 R2	TPE ST3 R4	TPE ST2 R3
SOIL						
Metals	Aluminum (Al) (mg/kg)	43000	50900	32500	26300	34300
	Antimony (Sb) (mg/kg)	0.36	0.43	0.19	0.17	0.62
	Arsenic (As) (mg/kg)	34.7	46.9	44.0	18.1	45.4
	Barium (Ba) (mg/kg)	12900	19200	4750	5010	6300
	Beryllium (Be) (mg/kg)	1.80	1.83	2.15	1.39	2.08
	Bismuth (Bi) (mg/kg)	6.53	8.53	4.04	3.36	4.80
	Cadmium (Cd) (mg/kg)	1.87	2.13	1.29	1.30	1.55
	Calcium (Ca) (mg/kg)	13700	19500	5650	7390	7180
	Chromium (Cr) (mg/kg)	572	669	201	171	268
	Cobalt (Co) (mg/kg)	29.9	33.7	23.8	23.5	25.7
	Copper (Cu) (mg/kg)	65.4	61.6	85.1	46.4	72.0
	Iron (Fe) (mg/kg)	67500	77600	74700	41000	87900
	Lead (Pb) (mg/kg)	45.4	55.9	34.6	32.9	34.3
	Lithium (Li) (mg/kg)	58.9	64.4	56.7	47.2	56.4
	Magnesium (Mg) (mg/kg)	27900	32800	14800	13000	17300
	Manganese (Mn) (mg/kg)	970	828	1070	1990	1840
	Mercury (Hg) (mg/kg)	0.0172	0.0262	0.0184	0.0173	0.0233
	Molybdenum (Mo) (mg/kg)	4.24	3.13	6.82	3.77	5.98
	Nickel (Ni) (mg/kg)	199	229	123	94.2	145
	Phosphorus (P) (mg/kg)	1010	714	1210	760	1240
	Potassium (K) (mg/kg)	11500	15300	7290	6530	8200
	Selenium (Se) (mg/kg)	0.65	0.57	0.83	0.43	0.90
	Silver (Ag) (mg/kg)	0.74	0.96	0.39	0.38	0.45
	Sodium (Na) (mg/kg)	24400	36400	8320	8910	11900
	Strontium (Sr) (mg/kg)	161	232	43.9	49.1	52.6
	Thallium (Tl) (mg/kg)	0.419	0.454	0.476	0.446	0.501
	Tin (Sn) (mg/kg)	9.8	4.9	2.6	2.3	3.1
	Titanium (Ti) (mg/kg)	1180	1240	1100	1020	1180
	Uranium (U) (mg/kg)	20.7	15.3	27.1	17.9	24.6
	Vanadium (V) (mg/kg)	83.4	93.4	61.9	52.2	61.6
	Zinc (Zn) (mg/kg)	9180	13700	3280	3500	4580

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample ID		L938889-23	L938889-27	L938889-29	L938889-32	L938889-45
Description						
Sampled Date		20-SEP-10	21-SEP-10	21-SEP-10	21-SEP-10	23-SEP-10
Sampled Time						
Client ID		BG ST6 R3	TE ST4 R3	TE ST5 R2	TE ST1 R1	SP ST6 R2
Grouping	**Analyte**					
SOIL						
Metals	Aluminum (Al) (mg/kg)	49800	36700	40900	39200	36900
	Antimony (Sb) (mg/kg)	0.53	0.47	0.79	0.75	0.21
	Arsenic (As) (mg/kg)	34.4	16.7	11.9	45.9	26.6
	Barium (Ba) (mg/kg)	19600	17300	33000	28000	4090
	Beryllium (Be) (mg/kg)	1.60	2.31	1.89	2.26	3.01
	Bismuth (Bi) (mg/kg)	6.29	6.03	9.19	8.36	5.31
	Cadmium (Cd) (mg/kg)	0.75	0.81	1.05	1.03	1.68
	Calcium (Ca) (mg/kg)	17100	14200	25400	21900	6680
	Chromium (Cr) (mg/kg)	744	69.4	77.7	82.4	137
	Cobalt (Co) (mg/kg)	34.4	22.9	14.3	11.2	18.0
	Copper (Cu) (mg/kg)	57.8	75.4	53.4	63.1	142
	Iron (Fe) (mg/kg)	71300	57800	35700	65300	57700
	Lead (Pb) (mg/kg)	44.4	55.8	109	60.2	38.3
	Lithium (Li) (mg/kg)	54.1	58.8	58.8	50.7	62.3
	Magnesium (Mg) (mg/kg)	33700	11300	12700	12700	13600
	Manganese (Mn) (mg/kg)	770	6100	2340	848	838
	Mercury (Hg) (mg/kg)	0.0148	0.0258	0.0320	0.0275	0.0283
	Molybdenum (Mo) (mg/kg)	3.63	8.79	4.69	7.42	10.4
	Nickel (Ni) (mg/kg)	246	68.8	51.6	47.6	122
	Phosphorus (P) (mg/kg)	861	999	1050	2770	1040
	Potassium (K) (mg/kg)	14500	13700	21400	18600	7680
	Selenium (Se) (mg/kg)	0.53	0.67	0.99	0.89	1.40
	Silver (Ag) (mg/kg)	0.91	0.56	1.08	1.01	0.86
	Sodium (Na) (mg/kg)	33200	28600	55300	46800	8580
	Strontium (Sr) (mg/kg)	200	173	315	268	50.9
	Thallium (Tl) (mg/kg)	0.401	0.666	0.629	0.536	0.497
	Tin (Sn) (mg/kg)	5.0	5.1	7.9	11.1	3.2
	Titanium (Ti) (mg/kg)	1030	1210	1130	1100	927
	Uranium (U) (mg/kg)	12.8	33.3	23.7	24.2	36.3
	Vanadium (V) (mg/kg)	93.8	44.8	38.9	39.4	59.8
	Zinc (Zn) (mg/kg)	12300	10800	21000	17600	3400

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

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample ID / Description / Sampled Date / Sampled Time / Client ID		L938889-49	L938889-59	L938889-60	L938889-63	
Description						
Sampled Date		17-SEP-10	24-SEP-10	24-SEP-10		
Sampled Time						
Client ID		TPS ST1 R2	TPE ST4 R4	TPE ST2 OW R1	FILTER BLANK	
Grouping	**Analyte**					
SOIL						
Metals	Aluminum (Al) (mg/kg)	28600	31400	43000	513	
	Antimony (Sb) (mg/kg)	0.34	0.34	0.48	0.24	
	Arsenic (As) (mg/kg)	59.8	32.1	39.1	0.118	
	Barium (Ba) (mg/kg)	15200	9490	10700	1240	
	Beryllium (Be) (mg/kg)	1.57	1.86	2.21	<0.20	
	Bismuth (Bi) (mg/kg)	7.32	4.17	4.97	0.52	
	Cadmium (Cd) (mg/kg)	3.24	0.51	0.45	0.26	
	Calcium (Ca) (mg/kg)	12500	8170	9670	886	
	Chromium (Cr) (mg/kg)	105	124	363	1.07	
	Cobalt (Co) (mg/kg)	23.9	23.2	27.5	<0.10	
	Copper (Cu) (mg/kg)	60.7	92.3	69.0	8.76	
	Iron (Fe) (mg/kg)	57900	63900	71000	60	
	Lead (Pb) (mg/kg)	43.3	39.7	43.3	7.48	
	Lithium (Li) (mg/kg)	43.3	50.3	68.8	1.2	
	Magnesium (Mg) (mg/kg)	11600	12200	23000	255	
	Manganese (Mn) (mg/kg)	2250	2620	899	3.0	
	Mercury (Hg) (mg/kg)	0.0160	0.0238	0.0252	<0.0050	
	Molybdenum (Mo) (mg/kg)	6.46	6.38	4.76	<0.50	
	Nickel (Ni) (mg/kg)	78.3	89.6	170	<0.50	
	Phosphorus (P) (mg/kg)	1220	973	767	<50	
	Potassium (K) (mg/kg)	10100	9010	11800	1180	
	Selenium (Se) (mg/kg)	0.62	0.67	0.69	<0.20	
	Silver (Ag) (mg/kg)	0.51	0.43	0.82	0.16	
	Sodium (Na) (mg/kg)	27600	15200	17300	5430	
	Strontium (Sr) (mg/kg)	94.4	99.7	122	7.53	
	Thallium (Tl) (mg/kg)	0.407	0.499	0.503	<0.050	
	Tin (Sn) (mg/kg)	5.0	3.3	4.6	<2.0	
	Titanium (Ti) (mg/kg)	875	1020	1310	3.6	
	Uranium (U) (mg/kg)	21.1	21.6	21.8	<0.050	
	Vanadium (V) (mg/kg)	37.2	46.4	75.0	<0.20	
	Zinc (Zn) (mg/kg)	11100	5790	6540	1160	

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L938889-1	L938889-2	L938889-3	L938889-4	L938889-5
	Description					
	Sampled Date	18-SEP-10	18-SEP-10	18-SEP-10	18-SEP-10	20-SEP-10
	Sampled Time					
	Client ID	BG ST2 R1	BG ST2 R2	BG ST2 R3	BG ST2 R4	BG ST4 R1
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.850	0.746	0.775	1.03	0.726
	Ash Weight (g)	0.777	0.680	0.701		0.656
	Ash Free Dry Weight (g)	0.0733	0.0657	0.0739		0.0699

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		L938889-6	L938889-7	L938889-8	L938889-9	L938889-10
Sample ID		L938889-6	L938889-7	L938889-8	L938889-9	L938889-10
Description						
Sampled Date		20-SEP-10	20-SEP-10	20-SEP-10	20-SEP-10	20-SEP-10
Sampled Time						
Client ID		BG ST4 R2	BG ST4 R3	BG ST4 R4	TPE ST1 R1	TPE ST1 R2
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.745	0.788	0.746	0.921	2.87
	Ash Weight (g)	0.684		0.675	0.811	
	Ash Free Dry Weight (g)	0.0614		0.0719	0.111	

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L938889-11	L938889-12	L938889-13	L938889-14	L938889-15
	Description					
	Sampled Date	20-SEP-10	20-SEP-10	20-SEP-10	20-SEP-10	20-SEP-10
	Sampled Time					
	Client ID	TPE ST1 R3	TPE ST1 R4	TPE ST3 R1	TPE ST3 R2	TPE ST3 R3
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	1.01	1.53	1.44	2.34	1.41
	Ash Weight (g)	0.906	1.35	1.32	2.14	1.26
	Ash Free Dry Weight (g)	0.103	0.186	0.117	0.199	0.153

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		L938889-16	L938889-17	L938889-18	L938889-19	L938889-20
	Sample ID	L938889-16	L938889-17	L938889-18	L938889-19	L938889-20
	Description					
	Sampled Date	20-SEP-10	20-SEP-10	20-SEP-10	20-SEP-10	20-SEP-10
	Sampled Time					
	Client ID	TPE ST3 R4	TPE ST2 R1	TPE ST2 R2	TPE ST2 R3	TPE ST2 R4
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	2.84	0.953	0.683	1.15	0.715
	Ash Weight (g)		0.840	0.603		0.635
	Ash Free Dry Weight (g)		0.113	0.0804		0.0804

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L938889-21	L938889-22	L938889-23	L938889-24	L938889-25
	Description					
	Sampled Date	20-SEP-10	20-SEP-10	20-SEP-10	20-SEP-10	21-SEP-10
	Sampled Time					
	Client ID	BG ST6 R1	BG ST6 R2	BG ST6 R3	BG ST6 R4	TE ST4 R1
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.808	0.736	0.810	0.810	0.408
	Ash Weight (g)	0.741	0.664		0.749	0.334
	Ash Free Dry Weight (g)	0.0675	0.0721		0.0615	0.0741

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L938889-26 21-SEP-10 TE ST4 R2	L938889-27 21-SEP-10 TE ST4 R3	L938889-28 21-SEP-10 TE ST4 R4	L938889-29 21-SEP-10 TE ST5 R2	L938889-30 21-SEP-10 TE ST5 R3
Grouping	**Analyte**						
TISSUE							
Physical Tests	Dry Weight (g)		0.363	1.23	1.04	0.688	0.578
	Ash Weight (g)		0.292		0.909		0.443
	Ash Free Dry Weight (g)		0.0713		0.131		0.135

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		L938889-31	L938889-32	L938889-33	L938889-34	L938889-35
	Sample ID	L938889-31	L938889-32	L938889-33	L938889-34	L938889-35
	Description					
	Sampled Date	21-SEP-10	21-SEP-10	21-SEP-10	21-SEP-10	21-SEP-10
	Sampled Time					
	Client ID	TE ST5 R4	TE ST1 R1	TE ST1 R2	TE ST1 R3	TE ST1 R4
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.613	0.739	0.341	0.485	0.629
	Ash Weight (g)	0.486		0.243	0.339	0.513
	Ash Free Dry Weight (g)	0.127		0.0978	0.146	0.116

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L938889-36 23-SEP-10 SP ST1 R1	L938889-37 23-SEP-10 SP ST1 R2	L938889-38 23-SEP-10 SP ST1 R3	L938889-39 23-SEP-10 SP ST1 R4	L938889-40 23-SEP-10 SP ST7 R1
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.285	0.328	0.265	0.284	0.189
	Ash Weight (g)	0.242	0.278	0.225	0.245	0.109
	Ash Free Dry Weight (g)	0.0427	0.0501	0.0401	0.0387	0.0799

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L938889-41 23-SEP-10 SP ST7 R2	L938889-42 23-SEP-10 SP ST7 R3	L938889-43 23-SEP-10 SP ST7 R4	L938889-44 23-SEP-10 SP ST6 R1	L938889-45 23-SEP-10 SP ST6 R2
Grouping	**Analyte**						
TISSUE							
Physical Tests	Dry Weight (g)		0.213	0.179	0.180	1.25	3.71
	Ash Weight (g)		0.114	0.110		1.02	
	Ash Free Dry Weight (g)		0.0987	0.0684		0.225	

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L938889-46	L938889-47	L938889-48	L938889-49	L938889-50
	Description					
	Sampled Date	23-SEP-10	23-SEP-10	17-SEP-10	17-SEP-10	17-SEP-10
	Sampled Time					
	Client ID	SP ST6 R3	SP ST6 R4	TPS ST1 R1	TPS ST1 R2	TPS ST1 R3
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	2.07	1.21	0.727	0.876	0.300
	Ash Weight (g)	1.69	0.992	0.659		0.254
	Ash Free Dry Weight (g)	0.374	0.220	0.0684		0.0464

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

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample ID		L938889-51	L938889-52	L938889-53	L938889-54	L938889-55
Description						
Sampled Date		17-SEP-10	17-SEP-10	17-SEP-10	17-SEP-10	17-SEP-10
Sampled Time						
Client ID		TPS ST1 R4	TPS ST2 R1	TPS ST2 R2	TPS ST2 R3	TPS ST2 R4
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.568	0.239	0.206	0.234	0.194
	Ash Weight (g)	0.509	0.182	0.159	0.181	0.146
	Ash Free Dry Weight (g)	0.0599	0.0572	0.0462	0.0528	0.0481

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

ALS LABORATORY GROUP ANALYTICAL REPORT

		L938889-56	L938889-57	L938889-58	L938889-59	L938889-60
	Sample ID	L938889-56	L938889-57	L938889-58	L938889-59	L938889-60
	Description					
	Sampled Date	24-SEP-10	24-SEP-10	24-SEP-10	24-SEP-10	24-SEP-10
	Sampled Time					
	Client ID	TPE ST4 R1	TPE ST4 R2	TPE ST4 R3	TPE ST4 R4	TPE ST2 OW R1
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.878	1.34	0.444	2.35	1.58
	Ash Weight (g)	0.728	1.15	0.361		
	Ash Free Dry Weight (g)	0.151	0.187	0.0828		

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L938889-61	L938889-62			
	Description					
	Sampled Date	24-SEP-10	24-SEP-10			
	Sampled Time					
	Client ID	TPE ST2 OW R2	TPE ST2 OW R3			
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	1.54	1.48			
	Ash Weight (g)	1.36	1.30			
	Ash Free Dry Weight (g)	0.180	0.179			

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

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
RM-H	Reference Material recovery was above ALS DQO. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ASHFREE-DRY-VA	Tissue	Ash Free Dry Weight	44.3 ASH CONTENT & ORG. MATTER CONTENT

This analysis is carried out using procedures adapted from the Canadian Society of Soil Science method "44.3 Ash Content and Organic Matter Content", (1993). Ash Free Dry Weight is determined by the difference between 'Dry Weight' and 'Ash Weight' which are both determined gravimetrically. Dry Weight is determined by drying the sample at 105 ”C and the Ash Weight is subsequently determined by ashing the dried sample at 550 ”C.

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/245.7

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis is by atomic fluorescence spectrophotometry (EPA Method 245.7).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is dried at 40 C, then ground to < 2 mm particle size using a stainless steel flail grinder. A representative portion is digested with concentrated nitric and hydrochloric acids for 2 hours in an open vessel digestor at 95 degrees. Instrumental analysis of the digested exttract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

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

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

Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

1	2	3	4	5
6	7	8		

GLOSSARY OF REPORT TERMS

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

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

L938889-COFC

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COC #

Report to:		**Report Format / Distribution**	**Service Requested:**
Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other	☑ Regular Service (Default)
Contact:	Maggie McConnell	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address:	218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1: mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2: gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone:	604-730-1220 Fax:		**Analysis Request**
Invoice To:	☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →→	
Company:		**Client / Project Information:**	
Contact:		Job #: Meadowbank Mine EAS	
Address:		PO/AFE:	
Sample		Legal Site Description:	
Phone:	Fax:	Quote #: Q24230	
Lab Work Order # (lab use only)	L938889	ALS Contact: Natasha MM; Sampler (Initials): MDF, MLM	

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight										Hazardous?	Highly Contaminated?	Number of Containers
	BG ST2 R1	18-Sep-10		Other	X												1
	BG ST2 R2	18-Sep-10		Other	X												1
	BG ST2 R3	18-Sep-10		Other	X												1
	BG ST2 R4	18-Sep-10		Other	X												1
	BG ST4 R1	20-Sep-10		Other	X												1
	BG ST4 R2	20-Sep-10		Other	X												1
	BG ST4 R3	20-Sep-10		Other	X												1
	BG ST4 R4	20-Sep-10		Other	X												1

Guidelines / Regulations	Special Instructions / Hazardous Details
	** Samples are a mix of water and sediments; please contact us regarding other analyses (e.g., ash-free DW) **

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.

Relinquished By:	Morgan Finley	Date & Time:	26-Sep-10	Received By:	SH	Date & Time:	04 Oct 10:40	Sample Condition (lab use only)
Relinquished By:	[signature]	Date & Time:		Received By:		Date & Time:		Temperature: 14.8 ; Samples Received in Good Condition? Y / N (if no provided details)

L938889-COFC

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Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other		☑ Regular Service (Default)
Contact:	Maggie McConnell	☑ PDF ☑ Excel ☐ Fax		☐ Rush Service (2-3 Days)
Address:	218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1:	mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2:	gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone:	604-730-1220 Fax:			Analysis Request
Invoice To:	☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →		
Company:		Client / Project Information:		
Contact:		Job #:	Meadowbank Mine EAS	
Address:		PO/AFE:		
Sample		Legal Site Description:		
Phone:	Fax:	Quote #:	Q24230	
Lab Work Order # (lab use only)	L938889	ALS Contact:	Natasha MM	Sampler (Initials): MDF, MLM

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight										Hazardous?	Highly Contaminated?	Number of Containers
	TPE ST1 R1	20-Sep-10		Other	X												1
	TPE ST1 R2	20-Sep-10		Other	X												1
	TPE ST1 R3	20-Sep-10		Other	X												1
	TPE ST1 R4	20-Sep-10		Other	X												1
	TPE ST3 R1	20-Sep-10		Other	X												1
	TPE ST3 R2	20-Sep-10		Other	X												1
	TPE ST3 R3	20-Sep-10		Other	X												1
	TPE ST3 R4	20-Sep-10		Other	X												1

Guidelines / Regulations	Special Instructions / Hazardous Details
	** Samples are a mix of water and sediments; please contact us regarding other analyses (e.g., ash-free DW) **

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Relinquished By:	Morgan Finley	Date & Time:	26-Sep-10	Received By:	SH	Date & Time:	04/oct 10:40	Sample Condition (lab use only)	
Relinquished By:		Date & Time:		Received By:		Date & Time:		Temperature 14.8	Samples Received in Good Condition? Y / N (if no provided details)

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Report to:		Report Format / Distribution		Service Requested:
Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other		☑ Regular Service (Default)
Contact:	Maggie McConnell	☑ PDF ☑ Excel ☐ Fax		☐ Rush Service (2-3 Days)
Address:	218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1:	mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2:	gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone:	604-730-1220 Fax:			**Analysis Request**
Invoice To:	☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →→		
Company:		Client / Project Information:		
Contact:		Job #:	Meadowbank Mine EAS	
Address:		PO/AFE:		
Sample		Legal Site Description:		
Phone:	Fax:	Quote #:	Q24230	
Lab Work Order # (lab use only)	L938889	ALS Contact: Natasha MM	Sampler (Initials): MDF, MLM	

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight										Hazardous?	Highly Contaminated?	Number of Containers
	TPE ST2 R1	20-Sep-10		Other	X												1
	TPE ST2 R2	20-Sep-10		Other	X												1
	TPE ST2 R3	20-Sep-10		Other	X												1
	TPE ST2 R4	20-Sep-10		Other	X												1
	BG ST6 R1	20-Sep-10		Other	X												1
	BG ST6 R2	20-Sep-10		Other	X												1
	BG ST6 R3	20-Sep-10		Other	X												1
	BG ST6 R4	20-Sep-10		Other	X												1

Guidelines / Regulations	Special Instructions / Hazardous Details
	** Samples are a mix of water and sediments; please contact us regarding other analyses (e.g., ash-free DW) **

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
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Relinquished By:	Morgan Finley	Date & Time:	26-Sep-10	Received By:	SH	Date & Time:	04/Oct 10:4[illegible]	Sample Condition (lab use only)	
Relinquished By:	M Finley	Date & Time:		Received By:		Date & Time:		Temperature 14.8	Samples Received in Good Condition? Y / N (if no provided details)

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Report to:		Report Format / Distribution		Service Requested:
Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other		☑ Regular Service (Default)
Contact:	Maggie McConnell	☑ PDF ☑ Excel ☐ Fax		☐ Rush Service (2-3 Days)
Address:	218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1:	mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2:	gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone:	604-730-1220 Fax:			Analysis Request
Invoice To:	☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →		
Company:		Client / Project Information:		
Contact:		Job #:	Meadowbank Mine EAS	
Address:		PO/AFE:		
Sample		Legal Site Description:		
Phone:	Fax:	Quote #:	Q24230	
Lab Work Order # (lab use only)	L938889	ALS Contact: Natasha MM	Sampler (Initials): MDF, MLM	

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight										Hazardous?	Highly Contaminated?	Number of Containers
	TE ST4 R1	21-Sep-10		Other	X												1
	TE ST4 R2	21-Sep-10		Other	X												1
	TE ST4 R3	21-Sep-10		Other	X												1
	TE ST4 R4	21-Sep-10		Other	X												1
	TE ST5 R2	21-Sep-10		Other	X												1
	TE ST5 R3	21-Sep-10		Other	X												1
	TE ST5 R4	21-Sep-10		Other	X												1

Guidelines / Regulations	Special Instructions / Hazardous Details
	** Samples are a mix of water and sediments; please contact us regarding other analyses (e.g., ash-free DW) **

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Relinquished By:	Morgan Finley	Date & Time:	26-Sep-10	Received By:	SH	Date & Time:	04 Oct 10:40	Sample Condition (lab use only)	
Relinquished By:		Date & Time:		Received By:		Date & Time:		Temperature 14.8	Samples Received in Good Condition? Y / N (if no provided details)

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Report to:	
Company:	Azimuth Consulting Group Inc.
Contact:	Maggie McConnell
Address:	218 - 2902 West Broadway, Vancouver, BC, V6K 2G8
Phone:	604-730-1220 Fax:
Invoice To:	☑ Same as Report
Company:	
Contact:	
Address:	
Sample	
Phone:	Fax:
Lab Work Order # (lab use only)	L938889

Report Format / Distribution	
☑ Standard ☐ Other	
☑ PDF ☑ Excel ☐ Fax	
Email 1:	mmcconnell@azimuthgroup.ca
Email 2:	gmann@azimuthgroup.ca
Indicate Bottles: Filtered / Preserved (F/P) →	
Client / Project Information:	
Job #:	Meadowbank Mine EAS
PO/AFE:	
Legal Site Description:	
Quote #:	Q24230
ALS Contact:	Natasha MM
Sampler (Initials):	MDF, MLM

Service Requested:
☑ Regular Service (Default)
☐ Rush Service (2-3 Days)
☐ Priority Service (1 Day or ASAP)
☐ Emergency Service (<1 Day / Wkend) - Contact ALS

Analysis Request

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight	Hazardous?	Highly Contaminated?	Number of Containers
	TE ST1 R1	21-Sep-10		Other	X			1
	TE ST1 R2	21-Sep-10		Other	X			1
	TE ST1 R3	21-Sep-10		Other	X			1
	TE ST1 R4	21-Sep-10		Other	X			1
	SP ST1 R1	23-Sep-10		Other	X			1
	SP ST1 R2	23-Sep-10		Other	X			1
	SP ST1 R3	23-Sep-10		Other	X			1
	SP ST1 R4	23-Sep-10		Other	X			1

Guidelines / Regulations

Special Instructions / Hazardous Details

** Samples are a mix of water and sediments; please contact us regarding other analyses (e.g., ash-free DW) **

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.

Relinquished By:	Morgan Finley	Date & Time:	26-Sep-10	Received By:	SH	Date & Time:	04/Oct 10:41	Sample Condition (lab use only)
Relinquished By:	[signature]	Date & Time:		Received By:		Date & Time:		Temperature 14.8 / Samples Received in Good Condition? Y / N (if no provided details)

* L 9 3 8 8 8 9 - C O F C *

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Report to:	Report Format / Distribution	Service Requested:
Company: Azimuth Consulting Group Inc.	☑ Standard ☐ Other	☑ Regular Service (Default)
Contact: Maggie McConnell	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address: 218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1: mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
	Email 2: gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone: 604-730-1220 Fax:		Analysis Request
Invoice To: ☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →	
Company:	Client / Project Information:	
Contact:	Job #: Meadowbank Mine EAS	
Address:	PO/AFE:	
Sample	Legal Site Description:	
Phone: Fax:	Quote #: Q24230	
Lab Work Order # (lab use only) L938889	ALS Contact: Natasha MM — Sampler (Initials): MDF, MLM	

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight										Hazardous?	Highly Contaminated?	Number of Containers
	SP ST7 R1	23-Sep-10		Other	X												1
	SP ST7 R2	23-Sep-10		Other	X												1
	SP ST7 R3	23-Sep-10		Other	X												1
	SP ST7 R4	23-Sep-10		Other	X												1
	SP ST6 R1	23-Sep-10		Other	X												1
	SP ST6 R2	23-Sep-10		Other	X												1
	SP ST6 R3	23-Sep-10		Other	X												1
	SP ST6 R4	23-Sep-10		Other	X												1

Guidelines / Regulations	Special Instructions / Hazardous Details
	** Samples are a mix of water and sediments; please contact us regarding other analyses (e.g., ash-free DW) **

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Relinquished By:	Morgan Finley	Date & Time:	26-Sep-10	Received By:	SH	Date & Time:	04/Oct 10:40	Sample Condition (lab use only)	
Relinquished By:		Date & Time:		Received By:		Date & Time:		Temperature 14.8	Samples Received in Good Condition? Y / N (if no provided details)

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Contact: Maggie McConnell
Address: 218 - 2902 West Broadway, Vancouver, BC, V6K 2G8
Phone: 604-730-1220 Fax:

Invoice To: ☑ Same as Report
Company:
Contact:
Address:
Sample
Phone: Fax:

Lab Work Order # (lab use only): L938889

Report Format / Distribution
☑ Standard ☐ Other
☑ PDF ☑ Excel ☐ Fax
Email 1: mmcconnell@azimuthgroup.ca
Email 2: gmann@azimuthgroup.ca

Indicate Bottles: Filtered / Preserved (F/P) →

Client / Project Information:
Job #: Meadowbank Mine EAS
PO/AFE:
Legal Site Description:
Quote #: Q24230
ALS Contact: Natasha MM
Sampler (Initials): MDF, MLM

Service Requested:
☑ Regular Service (Default)
☐ Rush Service (2-3 Days)
☐ Priority Service (1 Day or ASAP)
☐ Emergency Service (<1 Day / Wkend) - Contact ALS

Analysis Request

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight										Hazardous?	Highly Contaminated?	Number of Containers
	TPS ST1 R1	17-Sep-10		Other	X												1
	TPS ST1 R2	17-Sep-10		Other	X												1
	TPS ST1 R3	17-Sep-10		Other	X												1
	TPS ST1 R4	17-Sep-10		Other	X												1
	TPS ST2 R1	17-Sep-10		Other	X												1
	TPS ST2 R2	17-Sep-10		Other	X												1
	TPS ST2 R3	17-Sep-10		Other	X												1
	TPS ST2 R4	17-Sep-10		Other	X												1

Guidelines / Regulations

Special Instructions / Hazardous Details
** Samples are a mix of water and sediments; please contact us regarding other analyses (e.g., ash-free DW) **

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.

Relinquished By:	Date & Time:	Received By:	Date & Time:	Sample Condition (lab use only)
Morgan Finley	26-Sep-10	SH	04 Oct 10:40	Temperature: 14.8
Relinquished By: M. Finley	Date & Time:	Received By:	Date & Time:	Samples Received in Good Condition? Y / N (if no provided details)

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Phone:	604-730-1220 Fax:
Invoice To:	☑ Same as Report
Company:	
Contact:	
Address:	
Sample	
Phone:	Fax:
Lab Work Order # (lab use only)	L938889

Report Format / Distribution	
☑ Standard ☐ Other	
☑ PDF ☑ Excel ☐ Fax	
Email 1:	mmcconnell@azimuthgroup.ca
Email 2:	gmann@azimuthgroup.ca
Indicate Bottles: Filtered / Preserved (F/P) →	
Client / Project Information:	
Job #:	Meadowbank Mine EAS
PO/AFE:	
Legal Site Description:	
Quote #:	Q24230
ALS Contact:	Natasha MM
Sampler (Initials):	MDF, MLM

Service Requested:	
☑	Regular Service (Default)
☐	Rush Service (2-3 Days)
☐	Priority Service (1 Day or ASAP)
☐	Emergency Service (<1 Day / Wkend) - Contact ALS

Analysis Request

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry Weight										Hazardous?	Highly Contaminated?	Number of Containers
	TPE ST4 R1	24-Sep-10		Other	X												1
	TPE ST4 R2	24-Sep-10		Other	X												1
	TPE ST4 R3	24-Sep-10		Other	X												1
	TPE ST4 R4	24-Sep-10		Other	X												1
	TPE ST2 OW R1	24-Sep-10		Other	X												1
	TPE ST2 OW R2	24-Sep-10		Other	X												1
	TPE ST2 OW R3	24-Sep-10		Other	X												1

Guidelines / Regulations	Special Instructions / Hazardous Details
	** Samples are a mix of water and sediments; please contact us regarding other analyses (e.g., ash-free DW) **

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.

Relinquished By:	Morgan Finley	Date & Time:	26-Sep-10	Received By:	SH	Date & Time:	04/Oct 10:40	Sample Condition (lab use only)	
Relinquished By:		Date & Time:		Received By:		Date & Time:		Temperature 14.8	Samples Received in Good Condition? Y / N (if no provided details)

APPENDIX F

PRESENCE (+) / ABSENCE (-) MATRIX OF PERIPHYTON SPECIES 2010

Appendix F. Presence (+) / absence (-) matrix of periphyton species 2010.

	Species & Code	SP-BL-1 22-Aug-10	SP-BL-2 22-Aug-10	SP-BL-3 22-Aug-10	SP-BL-4 22-Aug-10	SP-BL-5 22-Aug-10	SP-GSM-1 22-Aug-10	SP-GSM-2 22-Aug-10	SP-GSM-3 22-Aug-10	SP-GSM-4 22-Aug-10	SP-GSM-5 22-Aug-10
	Cyanophyte										
1014	*Chroococcus limneticus* Lemmermann	-	-	-	-	-	-	-	-	-	-
1015	*Chroococcus turgidus* (Kutzing) Nageli	-	-	-	-	-	-	-	-	-	-
1033	*Rhabdogloea lineare* Schmidle and Lauterbo	-	-	-	-	-	-	-	-	-	-
1040	*Phormidium*	-	-	-	-	-	-	-	-	-	-
1070	*Anabaenopsis*	-	-	-	+	-	-	+	-	+	+
1077	*Pseudoanabaena*	+	+	-	-	+	+	+	+	-	+
1081	*Nostoc*	-	-	-	+	-	-	-	-	-	-
1084	*Gloeocapsa punctata*	+	+	+	-	+	+	+	+	+	-
1104	*Scytonema*	-	-	-	-	-	-	-	-	-	-
1122	*Phormidium autumnale* Agardh	-	-	-	-	-	+	-	-	-	-
1124	*Petalonema alatum* Berk	-	-	+	-	+	+	+	+	+	+
1133	*Anabaena flos-aquae* (Lyngb.) Breb. & Borne	-	-	-	-	-	-	-	-	-	-
1135	*Anabaena mendotae*	-	-	-	-	-	-	-	-	-	-
1136	*Lyngbya mucicola* Lemmermann	+	+	+	+	+	+	+	+	+	+
1219	*Stigonema mamillosum* Gardner	-	-	-	-	-	-	-	-	-	-
1220	*Rivularia dura* Roth	-	+	-	-	-	-	-	-	-	-
1224	*Chroococcopsis fluviatilas* Geitler	-	-	-	-	-	-	-	-	-	-
	Chlorophyte										
2121	*Oocystis lacustris* Chodat	-	-	-	-	-	-	-	-	-	-
2178	*Cosmarium*	-	+	-	-	-	-	-	-	-	+
2199	*Spondylosium planum* (Wolle) W. and G.S. W	-	-	-	-	-	-	-	-	-	-
2205	*Mougeotia*	-	-	-	-	-	+	+	-	+	-
2216	*Zygnema*	-	-	-	-	-	-	-	+	+	+
2228	*Oedogonium*	-	-	-	-	-	-	-	-	-	-
2511	*Ulothrix zonata* Kutzing	-	-	-	-	-	-	-	-	-	-
	Chrysophyte										
4388	*Dinobryon sertularia* Ehrenberg	-	-	-	-	-	-	+	-	-	-
	Diatom										
5507	*Cyclotella stelligera* Cleve and Grunow	-	-	-	-	+	+	+	+	+	-
5513	*Tabellaria fenestrata* (Lyngbye) Kutzing	+	+	-	-	+	+	+	+	+	-
5514	*Tabellaria flocculsa* (Roth) Kutzing	+	+	+	+	+	+	+	+	+	+
5516	*Fragilaria construens* (Ehrenberg) Grunow	-	-	-	-	-	-	-	-	+	-
5518	*Synedra acus* Kutzing	-	-	+	-	-	-	-	-	+	-
5523	*Synedra ulna* (Nitzsch) Ehrenberg	-	-	-	-	-	-	-	-	-	-
5524	*Asterionella formosa* Hassall	-	-	-	-	-	-	-	-	-	-
5538	*Penate diatoms*	-	-	-	-	-	-	-	-	-	-
5546	*Gyrosigma*	+	-	-	-	-	-	-	-	-	-
5547	*Frustulia rhomboides* (Ehrenberg) de Toni	-	-	-	-	-	-	+	-	+	+
5551	*Cyclotella michiganiana* Skvortzow	+	-	+	+	+	+	-	-	-	+
5702	*Achnanthes minutissima* Kutzing	+	+	+	+	+	+	+	+	+	+
5720	*Cyclotella bodanica* Eulenst	-	-	-	-	-	-	-	-	-	+
5726	*Eucocconeis*	+	+	+	-	+	-	-	+	-	-
5728	*Epithemia argus* Kutzing	+	-	+	-	-	+	-	-	+	-
5733	*Eunotia pectinalis* (Kutzing) Rabenhorst	-	-	-	-	+	-	-	+	-	-
5753	*Navicula*	-	-	-	-	-	-	-	-	-	-
5778	*Stauroneis anceps* Ehrenberg	+	-	-	+	-	-	-	+	+	+
5792	*Neidium iridis* (Ehrenberg) Cleve	-	-	-	-	-	-	-	-	-	-
5794	*Pinnularia flexuosa* Cleve	-	-	-	-	-	-	-	-	-	-
5805	*Cocconies*	-	-	-	-	-	+	-	+	-	-
5821	*Eunotia exigua* (Brebisson) Grunow	-	-	-	-	-	-	-	-	-	-
5825	*Fragilaria pinata* Ehrenberg	-	-	-	-	-	-	-	-	-	-
5826	*Cymbella gracilis* (Rabhorst) Cleve	+	-	-	-	-	-	-	-	-	-
5834	*Cymbella microcephala* Grunow	+	+	+	+	-	-	-	-	-	-
5836	*Encyonema silesiacum* (Bleisch) D.G. Mann	+	-	-	+	+	+	+	+	-	-
5854	*Pinnularia borealis* Ehrenberg	-	+	-	+	-	-	+	-	-	-
5860	*Diatoma vulgare* Bory	+	+	+	+	+	+	+	-	-	+
5865	*Cymbella prostata* (Berkeley) Cleve	-	-	-	-	-	-	+	-	-	-
5866	*Surirella ovata* Kutzing	-	-	-	-	-	-	-	-	-	-
5870	*Navicula radiosa* Kutzing	-	-	+	-	-	-	-	+	+	-
5871	*Cymbella lapponica*	+	-	-	-	-	-	+	+	-	-
5873	*Gomphonema minutum*	-	+	+	-	-	+	-	-	-	+
5874	*Nitzschia palea* (Kutzing) W. Smith	-	+	+	-	-	-	-	-	-	-
5882	*Anomoenies vitrea* Ross	+	+	+	+	+	+	+	+	+	+
5884	*Gomphonema angustum* Agardh	-	-	-	-	-	-	-	-	+	-
5887	*Navicula pupula* Kutzing	-	+	+	+	+	-	-	-	-	-
5916	*Fragilaria capucina* Grunow	+	+	+	+	-	+	+	+	+	-
	Dinoflagellate										
7632	*Gymnodinium*	-	-	-	-	-	-	-	-	-	-

Appendix F. Presence (+) / absence (-) matrix of periphyton species 2010.

	Species & Code	SP-AZI-1 22-Aug-10	SP-AZI-2 22-Aug-10	SP-AZI-3 22-Aug-10	SP-AZI-4 22-Aug-10	SP-AZI-5 22-Aug-10	SP-ISLA-1 21-Aug-10	SP-ISLA-2 21-Aug-10	SP-ISLA-3 21-Aug-10	SP-ISLA-4 21-Aug-10	SP-ISLA-5 21-Aug-10
	Cyanophyte										
1014	*Chroococcus limneticus* Lemmermann	-	+	-	-	+	-	-	-	-	-
1015	*Chroococcus turgidus* (Kutzing) Nageli	-	-	-	-	-	-	+	-	-	-
1033	*Rhabdogloea lineare* Schmidle and Lauterbo	+	-	-	-	-	+	-	-	-	-
1040	*Phormidium*	-	-	-	+	-	-	-	-	-	-
1070	*Anabaenopsis*	+	+	+	+	-	-	+	+	+	-
1077	*Pseudoanabaena*	-	-	-	-	-	-	-	+	-	-
1081	*Nostoc*	-	-	-	-	-	-	-	-	-	-
1084	*Gloeocapsa punctata*	-	-	+	+	+	+	+	+	-	+
1104	*Scytonema*	-	-	-	-	-	+	-	-	+	-
1122	*Phormidium autumnale* Agardh	-	-	-	-	-	-	-	-	-	+
1124	*Petalonema alatum* Berk	+	+	+	+	+	+	+	+	+	-
1133	*Anabaena flos-aquae* (Lyngb.) Breb. & Borne	-	-	-	-	-	-	-	-	-	-
1135	*Anabaena mendotae*	-	+	-	-	-	-	-	-	-	-
1136	*Lyngbya mucicola* Lemmermann	+	-	+	+	+	+	+	+	+	+
1219	*Stigonema mamillosum* Gardner	-	-	-	-	-	-	-	-	-	-
1220	*Rivularia dura* Roth	-	-	-	-	+	-	-	-	-	+
1224	*Chroococcopsis fluviatilas* Geitler	-	-	-	-	-	-	-	-	-	-
	Chlorophyte										
2121	*Oocystis lacustris* Chodat	-	-	-	-	-	-	-	-	-	-
2178	*Cosmarium*	-	-	-	-	-	-	-	-	-	-
2199	*Spondylosium planum* (Wolle) W. and G.S. W	-	-	-	-	-	-	-	-	-	+
2205	*Mougeotia*	+	+	+	-	+	+	-	-	-	-
2216	*Zygnema*	-	-	+	-	-	-	-	+	+	+
2228	*Oedogonium*	-	+	-	-	-	-	-	-	-	-
2511	*Ulothrix zonata* Kutzing	-	-	-	+	-	-	-	-	-	-
	Chrysophyte										
4388	*Dinobryon sertularia* Ehrenberg	-	-	-	-	-	-	-	-	-	-
	Diatom										
5507	*Cyclotella stelligera* Cleve and Grunow	-	-	+	-	-	-	-	-	-	-
5513	*Tabellaria fenestrata* (Lyngbye) Kutzing	-	-	+	+	-	+	+	+	+	+
5514	*Tabellaria flocculsa* (Roth) Kutzing	+	+	+	+	+	+	+	+	+	+
5516	*Fragilaria construens* (Ehrenberg) Grunow	+	-	-	-	-	-	-	-	+	-
5518	*Synedra acus* Kutzing	-	-	+	-	-	-	-	-	-	+
5523	*Synedra ulna* (Nitzsch) Ehrenberg	-	+	-	-	-	-	-	-	-	-
5524	*Asterionella formosa* Hassall	-	-	-	-	-	-	-	-	-	-
5538	*Penate diatoms*	-	-	-	-	-	-	-	-	-	-
5546	*Gyrosigma*	-	-	+	-	-	-	-	+	-	+
5547	*Frustulia rhomboides* (Ehrenberg) de Toni	-	-	+	+	+	-	-	-	+	+
5551	*Cyclotella michiganiana* Skvortzow	+	-	-	+	+	-	-	-	-	+
5702	*Achnanthes minutissima* Kutzing	+	+	+	+	+	+	+	+	+	+
5720	*Cyclotella bodanica* Eulenst	-	-	-	-	-	-	-	-	-	-
5726	*Eucocconeis*	+	+	+	+	+	-	-	+	-	+
5728	*Epithemia argus* Kutzing	-	-	-	-	-	-	-	-	-	-
5733	*Eunotia pectinalis* (Kutzing) Rabenhorst	-	-	-	-	-	-	+	-	-	-
5753	*Navicula*	+	-	-	-	-	-	-	-	-	-
5778	*Stauroneis anceps* Ehrenberg	+	-	-	-	-	+	+	+	+	-
5792	*Neidium iridis* (Ehrenberg) Cleve	-	-	-	-	+	-	-	-	-	-
5794	*Pinnularia flexuosa* Cleve	-	-	-	-	-	-	-	-	-	-
5805	*Cocconies*	-	-	-	-	-	-	+	-	-	-
5821	*Eunotia exigua* (Brebisson) Grunow	-	-	-	-	+	-	-	-	-	-
5825	*Fragilaria pinata* Ehrenberg	-	-	-	-	-	-	-	+	-	-
5826	*Cymbella gracilis* (Rabhorst) Cleve	-	-	-	-	-	-	-	-	-	-
5834	*Cymbella microcephala* Grunow	+	+	-	-	-	-	-	-	-	-
5836	*Encyonema silesiacum* (Bleisch) D.G. Mann	-	+	+	-	+	-	-	-	-	+
5854	*Pinnularia borealis* Ehrenberg	-	-	-	-	-	-	+	-	-	+
5860	*Diatoma vulgare* Bory	+	-	-	-	-	-	+	-	+	+
5865	*Cymbella prostata* (Berkeley) Cleve	-	-	-	+	-	+	+	-	-	-
5866	*Surirella ovata* Kutzing	-	-	-	-	-	-	-	+	-	-
5870	*Navicula radiosa* Kutzing	+	+	-	-	-	-	-	-	+	-
5871	*Cymbella lapponica*	+	+	-	-	+	-	-	-	-	-
5873	*Gomphonema minutum*	-	-	-	+	-	+	+	-	-	-
5874	*Nitzschia palea* (Kutzing) W. Smith	+	-	-	-	-	-	+	-	-	-
5882	*Anomoenies vitrea* Ross	+	+	+	+	+	+	+	+	+	+
5884	*Gomphonema angustum* Agardh	-	-	-	-	-	-	-	-	-	-
5887	*Navicula pupula* Kutzing	-	-	-	+	-	-	-	-	+	+
5916	*Fragilaria capucina* Grunow	+	+	+	+	+	+	-	+	+	+
	Dinoflagellate										
7632	*Gymnodinium*	-	-	-	-	-	-	-	-	-	-

Appendix F. Presence (+) / absence (-) matrix of periphyton species 2010.

	Species & Code	SP-CREMP-1 23-Aug-10	SP-CREMP-2 23-Aug-10	SP-CREMP-3 23-Aug-10	SP-CREMP-4 23-Aug-10	SP-CREMP-5 23-Aug-10	SP-DT-1 23-Aug-10	SP-DT-2 23-Aug-10	SP-DT-3 24-Aug-10	SP-DT-4 24-Aug-10	SP-DT-5 24-Aug-10
	Cyanophyte										
1014	*Chroococcus limneticus* Lemmermann	-	-	-	-	-	-	-	+	+	-
1015	*Chroococcus turgidus* (Kutzing) Nageli	-	-	-	-	-	-	-	-	-	-
1033	*Rhabdogloea lineare S* chmidle and Lauterbo	-	-	+	-	-	-	-	+	-	-
1040	*Phormidium*	-	-	-	-	-	-	-	-	-	-
1070	*Anabaenopsis*	+	+	-	+	+	+	+	+	+	+
1077	*Pseudoanabaena*	+	+	+	-	-	-	-	-	-	-
1081	*Nostoc*	-	+	-	-	+	-	-	-	-	-
1084	*Gloeocapsa punctata*	+	+	+	+	+	+	+	+	+	+
1104	*Scytonema*	-	-	-	-	-	-	-	-	-	-
1122	*Phormidium autumnale* Agardh	-	-	-	-	-	-	-	-	-	-
1124	*Petalonema alatum* Berk	+	+	-	+	-	+	+	+	-	-
1133	*Anabaena flos-aquae* (Lyngb.) Breb. & Borne	-	-	-	-	-	-	+	-	-	-
1135	*Anabaena mendotae*	-	-	-	-	-	-	-	-	-	-
1136	*Lyngbya mucicola* Lemmermann	+	+	+	+	+	+	+	+	+	+
1219	*Stigonema mamillosum* Gardner	-	-	-	-	-	-	-	-	-	+
1220	*Rivularia dura* Roth	-	-	-	+	+	+	+	-	-	-
1224	*Chroococcopsis fluviatilas* Geitler	-	-	+	-	-	-	-	-	-	-
	Chlorophyte										
2121	*Oocystis lacustris* Chodat	-	-	-	-	-	-	+	-	-	-
2178	*Cosmarium*	-	-	-	-	-	-	-	-	+	-
2199	*Spondylosium planum* (Wolle) W. and G.S. W	-	-	-	-	-	-	-	-	-	-
2205	*Mougeotia*	+	-	+	-	+	-	-	+	+	-
2216	*Zygnema*	+	-	-	-	+	-	-	-	-	-
2228	*Oedogonium*	-	-	-	-	-	-	-	+	-	-
2511	*Ulothrix zonata* Kutzing	-	-	-	-	-	-	-	-	-	+
	Chrysophyte										
4388	*Dinobryon sertularia* Ehrenberg	-	-	-	-	-	-	-	-	-	-
	Diatom										
5507	*Cyclotella stelligera* Cleve and Grunow	-	+	-	-	+	-	-	+	+	-
5513	*Tabellaria fenestrata* (Lyngbye) Kutzing	+	+	-	-	+	+	+	+	+	-
5514	*Tabellaria flocculsa* (Roth) Kutzing	+	+	+	+	+	+	+	+	+	+
5516	*Fragilaria construens* (Ehrenberg) Grunow	-	-	-	-	-	-	-	-	-	-
5518	*Synedra acus* Kutzing	-	+	-	-	-	-	-	-	-	-
5523	*Synedra ulna* (Nitzsch) Ehrenberg	-	-	-	-	-	-	+	-	-	-
5524	*Asterionella formosa* Hassall	-	-	-	+	-	-	-	-	-	-
5538	*Penate diatoms*	-	-	+	-	-	-	-	-	-	-
5546	*Gyrosigma*	+	-	+	-	-	-	-	+	-	-
5547	*Frustulia rhomboides* (Ehrenberg) de Toni	+	+	-	-	+	-	-	-	-	+
5551	*Cyclotella michiganiana* Skvortzow	+	-	-	-	+	-	-	-	-	-
5702	*Achnanthes minutissima* Kutzing	+	+	+	+	+	+	+	+	+	+
5720	*Cyclotella bodanica* Eulenst	-	-	-	-	-	-	-	-	-	-
5726	*Eucocconeis*	+	-	-	+	+	+	-	+	-	+
5728	*Epithemia argus* Kutzing	-	-	-	+	-	+	-	+	+	+
5733	*Eunotia pectinalis* (Kutzing) Rabenhorst	-	-	-	-	-	-	-	-	-	-
5753	*Navicula*	-	-	-	-	-	-	-	-	-	-
5778	*Stauroneis anceps* Ehrenberg	-	-	-	-	-	-	-	-	-	-
5792	*Neidium iridis* (Ehrenberg) Cleve	-	-	-	-	-	-	-	+	-	-
5794	*Pinnularia flexuosa* Cleve	-	-	-	-	-	-	-	+	-	-
5805	*Cocconies*	-	-	-	+	-	-	-	-	-	-
5821	*Eunotia exigua* (Brebisson) Grunow	-	-	-	-	-	-	-	-	+	-
5825	*Fragilaria pinata* Ehrenberg	-	-	+	-	-	-	+	-	-	+
5826	*Cymbella gracilis* (Rabhorst) Cleve	-	-	-	-	-	-	-	-	-	-
5834	*Cymbella microcephala* Grunow	-	+	+	-	-	-	+	+	+	+
5836	*Encyonema silesiacum* (Bleisch) D.G. Mann	+	-	+	+	+	-	+	+	-	+
5854	*Pinnularia borealis* Ehrenberg	-	-	-	-	-	-	-	-	-	-
5860	*Diatoma vulgare* Bory	+	+	+	+	-	-	-	-	+	+
5865	*Cymbella prostata* (Berkeley) Cleve	+	+	+	-	-	-	-	-	-	-
5866	*Surirella ovata* Kutzing	-	-	-	-	-	-	-	-	-	-
5870	*Navicula radiosa* Kutzing	-	-	-	-	-	+	-	-	+	+
5871	*Cymbella lapponica*	-	+	+	-	-	+	+	-	+	+
5873	*Gomphonema minutum*	-	-	-	-	-	+	+	-	+	-
5874	*Nitzschia palea* (Kutzing) W. Smith	-	+	-	+	+	-	-	-	-	+
5882	*Anomoenies vitrea* Ross	+	+	+	+	+	+	+	+	+	+
5884	*Gomphonema angustum* Agardh	-	+	+	+	-	-	-	-	-	+
5887	*Navicula pupula* Kutzing	-	+	-	+	+	+	-	+	+	+
5916	*Fragilaria capucina* Grunow	+	+	+	+	+	+	+	+	+	+
	Dinoflagellate										
7632	*Gymnodinium*	+	-	-	-	-	-	-	-	-	-

APPENDIX G

PERIPHYTON LOSS ON IGNITION LABORATORY DATA – ALS ENVIRONMENTAL

AZIMUTH CONSULTING GROUP INC.
ATTN: MAGGIE McCONNELL
218 - 2902 WEST BROADWAY
VANCOUVER BC V6K 2G8
Phone: 604-730-1220

Date Received: 03-SEP-10
Report Date: 15-OCT-10 17:38 (MT)
Version: FINAL

Certificate of Analysis

Lab Work Order #: L928174
Project P.O. #: NOT SUBMITTED
Job Reference: MEADOWBANK MINE EAS PERI
Legal Site Desc:
C of C Numbers:

Natasha Markovic-Mirovic
Account Manager

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L928174-1	L928174-2	L928174-3	L928174-4	L928174-5
	Description					
	Sampled Date	21-AUG-10	21-AUG-10	21-AUG-10	21-AUG-10	21-AUG-10
	Sampled Time					
	Client ID	SP-ISLA-1	SP-ISLA-2	SP-ISLA-3	SP-ISLA-4	SP-ISLA-5
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.867	1.59	0.591	0.854	0.308
	Ash Weight (g)	0.770	1.47	0.517	0.736	0.237
	Ash Free Dry Weight (g)	0.0967	0.116	0.0743	0.118	0.0711

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L928174-6	L928174-7	L928174-8	L928174-9	L928174-10
	Description					
	Sampled Date	22-AUG-10	22-AUG-10	22-AUG-10	22-AUG-10	22-AUG-10
	Sampled Time					
	Client ID	SP-BL-1	SP-BL-2	SP-BL-3	SP-BL-4	SP-BL-5
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	1.44	0.829	3.04	2.92	1.81
	Ash Weight (g)	1.32	0.773	2.88	2.79	1.72
	Ash Free Dry Weight (g)	0.127	0.0564	0.163	0.134	0.0957

ALS LABORATORY GROUP ANALYTICAL REPORT

		L928174-11	L928174-12	L928174-13	L928174-14	L928174-15
	Sample ID	L928174-11	L928174-12	L928174-13	L928174-14	L928174-15
	Description					
	Sampled Date	22-AUG-10	22-AUG-10	22-AUG-10	22-AUG-10	22-AUG-10
	Sampled Time					
	Client ID	SP-GSM-1	SP-GSM-2	SP-GSM-3	SP-GSM-4	SP-GSM-5
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	1.32	0.483	0.928	0.620	0.712
	Ash Weight (g)	1.17	0.418	0.783	0.532	0.553
	Ash Free Dry Weight (g)	0.145	0.0645	0.146	0.0875	0.159

ALS LABORATORY GROUP ANALYTICAL REPORT

		Sample ID	L928174-16	L928174-17	L928174-18	L928174-19	L928174-20
		Description					
		Sampled Date	22-AUG-10	22-AUG-10	22-AUG-10	22-AUG-10	22-AUG-10
		Sampled Time					
		Client ID	SP-AZI-1	SP-AZI-2	SP-AZI-3	SP-AZI-4	SP-AZI-5
Grouping	**Analyte**						
TISSUE							
Physical Tests	Dry Weight (g)		0.406	0.480	0.659	0.548	0.478
	Ash Weight (g)		0.367	0.379	0.570	0.428	0.402
	Ash Free Dry Weight (g)		0.0395	0.101	0.0888	0.121	0.0765

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L928174-21	L928174-22	L928174-23	L928174-24	L928174-25
	Description					
	Sampled Date	23-AUG-10	23-AUG-10	23-AUG-10	23-AUG-10	23-AUG-10
	Sampled Time					
	Client ID	SP-CREMP-1	SP-CREMP-2	SP-CREMP-3	SP-CREMP-4	SP-CREMP-5
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.791	0.417	0.248	0.712	0.607
	Ash Weight (g)	0.521	0.369	0.198	0.393	0.480
	Ash Free Dry Weight (g)	0.270	0.0485	0.0498	0.318	0.127

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L928174-26	L928174-27	L928174-28	L928174-29	L928174-30
	Description					
	Sampled Date	23-AUG-10	23-AUG-10	24-AUG-10	24-AUG-10	24-AUG-10
	Sampled Time					
	Client ID	SP-DT-1	SP-DT-2	SP-DT-3	SP-DT-4	SP-DT-5
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.319	0.201	0.224	0.258	0.660
	Ash Weight (g)	0.177	0.102	0.115	0.149	0.327
	Ash Free Dry Weight (g)	0.142	0.0991	0.109	0.109	0.333

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ASHFREE-DRY-VA	Tissue	Ash Free Dry Weight	44.3 ASH CONTENT & ORG. MATTER CONTENT

This analysis is carried out using procedures adapted from the Canadian Society of Soil Science method "44.3 Ash Content and Organic Matter Content", (1993). Ash Free Dry Weight is determined by the difference between 'Dry Weight' and 'Ash Weight' which are both determined gravimetrically. Dry Weight is determined by drying the sample at 105 ”C and the Ash Weight is subsequently determined by ashing the dried sample at 550 ”C.

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

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

Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

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

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

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

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

COC # ____

Report to: ~~Randy Baker~~	**Report Format / Distribution**	**Service Requested:**
Company: Azimuth Consulting Group Inc.	☑ Standard ☐ Other	☑ Regular Service (Default)
Contact: Maggie McConnell	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address: 218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1: mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
	Email 2: gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone: 604-730-1220 Fax:		**Analysis Request**
Invoice To: ☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →→	
Company:	**Client / Project Information:**	
Contact:	Job #: Meadowbank Mine EAS Peri	
Address:	PO/AFE:	
Sample	Legal Site Description:	
Phone: Fax:	Quote #: Q24230	
Lab Work Order # (lab use only): C928174	ALS Contact: Natasha MM; Sampler (Initials): MF/AC/ZI	

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry weight (in dry weight, not %	Ash-Free DW (in dw, not %)									Hazardous?	Highly Contaminated?	Number of Containers
1	SP-ISLA-1	21-Aug-10		Other	x	x											1
2	SP-ISLA-2	21-Aug-10		Other	x	x											1
3	SP-ISLA-3	21-Aug-10		Other	x	x											1
4	SP-ISLA-4	21-Aug-10		Other	x	x											1
5	SP-ISLA-5	21-Aug-10		Other	x	x											1
6	SP-BL-1	22-Aug-10		Other	x	x											1
7	SP-BL-2	22-Aug-10		Other	x	x											1
8	SP-BL-3	22-Aug-10		Other	x	x											1
9	SP-BL-4	22-Aug-10		Other	x	x											1
10	SP-BL-5	22-Aug-10		Other	x	x											1

Guidelines / Regulations	Special Instructions / Hazardous Details
	Samples are periphyton, with sediment mixed in; not preserved; email Gary Mann if there are any questions

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.

Relinquished By:	Date & Time:	Received By:	Date & Time:	Sample Condition (lab use only)	
Morgan Finley	29-Aug-10			Temperature	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By: M Finley	Date & Time	Received By: R.C	Date & Time: 03/09 10:35	15.2	

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ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

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

COC # ______

Report to:	**Randy Baker**
Company:	Azimuth Consulting Group Inc.
Contact:	Maggie McConnell
Address:	218 - 2902 West Broadway, Vancouver, BC, V6K 2G8
Phone:	604-730-1220 Fax:
Invoice To:	☑ Same as Report
Company:	
Contact:	
Address:	
Sample	
Phone:	Fax:
Lab Work Order # (lab use only)	

Report Format / Distribution	
☑ Standard ☐ Other	
☑ PDF ☑ Excel ☐ Fax	
Email 1:	mmcconnell@azimuthgroup.ca
Email 2:	gmann@azimuthgroup.ca
Client / Project Information:	
Job #:	Meadowbank Mine (EAS) Peri
PO/AFE:	
Legal Site Description:	
Quote #:	Q24230
ALS Contact:	Natasha MM
Sampler (Initials):	MF/AC/ZI

Service Requested:
- ☑ Regular Service (Default)
- ☐ Rush Service (2-3 Days)
- ☐ Priority Service (1 Day or ASAP)
- ☐ Emergency Service (<1 Day / Wkend) - Contact ALS

Analysis Request

Indicate Bottles: Filtered / Preserved (F/P) →→

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry weight (in dry weight, not	Ash-Free DW (in dw, not %)	Hazardous?	Highly Contaminated?	Number of Containers
11	SP-GSM-1	22-Aug-10		Other	x	x			1
12	SP-GSM-2	22-Aug-10		Other	x	x			1
13	SP-GSM-3	22-Aug-10		Other	x	x			1
14	SP-GSM-4	22-Aug-10		Other	x	x			1
15	SP-GSM-5	22-Aug-10		Other	x	x			1
16	SP-AZI-1	22-Aug-10		Other	x	x			1
17	SP-AZI-2	22-Aug-10		Other	x	x			1
18	SP-AZI-3	22-Aug-10		Other	x	x			1
19	SP-AZI-4	22-Aug-10		Other	x	x			1
20	SP-AZI-5	22-Aug-10		Other	x	x			1

Guidelines / Regulations

Special Instructions / Hazardous Details

Samples are periphyton, with sediment mixed in; not preserved; email Gary Mann if there are any questions

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.

Relinquished By:	Morgan Finley	Date & Time:	29-Aug-10	Received By:		Date & Time:	
Relinquished By:	[signature]	Date & Time:		Received By:	RC	Date & Time:	03/09 10:35

Sample Condition (lab use only)	
Temperature	Samples Received in Good Condition? Y / N (if no provided details)
15.2	

ALS Laboratory Group
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Environmental Division

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

COC # ____________

Report to: Randy Baker	**Report Format / Distribution**	**Service Requested:**
Company: Azimuth Consulting Group Inc.	☑ Standard ☐ Other	☑ Regular Service (Default)
Contact: Maggie McConnell	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address: 218 - 2902 West Broadway, Vancouver, BC, V6K 2G8	Email 1: mmcconnell@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
	Email 2: gmann@azimuthgroup.ca	☐ Emergency Service (<1 Day / Wkend) - Contact ALS
Phone: 604-730-1220 Fax:		**Analysis Request**
Invoice To: ☑ Same as Report	Indicate Bottles. Filtered / Preserved (F/P) →→	
Company:	**Client / Project Information:**	
Contact:	Job #: Meadowbank Mine EAS Peri;	
Address:	PO/AFE:	
Sample	Legal Site Description:	
Phone: Fax:	Quote #: Q24230	
Lab Work Order # (lab use only)	ALS Contact: Natasha MM; Sampler (Initials): MF/AC/ZI	

Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-yy	Time hh:mm	Sample Type (Select from drop-down list)	Dry weight (in dry weight, not %	Ash-Free DW (in dw, not %)	Hazardous?	Highly Contaminated?	Number of Containers
01	SP-CREMP-1	23-Aug-10		Other	x	x			1
22	SP-CREMP-2	23-Aug-10		Other	x	x			1
23	SP-CREMP-3	23-Aug-10		Other	x	x			1
24	SP-CREMP-4	23-Aug-10		Other	x	x			1
25	SP-CREMP-5	23-Aug-10		Other	x	x			1
26	SP-DT-1	23-Aug-10		Other	x	x			1
27	SP-DT-2	23-Aug-10		Other	x	x			1
28	SP-DT-3	24-Aug-10		Other	x	x			1
29	SP-DT-4	24-Aug-10		Other	x	x			1
30	SP-DT-5	24-Aug-10		Other	x	x			1

Guidelines / Regulations	Special Instructions / Hazardous Details
	Samples are periphyton, with sediment mixed in; not preserved; email Gary Mann if there are any questions

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.

								Sample Condition (lab use only)	
Relinquished By:	Morgan Finley	Date & Time:	29-Aug-10	Received By:		Date & Time:		Temperature	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By:	[signature]	Date & Time:		Received By:		Date & Time:			

APPENDIX H

BENTHIC INVERTEBRATE SUMMARIZED AND RAW DATA, MEADOWBANK EAS 2010

Benthic invertebrate total abundance (#/m^2), Meadowbank EAS 2010.

Station	Date	Depth	Total Abundance (#/m^2)				Total	Simpson's Diversity
			Oligochaetes	Insects	Molluscs	Other Taxa		
Third Portage Lake								
TP-E1-1	25-Aug-10	7.4	0	196	174	22	391	0.81
TP-E1-2	25-Aug-10	7.5	22	370	261	0	652	0.87
TP-E1-3	25-Aug-10	8.0	22	152	391	43	609	0.76
TP-E1-4	25-Aug-10	8.0	0	261	326	22	609	0.80
TP-E1-5	25-Aug-10	8.5	0	87	130	0	217	0.87
		Station Mean	***9***	***213***	***257***	***17***	***496***	***0.82***
TP-E2-1	27-Aug-10	9.5	0	587	261	43	891	0.88
TP-E2-2	27-Aug-10	10.0	22	304	391	0	717	0.66
TP-E2-3	27-Aug-10	9.9	65	935	630	22	1652	0.82
TP-E2-4	27-Aug-10	9.0	22	326	500	65	913	0.68
TP-E2-5	27-Aug-10	8.9	22	217	130	0	370	0.87
		Station Mean	***26***	***474***	***383***	***26***	***909***	***0.78***
TP-E3-1	25-Aug-10	11.0	0	261	652	0	913	0.53
TP-E3-2	25-Aug-10	12.0	0	152	370	43	565	0.58
TP-E3-3	28-Aug-10	10.0	0	43	174	0	217	0.53
TP-E3-4	28-Aug-10	10.0	22	261	457	22	761	0.61
TP-E3-5	28-Aug-10	10.0	0	239	348	87	674	0.78
		Station Mean	***4***	***191***	***400***	***30***	***626***	***0.61***
HVH4-1	24-Aug-10	7.5	22	87	174	0	283	0.60
HVH4-2	24-Aug-10	7.8	0	87	217	65	370	0.66
HVH4-3	24-Aug-10	7.0	0	304	283	0	587	0.74
HVH4-4	24-Aug-10	7.2	43	500	239	65	848	0.89
HVH4-5	24-Aug-10	8.0	0	0	109	0	109	0.40
		Station Mean	***13***	***196***	***204***	***26***	***439***	***0.66***
Second Portage Lake								
SP-DT-1	23-Aug-10	7.4	43	478	522	43	1087	0.77
SP-DT-2	23-Aug-10	8.5	65	326	152	109	652	0.91
SP-DT-3	23-Aug-10	8.7	43	261	435	109	848	0.71
SP-DT-4	23-Aug-10	7.3	87	283	370	130	870	0.81
SP-DT-5	23-Aug-10	9.8	0	391	130	109	630	0.85
		Station Mean	***48***	***348***	***322***	***100***	***817***	***0.81***
SP-F1-1	20-Aug-10	7.7	43	696	435	174	1348	0.82
SP-F1-2	20-Aug-10	9.6	22	500	587	196	1304	0.74
SP-F1-3	20-Aug-10	8.5	0	457	239	65	761	0.71
SP-F1-4	20-Aug-10	9.7	0	761	413	65	1239	0.75
SP-F1-5	20-Aug-10	9.9	0	543	348	130	1022	0.83
		Station Mean	***13***	***591***	***404***	***126***	***1135***	***0.77***
SP-F2-1	23-Aug-10	7.4	0	348	326	43	717	0.80
SP-F2-2	23-Aug-10	7.8	22	217	239	0	478	0.79
SP-F2-3	23-Aug-10	7.2	22	1696	609	22	2348	0.64
SP-F2-4	23-Aug-10	7.2	0	1457	348	22	1826	0.74
SP-F2-5	23-Aug-10	7.8	0	130	457	109	696	0.76
		Station Mean	***9***	***770***	***396***	***39***	***1213***	***0.75***
SP-N1-1	20-Aug-10	8.0	22	848	500	152	1522	0.80
SP-N1-2	20-Aug-10	7.5	0	848	304	65	1217	0.57
SP-N1-3	20-Aug-10	7.1	0	0	130	22	152	0.29
SP-N1-4	20-Aug-10	10.0	0	2000	522	87	2609	0.74
SP-N1-5	20-Aug-10	7.2	0	130	457	109	696	0.55
		Station Mean	***4***	***765***	***383***	***87***	***1239***	***0.59***
SP-N2-1	20-Aug-10	8.2	22	261	370	43	696	0.69
SP-N2-2	20-Aug-10	7.5	0	761	304	0	1065	0.78
SP-N2-3	20-Aug-10	8.7	109	870	391	65	1435	0.66
SP-N2-4	20-Aug-10	9.3	22	239	370	22	652	0.67
SP-N2-5	20-Aug-10	8.3	87	565	196	87	935	0.86
		Station Mean	***48***	***539***	***326***	***43***	***957***	***0.73***
SP-N3-1	19-Aug-10	7.4	0	130	109	65	304	0.79
SP-N3-2	19-Aug-10	8.9	22	196	152	43	413	0.84
SP-N3-3	19-Aug-10	9.2	65	217	522	109	913	0.82
SP-N3-4	19-Aug-10	8.7	0	196	674	65	935	0.56
SP-N3-5	19-Aug-10	7.3	43	457	435	0	935	0.76
		Station Mean	***26***	***239***	***378***	***57***	***700***	***0.75***

Benthic invertebrate total richness (#taxa), Meadowbank EAS 2010.

Station	Date	Depth (m)	Total Richness (#/taxa)				Total
			Oligochaetes	Insects	Molluscs	Other Taxa	
Third Portage Lake							
TP-E1-1	25-Aug-10	7.4	0	4	2	1	7
TP-E1-2	25-Aug-10	7.5	1	5	2	0	8
TP-E1-3	25-Aug-10	8.0	1	5	2	1	9
TP-E1-4	25-Aug-10	8.0	0	3	2	1	6
TP-E1-5	25-Aug-10	8.5	0	4	2	0	6
		Station Mean	***0***	***4***	***2***	***1***	***7***
TP-E2-1	27-Aug-10	9.5	0	9	2	1	12
TP-E2-2	27-Aug-10	10.0	1	6	1	0	8
TP-E2-3	27-Aug-10	9.9	1	7	2	1	11
TP-E2-4	27-Aug-10	9.0	1	5	1	1	8
TP-E2-5	27-Aug-10	8.9	1	7	1	0	9
		Station Mean	***1***	***7***	***1***	***1***	***10***
TP-E3-1	25-Aug-10	11.0	0	3	2	0	5
TP-E3-2	25-Aug-10	12.0	0	5	1	1	7
TP-E3-3	28-Aug-10	10.0	0	2	2	0	4
TP-E3-4	28-Aug-10	10.0	1	4	1	1	7
TP-E3-5	28-Aug-10	10.0	0	6	2	1	9
		Station Mean	***0***	***4***	***2***	***1***	***6***
HVH4-1	24-Aug-10	7.5	1	2	1	0	4
HVH4-2	24-Aug-10	7.8	0	4	1	2	7
HVH4-3	24-Aug-10	7.0	0	5	2	0	7
HVH4-4	24-Aug-10	7.2	2	7	2	1	12
HVH4-5	24-Aug-10	8.0	0	0	2	0	2
		Station Mean	***1***	***4***	***2***	***1***	***6***
Second Portage Lake							
SP-DT-1	23-Aug-10	7.4	0	7	2	1	10
SP-DT-2	23-Aug-10	8.5	1	5	3	1	10
SP-DT-3	23-Aug-10	8.7	1	5	1	1	8
SP-DT-4	23-Aug-10	7.3	1	5	3	1	10
SP-DT-5	23-Aug-10	9.8	0	6	1	1	8
		Station Mean	***1***	***6***	***2***	***1***	***9***
SP-F1-1	20-Aug-10	7.7	0	6	1	1	8
SP-F1-2	20-Aug-10	9.6	1	6	1	1	9
SP-F1-3	20-Aug-10	8.5	0	3	1	1	5
SP-F1-4	20-Aug-10	9.7	0	6	1	1	8
SP-F1-5	20-Aug-10	9.9	0	8	1	1	10
		Station Mean	***0***	***6***	***1***	***1***	***8***
SP-F2-1	23-Aug-10	7.4	0	4	2	1	7
SP-F2-2	23-Aug-10	7.8	1	4	2	0	7
SP-F2-3	23-Aug-10	7.2	0	6	2	1	9
SP-F2-4	23-Aug-10	7.2	0	7	2	1	10
SP-F2-5	23-Aug-10	7.8	0	4	2	1	7
		Station Mean	***0***	***5***	***2***	***1***	***8***
SP-N1-1	20-Aug-10	8.0	0	5	2	1	8
SP-N1-2	20-Aug-10	7.5	0	4	1	1	6
SP-N1-3	20-Aug-10	7.1	0	0	1	1	2
SP-N1-4	20-Aug-10	10.0	0	7	2	1	10
SP-N1-5	20-Aug-10	7.2	0	4	1	1	6
		Station Mean	***0***	***4***	***1***	***1***	***6***
SP-N2-1	20-Aug-10	8.2	1	5	1	1	8
SP-N2-2	20-Aug-10	7.5	0	5	2	0	7
SP-N2-3	20-Aug-10	8.7	0	3	2	1	6
SP-N2-4	20-Aug-10	9.3	1	6	1	1	9
SP-N2-5	20-Aug-10	8.3	0	5	2	1	8
		Station Mean	***0***	***5***	***2***	***1***	***8***
SP-N3-1	19-Aug-10	7.4	0	2	2	1	5
SP-N3-2	19-Aug-10	8.9	0	6	1	1	8
SP-N3-3	19-Aug-10	9.2	1	4	2	1	8
SP-N3-4	19-Aug-10	8.7	0	4	2	1	7
SP-N3-5	19-Aug-10	7.3	1	6	2	0	9
		Station Mean	***0***	***4***	***2***	***1***	***7***

Appendix H. Benthic invertebrate raw data (total number of organisms in two 0.023 m2 grabs), Meadowbank EAS 2010.

Station	**HVH-4**	**HVH-4**	**HVH-4**	**HVH-4**	**HVH-4**	**SP-DT**	**SP-DT**	**SP-DT**	**SP-DT**	**SP-DT**	**SP-F1**	**SP-F1**	**SP-F1**	**SP-F1**	**SP-F1**	**SP-N1**	**SP-N1**	**SP-N1**	**SP-N1**	**SP-N1**	**SP-N2**	**SP-N2**	**SP-N2**
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3
Depth (m)	7.5	7.8	7.0	7.2	8.0	7.4	8.5	8.7	7.3	9.8	7.7	9.6	8.5	9.7	9.9	8.0	7.5	7.1	10.0	7.2	8.2	7.5	8.7
# Grabs/sample	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mesh Size (µm)	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Date	24-Aug-10	24-Aug-10	24-Aug-10	24-Aug-10	24-Aug-10	23-Aug-10	23-Aug-10	23-Aug-10	23-Aug-10	23-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10
ROUNDWORMS																							
P. Nemata			3					1	1	1	1	2	2	6	2		1	6	3				
FLATWORMS																							
P. Platyhelminthes																							
Cl. Turbellaria																							
indeterminate																							
ANNELIDS																							
P. Annelida																							
WORMS																							
Cl. Oligochaeta																							
F. Enchytraeidae																							
F. Naididae																							
Nais barbata																							
Nais communis																							
Nais																							
Slavina appendiculata																							
F. Tubificidae																							
Limnodrilus hoffmeisteri																							
Rhyacodrilus coccineus	1			1			1	1	3														
Rhyacodrilus montana																							
Rhyacodrilus sodalis																							
Tasserkidrilus americanus																							
immatures with hair chaetae						2	2	1	1		2					1							5
immatures without hair chaetae																							
F. Lumbriculidae																							
Lumbriculus				1								1									1		
indeterminate																							
ARTHROPODS																							
P. Arthropoda																							
MITES																							
Cl. Arachnida																							
O. Acarina		2		3		2	5	5	6	5	8	9	3	3	6	7	3	1	4	5	2		3
HARPACTICOIDS																							
O. Harpacticoida																							
SEED SHRIMPS																							
Cl. Ostracoda	20	22	63	22	6	4	5	1	1	2	5	6	2	8	7	23	3	3	2	21	5	14	12
TADPOLE SHRIMP																							
O. Notostraca																							
Lepidurus arcticus																							
WATER SCUDS																							
O. Amphipoda																							
F. Gammaracanthidae																							
Gammaracanthus																							
F. Hyalellidae																							
Hyalella		1																					
INSECTS																							
Cl. Insecta																							
BEETLES																							
O. Coleoptera																							
F. Staphylinidae																							
MAYFLIES																							
O. Ephemeroptera																							
F. Baetidae																							
indeterminate															1								
CADDISFLIES																							
O. Trichoptera																							
F. Limnephilidae																							
Grammotaulius																							
Grensia praeterita		1					1			2			1		1								
pupae																							
immature																							

Appendix H. Benthic invertebrate raw data (total number of organisms in two 0.023 m2 grabs), Meadowbank EAS 2010.

Station	HVH-4	HVH-4	HVH-4	HVH-4	HVH-4	SP-DT	SP-DT	SP-DT	SP-DT	SP-DT	SP-F1	SP-F1	SP-F1	SP-F1	SP-F1	SP-N1	SP-N1	SP-N1	SP-N1	SP-N1	SP-N2	SP-N2	SP-N2
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3
Depth (m)	7.5	7.8	7.0	7.2	8.0	7.4	8.5	8.7	7.3	9.8	7.7	9.6	8.5	9.7	9.9	8.0	7.5	7.1	10.0	7.2	8.2	7.5	8.7
# Grabs/sample	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mesh Size (µm)	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Date	24-Aug-10	24-Aug-10	24-Aug-10	24-Aug-10	24-Aug-10	23-Aug-10	23-Aug-10	23-Aug-10	23-Aug-10	23-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10
TRUE FLIES																							
O. Diptera																							
MIDGES																							
F. Chironomidae																							
chironomid pupae				1										2									
S.F. Chironominae																							
Chironomus																							
Cladotanytarsus			1																				
Constempellina																							
Corynocera																							
Dicrotendipes																							
Micropsectra				4		3			1		13			2	7	19	34		49			16	1
Microtendipes																							
Parachironomus																							
Paracladopelma																							
Paratanytarsus																2				1			
Polypedilum		1																					
Sergentia																							
Stempellinella								1															
Stictochironomus		1	1	4		3	4	2	2	8	8	3	15	5	6	14			32	2	4	3	35
Tanytarsus			1	3								1		1									
indeterminate																							
S.F. Diamesinae																							
Potthastia																				1			
Protanypus	1			1		1			1	1		1			1				1		1		
Pseudodiamesa																							
S.F. Orthocladiinae																							
Abiskomyia																1					1	2	
Corynoneura																							
Cricotopus																							
Cricotopus/Orthocladius																							
Heterotrissocladius		1	5	6		1					1	4		3									
Hydrobaenus																							
Mesocricotopus				1		1									1		1		6				
Nanocladius																							
Paracladius																							
Parakiefferiella																							
Psectrocladius																							
Psectrocladius (Monopsectrocladius)																							
Psectrocladius							1	4		1	1												
Zalutschia																			1				
indeterminate																							
S.F. Prodiamesinae																							
Monodiamesa						8	5	1	2	4	2	2			2		1		1		1	3	
S.F. Tanypodinae																							
Ablabesmyia														1									
Procladius	3		6	3		5	4	4	7	2	7	12	5	21	6	3	3		2	2	5	11	4
Thienemannimyia complex																							
Trissopelopia																							
indeterminate																							
F. Empididae																							
Chelifera/Neoplasta																							
Chelifera																							
Wiedemannia																							
pupae																							
MOLLUSCS																							
P. Mollusca																							
CLAMS																							
Cl. Bivalvia																							
F. Sphaeriidae																							
Cyclocalyx/Neopisidium	8	10	12	10	4	22	4	20	15	6	20	27	11	19	16	20	14	6	18	21	17	13	16
Cyclocalyx			1	1	1		1		1							3			6			1	2
Cyclocalyx nitidium																							
Cyclocalyx (Pisidium)																							
Sphaerium nitidum						2	2		1														
TOTAL NUMBER OF TAXA [1]	4	7	7	12	2	10	10	8	10	8	8	9	5	8	10	8	6	2	10	6	8	7	6
TOTAL NUMBER OF ORGANISMS [2]	13	17	27	39	5	50	30	39	40	29	62	60	35	57	47	70	56	7	120	32	32	49	66

Notes:

[1] Number of taxa totals exclude nematodes & ostracods, immatures & pupae (Tubificidae, Limnephilidae, Chironomidae, Empididae), and indeterminates (Lumbriculidae, Chironominae, Orthocladiinae, Tanypodinae).

[2] Number of organisms totals exclude nematodes (P. Nemata) & ostracods (Cl. Ostracoda).

Third Portage Lake - East Stations include: TP-E1, TP-E2, TP-E3, HVH-4.

Second Portage Lake Stations include: SP-DT, SP-F1, SP-F2, SP-N1, SP-N2, SP-N3.

Appendix H. Benthic invertebrate raw data (total number of organisms in two 0.023 m2 grabs), Meadowbank EAS 2010.

Station	SP-N2	SP-N2	SP-N3	SP-N3	SP-N3	SP-N3	SP-N3	TP-E1	TP-E1	TP-E1	TP-E1	TP-E1	TP-E2	TP-E2	TP-E2	TP-E2	TP-E2	TP-E3	TP-E3	TP-E3	TP-E3	TP-E3	SP-F2	SP-F2	SP-F2	SP-F2	SP-F2
Replicate	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Depth (m)	9.3	8.3	7.4	8.9	9.2	8.7	7.3	7.4	7.5	8.0	8.0	8.5	9.5	10.0	9.9	9.0	8.9	11.0	12.0	10.0	10.0	10.0	7.4	7.8	7.2	7.2	7.8
# Grabs/sample	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mesh Size (µm)	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Date	20-Aug-10	20-Aug-10	19-Aug-10	19-Aug-10	19-Aug-10	19-Aug-10	19-Aug-10	25-Aug-10	25-Aug-10	25-Aug-10	25-Aug-10	25-Aug-10	27-Aug-10	27-Aug-10	27-Aug-10	27-Aug-10	27-Aug-10	25-Aug-10	25-Aug-10	28-Aug-10	28-Aug-10	28-Aug-10	23-Aug-10	23-Aug-10	23-Aug-10	23-Aug-10	23-Aug-10
ROUNDWORMS																											
P. Nemata	2	1											7		4			4		1	3	2	1				
FLATWORMS																											
P. Platyhelminthes																											
Cl. Turbellaria																											
indeterminate																											
ANNELIDS																											
P. Annelida																											
WORMS																											
Cl. Oligochaeta																											
F. Enchytraeidae																											
F. Naididae																											
Nais barbata																											
Nais communis																											
Nais																											
Slavina appendiculata																											
F. Tubificidae																											
Limnodrilus hoffmeisteri																											
Rhyacodrilus coccineus									1	1					3	1	1										
Rhyacodrilus montana																											
Rhyacodrilus sodalis																											
Tasserkidrilus americanus																											
immatures with hair chaetae		4		1	2																				1		
immatures without hair chaetae																											
F. Lumbriculidae																											
Lumbriculus	1				1		2							1							1			1			
indeterminate																											
ARTHROPODS																											
P. Arthropoda																											
MITES																											
Cl. Arachnida																											
O. Acarina	1	4	3	2	5	3		1		2	1		2		1	3			2		1	4	2		1	1	5
HARPACTICOIDS																											
O. Harpacticoida																											
SEED SHRIMPS																											
Cl. Ostracoda	9	26		2	2	3	5	27	10	31	49	5	36	25	44	12	14	15	44	4	5	17	1	3	2	3	2
TADPOLE SHRIMP																											
O. Notostraca																											
Lepidurus arcticus																											
WATER SCUDS																											
O. Amphipoda																											
F. Gammaracanthidae																											
Gammaracanthus																											
F. Hyalellidae																											
Hyalella																											
INSECTS																											
Cl. Insecta																											
BEETLES																											
O. Coleoptera																											
F. Staphylinidae																											
MAYFLIES																											
O. Ephemeroptera																											
F. Baetidae																											
indeterminate																											
CADDISFLIES																											
O. Trichoptera																											
F. Limnephilidae																											
Grammotaulius																											
Grensia praeterita				1				1																	1		
pupae																											
immature																											

Appendix H. Benthic invertebrate raw data (total number of organisms in two 0.023 m2 grabs), Meadowbank EAS 2010.

Station	**SP-N2**	**SP-N2**	**SP-N3**	**SP-N3**	**SP-N3**	**SP-N3**	**SP-N3**	**TP-E1**	**TP-E1**	**TP-E1**	**TP-E1**	**TP-E1**	**TP-E2**	**TP-E2**	**TP-E2**	**TP-E2**	**TP-E2**	**TP-E3**	**TP-E3**	**TP-E3**	**TP-E3**	**TP-E3**	**SP-F2**	**SP-F2**	**SP-F2**	**SP-F2**	**SP-F2**
Replicate	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Depth (m)	9.3	8.3	7.4	8.9	9.2	8.7	7.3	7.4	7.5	8.0	8.0	8.5	9.5	10.0	9.9	9.0	8.9	11.0	12.0	10.0	10.0	10.0	7.4	7.8	7.2	7.2	7.8
# Grabs/sample	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mesh Size (µm)	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Date	20-Aug-10	20-Aug-10	19-Aug-10	19-Aug-10	19-Aug-10	19-Aug-10	19-Aug-10	25-Aug-10	25-Aug-10	25-Aug-10	25-Aug-10	25-Aug-10	27-Aug-10	27-Aug-10	27-Aug-10	27-Aug-10	27-Aug-10	25-Aug-10	25-Aug-10	28-Aug-10	28-Aug-10	28-Aug-10	23-Aug-10	23-Aug-10	23-Aug-10	23-Aug-10	23-Aug-10
TRUE FLIES																											
O. Diptera																											
MIDGES																											
F. Chironomidae																											
chironomid pupae		1																	1		1						
S.F. Chironominae																											
Chironomus																											
Cladotanytarsus	1																										
Constempellina																											
Corynocera																								1		1	1
Dicrotendipes																											
Micropsectra	1	5		1	2	1	6	4	5		7	1	6	1	10	2	2		1		1		10	7	59	27	3
Microtendipes																											
Parachironomus																											
Paracladopelma																											
Paratanytarsus									1				2		1									1			
Polypedilum																											
Sergentia																											
Stempellinella	1																										
Stictochironomus	3	13		1	4		7			1					10	1	1	3		1		2	4		14	32	
Tanytarsus	1									1			1				1						1			1	1
indeterminate																											
S.F. Diamesinae																											
Potthastia																											
Protanypus			1	1			1												1			2			1		
Pseudodiamesa																											
S.F. Orthocladiinae																											
Abiskomyia		3		1									9	8	7	5	1										
Corynoneura																											
Cricotopus																											
Cricotopus/Orthocladius																											
Heterotrissocladius								2	4	1	3	1	4	1		3	2				2	2					
Hydrobaenus																											
Mesocricotopus																										1	
Nanocladius																											
Paracladius																											
Parakiefferiella																											
Psectrocladius																											
Psectrocladius (Monopsectrocladius)						1																					
Psectrocladius							1						1				1										
Zalutschia													1		1												
indeterminate																											
S.F. Prodiamesinae																											
Monodiamesa		2			3	1	2					1	1	1	3			2	1		1	1				2	
S.F. Tanypodinae																											
Ablabesmyia																									1		
Procladius	4	2	5	4	1	6	4		4	3	2	1	2	1	11	4	2	7	2	1	7	3	1	1	2	3	1
Thienemannimyia complex								2	3	1				2					1			1					
Trissopelopia																											
indeterminate																											
F. Empididae																											
Chelifera/Neoplasta																											
Chelifera																											
Wiedemannia																											
pupae																											
MOLLUSCS																											
P. Mollusca																											
CLAMS																											
Cl. Bivalvia																											
F. Sphaeriidae																											
Cyclocalyx/Neopisidium	17	7	4	7	14	28	19	7	7	13	8	3	9	18	26	23	6	28	17	7	21	14	6	4	24	10	8
Cyclocalyx		2	1		10	3	1	1	5	5	7	3	3		3			2		1		2	9	7	4	6	13
Cyclocalyx nitidium																											
Cyclocalyx (Pisidium)																											
Sphaerium nitidum																											
TOTAL NUMBER OF TAXA [1]	9	8	5	8	8	7	9	7	8	9	6	6	12	8	11	8	9	5	7	4	7	9	7	7	9	10	7
TOTAL NUMBER OF ORGANISMS [2]	30	43	14	19	42	43	43	18	30	28	28	10	41	33	76	42	17	42	26	10	35	31	33	22	108	84	32

Notes:

[1] Number of taxa totals exclude nematodes & ostracods, immatures & pupae (Tubificidae, Limnephilidae, Chironomidae, Empididae), and indeterminates (Lumbriculidae, Chironominae, Orthocladiinae, Tanypodinae).

[2] Number of organisms totals exclude nematodes (P. Nemata) & ostracods (Cl. Ostracoda).

Third Portage Lake - East Stations include: TP-E1, TP-E2, TP-E3, HVH-4.

Second Portage Lake Stations include: SP-DT, SP-F1, SP-F2, SP-N1, SP-N2, SP-N3.