Appendix A4-2

Aquatic Effects Monitoring Program – Targeted Study: Dike Construction TSS Effects Assessment Study 2009, Meadowbank Gold Project, April 2010

FINAL

Aquatic Effects Monitoring Program – Targeted Study: Dike Construction TSS Effects Assessment Study 2009

Meadowbank Gold Project

Prepared for:

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- Gary Mann, Randy Baker and Ryan Hill (Azimuth) – Gary, Randy and Ryan provided overall management of EAS monitoring at Meadowbank in 2008. Gary was co-author of this report and conducted the statistical analyses. Randy Baker reviewed the report.
- 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.
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ACRONYMS

EAS-BGE – EAS area (exposure)

EAS-BGW – EAS area (exposure)

EAS-SPC – EAS area (exposure)

EAS-DT – EAS area (reference)

EAS-TPS – EAS area (reference)

AEM – Agnico-Eagle Mines Ltd.

AEMP – Aquatic Effects Monitoring Program

ANOVA – Analysis of Variance

ANOVA – Analysis of variance

AWPAR – All Weather Private Access Road

BACI – Before-after-control-impact

CCME – Canadian Council of Ministers of the Environment

CPUE – Catch per unit effort

DQO – Data Quality Objective

EAS – Effects Assessment Study

ED – East Dike

EEM – Environmental Effects Monitoring

GPS – Global Positioning System

HVH – High value habitat

INUG – Inuggugayualik Lake

ISQG – Interim Sediment Quality Guidelines

KW – Kruskal Wallis

MDL – Method Detection Limit

MMER – Metal Mining Effluent Regulations

PEL – Probable Effect Level

QA/QC – Quality Assurance / Quality Control

RPD – Relative Percent Difference

SIA – Stable isotopes analysis

SIE – severity of ill effects

SOP – Standard Operating Procedure

SP – Second Portage Lake

SQG – Sediment Quality Guidelines

TE – Tehek Lake

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

WCD – Western Channel Dike

EXECUTIVE SUMMARY

AEM commissioned studies in each of the last two years (2008 and 2009) 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). This study continued in 2009 (as reported in Section 2) to implement some planned components as well as to address some new uncertainties raised by the 2008 results. Further work for 2010 is discussed below.

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 and others slated for either 2010 and/or 2011.

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 ES-1** for both TSS EAS studies to provide a more holistic perspective.

TSS EAS studies 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 two years. 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.

From an 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. 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. Based on the CREMP data, it is apparent that even prior to the onset of construction activities studies, benthic communities in Second Portage and Tehek lakes had lower abundances relative to the other project lakes. More intensive sampling was conducted in Second Portage and Tehek lakes in 2009 (the EAS data set), but when viewed in the broader context (e.g., relative to other CREMP areas) the results only highlighted the above differences.

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 found more obvious signs of sediment accumulation than areas further away.

TSS EAS studies continue in 2010. **Table ES-1** highlights (in bold) activities to be conducted in 2010. Planned components include:

- Continued benthic invertebrate community monitoring for East Dike TSS EAS.
- Sediment trap deployment (after retrieval of winter traps) throughout study area for Bay-Goose Dike TSS EAS.

Recommended changes for 2010:

- Benthic invertebrate community monitoring for Bay-Goose Dike TSS EAS should be initiated in 2010 rather 2011, as originally planned.
- Periphyton studies should be conducted again in Second Portage Lake to document temporal changes and provided better spatial resolution of potential adverse effects. The quantitative sampling should be coupled with the sediment mass estimates; the live-dead component did not provide much value and should not be repeated. This study component will also be useful for making inferences regarding potential changes to high-value habitat areas.

In light of the increased sediment metals concentrations in Second Portage Lake, toxicity testing should be initiated (comparing worst-case areas to reference areas) to assess metals bioavailability. This information will complement the detailed benthic community analysis currently being conducted by Ryan Vanengen (AEM) for his master's research.

Table ES-1. Conclusions to date from both TSS Effects Assessment Studies.

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 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.
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.	There was some indication of differences between the east and south basins of Third Portage Lake. However, biomass was actually higher in 2009 in the east basin than observed in 2008 in the absence of 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		
Zooplankton ● Lethal - *Daphnia magna* 48-hr LC50 ● Sublethal - *Ceriodaphnia dubia* 7-day growth/survival/repro	No direct effects were observed in toxicity tests.	No direct effects were observed in toxicity tests.
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.

1. INTRODUCTION

Azimuth Consulting Group Inc. (Azimuth) has conducted environmental monitoring of in-water dike construction activities at the Meadowbank Gold Project on behalf of Agnico-Eagle Mines Ltd. (AEM) since 2008. As per the requirements of the Nunavut Water Board A Licence (2AM-MEA081) for the project, monitoring followed the framework presented in the *Water Quality Monitoring and Management Plan for Dike Construction and Dewatering at the Meadowbank Mine* (AEM, 2008; updated in 2009).

As described in detail elsewhere (Azimuth, 2009a and 2010a), East Dike (during 2008) and Bay-Goose Dike (during 2009) construction activities resulted in widespread increases in total suspended solids (TSS) in Second and Third Portage Lake, respectively. In response to these situations, AEM commissioned studies in both 2008 and 2009 to evaluate the potential for adverse ecological effects related to chronic exposure to elevated TSS concentrations (the TSS Effects Assessment Study, or TSS EAS). Results of the 2008 TSS EAS studies related to East Dike construction were documented last year (Azimuth, 2009b). This report details the 2009 results of TSS EAS studies focusing on follow-up monitoring for the East Dike and on initial monitoring for the Bay-Goose Dike EAS.

1.1. Background

A general overview of the site related to dike construction is presented in **Figure 1-1**. The figure includes some of the naming conventions used in this report and shows local hydrology among the lakes.

Table 1-1 provides some context regarding the spatial and temporal dynamics of mine-related TSS elevations in key local receiving environments over the past two years.

1.2. Review of TSS Effects to Aquatic Life

The original *Meadowbank Gold Project Water Quality Monitoring and Management Plan for Dike Construction and Dewatering* (July 2008) contained a review of the potential effects of total suspended solids (TSS) and turbidity on fish and fish habitat. These include smothering (e.g., of fish eggs or benthic invertebrates), decreased productivity (i.e., due to reduced light), reduced feeding (i.e., due to limited visibility), and gill clogging/abrasion. Effects are influenced by exposure and duration, as well as the size and shape of suspended particles. Overall, the most sensitive group appears to be salmonids (e.g., lake trout, Arctic char and whitefish), with their early life stages the most at risk.

Given the duration of elevated TSS concentrations in Third Portage Lake, this discussion of potential effects focuses only on long-term exposures and includes both less-sensitive and sensitive salmonid life history stages. A detailed analysis of the data used to derive the Meadowbank TSS triggers was presented in AEM (2008). The underlying data set, comprised of more than 300 data sets, was compiled from Caux et al. (1997) and was the basis for deriving the CCME TSS guidelines. Relevant results for chronic (i.e., long-term) exposures are discussed below. Response is estimated using a scale of 0 to 14 to indicate the "severity of ill effects" (SIE). SIE scores of 1 to 3 are behavioural responses such as alarm reaction, abandonment of cover or avoidance response. SIE scores from 4 to 8/9 indicate increasingly severe sub-lethal effects. SIE scores of 10 to 14 indicate mortality, ranging from 0 to 20% (for SIE score =10) to >80% (SIE score = 14).

Less-sensitive Life History Stages (non-spawning habitat; spawning habitat prior to September)

After excluding data for short exposures, high TSS (>100 mg/L) and those specific to eggs or larvae, 28 data points remained (**Figure 1-2**). There are limited data at low TSS concentrations, with the first five shown in **Table 1-2**. None of the measured responses indicate mortality. At slightly higher TSS concentrations (18 mg/L) reduced abundance has been observed (SIE = 10, 30 day exposure for adult brown trout and rainbow trout). Mortality is first observed at 22 mg/L, but that data point involved a full year (365 days) of exposure and applies to a warm water fish species. Beyond that, the next study showing mortality occurs at a TSS concentration of 90 mg/L (<20% mortality of rainbow trout under-yearlings exposed for 19 days). These data suggest that direct mortality may be quite unlikely at TSS concentrations < 20 mg/L. Nevertheless, reduced growth, which is observed at lower TSS concentrations, can be a significant sub-lethal effect.

A key consideration in the potential for adverse effects is whether juveniles and adults would be able to swim to avoid turbid waters. Adult Lake trout have demonstrated the ability to avoid TSS by altering their feeding habit from pelagic to benthic feeding (Rowe, 1984). During an elevated TSS event, the ability of Lake trout to feed on benthic invertebrates was found to not be significantly altered (Rowe, 2003). Furthermore, in cold unstratified lakes such as Third Portage Lake, where there are few physical constraints, it would be expected that lake trout could find refuge from the elevated TSS concentrations (i.e., 10-20 mg/L) to less impacted areas in the 0- 10 mg/L TSS concentration range. This is particularly true when the highest TSS concentrations occur at depth, as seen for both the East Dike and Bay-Goose Dike construction (Azimuth, 2009a, 2010a).

Sensitive Life History Stages (spawning habitat starting in September)

The data set from above was expanded to include those points associated with early life history stages, resulting in the 38 cases shown in **Figure 1-3**. It is important to note that the concentration-response curve in this case appears to be quite flat except at very low TSS concentrations – the mean SIE score for the data points shown in **Figure 1-3** is 9.4, while the mean SIE score for the remaining data points (>100 mg/L TSS) is only slightly higher at 10.1. However, the SIE scale is not really linear, because direct measures of mortality apply only to SIE scores of 10 to 14.

Clearly there are variable, sometimes significant effects (e.g., mortality, SIE = 10 or more) that result from long-term exposure to TSS concentrations above around 15 mg/L. However, effects at concentrations of 12 mg/L or lower warrant a more detailed analysis. There are six data points where TSS concentrations are equal to or less than 12 mg/L; five were reported in **Table 1-2**, and one case targeting egg mortality that is presented in **Table 1-3**.

Among the cases in **Tables 1-2 and 1-3**, the most significant study and one that drives existing federal guidance, is the study showing 40% mortality of rainbow trout eggs at a TSS concentration of 7 mg/L. We used this study to set the chronic (7-day) trigger for the management plan. While the lack of multiple studies corroborating this particular dose-response point increases the uncertainty, the magnitude of response alone warrants taking it seriously.

1.3. General Assessment Strategy

Given that suspended sediments can directly or indirectly affect the entire range of organisms in the aquatic environment, the strategy developed for the EAS studies addressed a broad array of concerns. An overview of the strategy for the East Dike EAS was presented in last year's report (Azimuth, 2009b); the Bay-Goose EAS overview is presented in **Table 1-4**. The general components included in the TSS EAS (using the BG EAS as an example) are:

- *Water Quality and Limnology* – The most obvious effect of sediment inputs into clear lakes is a noticeable reduction in water clarity and reduced light penetration. There are other possible effects, however, which can be equally significant. These include introduction of metals and nutrients, or other changes to normal conditions (e.g., oxygen reductions or increased temperature). The program detailed in **Table 1-4** includes a comprehensive list of components to quantify these issues.
- *Field Effects Measurements* – Directly measuring key aspects of target aquatic receptors in the field is the best approach to determining the ecological significance of elevated TSS in Third Portage Lake. The components detailed in

Table 1-4 range from the base of the food chain to fish. Water-clarity related changes in productivity could affect primary and secondary productivity of the water column. Potential effects to fish will be most likely manifested through changes to high-value habitat (e.g., sedimentation of spawning areas).

- *Laboratory Effects Measurements* – Taking site water into the laboratory provides a unique opportunity to conduct a suite of tests on sensitive life history stages under controlled conditions. These tests provide insights into how turbid water and/or settled sediment affect zooplankton and fish survival, feeding and growth. The fish tests in 2009 targeted key developmental stages, as was done in 2008 (Azimuth, 2009b).

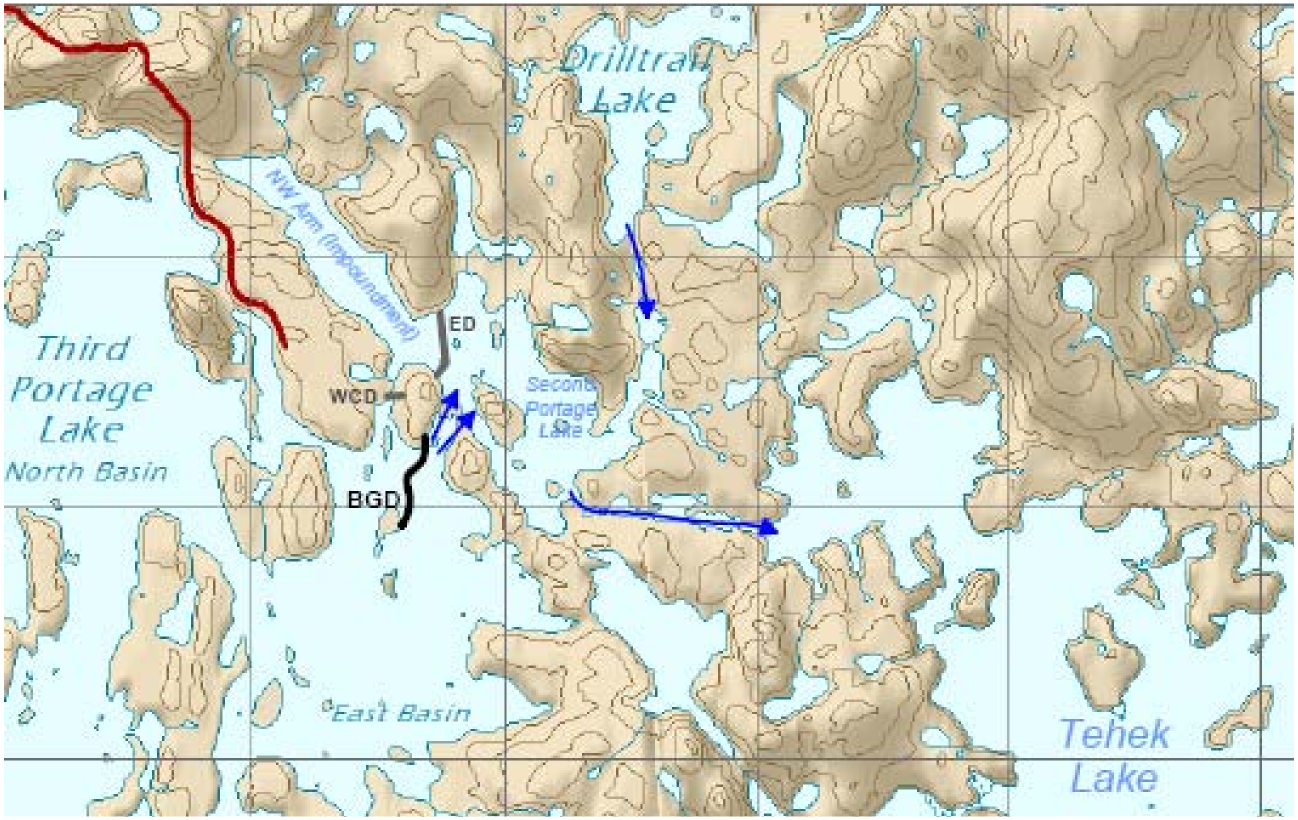
While the East Dike and Bay-Goose Dike TSS EAS studies are reported separately herein, the information generated from these studies provides a weight-of-evidence regarding the potential effects of elevated TSS in local receiving environments.

1.4. Report Organization

The remainder of this report is organized into the following sections:

- **Section 2** *East Dike TSS EAS* – gives an overview of the components that were conducted in 2009, describes the methods used to collect data, and presents and discusses the results for each study component.
- **Section 3** *Bay-Goose Dike TSS EAS* – gives an overview of the target study strategy, describes the methods used to collect data, and 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 and recommendations for 2010.

Figure 1-1. General site map highlighting 2009 dike construction areas and adjacent receiving environments.



Notes: BGD = Bay-Goose Dike; WCD = Western Channel Dike; ED = East Dike; blue arrows represent lake drainage directions.

Figure 1-2. Fish concentration-response data for long-term (> 24hr) exposure to TSS, excluding data points for eggs/larvae (source: Caux et al. 1997; data for TSS concentrations > 100 mg/L not shown)

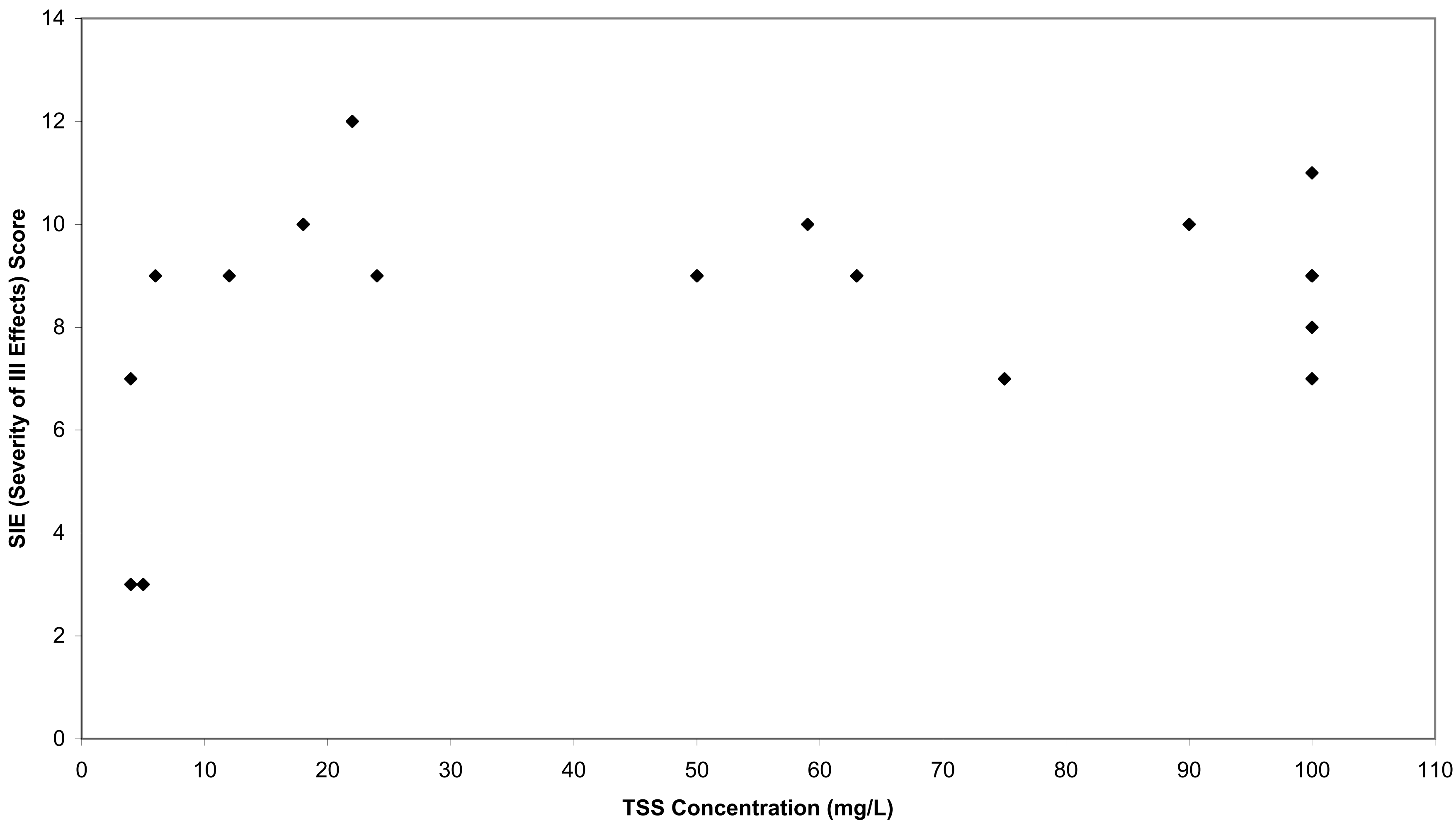


Figure 1-3. Fish concentration-response data for long-term (> 24hr) exposure to TSS (source: Caux et al. 1997; data for TSS concentrations > 100 mg/L not shown)

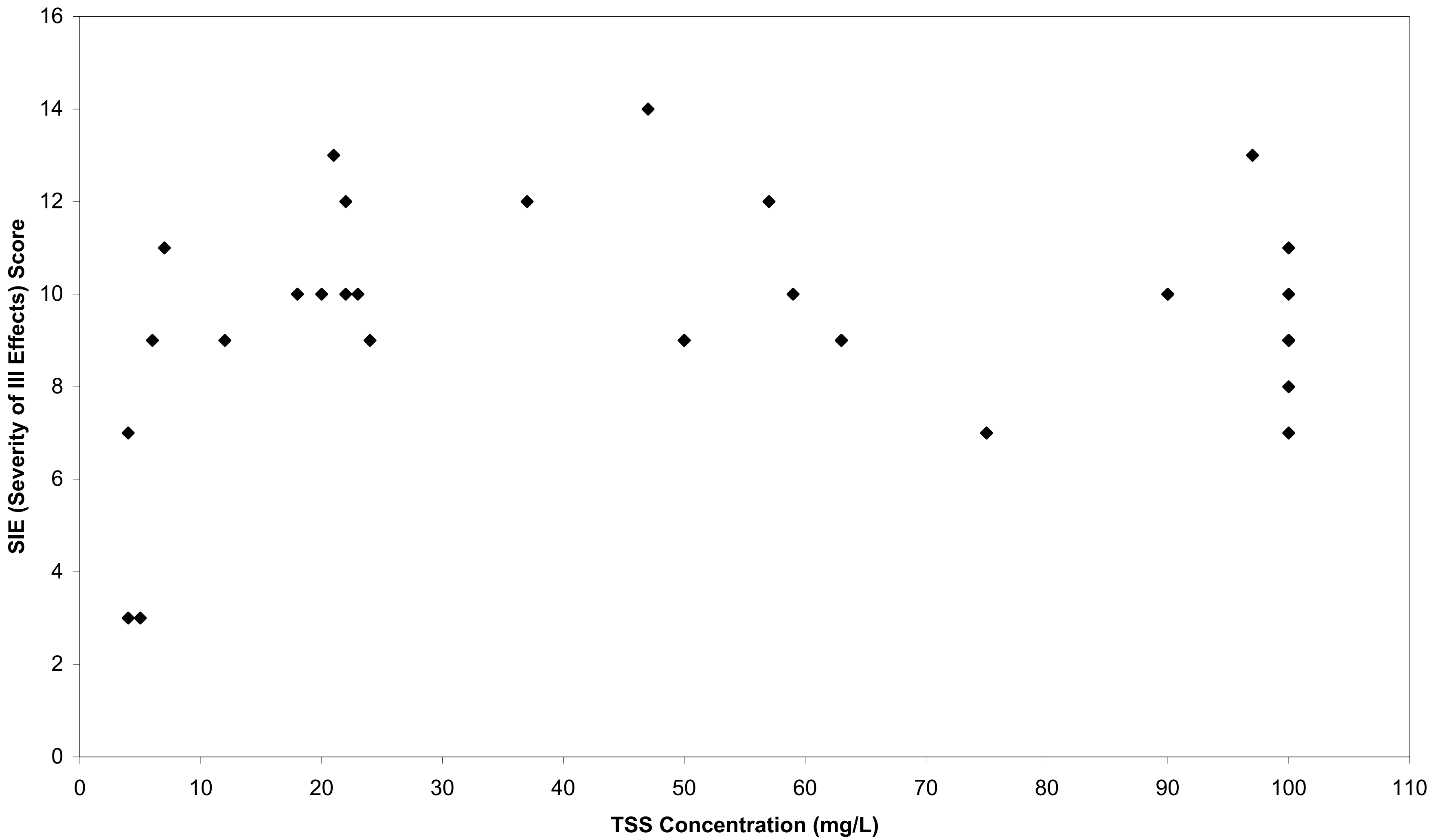


Table 1-1. Status of key receiving environments related to TSS in 2008 and 2009.

	2008				2009				
	July	Aug	Sept	Oct - Dec	Jan - Jun	July	Aug	Sept	Oct - Dec
Third Portage Lake									
North Basin	Background	Background	Background	Background	Dewatering - no apparent TSS increase	Dewatering finished	Background	Background	Background
South Basin	Background	Background	Background	Background	Background	Background	Background	Background	Background
East Basin	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
Second Portage Lake									
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?	Dewatering starts in March	TSS elevated due to dewatering activities; dewatering stops in early July	Isolated	Isolated	Dewatering started again; TSS/turbidity triggers met
Main Basin	Background	ED construction starts; TSS rises dramatically in third week	TSS drops over time; meets targets by end of month	TSS drops?	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
Drilltrail Arm	Background	Background	Background	Background	Background	Background	Background	Background	Background
Tehek Lake									
Near-field Basin	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
Far-field Basin	Background	Background	Background	Background	Background	Background	Background	Background	Background

Notes: Shaded months indicate ice cover on lakes. "?" Indicates uncertainty
Accronyms: ED = East Dike; BG = Bay-Goose Dike; TSS = total suspended solids.

Table 1-2. Effects of chronic exposure to less-sensitive life history stages from chronic exposure to low TSS concentrations.

Species	Life Stage	TSS (mg/L)	Exposure Duration (days)	SIE Score	Response
Smelt	Adult	4	7	7	Increased vulnerability to predation
Lake Trout	Adult	4	7	3	Fish avoided turbid areas
Brook Trout	Adult	5	7	3	Fish more active and less dependent on cover
Chinook Salmon	Juv	6	60	9	Growth rate reduced
Brook Trout	Fry	12	245	9	Growth rates declined

Source: Caux et al. (1997)

Table 1-3. Potential effects to sensitive life stages during chronic exposure to low TSS concentrations.

Species	Life Stage	TSS (mg/L)	Exposure Duration (days)	SIE Score	Response
Rainbow Trout	Egg	7	48	11	Mortality rate 40%

Source: Caux et al. (1997)

Table 1-4. Bay-Goose Dike TSS Effects Assessment Study (EAS) - program overview.

2. EAST DIKE TSS EAS

2.1. Study Outline

The East Dike TSS EAS was first initiated in 2008 to assess the ecological significance of elevated TSS concentrations associated with construction of the East Dike (Azimuth, 2009b). EAS monitoring related to East Dike construction was continued in 2009 for the following components:

- *Surface sediment chemistry (coring)* - Sediment trap chemistry results in 2008 suggested that certain metals (chromium and zinc in particular) may be elevated in the suspended (or settled) sediments introduced during dike construction. To verify whether the elevated metals in trap sediments may have affected sediment chemistry of the lake bottom in Second Portage Lake, the 2008 (conducted prior to any construction activities) sediment coring program (15 cores/area) was repeated at four CREMP locations (TPE, SP, TE and INUG) in 2009.
- *Benthic community analysis* – The EAS strategy for the East Dike called for plume monitoring in 2008 (i.e., year of construction), followed by benthic community analysis over the next two years (i.e., 2009 and 2010). However, the CREMP data set (sampled in late August 2008) was opportunistically used last year to provide an initial indication of the extent and magnitude of TSS-related effects to the benthic community (Azimuth, 2009b). As planned, East Dike EAS-specific benthic sampling was initiated in 2009 to provide a complementary data set with greater spatial resolution within Second Portage Lake. In addition, the annual CREMP sampling was conducted again in 2009, providing another year of data for analysis.
- *High-value habitat assessment* – The 2008 EAS study identified sediment deposition as a potential concern, particularly to high-value habitat for fish. Sediment traps were redeployed over the winter to build on sediment deposition information report in the 2008 EAS study. In addition, an underwater video survey was proposed to compare and contrast high-value habitats across a range of exposure to TSS.
- *Periphyton community* – While not contemplated in the East Dike EAS strategy, it became apparent during early field work on Second Portage Lake in 2009 that settled sediments may be impacting periphyton communities through smothering. Consequently, an existing periphyton monitoring program in Second Portage Lake (Habitat Compensation Monitoring Program; Azimuth, 2008c; 2010c) was expanded to provide additional information to support the EAS.

While information regarding the study designs for each component are presented in **Section 2.2**, the underlying focus was on identifying potential differences between areas exposed to elevated TSS (i.e., "impact" areas) and background areas (i.e., "control" areas). It is important to note that Bay-Goose Dike construction did lead to elevated TSS in the east basin of Third Portage Lake in August and September 2009, and to a much lower extent in Second Portage Lake. This did require some modification of the planned East Dike EAS for 2009; overall, however, the influence of this situation is considered minor. UTM data for all sampling locations are listed in **Table 2-1** and shown in **Figure 2-1**.

2.2. Methods

2.2.1. Surface Sediment Chemistry (Coring)

Sediment coring was conducted in July 2009 from CREMP areas TPE, SP, TE and INUG using a hand-operated corer (barrel diameter of 7 cm). Fifteen independent cores plus one field duplicate were collected from each area. Cores were collected within a 250-m radius from the center of each sampling area, targeting depths of 6-10 m (**Table 2-1 and Figure 2-1**).

Only those sediment core samples that met the following acceptability criteria were retained for analysis (i.e., those that did not were discarded):

- Corer was deployed and remained perpendicular to the bottom
- Corer did not hit hard, impenetrable substrate
- Retrieved core sample was undisturbed (did not mix or fall out of bottom while being pulled to the surface).

The terms of reference for collecting the sediment cores are outlined in **Appendix A**. Only the top ~1 cm was collected and retained for analysis. Samples were kept cold (i.e., cooler with ice packs in the field; refrigerator at the mine site; cooler with ice packs for shipping to the analytical laboratory) and shipped to ALS Environmental (Vancouver, BC) for analysis. A completed chain-of-custody form accompanied the samples during transport. Sediment core samples were analyzed for total metals, pH and total organic carbon.

Sediment metals concentrations were compared to CCME (2002) sediment quality guidelines 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 sediment metals concentrations in lakes around the Meadowbank Project routinely exceed both ISQG and PEL guidelines, especially in mineralized areas.

Details regarding methods for statistical analyses are provided in **Appendix B**.

2.2.2. Benthic Invertebrates

As discussed in **Section 2.1**, two data sets were evaluated to assess potential TSS-related impacts to the benthic community:

1. *EAS Benthic Invertebrates* - This is the first of a two-year follow-up benthic community monitoring program targeting the potential effects of sedimentation related to construction of the East Dike. Consisting entirely of "after" sampling, the first year was analyzed using a control-impact design (see **Appendix B** for details). 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). The EAS program initially targeted 5 areas, but the data set was expanded by adding eight areas from the 2009 CREMP (Azimuth, 2010b) (**Figure 2-1**) to provide more robust conclusions.
2. *CREMP Benthic Invertebrates* – Key areas (INUG, TPN, TPS, SP, TE, TPE; see locations in Azimuth, 2010b) from the CREMP data set were assessed last year to determine the potential effects of exposure to elevated TSS (i.e., increased sedimentation) on benthic invertebrates (Azimuth, 2009b). The CREMP data set was started in 2006, so it provides both temporal and spatial data on the benthic community. The program was conducted again in mid- to late-August 2009 (Azimuth, 2010b), providing another year of data. Having both "before" and "after" data for all areas means that a spatial-temporal analysis can be used (see **Appendix B** for details), providing more robust inferences regarding identified differences between control and impact areas.

Both data sets were collected using the same methods. Specific details (e.g., sampling area coordinates, etc.) for the CREMP data set are provided elsewhere (Azimuth, 2010b). The following provides general information for the EAS program.

Benthic invertebrates were collected from five sampling areas in August of 2009, using a Petite Ponar grab (0.023 m^2) and a 500-µm sieve. Sampling locations are illustrated in **Figure 2-1**, and UTM coordinates for each sample are presented in **Table 2-1**. Five replicate samples were collected per area, each consisting of two independent grabs (i.e., the contents of two grabs were combined). Depths were limited to 6.5 to 8.0 m to minimize differences among areas.

The following grab acceptability criteria were used (i.e., those grabs not meeting these criteria were discarded):

- Grab did not contain large foreign objects
- Grab penetrated substrate to a depth of 5 to 10 cm.
- Grab was not overfilled (sediment surface not touching the screen)
- Grab sealed properly (there was overlying water present and no visible leaks)
- The sediment-water interface was undisturbed (sediment surface was relatively flat).

The procedures for collecting the benthic invertebrate samples are outlined in detail in the SOP for Benthos and Sediment Sampling (AEM, 2009b).

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, area and replicate number.

Abundance of organisms/m^2 was determined from the total number of organisms enumerated (see **Section 2.3.3**). 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.

Consistent with Environment Canada (2002), the following response variables were used for assessing benthic community structure:

- 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:

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

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:

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

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 both the EAS and CREMP benthic invertebrate data sets are provided in **Appendix B**.

2.2.3. High-value Habitat Assessment

2.2.3.1. Sediment Traps

As described in last year's EAS report (Azimuth, 2009b), there was some uncertainty as to the possible influence of rust from the trap frames on trap sediment chemistry results. While the possibility seemed remote, trap design was changed in 2009 to remove this concern; trap frames were fully painted prior to deployment and trap tube length increased.

While there was widespread use of sediment traps in 2009 to track sedimentation at various locations in relation to dike construction, there was only one minor aspect related to the East Dike EAS: the retrieval of the sediment traps deployed in late September 2008 and left over winter (**Figure 2-2**). All the remaining sediment trap information is presented under the Bay-Goose Dike EAS (**Section 3**).

Winter sediment traps set in Second Portage Lake on September 22 and 24, 2008 were retrieved on July 26, 2009. Trap retrieval and sampling methods are provided in **Section 3**.

2.2.3.2. Underwater Video Survey

Underwater video was used to document and qualitatively describe substrate composition and periphyton coverage of high-value habitats across a range of TSS exposure concentrations in Second Portage Lake (high to low TSS exposure) and in the East Basin of Third Portage Lake (no exposure; sampling was conducted in 2009 prior to the onset of Bay-Goose Dike construction). The intent of the survey was to document the status of high-value habitat relative to potential increased sediment loadings on rock surfaces related to East Dike construction, which could decrease the value of habitat for spawning (e.g., through smothering) or food. The comparative approach provided perspective and reference on typical periphyton coverage of HVH habitats the project lakes to contrast with what is observed in Second Portage Lake subsequent to the sedimentation event. The Third Portage Lake habitat footage also serves as "before" imagery to support the Bay-Goose Dike EAS.

Video imagery was acquired using a 'Deep Blue Pro' underwater camera manufactured by Oceans Systems Inc., Everett, Washington. The camera was deployed from a boat at high value habitat locations in Second and Third Portage Lake (**Table 2-1**; **Figure 2-1**). Five video segments of approximately 30 seconds each were taken at different locations within each station. Stations ranged in depth, but were all between 1 and 4 m deep. The shallower areas were included to complement the quantitative periphyton sampling (see **Section 2.2.4.1**). Representative photographs from each of the areas filmed are presented in **Appendix C**. To gauge rock size, a section of rebar was marked with 0.5 m increments and lowered over the side of the boat to provide scale.

Video interpretation emphasized substrate, % periphyton cover and appearance, presence of fine sediments, and indications of ice scour.

2.2.4. Periphyton Community

2.2.4.1. Quantitative Assessment of Periphyton Coverage

Periphyton community sampling was conducted in 2009 as part of AEM's Habitat Compensation Monitoring Program, which was targeting the East Dike (Azimuth, 2010c). While the goal of that program was to document periphyton growth on the newly installed East Dike, it also included sampling at other locations in Second Portage Lake for comparative purposes. These latter sampling areas were situated areas that were exposed to differing degrees of TSS exposure in 2008, thus providing insights into the potential effects of sedimentation to benthic primary production. These data are also useful to provide quantitative evidence of impacts of sedimentation, or lack thereof, to shallow habitats adjacent to HVH habitats that are important as foraging areas for fish.

Periphyton density (cells/cm^2) and biomass (µg/cm^2) were measured quantitatively from three locations along a TSS exposure gradient (based on 2008 monitoring results) in Second Portage Lake (**Figure 2-1**):

- Second Portage Lake Boat Launch (SP-BL), a near-field station situated just outside (east) of the area enclosed by turbidity barriers in 2008; this station would have been exposed to relatively high TSS concentrations in 2008.

- Second Portage CREMP location (SP-CREMP), a far-field location about 1.8 km from the dike; this area would have been exposed to some elevated TSS in 2008, but not nearly as high as SP-BL.
- Drilltrail Arm (SP-DT) a reference area that 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. 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.

Samples 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, 2009b) and photos of the procedure can be viewed in **Appendix D** (**Photos D-1 to D-3**). Periphyton 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 2.2.2**.

2.2.4.2. Dead/Alive Periphyton Analysis

During the course of investigations and observations along the lake shore and from underwater imagery, it was apparent that most shallow-water rocky substrate in Second Portage Lake close to the East Dike was smothered to some degree by sediment. Given that this is not normally seen in these lakes, it raised concerns regarding whether the periphyton community was adversely affected by the accumulated sediment. As it was not possible to distinguish between living and dead periphyton visually or from underwater video footage, we attempted a quantitative survey of living versus dead algal biomass. Given that periphyton community health is an important component of overall lake productivity, the relative biomass of dead and alive periphyton relative to the degree of sedimentation, could shed light on potential impacts as a result of dike construction.

The sampling procedure employed was similar to that of the quantitative biomass and density periphyton analysis. Periphyton was collected from 5 smooth rocks along the shoreline at SP-BL (near-field), SP-CREMP (far-field) and SP-DT (reference) by scraping the periphyton map layer off the rock surfaces (**Appendix D Photo D-4**) using the scrubber to ascribe a uniform surface area. Periphyton samples were preserved in the field with a small amount of Lugol's solution and sent to Plankton R Us Inc. (Winnipeg, MB) for analysis and processed according to the methods described in **Section 2.2.4.1**.

To estimate the amount of "dead epilithic biomass" in the samples, cells containing no viable chloroplasts were counted. To estimate "dead biomass", the biomasses from the associated live species counts were applied to each dead species count. Cells with chloroplasts were counted to determine "live epilithic biomass". Live periphyton was quantified by counting the cells with chloroplast, while dead algal cells were identified as having no chloroplast. Cell counts were converted to wet weight biomass by approximating cell volume.

Five replicate samples were collected from the same sampling stations as for taxonomy and also preserved with a small amount of Lugol's solution. Preserved periphyton samples were delivered to ALS Laboratories, Vancouver. At ALS, the sample was filtered to remove water before being air dried at 105 ºC to evaporate the remaining water, to determine dry weight of inorganic solids and organic material. The sample was then heated to 550 ºC to volatilize all organic material (ash weight) and weighed again. The difference between whole sample dry weight and ash weight is the weight of the organic material that was burned off or volatilized.

2.2.5. Quality Assurance/ Quality Control

The objective of quality assurance and quality control (QA/QC) is to assure 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 QA/QC – Data Quality Objectives (DQOs) are numerically definable measures of analytical precision and completeness. Analytical precision is a measurement of the variability associated with duplicate analyses of the same sample in the laboratory. Completeness for this study is defined as the percentage of valid analytical results. Results that were made uncertain due to missed hold times, improper calibration, contamination of analytical blanks, or poor calibration verification results were deemed invalid.

Duplicate results were assessed using the relative percent difference (RPD) between measurements. 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 DQOs for this project were:

- Analytical Precision = 25% RPD for concentrations that exceed 10x the method detection limit (MDL).
- Completeness = 95% valid data obtained.

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. The reason for this is apparent if one considers duplicate samples with concentrations of an analyte of 0.0005 and 0.0007 mg/L. In absolute terms, the concentration difference between the two is only 0.0002 mg/L, a very tiny amount; however, the RPD value is 33.3%. This may sometimes lead to a belief that the level of precision is less than it actually is. RPDs are not calculated for cases where either of the samples (i.e., either A and/or B above) is below detection.

Field QA/QC: Sediment Sampling – Field QA/QC during sediment core sampling was careful to avoid cross-contamination between sampling areas by rinsing and cleaning the corer between areas. This entailed rinsing the equipment with site water to remove sediment and organic material.

One field duplicate for sediment core samples was collected at each area to assess sampling variability and sample homogeneity; an RPD of 50% for concentrations that exceed 10x the MDL is considered acceptable. Field replicates were collected for sediment trap samples to determine natural variability and heterogeneity.

Field and Laboratory QA/QC: Biota Sampling – Standard procedures were used to collect biota samples. All sampling gear was thoroughly rinsed between sampling areas to ensure that there was no inadvertent introduction of biota from one area to another.

Field replicates were collected for periphyton and benthos to determine natural variability and heterogeneity. Also, laboratory replicate counts (density and biomass) for periphyton were performed on ~10% of all samples and were chosen at random. Data quality objectives (DQO) for replicates should be within ± 25% of the first count (i.e., the RPD).

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, documenting 90% recovery;
- Precision and accuracy estimates were calculated;
- A voucher was compiled;
- Sorted sediments and debris are re-preserved in 10% formalin and are retained for up to three months. For samples subject to subsampling, sorted and unsorted fractions were represerved separately.

2.3. Results

2.3.1. Quality Assurance / Quality Control (QA/QC)

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 2-2, 2-3 and 2-4** for sediment chemistry, benthos, and periphyton, respectively.

ALS Environmental 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 QA/QC procedures performed on the sediment core samples met all of the laboratory's internal data quality objectives for precision and completeness defined for this project.

One sediment core sample was collected in duplicate at each of the 4 coring lake basins. The results of the RPD analysis (for pH, total organic carbon and total metals) are presented in **Table 2-2**. RPD values met DQOs in all cases except one: an RPD of 71 occurred for arsenic in the Inuggugayualik Lake field duplicate. As discussed in **Section 2.3.2**, arsenic values in this reference lake were quite variable and much higher in 2009, suggesting the influence of a localized area of mineralization. Consequently, variable results for this parameter are not unexpected in this situation. Overall, DQOs were met for this study component.

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, 3/62 (4.8%), 2/123 (1.6%), and 2/48 (4.2%) organisms were missed (**Table 2-3**), with an overall omission rate of less than 4%. 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.

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 are evaluated based on *total* density and *total* biomass of the laboratory duplicate. Although laboratory duplicates showed high within-taxa variability, RPDs for *total* density and *total* biomass consistently met the DQOs (i.e., <25%) (**Table 2-4**).

2.3.2. Sediment Coring

Baseline sediment coring was conducted in July 2008 (prior to any in-water construction activities) to document physical and chemical properties of the top 1 cm of sediment as part of the CREMP (Azimuth, 2009c). The 2009 follow-up was conducted to address concerns raised in the 2008 EAS study (Azimuth, 2009b) regarding the potential impacts of elevated metals concentrations in settling sediments. This section starts by describing the 2009 results, then assesses how surface sediment metals concentrations changed between 2008 and 2009 (i.e., in relation to East Dike construction) for control (INUG and TPE [sampled in July prior to any Bay-Goose Dike construction activities in the east basin]) and impact (SP and TE) areas.

Total metals concentrations (mg/kg dry weight), pH, and total organic carbon were measured in surface sediment from the top 1 cm of each core from each of the four sampling areas in July 2009 (**Table 2-5**; **Appendix E**).

Sediment was acquired at depths ranging from 6.1–14.4 m, depending on the sampling location, but targeted fine sediments. Total organic carbon (TOC) concentrations typically fell within the 4–6% range and are a reflection of the very slow sedimentation rates in the project lakes. TOC was also fairly consistent within and among areas.

Arsenic, chromium and copper concentrations exceeded the ISQG guidelines in all sediment core samples, at all four lake basins (**Table 2-5**), which is consistent with results of bulk and core sediment collections in 2008 (Azimuth, 2009c) and historic data (BAER, 2005). Cadmium and zinc concentrations also exceeded the ISQG guidelines, but not for all sediment cores. Cadmium was more frequently in exceedance in Tehek and Inuggugayualik Lakes and zinc in Second Portage Lake.

Arsenic was particularly high in about half of the sediment core samples from INUG (>100 mg/kg dw). Chromium concentrations were variable among lake basins; generally TPE and INUG had higher concentrations, as many of these samples were in exceedance of the PEL guidelines. Copper concentrations in sediment core samples were mostly similar among lake basins, ranging from about 45–85 mg/kg, with the exception of Second Portage Lake which ranged from 75–114 mg/kg.

Detailed statistical analyses and graphical data presentation are provided in **Appendix B**. Statistically significant increases (see **Figure 2-3**) in metals concentrations at SP and/or TE in 2009 (i.e., impact Area-Year combinations) relative to control Area-Year combinations were found for aluminum (SP and TE), beryllium (SP), vanadium (SP and TE), and zinc (SP and TE). It should be noted that the greatest difference between 2008 and 2009 occurred at the control area INUG, where arsenic concentrations increased nearly four times, likely due to the influence of local mineralization. This raises some uncertainty as to whether the results identified above for SP and TE (i.e., the two impact areas) might also be due to natural differences. However, this is considered unlikely for the following reasons:

- First of all, it should be just as likely to "miss" a local area of mineralization (i.e., and show a drop in concentrations), so one would not expect the skewed pattern of year-to-year changes at both SP (all increased) and TE (all but one metal, arsenic, increased).
- Secondly, it is unlikely that such an occurrence could happen in both Impact Areas in the same year for the same metal.

Consequently, the observed results for aluminum, vanadium and zinc are likely related to sediment inputs from East Dike construction.

To further test the plausibility of these results, surface sediment concentrations in Second Portage Lake were modeled by "mixing" settled sediments (i.e., from the summer and winter sediment traps) with the 2008 surface sediments. Sediment chemistry results for each source (i.e., summer trap, winter trap, 2008 surface) were averaged by weighting each according to their contribution to the top 1 cm in 2009. Weights were based on estimated deposition thickness for sediment traps and the remainder of the 1 cm was made up of the 2008 surface sediments (see **Section 2.3.4.1**). Results are shown in **Table 2-6**. The predicted values for 2009 were generally within 10% of the actual surface sediment results from the 2009 coring program. The main exceptions were for arsenic, beryllium, cadmium and molybdenum. All but cadmium were underestimated by the model, suggesting that natural variability may be a factor. While not definitive, the overall results do confirm that it is plausible that settled sediments were responsible for some or all of observed increases in surface sediment chemistry at SP in 2009.

2.3.3. Benthic Invertebrates

The initial portion of this section provides descriptive results of the EAS benthic invertebrate data set; similar results are described elsewhere for the CREMP data set (Azimuth, 2010b). Detailed statistical analysis and associated graphical presentations are provided in **Appendix B**.

Benthic invertebrates (collectively referred to as "benthos") are small animals that live on or in the bottom sediments and are an important food source for most fish species, especially young-of-the-year and juvenile lake trout, round whitefish, and arctic char (Machniak, 1975; Scott and Crossman, 1979). This section gives a general description of observations made on abundance and richness of all major taxa (e.g., insects, molluscs, worms) for the EAS data set. The abundance of roundworms (Nematoda) and seed shrimp (Ostracoda) is reported, but is not included in statistical comparisons of total number of genera or abundance. Because of their small size they are not consistently retained on a 500-μm sieve, thus their presence would be confounding if they were used to quantitatively compare abundance estimates among areas. Summarized data are in **Tables 2-7 and 2-8** and raw data are in **Appendix F**.

A total of 21 taxa were identified and enumerated in the benthic invertebrate samples collected from 5 areas (**Appendix F**). At all areas, insects were the dominant/co-dominant benthos for both abundance (#/m^2, **Table 2-7**) and richness (# taxa, **Table 2-8**). Insects were represented almost exclusively by chironomid larvae (F. Chironomidae) and made up 71% (15 taxa) of all taxa identified in samples. Chironomid larvae present in the samples consisted of 5 subfamilies and the majority of them were from 6 genera (**Appendix F**). The most abundant chironomid genus was *Procladius* (S.F. Tanypodinae) followed by *Stictochironomous* (S.F. Chironominae). *Heterotrissocladius* (S.F. Orthocladiinae) was also in high abundance; however, this was only the case at the area in Third Portage Lake (TPL-HVH-4), with the Second Portage Lake areas generally having very low abundance of this genus.

Mollusks were much less taxon rich, represented by just two genera (**Table 2-8**), but co-dominated (with insects) benthos total abundance at most areas (**Table 2-7**). *Cyclocatyx sp.* (including C. *neopisidium*) of the family Sphaeriidae (fingernail clams) made up almost 100% of the mollusks enumerated as the only other species observed was *Sphaerium nitidum* of which only a single individual was identified at a single area (SP-DT). Molluscs were least abundant (23%) at area TPL-HVH4 of Third Portage Lake and most abundant (47% and 44% respectively) at areas SP-N1 (47%) and SP-DT (44%) of Second Portage Lake.

Arthropods, represented by just one taxon (two including Cl. Ostracoda), were consistently present in low numbers at all areas. Two species of Oligchaetes were also present at most areas, but were the least abundant order in samples (**Table 2-7**).

As described in **Section 2.1**, there were two data sets: the EAS data set (with CREMP areas added) that provided greater spatial resolution, but was limited to 2009 (i.e., limited to making comparisons between control and impact areas in a single year); and the CREMP data set that includes results from 2006 to 2009 from a broader spatial range (i.e., allowing consideration of trends at all areas and years). The former control-impact "C-I" designs do not provide conclusions that are as robust as the latter before-after-control-impact "BACI" design. Both these data sets were analyzed to determine what inferences could be made regarding TSS-related effects to the benthic invertebrate community. Details regarding statistical testing and associated graphical data presentations are provided in **Appendix B**, with highlights presented below.

Key results from spatial EAS data set are presented in **Table 2-9** and shown in **Figures 2-4** through **2-7**. The study design compared control (INUG, PDL, TPS, TEFF, SP-DT) areas to impact (TE, SP-F1, SP, SP-N1, SP-N3) areas; three other areas (TPN, TPE, and TPL-HVH4) were designated as "unassigned" and individually compared to the control areas (see **Appendix B** for rationale). All areas in this data set shared physical characteristics (e.g., depth, total organic carbon, grain size) that were generally not correlated to benthic community response variables (i.e., physical factors are unlikely to be responsible for any differences observed in the benthic community among areas). Results for comparisons among areas for benthic community response variables were as follows:

- *Total abundance* – Significant decreases in abundance were detected between control (C) and impact (I) areas ($p<0.05$), with the latter about 30% lower. There were no significant differences in abundance between TPE, TPL-HVH4 or TPN and the control areas.
- *Total taxa richness* – Similar to abundance, significant decreases in total species richness were detected between C and I areas ($p=0.001$), with the latter about 30% lower. There were no significant differences in richness between TPE, TPL-HVH4 or TPN and the control areas.
- *Simpson's Diversity* –Statistically significant differences were detected between the control and impact areas, with the latter having slightly lower Simpson's D. TPN was also significantly lower than the control areas. There were no statistically significant differences between controls and TPE or TPL-HVH4.
- *Bray Curtis Index* – A similar pattern to total abundance and taxa richness was observed for Bray Curtis Index. The impact areas were significantly "further" from the control areas, but no statistically significant differences were found for TPE, TPL-HVH4 or TPN.

It is important to note that the differences observed in these analyses are difficult to attribute to exposure to elevated TSS (i.e., increased sedimentation), primarily since there is evidence that benthic communities in Second Portage and Tehek lakes may be inherently different than most of the control areas. This is discussed more in the following paragraphs.

The second data set, from the CREMP, provided a broader temporal and spatial perspective to the TSS issue. Prior to analysis, Area-Year combinations were assigned as control or impact based on potential exposure to mine-related activities (**Table 2-10**). Six Area-Year combinations were of interest for potential impacts: SP-2008/2009, TE-2008/2009, TPE-2009, and TPN-2009. SP and TE were targeted for exposure to TSS related primarily to construction of the East Dike; exposure concentrations were much lower in 2009 (and due to Bay-Goose Dike construction). TPE was included since TSS concentrations had already started to increase when that area was sampled in August 2009. TPN was included due to potential exposure to TSS during dewatering. Key results for differences among areas are presented in **Table 2-11**, shown in **Figures 2-8** through **2-11**, and summarized below:

- *SP (2008 and 2009)* – Last year's EAS study (Azimuth, 2009b) reported a marginal trend (0.05<P<0.2) for decreased total abundance at SP that did not extend to TE (see **Table 2-11**, which also includes the 2008 results). As shown in **Figures 2-8 and 2-10**, 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); not surprisingly, abundance was not significantly different in 2009 relative to control Area-Year combinations. Effect sizes for richness were similar in both 2008 and 2009 (**Figures 2-8, 2-9 and 2-11**); both years showed a predicted loss of about 2.5 taxa, but were not statistically significant. Interestingly, Simpson's Diversity actually showed a positive (but not statistically significant) trend, despite the reduction in taxa richness[1]. There were no significant differences in Bray Curtis distance for either year. Overall, these results appear consistent with **Figure 2-8**, which shows the drop in abundance at SP in 2008, but fairly consistent grouping of 2006/2007 results with 2008/2009 results for the other response variables.
- *TE (2008 and 2009)* – 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 **Table 2-11**). The 2009 results confirm that finding and reaffirm that there does not appear to be any significant changes at TE related to TSS; this is not surprising as TSS concentrations in Tehek Lake were much lower than Second Portage Lake in 2008 and only just above background concentrations in 2009. **Figure 2-8** probably shows this the best for all response variables. Note, with the exception of Simpson's Diversity, the fairly tight grouping of all response variables at TE relative to the control Area-Year combinations. The two

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

low Simpson's Diversity results for TE in 2009 are due to replicate samples that actually contained relatively high numbers of sphaerid clams, which substantially reduced the diversity scores for those replicates.

- *TPE (2009)* – As discussed in **Appendix B** (**see its Section 3.2.2**), exposure to some TSS during the early stages of Bay-Goose Dike construction meant that it can no longer be considered a control area in 2009. Consequently, it was included as an impact Area-Year combination to test for adverse changes in response variables. Note that while this Area-Year is not related to East Dike construction, the response patterns observed are relevant to the overall assessment of the potential effects of dike construction on benthic communities. No statistically significant changes were identified at TPE in 2009. Again, **Figure 2-8** shows that the data for all response variables in 2009 were similar to previous years.
- *TPN (2009)* – As discussed in **Appendix B** (**see its Section 3.2.2**), this area was potentially exposed to elevated TSS during dewatering of the NW arm of Second Portage Lake between March and July 2009. While the CREMP water quality data suggest that exposure to TSS was low, this area could no longer be considered among the control areas for 2009. Consequently, it was added as an impact Area-Year combination out of interest (i.e., since it doesn't directly relate to East Dike construction). As seen in **Figure 2-8**, there were no apparent (or statistically significant; results not reported in **Table 2-11**) adverse changes at TPN in 2009.

As discussed in **Appendix B** (see its **Section 2**), effect sizes and associated confidence intervals help to place the observed results in to perspective. As seen in **Table 2-11**, 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 need 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 last year's EAS report (Azimuth 2009b), which highlighted the decrease in abundance at SP in 2008, trends have been identified 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.

Another key factor in the interpretation of results is causality, which pertains to the degree of association between cause and effect. The analyses reported above were conducted to provide inferences regarding the potential for TSS-related effects (from East

Dike construction) to benthic invertebrate communities. To explore the strength of association between cause and effect further, the mean response variable results per Area-Year combination were plotted against four physical variables:

- *Total suspended solids (TSS; mg/L)* – this water column parameter is an approximation of TSS concentrations prevalent in an area for the one-week period prior to sampling. All control Area-Year combinations were given a default value of 0.2 mg/L; impact Area-Year combinations were estimated using available dike construction monitoring data (Azimuth 2009a, 2010a) and/or CREMP monitoring results (Azimuth 2008a,b, 2009c,2010b). This should be a reasonable approximation of the relative degree of exposure to TSS for each Area-Year combination. However, the actual concentrations reported for TSS in the water column should not be taken too literally, since exposure is a function of both concentration and time.
- *Depth (m)* – Benthic communities are known to be influenced by depth.
- *TOC (%)* – Organic carbon content is generally associated with productivity. Spatial or temporal differences in TOC can affect benthic community structure.
- *Fines (%)* – Percent fines is a combination of the silt and clay particle size fractions. Grain size is also known to affect benthic community structure.

The results of the response variable vs. physical variable plots are shown in **Figure 2-12**. The CREMP design targeted locations within each basin that controlled for depth, TOC and grain size. Overall, physical conditions are quite similar among areas. Only one regression was significant for relationships with Depth, TOC and % Fines: taxa richness was positively correlated with TOC (P=0.03). The general lack of relationships between response and standard physical variables suggests that the CREMP design has been fairly effective at controlling these factors. Consequently, exposure to TSS concentrations are unlikely to be confounded by the influence of the other physical factors, so response patterns should be clear.

The TSS plots must be cautiously interpreted as the data are highly skewed to very low TSS concentrations (and thus fail the assumptions of the regression analysis, so p values are not provided; confidence intervals should only be considered a rough guide to relationship fit). The abundance (N) on TSS plot showed that the Area-Year combination with high TSS exposure (SP in 2008) did have the lowest abundance in the data set. The next highest exposure, TE in 2008, also showed fairly low abundance, but there were several other areas with lower abundance and much lower TSS exposure concentrations. This suggests that the importance of TSS as a factor in structuring the benthic invertebrate community drops off between the two highest exposure levels. This idea is supported by the Bray Curtis Index results, which again shows SP-2008 as the Area-Year most different from reference (i.e., control Area-Year combinations) conditions. TE in 2008, although the next highest in TSS exposure, is in the middle of the distance range for Area-Year combinations with negligible exposure. These data supports the conclusion of a marginal change in benthic abundance at SP in 2008 that did not extend to TE. None of the other TSS exposure concentrations appear sufficiently high to result in substantial changes to the benthic community.

2.3.4. High-value Habitat Assessment

2.3.4.1. Sediment Traps

Trap retrieval rates were lower than expected. Out of the 6 traps deployed over winter, only three were successfully recovered. Results for East Dike sediment deposition rates and estimated deposition thickness are presented alongside Bay-Goose Dike sediment trap results in **Table 3-12** (see **Section 3.3.3.3**).

Sediment accumulation in the 3 winter sediment traps was much less than accumulation measured during the summer and the peak of East Dike construction. We estimated that 1.79 mm of sediment was deposited at SP-ST1 during the summer of 2008 (this station was called HVH-1 in the 2008 TSS EAS report; Azimuth, 2009b). Here we estimate that a further 0.03 mm was deposited at SP-ST1 during the winter, post-construction, for a total accumulation of about 1.82 mm. Similarly, adding together the sediment accumulation at SP-ST5 from the summer of 2008 (1.1 mm) to the sediment deposited over the winter at the same station (0.011 mm), results in an approximate total of 1.11 mm.

Note that in 2009 we noticed that many traps contained more than just sediment (e.g., biota). Consequently, rather than just drying and weighing trap contents, as was done in 2008, we also ashed samples (see **Section 3.2.2.3** for methods) to remove organic matter. All sedimentation estimates were made using the ash weights (see **Section 3.3.3.3** for more discussion).

2.3.4.2. Underwater Video Survey

Underwater video is used to qualitatively describe substrate features and periphyton community on HVH areas of Second Portage Lake and Third Portage Lake. This method is used to document relative apparent volumes of sediment deposition on HVH habitats in Second Portage Lake relative to HVH habitats in Third Portage Lake, prior to Goose Dike construction. Video captures were used to describe key features of the substrate and visible periphyton communities (**Appendix C**). **Table 2-12** provides a detailed description of the site, depth and substrate composition and the density and description of periphyton coverage at HVH locations in Second and Third Portage Lakes. Evidence of sedimentation or coverage of the periphyton community would suggest that sediment might have settled into pore spaces between rocks where fish eggs would be laid for overwinter incubation. Because periphyton coverage on the rocks to about 4 m depth is fairly complete and because periphyton will accumulate sediment, if present because of their structure, this was considered a reliable indication of sediment accumulation.

Second Portage Lake High-Value Habitat

Underwater video footage of six HVH locations in Second Portage Lake Figure (video frame captures of representative features are shown in **Appendix C photos C-1 to C-4**) indicated that substrate consisted primarily of boulder, with cobble and some fines. All substrate types had high percentage periphyton cover (70-100 %), including fines (**Photo C-1**). Periphyton mats were generally more luxuriant and thicker in shallow water (**Photo C-2**, 1 m depth) than at depth (>2 m) (**Table 2-12**). There was evidence of ice scour at more than half of the stations as periphyton mats were patchy, especially on large boulders in shallow water (**Photo C-3**). At depth, periphyton mats were continuous, but generally not as dense. The HVH station closest to the East Dike (HVH1) had high periphyton coverage on all substrates but it had a grayish brown colour due to a thin layer of sediment covering all flat surfaces. The next closest stations to the East Dike (HVH2 and HVH3) also had some settled sediment but it was observed only on flat surfaces (**Photo C-4**) not on angled surfaces. At these stations, periphyton mats were generally green and appeared in good health; as was periphyton at the remaining Second Portage Lake HVH stations further afield (**Table 2-12**). The video imagery suggests that some sedimentation of rocky substrates occurred nearest the East Dike and diminished with increasing distance from the dike, a result that is supported by the quantitative sampling (**Section 2.3.5.2**). Periphyton was unaffected at the far-field SP-CREMP location.

Third Portage Lake High-Value Habitat

Third Portage Lake HVH station underwater video footage was taken as part of the ‘before dike construction’ monitoring database, and to provide perspective and reference on typical periphyton coverage in the project lakes. This imagery also provides a qualitative perspective on the possible effect of sedimentation on periphyton in Second Portage Lake. Substrate features in Third Portage Lake were very similar to Second Portage Lake, being dominated by large boulders with some large cobble interspersed throughout (**Table 2-12**). At HVH1 and HVH3 boulder was the exclusive substrate because of shallow depth, while at the other Third Portage Lake HVH stations, cobble and fines comprised a portion of the substrate, although still boulder dominated. Generally, periphyton coverage could be seen on all substrates, including fines (**Photo C-5**) as well as boulders (**Photos C-6 and C-7**). Periphyton was vibrant green in colour, luxuriant, had excellent density or coverage (>70%) with raised fronds, especially on sloped surfaces (**Photo C-8**). At some stations, mats were highly continuous and dense (**Photo C-9**). This may be due to ice scour at shallow depth and was evident on large boulders with periphyton bald patches (**Photo C-10**).

Overall Qualitative Assessment

Periphyton coverage of HVH substrates also did not appear to be different between Second and Third Portage lakes. Furthermore, there did not appear to be any diminishment of periphyton abundance in HVH areas affected by sediment from East Dike construction. Percent coverage ranged from 70% to 100% at HVH locations in both lakes. Periphyton coverage in both lakes appeared relatively dense, luxurious and healthy. Ice scour and erosion of periphyton was evident at a few locations where rocks were shallow and exposed to ice scour from wind-driven currents. Periphyton at HVH1 and HVH2 locations nearest to the dike appeared to be slightly impaired, with evidence of settled sediment on upward facing surfaces of large substrate. Smothering has slightly compressed periphyton fronds so they appear flattened (**Appendix C**). This was particularly true for shallow substrates adjacent to and within several hundred meters of the East Dike and HVH locations nearest the dike. The appearance of periphyton improved away from the East Dike toward Tehek Lake; this area received relatively reduced amounts of sediment which is consistent with the patterns of TSS movement in 2008. No such spatial differences were observed in Third Portage Lake in 2008.

Overall these results indicate that significant sedimentation of HVH habitats (primarily HVH1 and 2), based on evidence of impacts to periphyton from underwater video footage, is restricted to areas nearest the East Dike. Other HVHs areas away from the East Dike showed signs of minor sedimentation.

2.3.5. 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 the sun disappears.

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 contaminants. Because some periphyton species are sensitive to the presence of metals, reductions in periphyton communities over time can indicate the presence of dissolved metals in the water column. Three studies were carried out to assess the periphyton community which together will provide a complete understanding of the periphyton community in Second Portage and Third Portage Lakes. These involved a qualitative assessment of coverage in shallow high value habitat using underwater video, a quantitative assessment of periphyton community abundance and biomass ($\mu g/cm^2$), and an assessment of the living versus dead cell biomass to determine if the sedimentation event had adversely affected the community.

2.3.5.1. Quantitative Assessment of Periphyton Coverage

Periphyton density (cells/cm^2) and biomass (µg/cm^2) were measured in Second Portage Lake at one near-field station (SP-BL), one far-field station (SP-CREMP), and one reference station (in the Drilltrail Arm; SP-DT). Five independent samples were collected from each station in late August 2009, near the height of the growing season. SP-DT receives water from the Drilltrail/Wally Lake watershed and was not subject to sedimentation as a result of dike construction. It should be noted that estimates of periphyton biomass are inherently variable due to many factors including small surface area sampled, nutrient availability, predation, 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 (see Azimuth, 2010c). 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.

A total of 61 periphyton genera/species were identified at the 3 sampling stations in Second Portage Lake, represented by 3 major taxonomic groups. Overall, the periphyton community was co-dominated by Cyanophytes (*Stigonema mamillosum* Gardner, *Nostoc sp.*, *Petalonema alatum* Berk, *Rivularia dura* Roth *and Lyngbya mucicola* Lemmermann) and Diatoms (*Tabellaria flocculsa* (Roth) Kutzing, *Cymbella prostata* (Berkeley) Cleve, *Neidium iridis* (Ehrenberg) Cleve), while Chlorophytes made up the remaining minority (**Figure 2-13**). A matrix of the periphyton presence/absence at each sampling station is presented in **Appendix G**.

As expected, total periphyton density was quite variable both within and among stations and ranged from 353,759 cells/cm^2 at SP-BL to 1.23 million cells/cm^2 at SP-CREMP (**Table 2-13**). Cyanophytes comprised 73% of the total periphyton density at all stations, and diatoms had the next highest density at only 24% (**Table 2-13**).

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 highly variable and ranged from 103 - 925 µg/cm^2. Total station biomass at SP-BL (201 µg/cm^2) was significantly lower than at SP-DT (438 µg/cm^2) and SP-CREMP (549 µg/cm^2) (**Table 2-14, Figure 2-13**). The most noticeable changes at SP-BL were due to significant reductions in cyanobacteria and chlorophytes, with the latter being particularly depressed at SP-BL (**Table 2-14, Figure 2-13**). These data suggest that periphyton productivity and community structure have likely been impaired by sedimentation in close proximity to the East Dike (SP-BL). Note that within station variability was often just as great as among station variability, both for density and biomass (**Tables 2-13 and 2-14**). Compared to historical data from the SP CREMP station (Azimuth, 2008a,b) and baseline data (BAER, 2005), mean periphyton biomass at SP-BL from the current study was the lowest biomass recorded in Second Portage Lake.

Despite the differences in biomass and density, periphyton species richness was similar among stations, ranging from 15 to 20 (**Table 2-14**). Simpson's diversity did not differ among stations and ranged from 0.61 to 0.79, with an average of 0.73 (**Table 2-14**).

Community composition, abundance, and biomass at the Drilltrail Arm (SP-DT) and CREMP stations (SP-CREMP) were comparable with previous years (**Figure 2-13**). Abundance and biomass at the near-field station SP-BL, although within the range of historically observed values, was depressed in 2009 due to sedimentation.

2.3.5.2. Dead/Alive Periphyton Analysis

Based on plume monitoring during construction of the East Dike (Azimuth, 2009a), gross sedimentation in Second Portage Lake would be expected to be highest near the East Dike and diminish with distance. The results of the previous section documented reduced periphyton biomass and changes to community structure that are most likely due to the effects of sedimentation. This study, which looks at the correlation between periphyton health and the mass of sediment present in association with the community, was added to the EAS to help understand potential mechanisms for the observed responses.

Results for comparisons of mass of periphyton community *versus* associated sediment content are presented in **Table 2-15** (**Appendix H**). At the station closest to the East Dike (SP-BL), approximately 0.74 g of sediment had accumulated relative to 0.08 g of dry organic matter, resulting in a sediment:periphyton ratio of 9.3:1 (dry weights). At the SP-CREMP location, dry sediment mass was 0.30 g and dry organic mass was 0.24 g, for a ratio of 1.25:1. This was similar to the SP-DT location with a dry sediment mass of 0.12 g and an organic dry mass of 0.17 g (ratio of 0.71:1).

The results of living versus dead periphyton biomass are shown in **Table 2-16.** Overall, there were no differences in the proportion of live or dead biomass among locations. There were also no consistent patterns based on periphyton taxa groups. In terms of living biomass, the results were generally consistent with the quantitative periphyton sampling (**Section 2.3.5.1**) in that cyanobacteria and chlorophytes were much lower at SP-BL.

However, these samples showed less of a difference in total biomass between SP-BL and the reference area SP-DT.

2.3.5.3. Integrated Results.

The two sets of periphyton community data agree regarding reduced periphyton biomass and community structure changes at SP-BL close to the East Dike. Data on sediment content of the periphyton mat supports the hypothesis that the observed differences are likely due to increased sedimentation related to East Dike construction in 2008. While the available data point strongly to this conclusion, the lack of data for this area prior to dike construction prevents a definitive statement of causality. Reduced biomass was not observed at the CREMP location, which would have been exposed to TSS in 2008, but to a much lower degree than SP-BL.

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.

Ultimately, algal growth is driven by nutrient concentrations (carbon, nitrogen and phosphorus) and light. In the case of the Meadowbank lakes, nutrient concentrations are extremely low and one would expect algal growth to be very slow. In nutrient poor lakes of northwestern Ontario, Findlay et al. (2009) used ceramic tiles to assess the effects of an aquaculture cage operation on epilithic growth. Tiles were placed on floating trays in experimental and reference lakes which had total phosphorus concentrations 2.5 times higher than those recorded in Second Portage Lake. Findlay et al. observed an average growth rate of $< 4.3 \mu g/cm^2/day$. In other lakes, following recovery of an acidification event, colonization of rock substrate by periphyton was relatively quick (~ 3 yrs) (Turner et al. (2009). In another study, Turner et al. (2005) discussed the ramifications of lake level draw-down on the epilithic community in a small boreal shield lake. Lake level was allowed to drop by 2-3 m over the winter and allowed to refill during the open-water season for 3 consecutive years. No long-term effect on the epilithic community was observed as periphyton simply re-colonized the new littoral zone.

Based on the literature, epilithic communities in varying locales and nutrient regimes are resilient. While the observed biomass and community structure differences are likely related to construction-related sedimentation, the spatial extent was only roughly delineated (i.e., apparent reduction at SP-BL was bounded by the lack of effect at SP-CREMP). Given the resilience of periphyton, no long-term impacts are expected. Further sampling is recommended in 2010 to verify the extent of recovery of the community at near-field locations and to better define the zone of potential impacts.

Table 2-1. Sample date, ID, and UTM coordinates for all samples collected, East Dike EAS Follow-up, 2009.

Sample Type	Location		Date	Sample ID	UTM Location
Sediment Coring	Third Portage Lake - East Basin		17-Jul-09	TPE-SC-01	14 W 0638797 7211399
			17-Jul-09	TPE-SC-02	14 W 0638833 7211399
			17-Jul-09	TPE-SC-03	14 W 0638700 7211371
			17-Jul-09	TPE-SC-04	14 W 0638768 7211314
			17-Jul-09	TPE-SC-05	14 W 0638733 7211408
			17-Jul-09	TPE-SC-06	14 W 0638602 7211342
			17-Jul-09	TPE-SC-07	14 W 0638533 7211329
			17-Jul-09	TPE-SC-08	14 W 0638687 7211394
			17-Jul-09	TPE-SC-09	14 W 0638937 7211449
			17-Jul-09	TPE-SC-10	14 W 0638778 7211403
			17-Jul-09	TPE-SC-11	14 W 0638782 7211383
			17-Jul-09	TPE-SC-12	14 W 0638877 7211419
			17-Jul-09	TPE-SC-13	14 W 0638879 7211447
			17-Jul-09	TPE-SC-14	14 W 0638557 7211405
			17-Jul-09	TPE-SC-15	14 W 0638549 7211417
	Second Portage Lake		18-Jul-09	SP-SC-01	14 W 0639886 7213832
			18-Jul-09	SP-SC-02	14 W 0639877 7213849
			18-Jul-09	SP-SC-03	14 W 0639921 7213832
			18-Jul-09	SP-SC-04	14 W 0639980 7213796
			18-Jul-09	SP-SC-05	14 W 0639962 7213832
			18-Jul-09	SP-SC-06	14 W 0639952 7213807
			18-Jul-09	SP-SC-07	14 W 0639848 7213801
			18-Jul-09	SP-SC-08	14 W 0640076 7213923
			18-Jul-09	SP-SC-09	14 W 0639853 7213847
			18-Jul-09	SP-SC-10	14 W 0639875 7214014
			18-Jul-09	SP-SC-11	14 W 0639838 7214081
			18-Jul-09	SP-SC-12	14 W 0639801 7214046
			18-Jul-09	SP-SC-13	14 W 0639960 7214015
			18-Jul-09	SP-SC-14	14 W 0640018 7214085
			18-Jul-09	SP-SC-15	14 W 0640086 7214039
	Tehek Lake		20-Jul-09	TE-SC-01	15 W 0360070 7212276
			20-Jul-09	TE-SC-02	15 W 0360122 7212315
			20-Jul-09	TE-SC-03	15 W 0360154 7212288
			20-Jul-09	TE-SC-04	15 W 0360117 7212269
			20-Jul-09	TE-SC-05	15 W 0360162 7212253
			20-Jul-09	TE-SC-06	15 W 0360077 7212228
			20-Jul-09	TE-SC-07	15 W 0360041 7212192
			20-Jul-09	TE-SC-08	15 W 0359990 7212203
			20-Jul-09	TE-SC-09	15 W 0360144 7212329
			20-Jul-09	TE-SC-10	15 W 0360172 7212360
			20-Jul-09	TE-SC-11	15 W 0360144 7212348
			20-Jul-09	TE-SC-12	15 W 0360140 7212320
			20-Jul-09	TE-SC-13	15 W 0360115 7212282
			20-Jul-09	TE-SC-14	15 W 0360100 7212222
			20-Jul-09	TE-SC-15	15 W 0360081 7212188
	Inuggugayualik Lake		24-Jul-09	INUG-SC-01	14 W 0622842 7216863
			24-Jul-09	INUG-SC-02	14 W 0622852 7216839
			24-Jul-09	INUG-SC-03	14 W 0622852 7216847
			24-Jul-09	INUG-SC-04	14 W 0622873 7216786
			24-Jul-09	INUG-SC-05	14 W 0622864 7216817
			24-Jul-09	INUG-SC-06	14 W 0622855 7216846
			24-Jul-09	INUG-SC-07	14 W 0622879 7216814
			24-Jul-09	INUG-SC-08	14 W 0622876 7216835
			24-Jul-09	INUG-SC-09	14 W 0622929 7216815
			24-Jul-09	INUG-SC-10	14 W 0622909 7216840
			24-Jul-09	INUG-SC-11	14 W 0622897 7216867
			24-Jul-09	INUG-SC-12	14 W 0622941 7216724
			24-Jul-09	INUG-SC-13	14 W 0622935 7216753
			24-Jul-09	INUG-SC-14	14 W 0622921 7216779
			24-Jul-09	INUG-SC-15	14 W 0622904 7216808
Benthic Invertebrates	Second Portage Lake		15-Aug-09	SP-N1-1	14 W 639775 7213269
			15-Aug-09	SP-N1-2	14 W 639746 7213296
			15-Aug-09	SP-N1-3	14 W 639657 7213414
			15-Aug-09	SP-N1-4	14 W 639623 7213481
			15-Aug-09	SP-N1-5	14 W 639632 7213538
			23-Aug-09	SP-N3-1	14 W 639576 7214625
			23-Aug-09	SP-N3-2	14 W 639586 7214582
			23-Aug-09	SP-N3-3	14 W 639584 7214591
			23-Aug-09	SP-N3-4	14 W 639627 7214620
			23-Aug-09	SP-N3-5	
			23-Aug-09	SP-F1-1	14 W 640785 7213366
			23-Aug-09	SP-F1-2	14 W 640802 7213387
			23-Aug-09	SP-F1-3	14 W 640823 7213410
			23-Aug-09	SP-F1-4	14 W 640782 7213313
			23-Aug-09	SP-F1-5	14 W 640768 7213312
			19-Aug-09	SP-DT-1	15 W 358660 7213654
			19-Aug-09	SP-DT-2	15 W 358656 7213581
			19-Aug-09	SP-DT-3	14 W 641309 7213561
			19-Aug-09	SP-DT-4	14 W 641275 7213533
			19-Aug-09	SP-DT-5	14 W 641254 7213512
	Third Portage Lake		23-Aug-09	TPL-HVH4-1	14 W 639496 7212446
			23-Aug-09	TPL-HVH4-2	14 W 639482 7212430
			23-Aug-09	TPL-HVH4-3	14 W 639470 7212416
			23-Aug-09	TPL-HVH4-4	14 W 639487 7212387
			23-Aug-09	TPL-HVH4-5	14 W 639522 7212368
Periphyton Qualitative & Quantitative	Third Portage Lake	Qual.	28-Jul-09	3PL-HVH-1	14 W 0638672 7211817
			28-Jul-09	3PL-HVH-2	14 W 0638854 7212120
			28-Jul-09	3PL-HVH-3	14 W 0639749 7211954
			28-Jul-09	3PL-HVH-4	14 W 0639610 7212516
			28-Jul-09	3PL-HVH-5	14 W 0639052 7211093
			28-Jul-09	3PL-HVH-6	14 W 0639454 7213341
	Second Portage Lake	Qual.	27-Jul-09	2PL-HVH-1	14 W 0639641 7214006
			27-Jul-09	2PL-HVH-2	14 W 0640055 7213799
			27-Jul-09	2PL-HVH-3	14 W 0639747 7213400
			27-Jul-09	2PL-HVH-4	14 W 0640269 7213786
			27-Jul-09	2PL-HVH-5	14 W 0640825 7213350
			28-Jul-09	2PL-HVH-6	14 W 0640414 7213102
		Quant.	27-Aug-09	SP-BL	14 W 0639484 7214585
			28-Aug-09	SP-CREMP	14 W 0641003 7213264
			30-Aug-09	SP-DT	14 W 0638444 7213723

Table 2-2. QA/QC data for sediment core parameters, July 2009.

Analytes		Third Portage Lake - East Basin			Second Portage Lake			Tehek Lake			Inuggugayualik Lake			Various Lakes		
		TPE-SC-6	Field Dup	RPD	SP-SC-7	Field Dup	RPD	TE-SC-6	Field Dup	RPD	INUG-SC-8	Field Dup	RPD	Original	Laboratory Duplicate	RPD
	MDLs	17-Jul-09	17-Jul-09	(%)	18-Jul-09	18-Jul-09	(%)	20-Jul-09	20-Jul-09	(%)	24-Jul-09	24-Jul-09	(%)	July		(%)
CONVENTIONAL PARAMETERS																
Physical & Organic Parameters																
pH	0.1	5.52	6.36	-14.1	6.37	6.36	0.2	6.06	6.10	-0.66	5.97	5.98	-0.17			
Total Organic Carbon (% dw)	0.1	4.94	4.83	2.25	4.21	4.83	-13.7	4.05	3.79	6.63	3.94	4.53	-13.9	4.05	4.02	0.74
TOTAL METALS (mg/kg dw)																
Aluminum	50	25200	28700	-13.0	28300	28700	-1.4	22400	22900	-2.2	16900	16000	5.5			
Antimony	10	<10	<10	0	<10	<10	0	<10	<10	0	<20	<20	0			
Arsenic	5	39.2	32.5	18.7	28	32.5	-14.9	41.1	30.1	30.9	43	90	-71			
Barium	1	137	141	-2.88	139	141	-1.4	150	135	10.5	99.7	106	-6.13			
Beryllium	0.5	2.18	2.36	-7.93	2.35	2.36	-0.4	1.94	1.87	3.67	1.1	1.1	0			
Cadmium	0.5	<0.50	<0.50	0	<0.50	<0.50	0	0.74	0.52	35	1.1	1.3	-17			
Chromium	2	91.0	84.9	6.94	82.7	84.9	-2.6	48.1	51.0	-5.85	73.5	70.0	4.88			
Cobalt	2	19.9	16.8	16.9	16.5	16.8	-1.8	15.3	12.7	18.6	18.3	16.6	9.74			
Copper	1	81.5	94.6	-14.9	95.5	94.6	0.9	65.0	61.6	5.37	39.6	38.0	4.12			
Lead	30	<30	<30	0	<30	<30	0	<30	<30	0	<60	<60	0			
Mercury	0.005	0.0453	0.0450	0.664	0.0480	0.0470	2.11	0.0460	0.0400	14.0	0.0306	0.0318	-3.85			
Molybdenum	4	11.3	6.00	**61.3**	6.1	6.0	1.7	11.4	9.30	20.3	15.7	16.8	-6.77			
Nickel	5	82.8	64.3	25.2	70	64.3	8.5	54.7	43.2	23.5	60	66	-9.5			
Phosphorus	50	478	675	-34.2	610	684	-11.4	696	624	10.9	870	790	9.64			
Selenium	2	<2.0	<2.0	0	<2.0	<2.0	0	<2.5	<2.5	0	<4.0	<4.0	0			
Silver	2	<2.0	<2.0	0	<2.0	<2.0	0	<5.0	<4.0	0	<4.0	<4.0	0			
Thallium	1	<1.0	<1.0	0	<1.0	<1.0	0	<1.0	<1.0	0	<1.0	<1.0	0			
Tin	5	<5.0	<5.0	0	<5.0	<5.0	0	<5.0	<5.0	0	<10	<10	0			
Vanadium	2	42.3	45	-6.2	44.4	45.0	-1.34	31.8	32.4	-1.87	22.1	19.7	11.5			
Zinc	1	148	127	15.3	130	127	2.33	95.1	90.7	4.74	58.5	60.7	-3.69			

Notes:

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

Shaded RPDs exceed 25% (lab duplicates) or 50% (field duplicates).

Bolded RPDs exceed 50% (field duplicates) or 25% (laboratory duplicates), 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.

Table 2-3. Percent recovery of benthic invertebrate samples, August 2009.

Station	Number of Organisms Recovered	Number of Organisms in Re-sort	Percent Recovery
SP-DT-1	59	62	95.2%
SP-F1-3	121	123	98.4%
SP-N1-2	46	48	95.8%
		Average % Recovery	96.5%

Notes:
All twenty five samples were sorted in their entirety.

Table 2-4. QA/QC data for periphtyton, August 2009.

	Drill Trail Arm		
	DT-1Q 30-Aug-09	**Lab Duplicate**	**RPD** (%)
Periphyton Biomass (μg/cm^2)			
Cyanobacteria	478.1	735.2	-42.4
Chlorophyte	297.3	76.1	118.5
Diatom	134.5	227.3	-51.3
Total	**909.9**	**1038.6**	**-13.2**
Periphyton Density (cells/cm^2)			
Cyanobacteria	645995	798521	-21.1
Chlorophyte	71777	26917	90.9
Diatom	269165	403747	-40.0
Total	**986937**	**1229185**	**-21.9**
# Species	17	17	0
Simpson's Diversity	0.74	0.63	15.9

Notes:

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

Shaded RPDs exceeded 25% (lab duplicates).

Table 2-5. Sediment core chemistry and total metals (mg/kg), July 2009.

Lake & Basin	Station ID	Date	Depth (m)	CONVENTIONAL PARAMETERS		TOTAL METALS (mg/kg dw)																					
				pH	Total Organic Carbon (% dw)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Phosphorus	Selenium	Silver	Thallium	Tin	Vanadium	Zinc
	Sediment Quality Guidelines (CCME 2002)[1]		**ISQG**	NG	NG	NG	NG	5.9	NG	NG	0.6	37.3	NG	35.7	35.0	0.170	NG	NG	NG	NG	NG	NG	NG	NG	123
			PEL	NG	NG	NG	NG	17	NG	NG	3.5	90.0	NG	197	91.3	0.486	NG	NG	NG	NG	NG	NG	NG	NG	315
Third Portage Lake - East basin	TPE-SC-01	17-Jul-09	6.9	5.96	3.06	27200	<10	16.9	127	2.10	<0.50	94.1	16.4	56.0	<30	0.0143	4.4	58.9	362	<3.0	<3.0	<1.0	<5.0	43.8	111
	TPE-SC-02	17-Jul-09	10.7	6.30	3.72	25800	<20	23.0	153	2.00	<1.0	88.3	17.7	62.7	<60	0.0280	<8.0	118	460	<2.5	<4.0	<1.0	<10	41.5	121
	TPE-SC-03	17-Jul-09	6.3	6.26	4.97	25200	<10	16.2	124	1.96	<0.50	90.4	15.0	54.0	<30	0.0213	<4.0	58.7	409	<2.0	<2.0	<1.0	<5.0	40.3	106
	TPE-SC-04	17-Jul-09	14.4	6.15	4.92	19000	<10	30.8	321	1.44	<0.50	61.9	28.6	63.6	<30	0.0425	6.6	260	548	<2.5	<3.0	<1.0	<5.0	31.7	122
	TPE-SC-05	17-Jul-09	6.6	6.34	5.07	23400	<10	15.4	118	1.85	<0.50	85.1	14.5	49.6	<30	0.0211	<4.0	59.0	405	<2.0	<2.0	<1.0	<5.0	37.9	103
	TPE-SC-06	17-Jul-09	8.4	5.52	4.94	25200	<10	39.2	137	2.18	<0.50	91.0	19.9	81.5	<30	0.0453	11.3	82.8	478	<2.0	<2.0	<1.0	<5.0	42.3	148
	TPE-SC-07	17-Jul-09	9.0	5.75	4.65	25800	<10	9.1	151	1.88	<0.50	91.7	8.7	58.9	<30	0.0309	4.6	63.6	362	<2.0	<2.0	<1.0	<5.0	40.3	112
	TPE-SC-08	17-Jul-09	6.9	6.33	5.12	23400	<10	16.1	121	1.86	<0.50	92.3	15.2	50.2	<30	0.0290	4.1	60.4	434	<2.0	<2.0	<1.0	<5.0	38.8	108
	TPE-SC-09	17-Jul-09	11.0	6.09	4.29	26700	<10	33.4	150	2.18	<0.50	94.5	15.9	84.5	<30	0.0370	8.3	96.1	1060	<2.5	<2.0	<1.0	<5.0	44.7	127
	TPE-SC-10	17-Jul-09	7.2	6.08	3.52	26900	<10	17.6	123	2.11	<0.50	94.7	16.0	55.2	<30	0.0162	4.3	56.6	380	<2.0	<2.0	<1.0	<5.0	43.1	112
	TPE-SC-11	17-Jul-09	7.2	6.01	3.47	25600	<10	17.3	119	2.04	<0.50	90.9	15.5	55.4	<30	0.0173	4.6	55.3	365	<2.0	<3.0	<1.0	<5.0	41.5	106
	TPE-SC-12	17-Jul-09	9.4	5.98	4.16	27800	<10	18.6	128	1.91	<0.50	94.6	15.4	58.7	<30	0.0237	4.2	60.2	469	<2.5	<2.0	<1.0	<5.0	41.1	104
	TPE-SC-13	17-Jul-09	9.4	6.20	4.88	24900	<10	17.7	136	1.83	0.65	84.7	13.5	54.1	<30	0.0397	4.5	64.5	451	<2.5	<2.0	<1.0	<5.0	37.4	105
	TPE-SC-14	17-Jul-09	6.4	6.02	5.63	21500	<10	15.9	105	1.60	<0.50	79.5	11.8	45.4	<30	0.0290	<4.0	51.2	429	<2.0	<2.0	<1.0	<5.0	32.9	89.9
	TPE-SC-15	17-Jul-09	6.1	5.91	4.56	26900	<10	15.7	123	1.97	<0.50	93	15.6	52.6	<30	0.0188	<4.0	57.7	411	<2.0	<2.0	<1.0	<5.0	40.7	106
Second Portage Lake	SP-SC-01	18-Jul-09	10.0	6.85	5.45	28500	<10	33.2	141	2.28	<0.50	81.7	15.4	92.8	30	0.0490	6.7	59.7	766	<2.0	<2.0	<1.0	<5.0	42.9	120
	SP-SC-02	18-Jul-09	10.6	6.57	4.59	31400	<10	31.1	149	2.46	<0.50	85.3	16.2	101	<30	0.0429	6.2	61.2	730	<2.0	<2.0	<1.0	<5.0	45.8	124
	SP-SC-03	18-Jul-09	11.6	6.46	5.57	31600	<10	33.7	151	2.48	<0.50	87.2	16.8	104	<30	0.0540	6.6	61.3	782	<2.0	<2.0	<1.0	<5.0	46.5	126
	SP-SC-04	18-Jul-09	7.7	6.46	4.78	28700	<10	60.4	135	2.29	<0.50	78.9	18.0	94	<30	0.0435	7.3	61.3	665	<2.0	<2.0	<1.0	<5.0	43.7	119
	SP-SC-05	18-Jul-09	10.4	6.38	2.61	34500	<10	34.0	161	2.58	<0.50	84.6	17.7	104	31	0.0403	10.1	71.3	567	<3.0	<2.0	<1.0	<5.0	50.9	132
	SP-SC-06	18-Jul-09	11.9	6.31	4.08	30400	<10	30.9	138	2.33	<0.50	85.1	15.8	101	<30	0.0495	6.8	55.5	666	<2.0	<2.0	<1.0	<5.0	45.3	123
	SP-SC-07	18-Jul-09	7.8	6.37	4.21	28300	<10	28.0	139	2.35	<0.50	82.7	16.5	95.5	<30	0.0480	6.1	70.0	610	<2.0	<2.0	<1.0	<5.0	44.4	130
	SP-SC-08	18-Jul-09	12.1	6.31	4.96	27800	<10	29.3	132	2.16	<0.50	77.3	14.2	89.6	<30	0.0596	6.6	59.3	668	<2.0	<2.0	<1.0	<5.0	41.8	119
	SP-SC-09	18-Jul-09	10.9	6.36	4.05	32100	<10	24.3	149	2.5	<0.50	88.0	14.8	105	<30	0.0581	6.2	72.1	707	<2.0	<2.0	<1.0	<5.0	47.3	132
	SP-SC-10	18-Jul-09	11.6	6.29	3.18	36200	<10	36.7	163	2.67	<0.50	95.0	17.9	114	<30	0.0378	8.3	63.0	659	<2.5	<2.0	<1.0	<5.0	52.2	139
	SP-SC-11	18-Jul-09	9.2	6.38	4.38	27400	<10	29.2	129	2.07	<0.50	78.8	16.9	84.1	<30	0.0453	6.7	63.4	587	<2.5	<2.0	<1.0	<5.0	42.8	121
	SP-SC-12	18-Jul-09	12.8	6.42	5.78	19700	<20	93.0	312	1.50	1.1	58.5	28.9	75.0	<60	0.0684	22.8	94.0	890	<2.5	<4.0	<1.0	<10	28.7	107
	SP-SC-13	18-Jul-09	12.6	6.47	4.95	29000	<10	32.4	151	2.21	<0.50	83.4	18.1	96.3	<30	0.0565	7.3	87.6	745	<2.0	<2.0	<1.0	<5.0	45.1	126
	SP-SC-14	18-Jul-09	10.0	6.26	5.69	22000	<10	63.4	160	1.77	<0.50	62.8	19.6	79.6	<30	0.0651	10.8	81.4	747	<2.0	<2.0	<1.0	<5.0	36.1	104
	SP-SC-15	18-Jul-09	8.7	6.28	4.69	25000	<10	43.0	116	2.06	<0.50	72.0	14.2	78.9	<30	0.0520	8.0	52.8	596	<2.0	<2.0	<1.0	<5.0	40.4	110

Table 2-5. Sediment core chemistry and total metals (mg/kg), July 2009.

Lake & Basin	Station ID	Date	Depth (m)	CONVENTIONAL PARAMETERS: pH	CONVENTIONAL PARAMETERS: Total Organic Carbon (% dw)	TOTAL METALS (mg/kg dw): Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Phosphorus	Selenium	Silver	Thallium	Tin	Vanadium	Zinc
	Sediment Quality Guidelines (CCME 2002)[1]		**ISQG**	NG	NG	NG	NG	5.9	NG	NG	0.6	37.3	NG	35.7	35.0	0.170	NG	NG	NG	NG	NG	NG	NG	NG	123
			PEL	NG	NG	NG	NG	17	NG	NG	3.5	90.0	NG	197	91.3	0.486	NG	NG	NG	NG	NG	NG	NG	NG	315
Tehek Lake	TE-SC-01	20-Jul-09	6.6	6.00	4.16	21300	<20	40.0	206	1.80	1.3	45.4	16.8	76.4	<60	0.0431	13.8	92.0	770	<2.5	<4.0	<1.0	<10	28.6	117
	TE-SC-02	20-Jul-09	7.7	6.02	3.83	22900	<20	25.0	203	1.90	<1.0	49.2	23.0	66.9	<60	0.0335	10.4	65.0	710	<1.3	<6.0	<1.0	<10	30.4	101
	TE-SC-03	20-Jul-09	12.8	6.05	4.90	27800	<10	16.6	166	2.36	0.63	62.7	10.0	79.0	<30	0.0640	4.2	49.9	1140	<3.0	<2.0	<1.0	<5.0	39.9	115
	TE-SC-04	20-Jul-09	7.3	6.08	3.74	29900	<10	23.9	156	2.44	0.77	62.3	14.5	78.1	<30	0.0316	6.8	72.6	629	<2.0	<3.0	<1.0	<5.0	41.1	121
	TE-SC-05	20-Jul-09	12.9	6.05	5.01	28100	<10	9.6	163	2.21	<0.50	60.1	8.6	70.1	<30	0.0577	<4.0	46.9	707	<2.0	<2.0	<1.0	<5.0	38.8	108
	TE-SC-06	20-Jul-09	8.0	6.06	4.05	22400	<10	41.1	150	1.94	0.74	48.1	15.3	65.0	<30	0.0460	11.4	54.7	696	<2.5	<5.0	<1.0	<5.0	31.8	95.1
	TE-SC-07	20-Jul-09	10.1	5.81	3.36	21100	<10	12.1	97	1.79	<0.50	48.6	8.4	55.6	<30	0.0386	<4.0	34.6	704	<2.0	<2.0	<1.0	<5.0	32.2	86.5
	TE-SC-08	20-Jul-09	7.9	5.8	3.08	19100	<10	27.6	85	1.60	<0.50	43.5	8.4	51.8	<30	0.0316	6.3	29.6	673	<2.0	<2.0	<1.0	<5.0	28.0	79.6
	TE-SC-09	20-Jul-09	8.5	5.9	3.15	27400	<10	20.0	254	2.23	0.53	58.6	19.2	73.6	<30	0.0340	7.4	61.3	604	<2.5	<6.0	<1.0	<5.0	39.9	114
	TE-SC-10	20-Jul-09	8.6	5.94	4.43	28000	<10	21.5	154	2.39	0.71	62.5	14.6	80.4	<30	0.0410	6.0	73.3	690	<2.5	<3.0	<1.0	<5.0	40.4	125
	TE-SC-11	20-Jul-09	7.0	5.83	3.18	27500	<10	24.2	182	2.31	0.6	57.4	20.8	71.2	<30	0.0301	7.2	63.2	567	<2.5	<5.0	<1.0	<5.0	38.3	108
	TE-SC-12	20-Jul-09	9.4	5.99	4.04	29400	<10	20.8	154	2.5	0.54	64.1	14.3	77.7	<30	0.0370	6.6	58.0	687	<2.5	<2.0	<1.0	<5.0	41.0	123
	TE-SC-13	20-Jul-09	7.2	6.15	4.65	28300	<10	20.3	145	2.47	0.59	61.3	13.7	74.0	<30	0.0410	6.3	54.1	721	<3.0	<3.0	<1.0	<5.0	39.9	122
	TE-SC-14	20-Jul-09	11.1	6.02	4.21	23100	<10	45.4	134	1.92	0.71	49.3	14.8	64.9	<30	0.0442	14.8	49.1	722	<2.5	<4.0	<1.0	<5.0	31.5	93.9
	TE-SC-15	20-Jul-09	10.2	6.08	4.46	19300	<10	52.6	110	1.66	0.85	42.8	15.3	62.8	<30	0.0480	18.7	47.4	1050	<2.5	<4.0	<1.0	<5.0	27.5	88.9
Inuggugayualik Lake	INUG-SC-01	24-Jul-09	8.0	6.07	3.36	24100	<10	8.7	115	1.47	<0.50	111	10.2	51.8	<30	0.0249	<4.0	72.1	931	<2.0	<2.0	<1.0	<5.0	37.9	83.7
	INUG-SC-02	24-Jul-09	8.4	5.53	4.54	21100	<10	120	130	1.38	0.96	95.3	14.2	51.4	<30	0.0389	7.7	80.5	3170	<2.0	<2.0	<1.0	<5.0	30.6	84.1
	INUG-SC-03	24-Jul-09	8.0	5.81	4.84	15900	<20	318	117	1.00	1.1	71.4	16.2	36.2	<60	0.0353	12.5	68.0	4240	<4.0	<4.0	<1.0	<10	20.3	65.6
	INUG-SC-04	24-Jul-09	12.5	6.05	4.96	25200	<10	25.6	156	1.60	0.62	113	12.7	61.9	<30	0.0590	5.0	84.9	1520	<2.0	<2.0	<1.0	<5.0	38.8	92.0
	INUG-SC-05	24-Jul-09	10.2	5.84	4.86	16200	<20	310	141	1.00	1.4	71.1	16.3	37.9	<60	0.0430	16.6	67.0	3060	<4.0	<4.0	<1.0	<10	18.8	62.7
	INUG-SC-06	24-Jul-09	8.2	5.84	5.18	16400	<10	354	110	0.99	1.1	76.7	15.4	42.9	<30	0.0440	13.5	65.7	3080	<2.0	<2.0	<1.0	<5.0	22.0	64.4
	INUG-SC-07	24-Jul-09	11.5	5.84	2.83	17200	<20	233	204	1.10	1.5	73.2	22.9	42.7	<60	0.0539	19.6	114	2310	<4.0	<4.0	<1.0	<10	22.3	78.3
	INUG-SC-08	24-Jul-09	9.3	5.97	3.94	16900	<20	43.0	99.7	1.10	1.1	73.5	18.3	39.6	<60	0.0306	15.7	60.0	870	<4.0	<4.0	<1.0	<10	22.1	58.5
	INUG-SC-09	24-Jul-09	12.5	5.69	5.02	23900	<10	98.5	151	1.51	0.68	107	12.6	59.0	<30	0.0568	7.4	85.5	2980	<2.0	<2.0	<1.0	<5.0	34.5	95.5
	INUG-SC-10	24-Jul-09	11.3	5.78	5.4	16000	<20	137	273	1.10	1.3	69.9	20.0	46.2	<60	0.0613	10.5	131	2850	<4.0	<4.0	<1.0	<10	20.2	88.7
	INUG-SC-11	24-Jul-09	8.6	5.93	4.87	15800	<20	70	112	<1.0	1.1	69.8	23.7	37.6	<60	0.0364	<8.0	68.0	950	<4.0	<4.0	<1.0	<10	19.5	61.3
	INUG-SC-12	24-Jul-09	11.8	6.03	5.08	26800	<10	8.8	164	1.60	<0.50	122	10.1	57.8	<30	0.0440	<4.0	82.0	1070	<2.0	<2.0	<1.0	<5.0	40.6	96.7
	INUG-SC-13	24-Jul-09	12.1	6	5.6	26200	<10	11.2	154	1.59	<0.50	119	10.1	57.7	<30	0.0545	<4.0	77.1	1150	<2.0	<2.0	<1.0	<5.0	40.1	90.0
	INUG-SC-14	24-Jul-09	12.4	5.78	6.81	23700	<10	12.2	135	1.42	<0.50	106	9.7	52.2	<30	0.0644	<4.0	72.1	1130	<3.0	<2.0	<1.0	<5.0	35.6	82.2
	INUG-SC-15	24-Jul-09	12.2	5.85	6.53	23700	<10	9.2	145	1.40	<0.50	104	9.3	51.9	<30	0.0600	<4.0	79.4	917	<2.0	<2.0	<1.0	<5.0	35.3	89.3

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 concentrations also > PEL.

Table 2-6. Model predicted total metals concentrations for 2009 sediment cores in Second Portage Lake.

	Actual			Model Predicted[2]		Actual	RPD (%)[4]	
Season	**Summer[1]**	**Summer**	**Winter**	**Summer**		**Summer[3]**	**Summer**	
Year	2008	2008	2008-09	2009		2009	2009	
Location & Type	SP Sed Cores	SP Sed Trap	SP Sed Trap	Top 1-cm SP sediment		SP Sed Cores	Top 1-cm SP sediment	
Collection Date	19-Jul-08	22-Sep-08	26-Jul-09	Range		18-Jul-09	Range	
TOTAL METALS (mg/kg dw)								
Aluminum	24320	42200	28040	26255	27531	28840	**-9.4**	**-4.6**
Antimony	<10	<10	<20	<10	<10	<10	**0**	**0**
Arsenic	32.6	16.7	<5	31	30	40.2	**-26**	**-30**
Barium	133	234	73.6	144	151	155	**-7.6**	**-2.8**
Beryllium	1.93	1.65	1.2	1.90	1.88	2.25	**-17**	**-18**
Cadmium	0.65	0.51	<1.0	0.64	0.63	0.54	**17**	**15**
Chromium	65.3	175	259	77.4	85.5	80.1	**-3.4**	**7**
Cobalt	15.2	25.5	22	16.3	17.1	17.4	**-6.3**	**-1.9**
Copper	83.1	87.6	111	83.6	84.0	94.3	**-12**	**-12**
Lead	<30	<30	<60	<30	<30	<30	**0**	**0**
Mercury	0.0454	0.0303	0.036	0.0438	0.0427	0.0513	**-16**	**-18**
Molybdenum	6.6	<4.0	14.6	6.3	6.2	8.4	**-28**	**-31**
Nickel	61.4	109	128	66.6	70.1	67.6	**-1.4**	**3.7**
Selenium	<2.0	<2.0	<4.0	<2.0	<2.0	<2.0	**0**	**0**
Silver	<2.0	<2.0	<4.0	<2.0	<2.0	<2.0	**0**	**0**
Thallium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**0**	**0**
Tin	<5.0	<5.0	10	<5.0	<5.0	<5.0	**0**	**0**
Vanadium	34.1	70.5	58.8	38.0	40.7	43.6	**-14**	**-7.0**
Zinc	97.7	235	502.1	113	123	122	**-7.8**	**1.0**

Notes:

[1] The actual data presented here for 2008 Second Portage Lake (SP) sediment cores is the mean of 15 cores sampled, for each parameter.

[2] Surface sediment concentrations in SP were modeled by adding together weighted data from each of: summer 2008 sediment cores and sediment traps, and winter 2008-09 sediment traps.
Weighting of these data was based on their actual contribution to the top 1 cm of sediment, as estimated from sediment trap accumulation during these time periods; 2 scenarios: data from SP-ST1 and SP-ST5
A range is presented to account for small differences in accumulation thickness between SP stations (data from SP-ST1 and SP-ST5 were used).

[3] The actual data presented here for 2009 Second Portage Lake (SP) sediment cores is the mean of 15 cores sampled, for each parameter.

[4] RPD = Relative Percent Difference (%) = ((predicted - actual) / (predicted + actual)/2) x 100; for summer 2009 data.

Table 2-7. Benthic invertebrates total abundance (#/m^2), August 2009.

Station	Date	Depth (m)	Total Abundance (#/m^2)				Total
			Oligochaetes	Insects	Molluscs	Other Taxa	
Second Portage Lake							
SP-N1-1	15-Aug-09	6.5	22	370	478	152	1022
SP-N1-2	15-Aug-09	7.0	0	522	457	22	1000
SP-N1-3	15-Aug-09	7.4	22	348	565	87	1022
SP-N1-4	15-Aug-09	7.7	0	804	804	130	1739
SP-N1-5	15-Aug-09	7.2	87	348	370	87	891
		Station Mean	**26**	**478**	**535**	**96**	**1135**
SP-N3-1	23-Aug-09	6.9	43	413	413	43	913
SP-N3-2	23-Aug-09	8.0	0	304	217	43	565
SP-N3-3	23-Aug-09	7.5	22	370	174	130	696
SP-N3-4	23-Aug-09	7.3	0	370	239	174	783
SP-N3-5	23-Aug-09		0	261	391	43	696
		Station Mean	**13**	**343**	**287**	**87**	**730**
SP-F1-1	23-Aug-09	7.0	109	565	348	87	1109
SP-F1-2	23-Aug-09	7.2	0	630	630	130	1391
SP-F1-3	23-Aug-09	6.8	22	1348	870	130	2370
SP-F1-4	23-Aug-09	6.8	0	674	283	87	1043
SP-F1-5	23-Aug-09	7.3	0	826	478	152	1457
		Station Mean	**26**	**809**	**522**	**117**	**1474**
SP-DT-1	19-Aug-09	6.5	0	326	739	109	1174
SP-DT-2	19-Aug-09	7.5	0	435	457	87	978
SP-DT-3	19-Aug-09	7.3	87	543	630	43	1304
SP-DT-4	19-Aug-09	7.6	152	652	413	0	1217
SP-DT-5	19-Aug-09	7.6	87	457	239	152	935
		Station Mean	**65**	**483**	**496**	**78**	**1122**
Third Portage Lake							
TPL-HVH4-1	23-Aug-09	7.1	43	522	239	196	1000
TPL-HVH4-2	23-Aug-09	6.9	109	696	196	87	1087
TPL-HVH4-3	23-Aug-09	7.5	22	522	261	43	848
TPL-HVH4-4	23-Aug-09	7.7	0	674	283	109	1065
TPL-HVH4-5	23-Aug-09	7.3	65	630	174	65	935
		Station Mean	**48**	**609**	**230**	**100**	**987**

Table 2-8. Benthic invertebrates total richness (# taxa), August 2009.

Station	Date	Total Richness (# taxa)				Total
		Oligochaetes	Insects	Molluscs	Other Taxa	
Second Portage Lake						
SP-N1-1	15-Aug-09	0	3	1	1	5
SP-N1-2	15-Aug-09	0	4	2	1	7
SP-N1-3	15-Aug-09	1	3	1	1	6
SP-N1-4	15-Aug-09	0	5	2	1	8
SP-N1-5	15-Aug-09	0	4	2	1	7
	Station Mean	**0**	**4**	**2**	**1**	**7**
SP-N3-1	23-Aug-09	1	7	2	1	11
SP-N3-2	23-Aug-09	0	4	2	1	7
SP-N3-3	23-Aug-09	1	7	2	1	11
SP-N3-4	23-Aug-09	0	6	1	1	8
SP-N3-5	23-Aug-09	0	5	1	1	7
	Station Mean	**0**	**6**	**2**	**1**	**9**
SP-F1-1	23-Aug-09	1	5	1	1	8
SP-F1-2	23-Aug-09	0	5	1	1	7
SP-F1-3	23-Aug-09	1	8	1	1	11
SP-F1-4	23-Aug-09	0	7	1	1	9
SP-F1-5	23-Aug-09	0	6	1	1	8
	Station Mean	**0**	**6**	**1**	**1**	**9**
SP-DT-1	19-Aug-09	0	8	2	1	11
SP-DT-2	19-Aug-09	0	6	2	1	9
SP-DT-3	19-Aug-09	1	9	1	1	12
SP-DT-4	19-Aug-09	1	8	2	0	11
SP-DT-5	19-Aug-09	2	6	2	1	11
	Station Mean	**1**	**7**	**2**	**1**	**11**
Third Portage Lake						
TPL-HVH4-1	23-Aug-09	1	6	2	1	10
TPL-HVH4-2	23-Aug-09	2	5	1	1	9
TPL-HVH4-3	23-Aug-09	0	7	1	1	9
TPL-HVH4-4	23-Aug-09	0	5	1	1	7
TPL-HVH4-5	23-Aug-09	1	8	1	1	11
	Station Mean	**1**	**6**	**1**	**1**	**9**

Table 2-9. Results of statistical analyses of benthic invertebrate community descriptors for East Dike EAS 2009.

	Total Abundance (#/m²)	Taxa Richness (# taxa/ sample)	Simpson's Diversity (unitless)	Bray Curtis Distance (unitless)
Data Transformation[1]	Log10	Log10	None	None
Advanced Transformation[2]	Log10(x-400)	Log10(x+15)	NA	NA
Tests relative to control [C]				
C-I Differences?	Yes	Yes	Yes[4]	Yes
p-value	0.049	0.001	0.01	0.005
Control Group Mean	1268	11.1	0.83	0.48
Impact Group Mean	880	7.5	0.77	0.54
Effect Size	-389	-3.6	-0.052	0.06
95% Upper CI[3] of Effect Size	-602	-5.1	-0.088	0.10
95% Lower CI[3] of Effect Size	-4	-2.0	-0.017	0.03
TPE Mean	1644	11.2	0.83	0.47
C-TPE Difference?	No	No	No	No
p-value	0.42	0.97	0.89	0.97
TPL-HVH4 Mean	980	9.2	0.83	0.51
C-TPL-HVH4 Difference?	No	No	No	No
p-value	0.39	0.17	0.98	0.32
TPN Mean	1200	9.1	0.79	0.46
C-TPN Difference?	No	No	Yes	No
p-value	0.86	0.17	0.046	0.49

Notes:

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

2. Advanced transformations determined using Box-Cox method (Venables & Ripley 2002).

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).

Table 2-10. Area "effect" status by year for CREMP data set.

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

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

Table 2-11. Results of statistical analyses of benthic invertebrate community descriptors for the 2006 - 2009 CREMP data set.

	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?	No	No	No	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	No	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 2-12. Qualitative characteristics of the periphyton community from underwater video analysis, 2009.

Site Info				Periphyton Description					
Area	Habitat Station	Depth (m)	Substrate	% Cover	Mat Density & Description	Color	Snap Shots (Appendix C)	Ice Scour / Other	Notes
Second Portage Lake	HVH-1	3.0 to 3.9	20% boulder, 30% cobble, 50% fines	~80%	Denser/more luxuriant peri mats in areas of shallower depth.	green	15:08:40	No ice scour. Periphyton coverage on fines is continuous (snapshot)	
	HVH-2	2.2 to 2.4	50% boulder, 40% cobble, 10% fines	~80-100% coverage	Mats are thick, moderately luxuriant in areas where some sedimentation may be flattening, in others highly luxuriant where protected (rock sides).	green	14:44:27	No ice scour. Some surfaces covered with highly luxuriant periphyton, while adjacent surfaces more sparse due to sediment layer (snapshot 1)	
	HVH-3	1.0 to 3.0	55% boulder, 35% cobble, 5% gravel, 10% fines	~80%	Denser/more luxuriant peri mats in areas of shallower depth.	green	15:29:55	Periphyton mat at depth is continuous but not thick, but in shallow water periphyton mat is thick, very luxurious, green, with raised fronds (snapshot)	
	HVH-4	1.4 to 2.0	70% boulder, 30% cobble	95%	Patchy in places, very luxuriant in others, but generally all areas had fluffy fronds	green	13:42:24	Periphyton mat may have been damaged by ice scour in the shallowest regions (snapshot) but otherwise healthy looking	
	HVH-5	1.6 to 2.0	60% boulder, 35% cobble, 5% fines	90%	Patchy in places, very luxuriant in others, but generally peri coverage appears thick and fluffy (raised fronds)	green		Some evidence of ice scour where periphyton is patchy in shallow areas.	
	HVH-6	1.4 to 1.5	100% boulder	70%	Mat is thick in places, but not coninuous, highly patchy. In some areas sporadic long fronds are surrounded by bare rock.	green		Ice scour is evident from highly patchy periphyton mat. More patchiness than seen at HVH4 or HVH5.	
Third Portage Lake	HVH-1	1.5 to 1.9	100% boulder	75%	Most surfaces covered with mat of high density and luxurious, raised fronds. However, some areas appear to have ice scour where peri is absent or very thin.	green, grey	10:22:49	Ice scour evident from patchy areas (see snapshot).	
	HVH-2	2.2 to 2.6	40% boulder, 40% cobble, 20% fines	90-100%	Highly dense mat, thick and volumous with well developed, raised fronds. Mat is continuous on all substrates.	green	08:20:28 08:22:25	No ice scour. Mat is completely continuous over all substrates and fronds are large and raised.	
	HVH-3	1.6 to 2.2	100% boulder	75%	Generally thin-moderate density and thickness of mat. Some protected areas are thick and dense with well raised fronds (sides of rocks and in crevices). Some evidence of ice scour.	green	09:08:58 09:12:55 09:12:57	Generally thin peri on tops of boulders in shallow water with some areas bald (shapshot 1). Other areas luxurious peri (snapshot 2). Some clumpy looking peri on boulders at depths >2m.	
	HVH-4	3.2 to 3.6	65% boulder, 15% cobble, 20% fines	70-90%	Fairly homogeneous characteristics between all reps. Peri covers all substrate, mat is mostly continuous, of medium density and thickness. Peri on fines is highly textured. No areas of highly luxurious peri, even in crevices.	green, grey	9:35:29	No ice scoure. Peri is continuous on all substrates, and is particularly textured on fines (snapshot).	
	HVH-5	1.7 to 2.3	80% boulder, 20% cobble	70%, but higher at depth	Not as thick or dense as HVH-2 but highly continuous, especially at depth. Looks like peri was ice scoured on shallower surfaces on big boulders. At depth, thick and luxurious peri covers all substrate.	green		Ice scour looks to have shorn the periphyton mat in most shallow areas on big boulders.	
	HVH-6	1.6 to 2.9	60% boulder, 30% cobble, 10% fines	60-80%	Highly variable peri mat. Some areas on boulders and cobble (especially on sides) is very luxurious and dense, while other boulders and cobble have thin or no peri mat. Mat, where present is continuous, especially on fines.	green		Random rocks had no periphyton or very thin mat.	video quality not great (glare & unstable)

Table 2-13. Density (cells/cm^2) of major periphyton groups, August 2009.

Station & Rep	Date	Periphyton Density (cells/cm^2)			
		Cyanobacteria	Chlorophyte	Diatom	Total
Boat Launch					
SP-BL-001	27-Aug-09	568236	5981	278137	852354
SP-BL-002	27-Aug-09	714781	2991	328979	1046751
SP-BL-003	27-Aug-09	634032	5981	139567	779580
SP-BL-004	27-Aug-09	46143	0	307617	353759
SP-BL-005	27-Aug-09	486739	8972	181686	677397
	station mean	**489986**	**4785.1**	**247197**	**741968**
	(as %)	**66**	**1**	**33**	
CREMP					
SP-CREMP-P1	28-Aug-09	744689	49347	192901	986937
SP-CREMP-P2	28-Aug-09	724950	21533	154321	900804
SP-CREMP-P3	28-Aug-09	610106	29907	116638	756651
SP-CREMP-P4	28-Aug-09	850560	50244	222509	1123313
SP-CREMP-P5	28-Aug-09	829027	17944	236865	1083836
	station mean	**751866**	**33795.1**	**184647**	**970308**
	(as %)	**77**	**3**	**19**	
Drilltrail Arm					
SP-DT-P1	30-Aug-09	645995	71777	269165	986937
SP-DT-P2	30-Aug-09	628051	2991	152527	783568
SP-DT-P3	30-Aug-09	520385	38879	122619	681883
SP-DT-P4	30-Aug-09	658812	35889	112793	807494
SP-DT-P5	30-Aug-09	476806	0	225586	702391
	station mean	**586010**	**29907.2**	**176538**	**792454**
	(as %)	**74**	**4**	**22**	
Relative Abundance (%):		**73**	**3**	**24**	

Table 2-14. Biomass ($\mu g/cm^2$) and diversity of major periphyton groups, August 2009.

Station & Rep	Date	Periphyton Biomass ($\mu g/cm^2$)				# Species	Simpsons Diversity
		Cyanobacteria	Chlorophyte	Diatom	Total		
Boat Launch							
SP-BL-001	27-Aug-09	44.8	12.5	127.5	184.8	19	0.79
SP-BL-002	27-Aug-09	63.0	8.0	233.1	304.1	19	0.76
SP-BL-003	27-Aug-09	18.4	0.2	84.9	103.5	17	0.77
SP-BL-004	27-Aug-09	4.7	0	172.4	177.1	15	0.75
SP-BL-005	27-Aug-09	123.0	11.7	103.0	237.7	16	0.74
	station mean	**51**	**6.5**	**144**	**201**	**17**	**0.76**
	(as %)	**25**	**3**	**72**			
CREMP							
SP-CREMP-P1	28-Aug-09	212.3	494.7	218.7	925.7	20	0.66
SP-CREMP-P2	28-Aug-09	318.3	71.2	213.1	602.6	19	0.75
SP-CREMP-P3	28-Aug-09	179.6	10.9	77.8	268.3	15	0.72
SP-CREMP-P4	28-Aug-09	160.0	88.3	345.5	593.8	20	0.74
SP-CREMP-P5	28-Aug-09	123.6	84.6	148.7	356.9	19	0.78
	station mean	**199**	**150**	**201**	**549**	**19**	**0.73**
	(as %)	**36**	**27**	**37**			
Drilltrail Arm							
SP-DT-P1	30-Aug-09	478.1	297.3	134.5	909.9	17	0.74
SP-DT-P2	30-Aug-09	230.5	6.0	116.1	352.6	18	0.69
SP-DT-P3	30-Aug-09	148.1	72.7	78.6	299.5	19	0.61
SP-DT-P4	30-Aug-09	170.1	70.4	63.3	303.8	20	0.70
SP-DT-P5	30-Aug-09	117.9	0	206.2	324.2	20	0.74
	station mean	**229**	**89**	**120**	**438**	**19**	**0.70**
	(as %)	**52**	**20**	**27**			
Relative Biomass (%):		**40**	**21**	**39**			

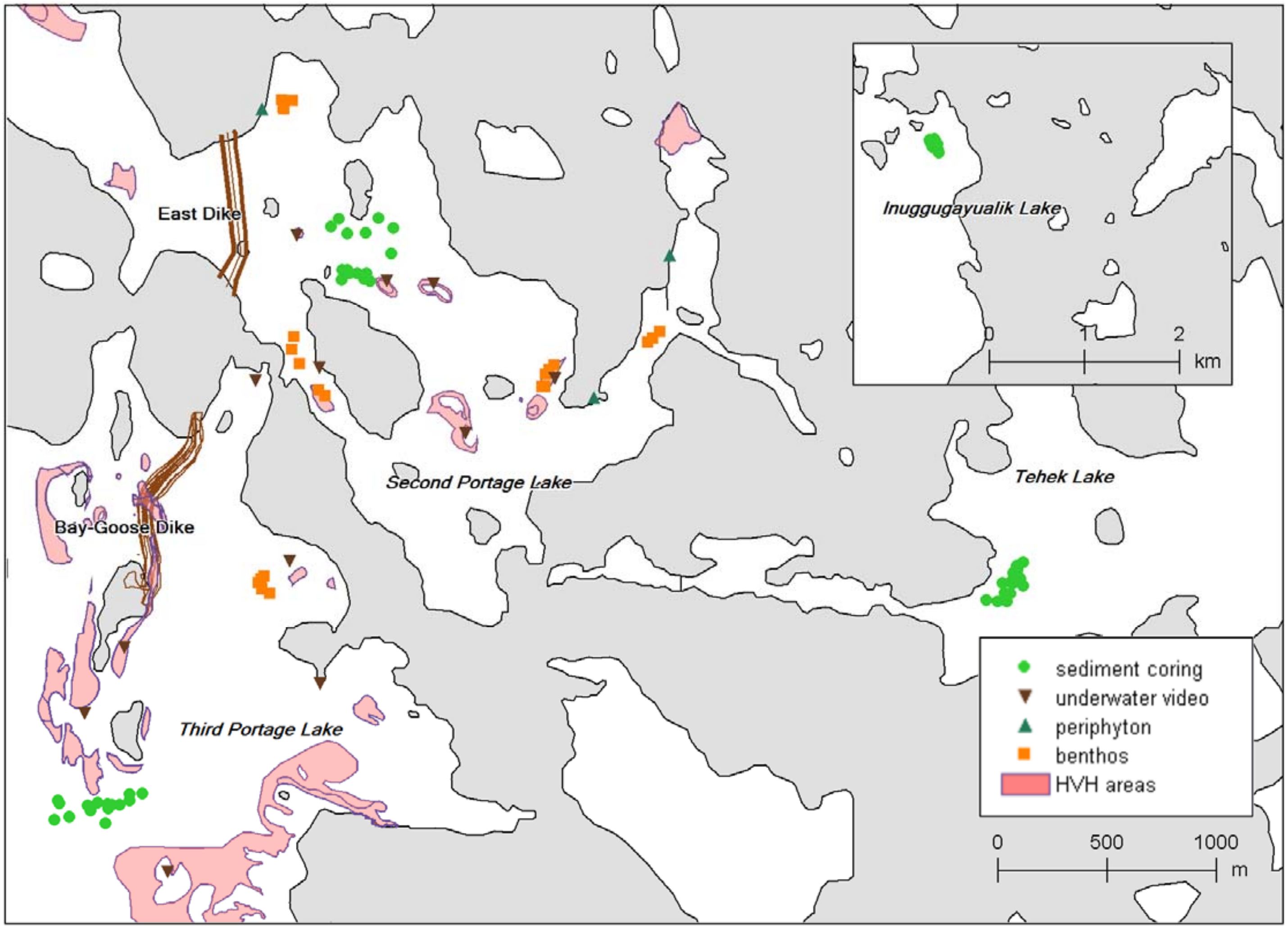
Table 2-15. Weights and content ratio of periphyton samples collected for dead/live analysis.

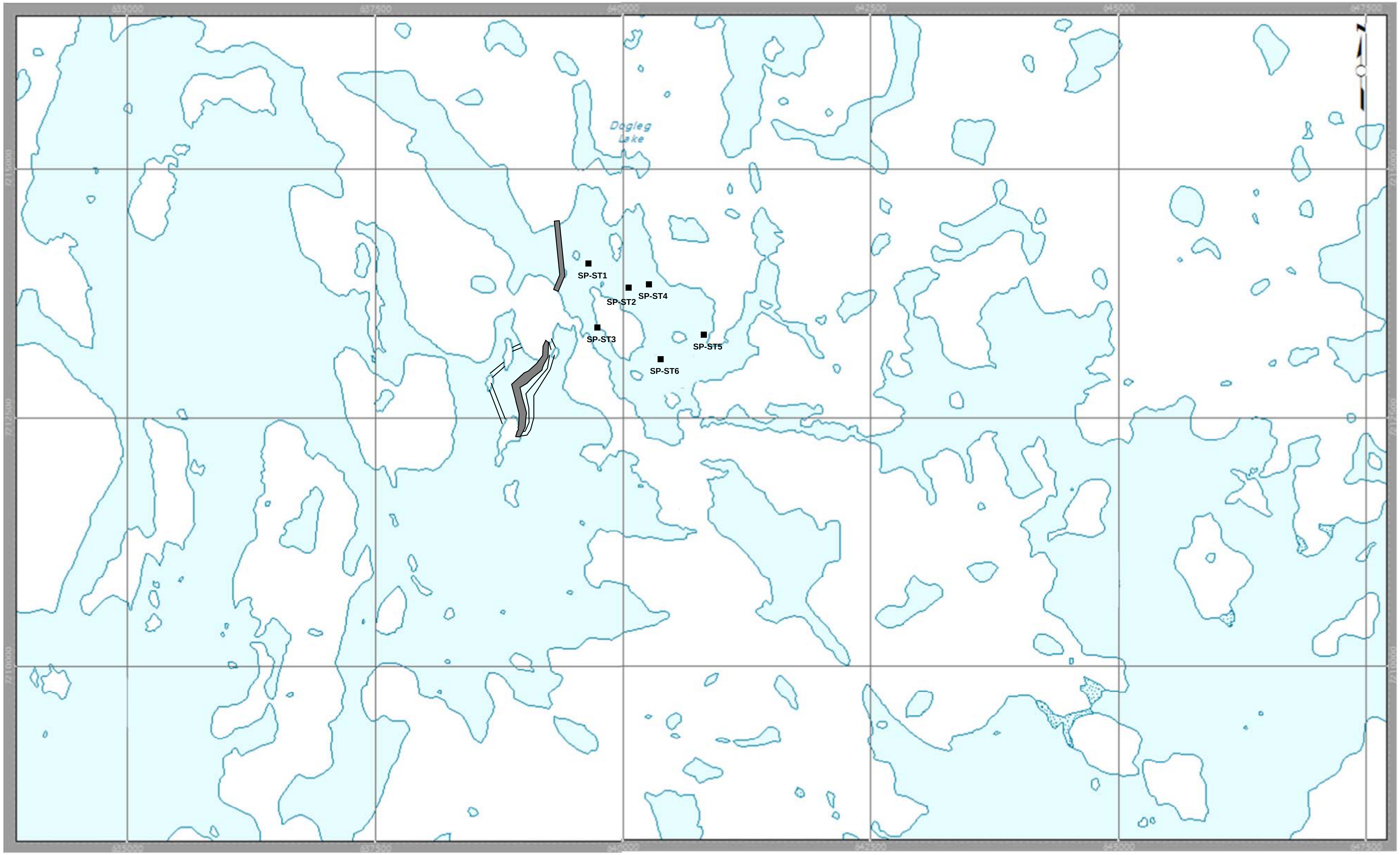
Station	n	Sample Weight (g)			Ratio (sediment:organic)
		Sediment	Organic	Total	
SP-BL	5	0.74	0.08	0.82	9.25:1
SP-CREMP	5	0.30	0.24	0.53	1.25:1
SP-DT	5	0.12	0.17	0.30	0.71:1

Table 2-16. Biomass (µg/cm^2) of live and dead periphyton from the Boat Launch (BL), CREMP and Drilltrail (DT) locations.

		Biomass (µg/cm^2)									
		Cyanobacteria		Chlorophyte		Chrysophyte		Diatom		Total	
Location	Station	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
SP-BL	1	95	69	0	0	0	0	94	93	188	163
	2	34	5.9	36	0	0	0	165	137	235	143
	3	12	1.8	12	0	0	0	106	67	130	69
	4	2.9	0.1	5.1	1.7	0	0	135	62	143	64
	5	3.5	0.9	3.0	1.5	0	5.0	117	59	124	66
	mean	**29**	**16**	**11**	**0.6**	**0**	**1.0**	**123**	**84**	**164**	**101**
	proportion live/dead	**0.7**	**0.3**	**0.9**	**0.1**	**0**	**1.0**	**0.6**	**0.4**	**0.6**	**0.4**
% of total station mean		***18%***		***7%***		***0%***		***75%***			
SP-CREMP	1	21	3.4	14	35	0	0	183	191	219	229
	2	781	253	22.0	0	0	0	75	196	878	449
	3	150	56.4	15.7	0	0	0	154	135	320	191
	4	15.6	2.2	124	4.1	0	0	122	146	262	153
	5	34	4.8	140	49	0	0	157	121	332	175
	mean	**200**	**64**	**63**	**18**	**0**	**0**	**138**	**158**	**402**	**239**
	proportion live/dead	**0.8**	**0.2**	**0.8**	**0.2**			**0.5**	**0.5**	**0.6**	**0.4**
% of total station mean		***50%***		***16%***		***0%***		***34%***			
SP-DT	1	177	40	6.4	1.6	0	0	80	58	263	100
	2	34	4.5	3.7	34	0	0	144	53	182	92
	3	37	18	23	0.2	1.3	0.3	112	111	173	130
	4	162	42	14	39	0	4.1	95	111	271	197
	5	53	17	1.3	8.0	0	0	17	62	71.2	87.3
	mean	**92**	**25**	**9.7**	**17**	**0.3**	**0.9**	**89**	**79**	**192**	**121**
	proportion live/dead	**0.8**	**0.2**	**0.4**	**0.6**	**0.2**	**0.8**	**0.5**	**0.5**	**0.6**	**0.4**
% of total station mean		***48%***		***5%***		***0%***		***47%***			

Figure 2-1. Map of sampling locations for the East Dike TSS EAS, 2009.





Legend

- ▲ Broad Survey Stns
- ● BG Routine Stns
- ○ BG HVH Stns
- ■ TE Sed Trap Stns

BG = Bay-Goose Routine Stations
HVH = High Value Habitat Stations

n/a = data do not cover full duration
blank = no data available

TSS Trigger Values (mg/L)

Station	24-hr	30-day
Routine	50	15
HVH_a	50	15
HVH_b	25	6
a = prior to Sept 1		
b = after Sept 1		

AZIMUTH

Azimuth Consulting Group Inc.

MEADOWBANK GOLD PROJECT
SEDIMENT TRAP LOCATIONS

WINTER 2008-09

Figure 2-2

Figure 2-3. Surface (top 1 cm from cores) sediment chemistry results comparing control (INUG, TPE) and impact (SP, TE) areas in 2008 and 2009.

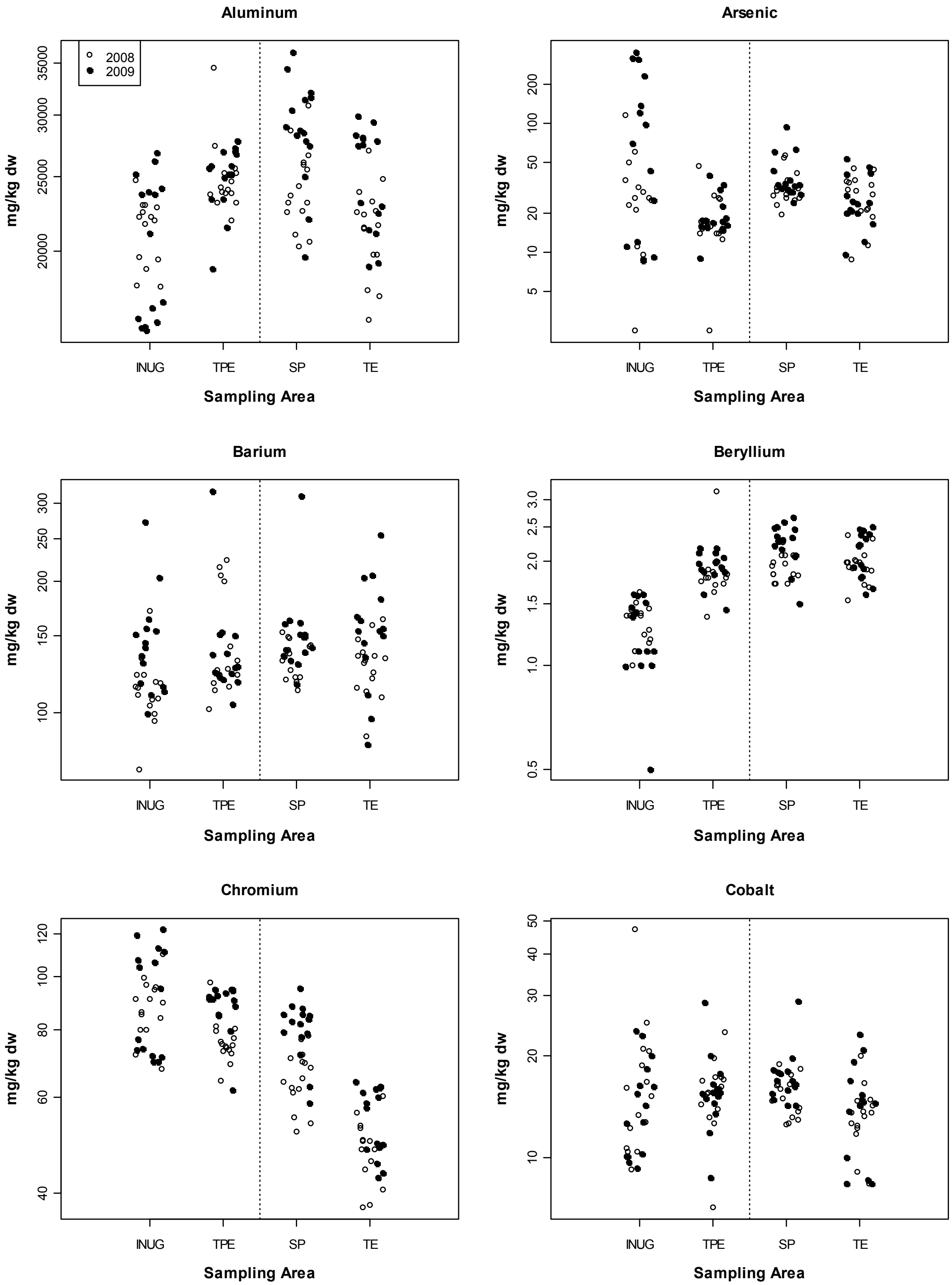


Figure 2-3 (con't). Sediment chemistry results comparing control (INUG, TPE) and impact (SP, TE) areas in 2008 and 2009.

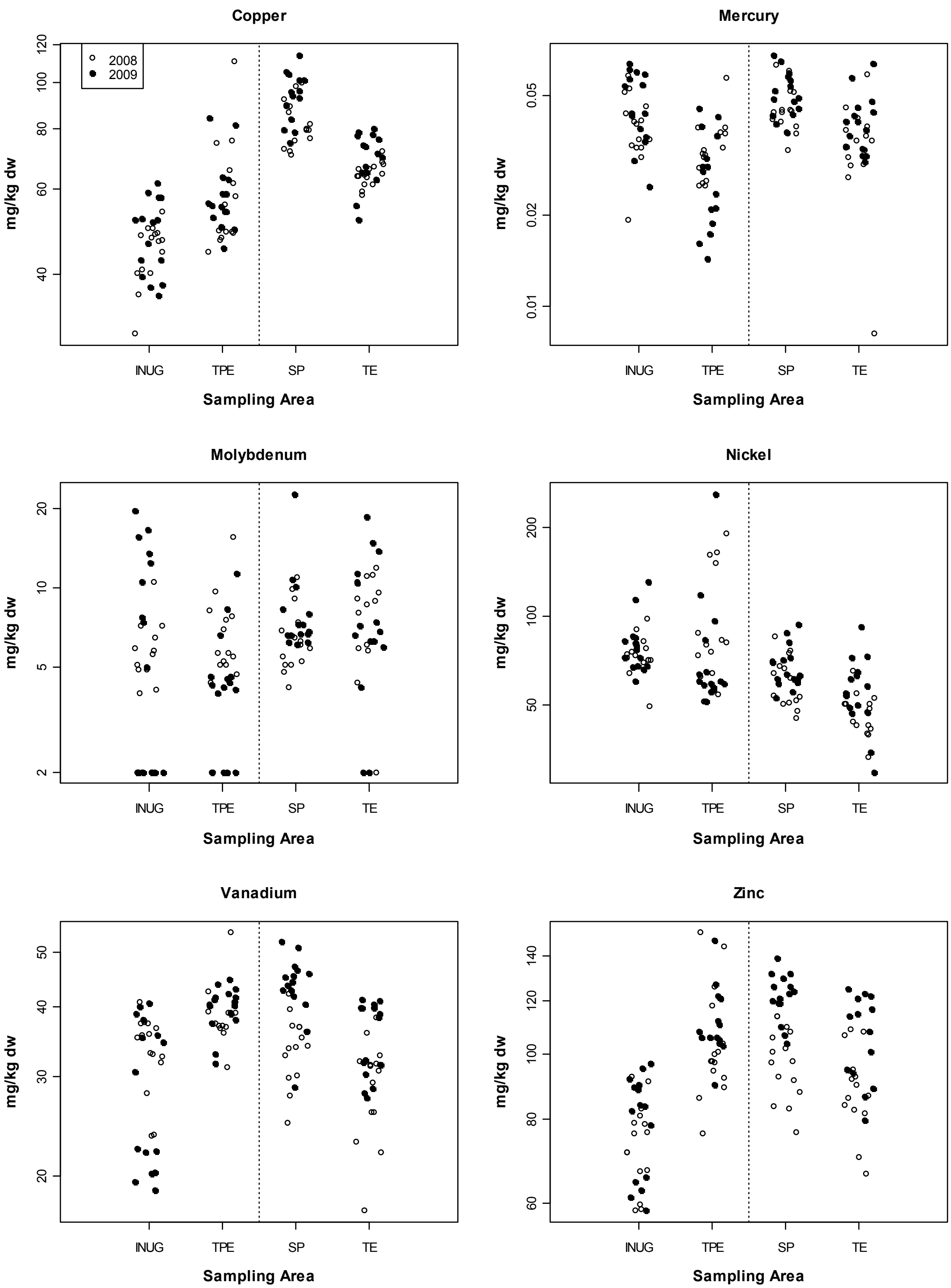


Figure 2-4. Benthic invertebrate replicates of abundance by major taxa group for the ED EAS data set, August 2009.

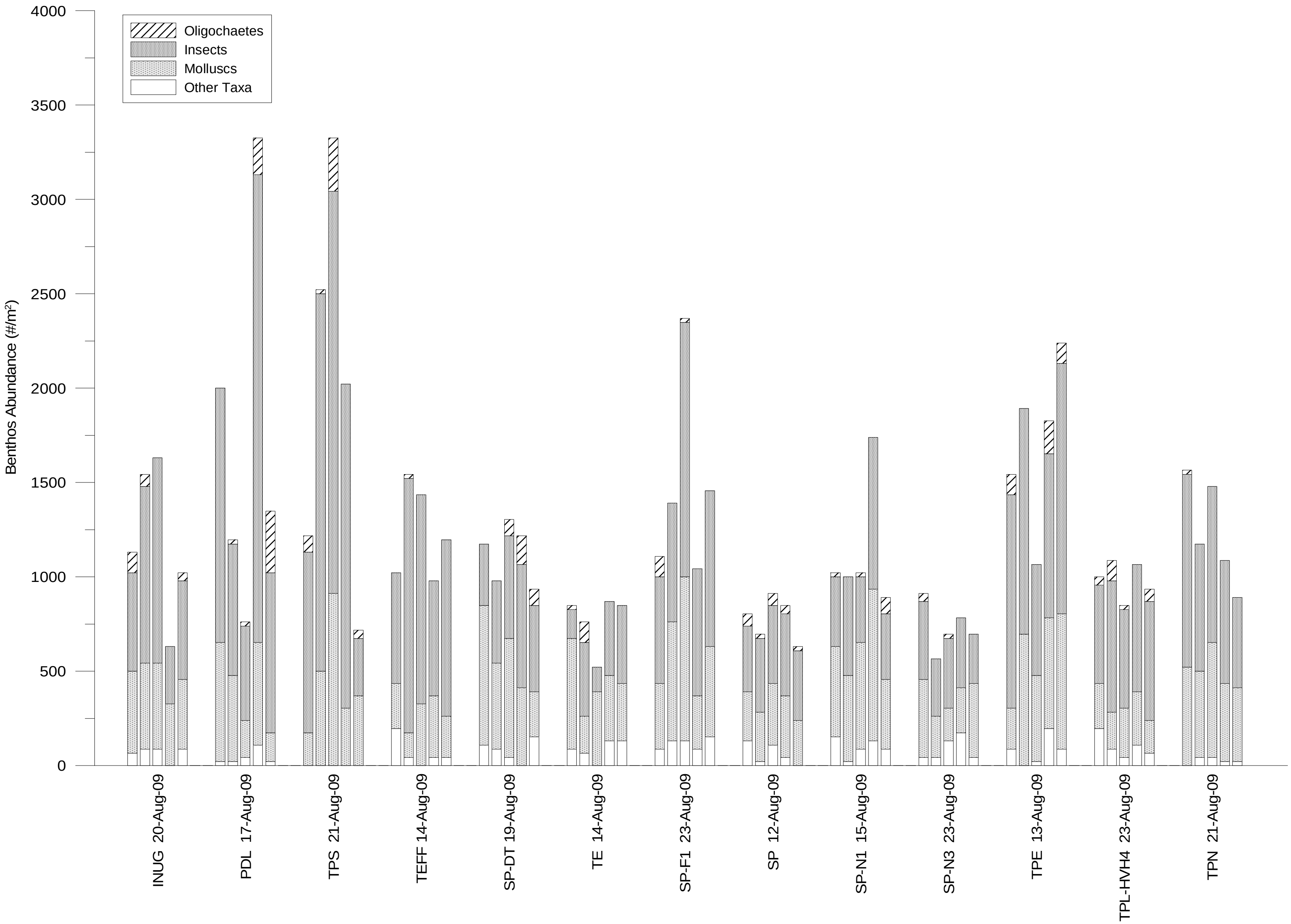


Figure 2-5. Benthic invertebrate replicates of richness by major taxa group for the ED EAS data set, August 2009.

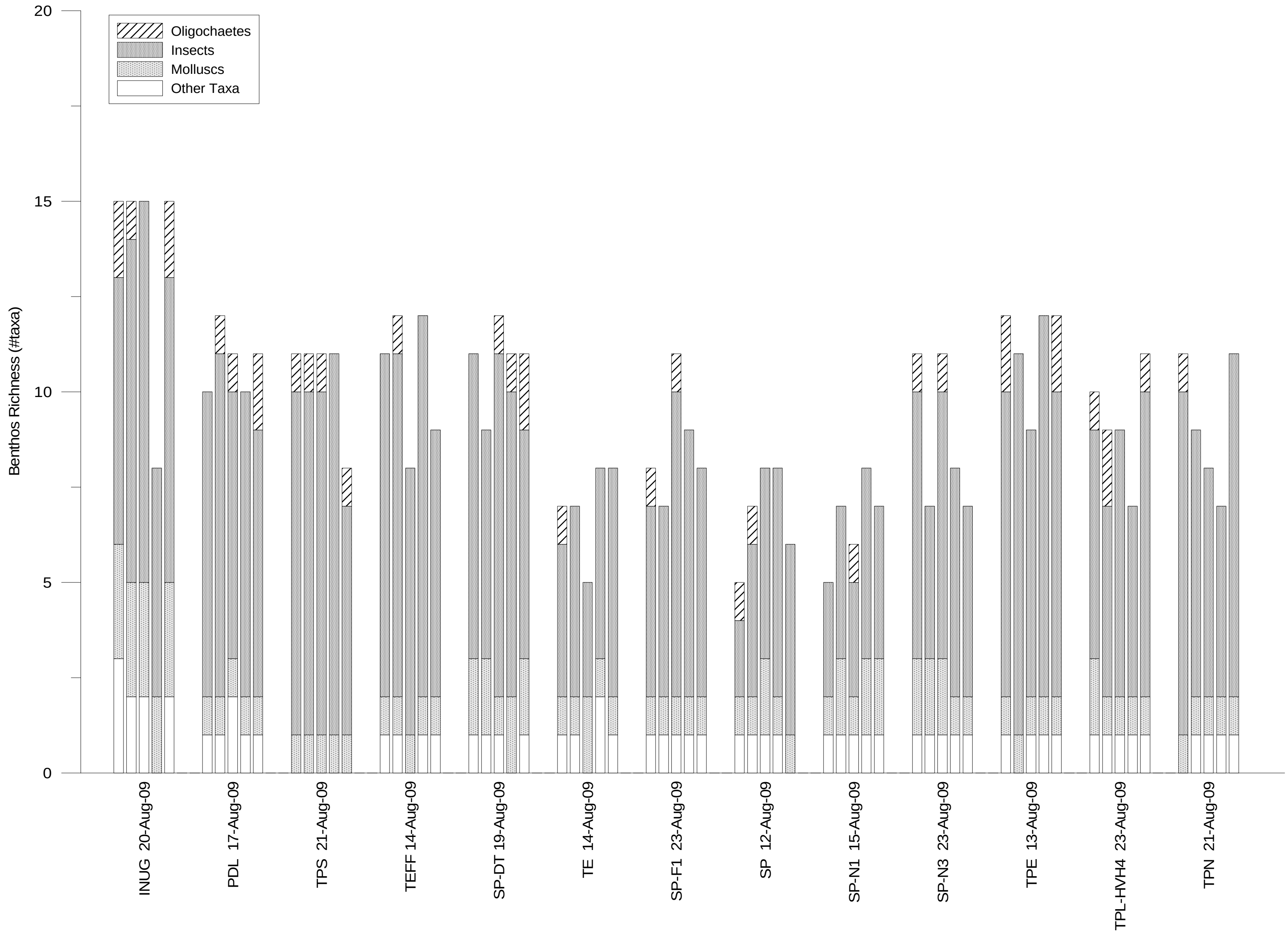


Figure 2-6. Benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) across Control, Impact and Unassigned areas for East Dike EAS 2009.

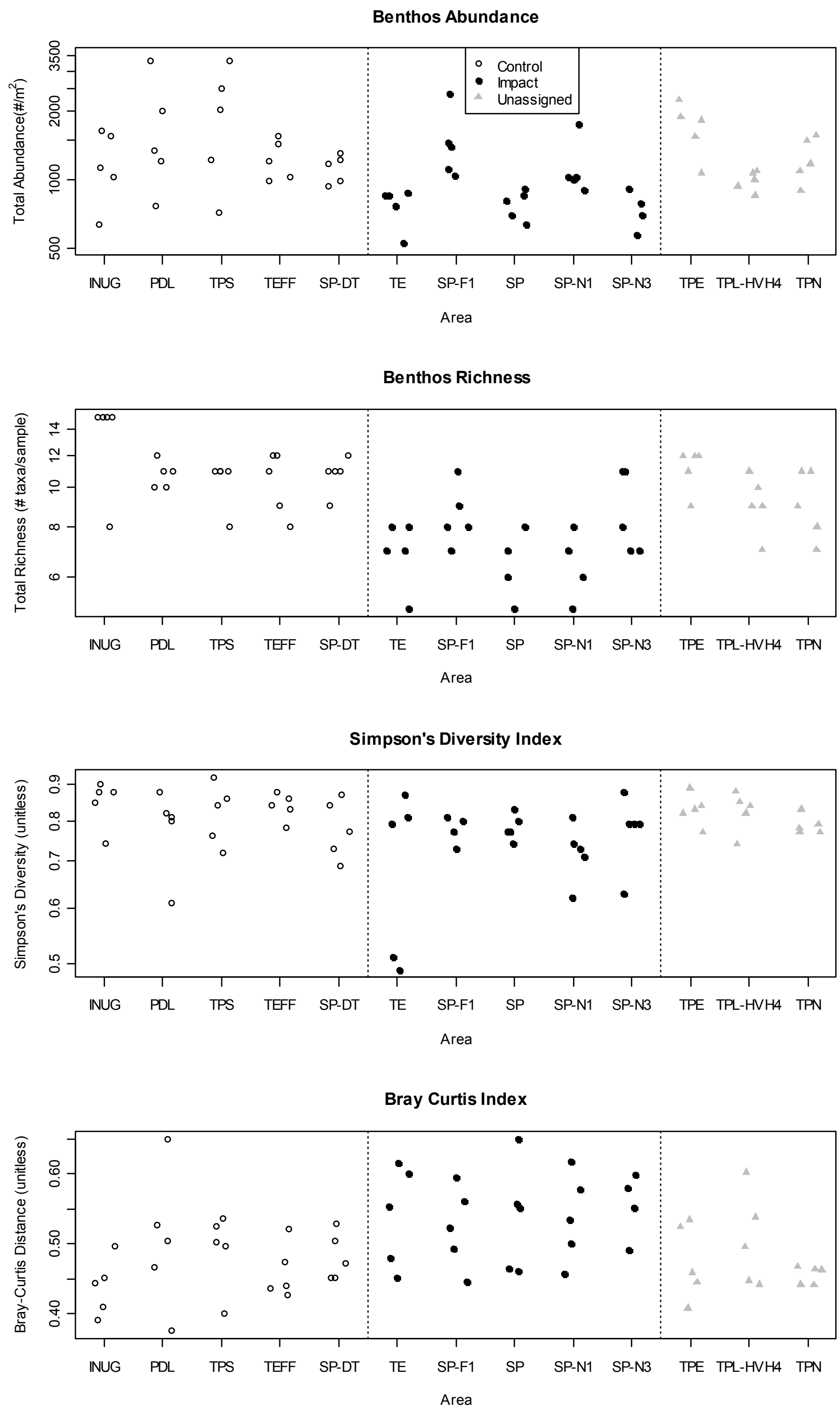


Figure 2-7. Boxplots of benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) by Effect grouping for East Dike EAS 2009.

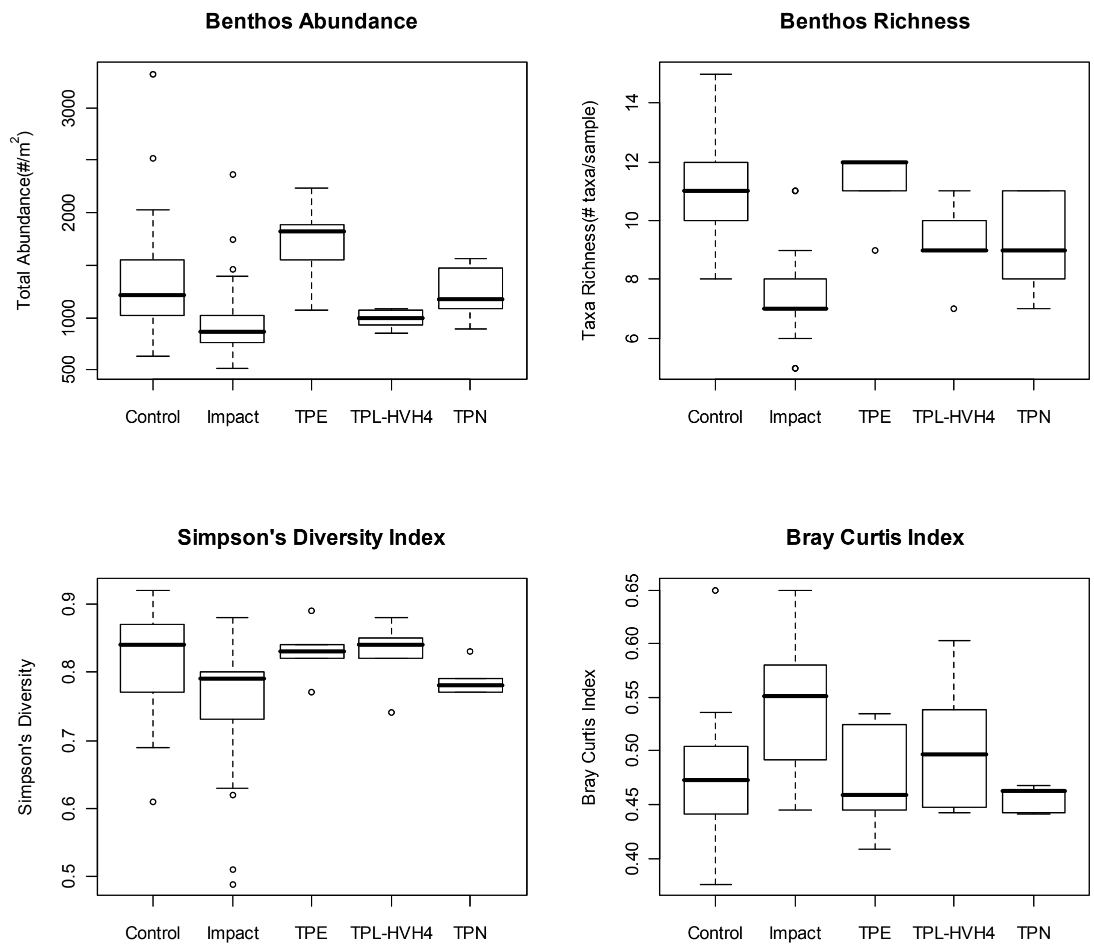


Figure 2-8. Benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) across areas for the CREMP data set, 2006 through 2009. Filled points are for areas considered potentially "impacted" by mine-related activities (see **Table 2-10**).

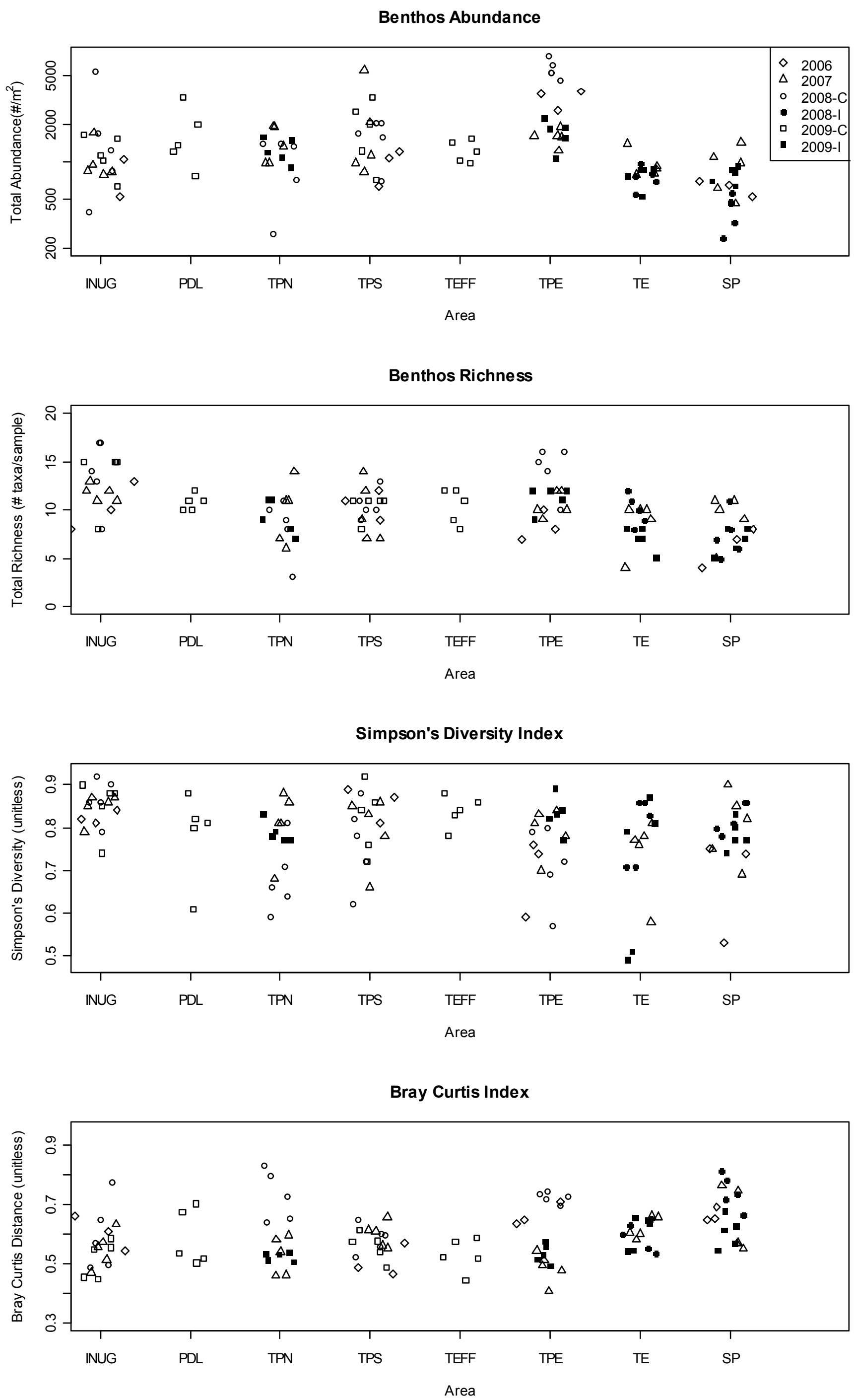


Figure 2-9. Boxplots of benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) by Effect grouping for CREMP data set.

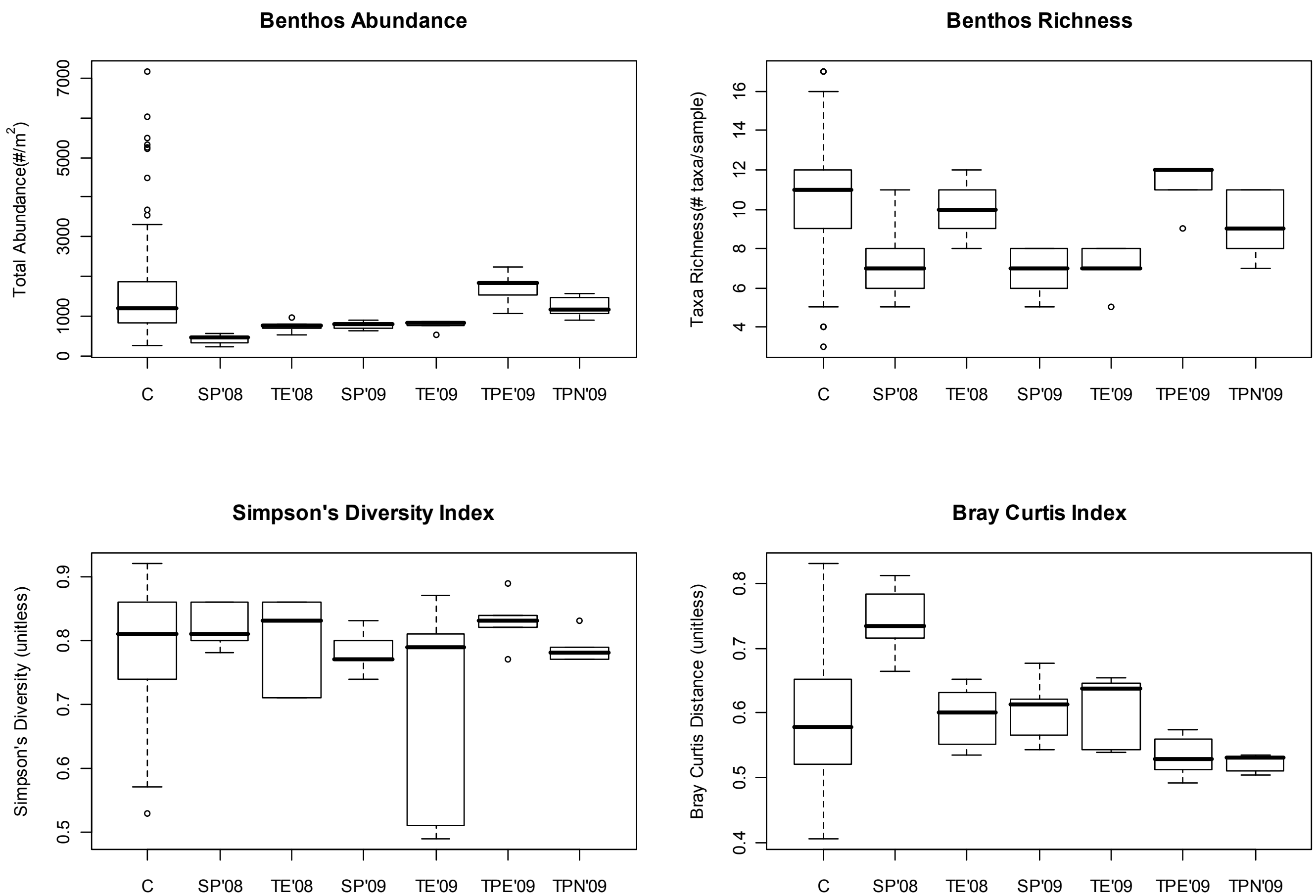


Figure 2-10. Benthic invertebrate replicates of abundance by major taxa group for the CREMP data set, August 2006 through August 2009.

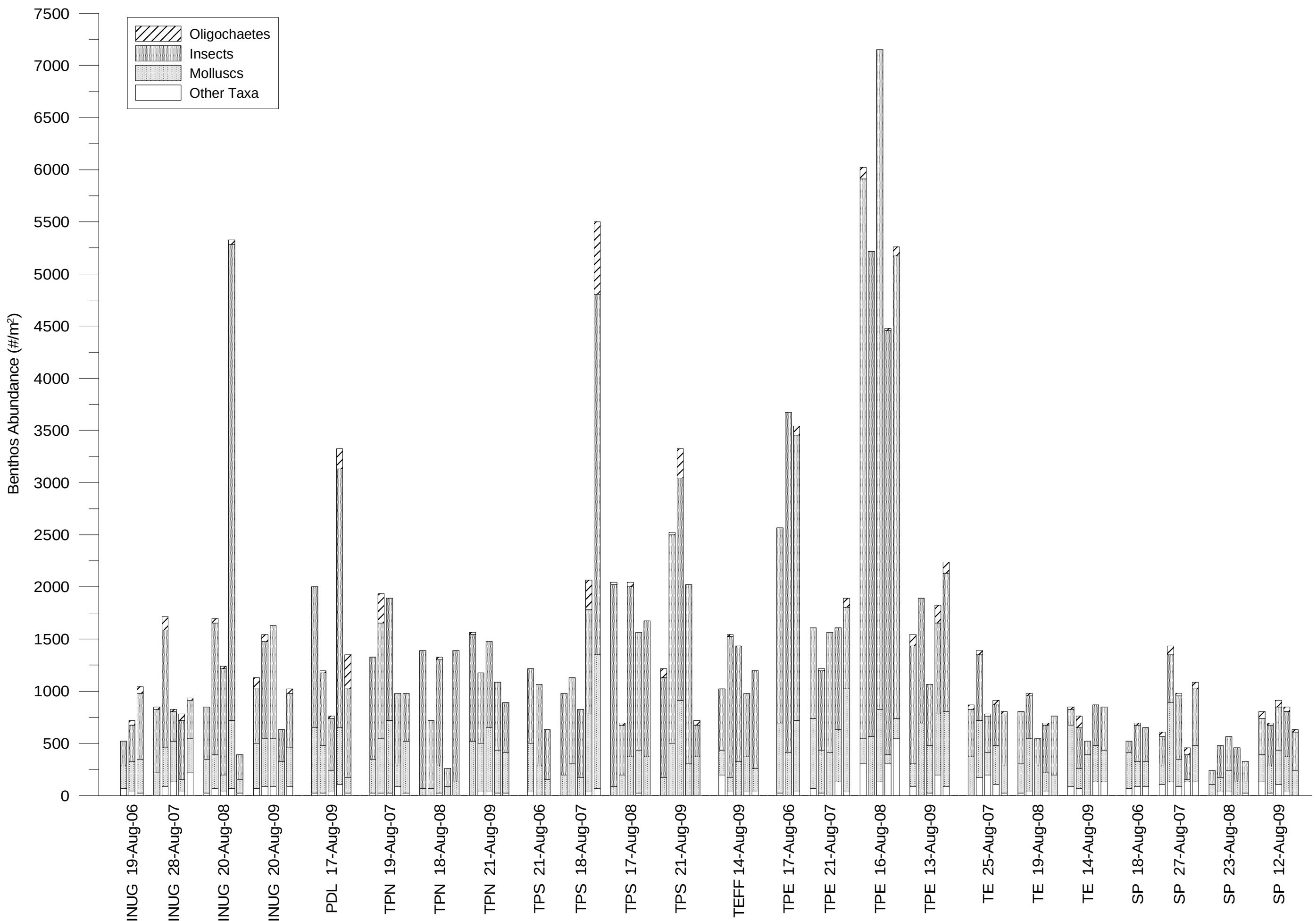


Figure 2-11. Benthic invertebrate replicates of richness by major taxa group for the CREMP data set, August 2006 through August 2009.

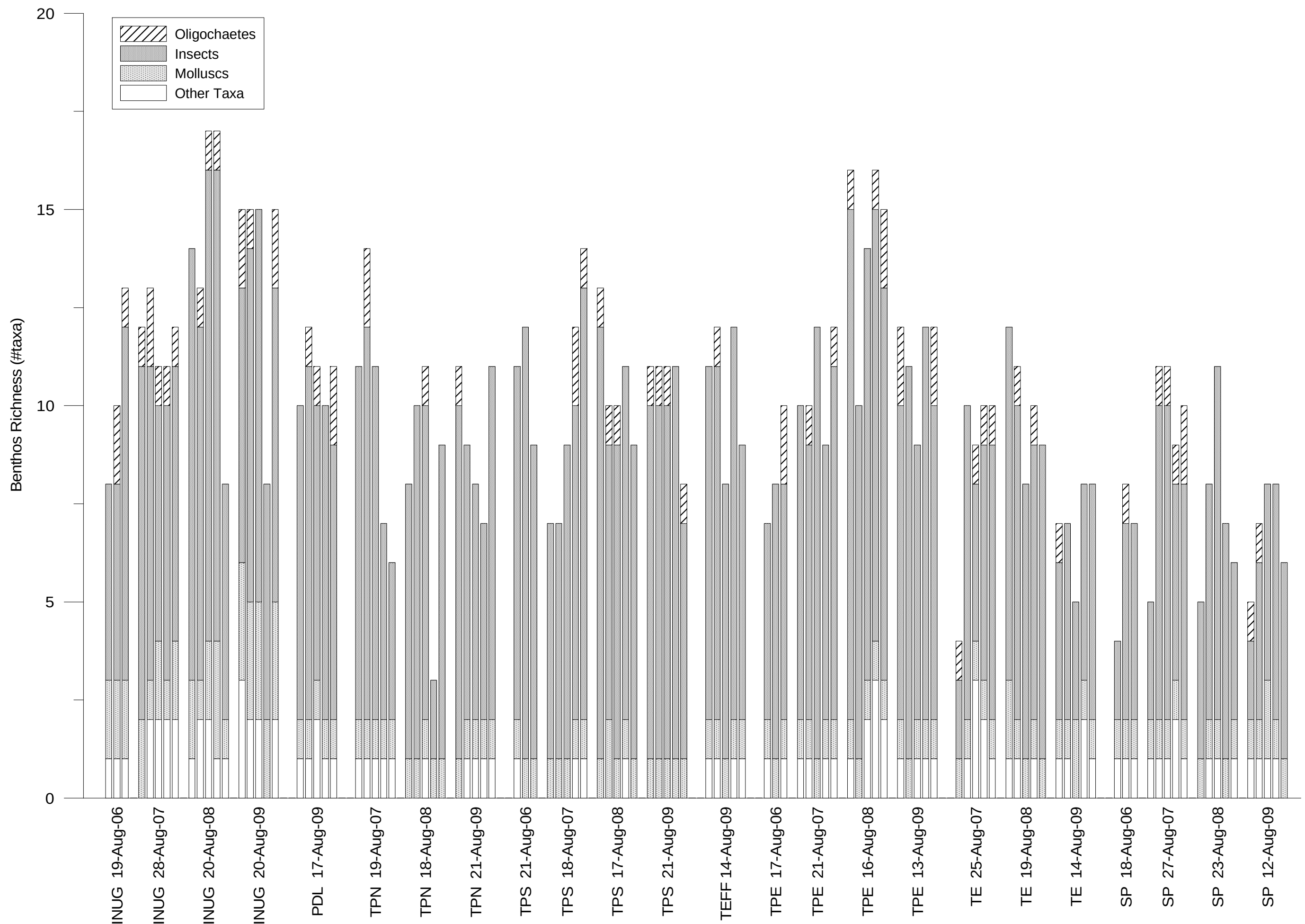


Figure 2-12. Key benthic community descriptors (N [abundance], R [richness], SimpDiv [Simpson's Diversity Index], and BrayCurtis [Bray Curtis Distance Index) as a function of TSS exposure, depth (m), total organic carbon (% TOC), and sediment grain size (% fines) for the CREMP data set.

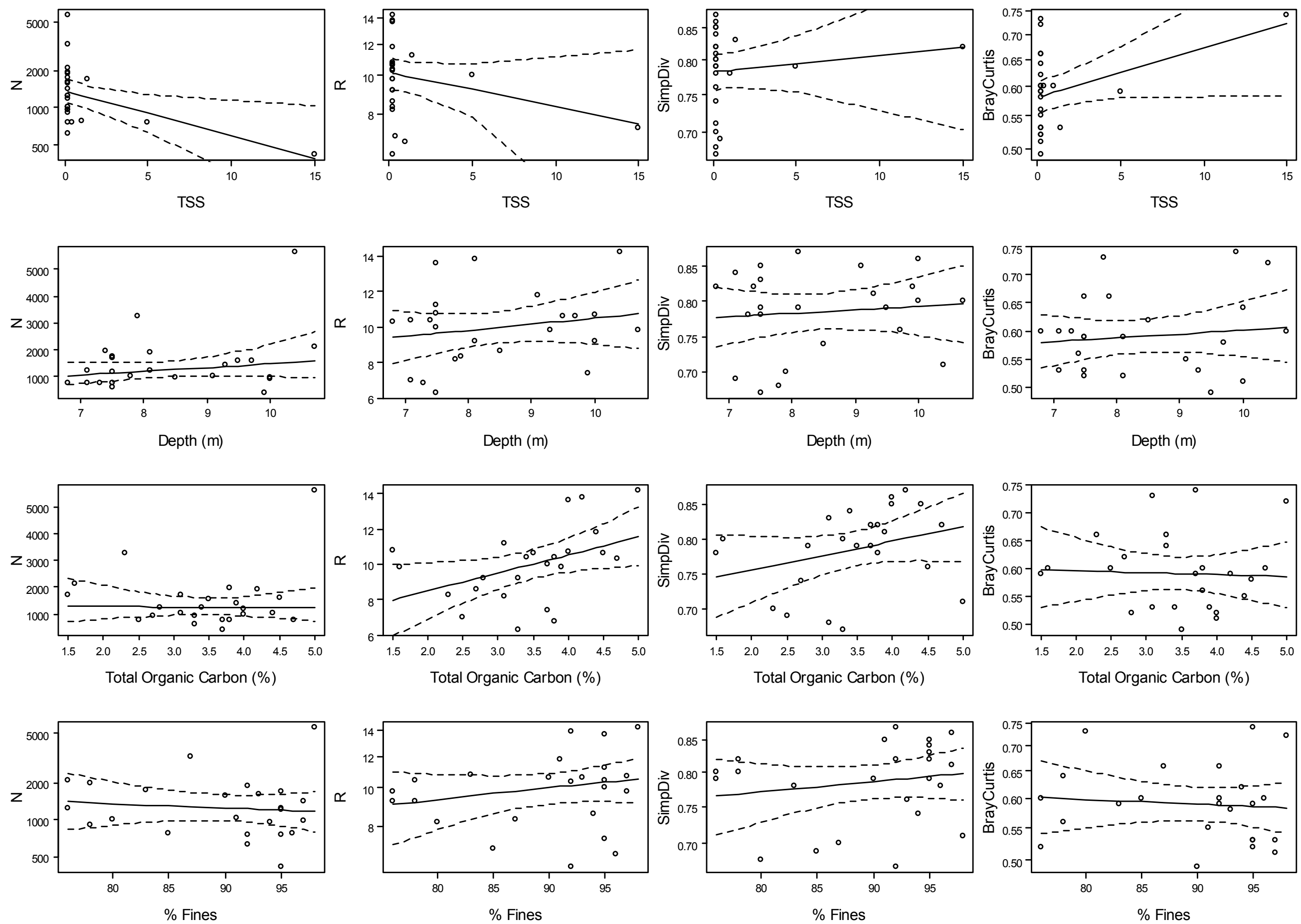
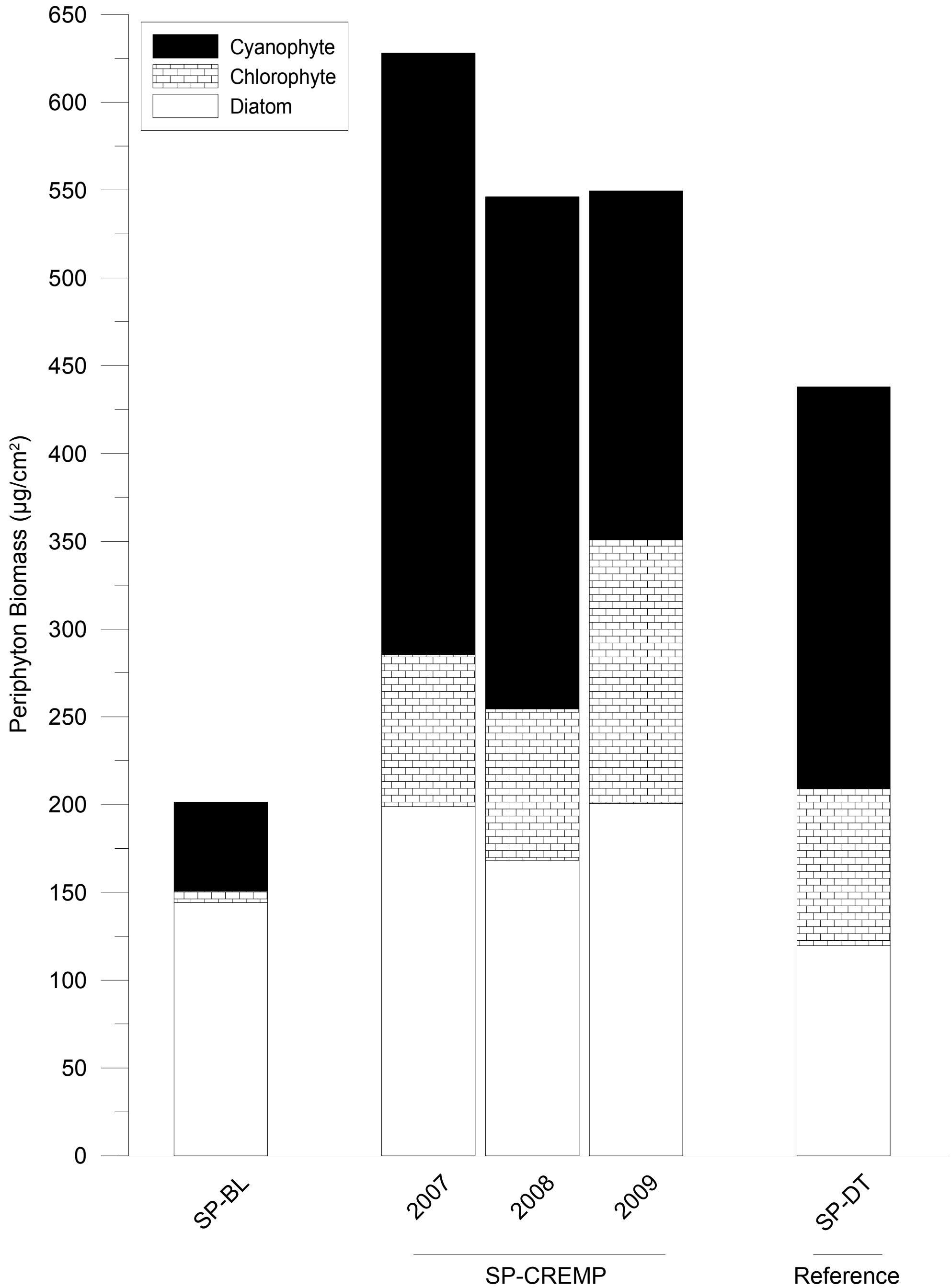


Figure 2-13. Mean periphyton biomass (μg/cm²) in Second Portage Lake, August 2009.



3. BAY-GOOSE DIKE TSS EAS

3.1. Study Outline

As described in **Section 1**, construction activities for the Bay-Goose Dike resulted in increased TSS concentrations throughout much of Third Portage Lake's east basin (for details see Azimuth, 2010a). AEM commissioned the Bay-Goose TSS EAS (see **Table 1-4** for overview) to assess the potential adverse ecological effects related to TSS. This report documents the methods (**Section 3.2**) and results (**Section 3.3**) of the study components conducted in 2009.

Field sampling in 2009 can be categorized into 3 broad groups: (1) general limnology and water quality sampling, (2) biological sampling (primary & secondary production) for field effects measurements, and (3) water sampling for laboratory effects measurements.

The study design used a multiple reference/multiple impact approach as follows (**Figure 3-1**):

- *Control (Reference) Areas* – two areas were selected, EAS-DT and EAS-TPS. EAS-DT is located in the "drilltrail arm" portion of southeast Second Portage Lake, which receives flows from the Wally Lake drainage; this arm had consistently low TSS (i.e., background concentrations) throughout 2008 and was also used as a reference area in the 2008 East Dike TSS EAS (see Azimuth, 2009b for more details). Both the north and south basins of Third Portage Lake were good candidates as the location for a reference area, because they were both a good distance from, and up wind of, 2009 dike construction activities. However, due to the possibility that dewatering activity would resume 2009 in the north basin, the south basin of Third Portage Lake was chosen as a reference area (EAS-TPS).

- *Impact (Exposure) Areas* – three exposure areas were selected, EAS-BGE, EAS-BGW, and EAS-SPC. Two areas were located in Third Portage Lake, one on the east side (EAS- BGE) and one on the west side (EAS-BGW) of Bay-Goose dike construction. The third area was located in the central basin of southeast Second Portage Lake, near the traditional CREMP monitoring location (SP). Given the extensive mixing documented in the dike construction monitoring report (Azimuth, 2010a), exposure to elevated TSS concentrations would have been much higher at all exposure areas relative to the reference areas. In addition, there was a strong gradient in TSS concentrations between Third and Second Portage lakes. Consequently, areas EAS-BGE and EAS-BGW were considered near-field areas and EAS-SPC was a far-field area.

General limnology and water quality, chlorophyll-α and phytoplankton (primary production) and zooplankton (secondary production) were sampled/collected during two time periods: September 17-19 and September 24–27. Water was also collected on September 19, 2009 for toxicity testing (using zooplankton and fish); the sample was collected from area EAS-BGE in Third Portage Lake.

A summary of samples collected for this study, including GPS locations, is provided in **Table 3-1**.

3.2. Methods

3.2.1. Limnology and Water Quality

Vertical temperature (^{o}C), oxygen (mg/L) and conductivity (µS/cm) depth profiles were acquired using a YSI Model 85 temperature – oxygen meter. Profiles were acquired from each area during both sampling events to track changes in oxygen and temperature profiles. Secchi depth (m) was measured prior to collection of water samples.

One water sample for chemical and physical analysis was collected from 3 m depth at each area for both events. Sampling, handling and analysis and QA/QC procedures were the same as those outlined in the *Aquatic Effects Monitoring Program – Core Receiving Environment Monitoring Program 2009* (Azimuth, 2010b).

Water samples were analyzed by ALS Environmental for conventional parameters (hardness, conductivity, pH, turbidity, and total dissolved and suspended solids), anions (alkalinity, bromide, chloride, fluoride, silicate and sulfate), nutrients (ammonia, nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate and total phosphate), organic parameters (chlorophyll-α, dissolved and total organic carbon) and total and dissolved metals. Details on analyses provided in **Appendix I**.

Water chemistry concentrations were tabulated and compared against each other, and, when available, the federal Canadian Council of Ministers of the Environment (CCME, 2007) water quality guidelines for the protection of aquatic life. These guidelines are intended to provide a conservative level of protection to freshwater aquatic life from anthropogenic contaminants or other physical changes (suspended solids, temperature).

3.2.2. Field Effects Measurements

3.2.2.1. Primary Production

Chlorophyll-α and phytoplankton samples were also collected during both sampling events. Five replicates of each were collected from all areas and sampling events.

Chlorophyll-α samples were prepared by vacuum filtering 1 L of water through an ashless filter paper on the screen of a hand-held vacuum pump. The filter is then removed with tweezers, preserved and wrapped in tinfoil and frozen for shipping to ALS laboratory Vancouver.

For phytoplankton biomass and density analysis, unfiltered water was collected at 3 m depth from each sampling area during the spring, summer, fall and winter of 2009 and a small aliquot was transferred to a 50 mL vial and preserved with Lugol's solution. The procedures for collecting the phytoplankton samples are outlined in detail in the SOP for Water and Phytoplankton Sampling (AEM, 2009b).

Preserved samples were transported to Winnipeg, MB for taxonomic identification and analysis by Plankton R Us Inc. For the analysis, 10-mL aliquots of preserved sample were gravity settled for 24 hours. Counts were performed on an inverted microscope at magnifications of 125X, 400X, and 1200X with phase contrast illumination. Cell counts were performed using the Ütermohl technique as modified by Nauwerck (1963). Cell counts were converted to wet weight biomass (mg/m^3) by estimating 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). A specific gravity of 1 was assumed for cellular mass. All biomass (mg/m^3) and density (cells/L) estimates are summed by major taxa, per area and sampling event.

3.2.2.2. Secondary Production – Pelagic

Zooplankton were collected using a 70-µm nitex mesh net with a 30-cm diameter mouth opening and total length of 2.2 m. Five replicate samples were collected (composite of one or two vertical tows) at each area for biomass analyses and one sample was collected (composite of two vertical tows) at each area for taxonomic identification. Tows were taken from depths of 8 m to the surface for all areas. After collection, all samples were placed into uniquely labeled plastic Whirl-Pac bags and were preserved in a 10% buffered formalin solution. All bags were sealed tight to prevent leakage and were sent to North-South Consultants, Winnipeg, MB. Zooplankton samples for biomass were filtered through a pre-dried 45 µm filter, wet weighed and then dried in an oven at 60^{o}C until completely dry. Samples were weighed dry to determine moisture content and dry weight. Dry biomass (mg/m^3) was calculated using the dry sample weight and the volume of water filtered by the net during each vertical tow.

3.2.2.3. Sediment Traps

A network of 19 sediment trap installations (each consisting of up to 4 replicate traps) was deployed throughout the local receiving environments prior to the onset of Bay-Goose Dike construction activities; these traps were deployed in late July and retrieved in mid-to-late September. The trap locations were primarily selected in areas near high value habitat to provide data on sediment deposition in proximity to important fish habitat (**Figure 3-2**). Sediment trap coordinates are presented in **Table 3-2**.

Each installation consisted of up to four PVC sediment traps, positioned vertically, open-end up, in a grid formation on a small metal frame. Each trap had the following dimensions: 7.6 cm inner diameter opening, 51.4 cm long. Traps were deployed in the open water by looping sideline to all corners of the platform, 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 buoy at the surface and labeled according to its ID.

Sediment traps were retrieved by slowly pulling the line when the boat is directly above the buoy to keep the trap vertical. In a few cases one or two of the four tubes were lost. In one other instance, the entire trap assembly was found on its side. Once removed from the lake, each pipe was capped, removed from the platform and left to settle for at least one day. Overlying water was decanted from each 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.

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 (12 individual rep samples) was then analyzed for total metals, while the remainder of the samples was ashed by further drying the sample at 550°C and subtracting the ash weight from the dry weight of the sample. Total metals were analyzed by digesting the dry sample (including the filter); “blank” filters were treated in the same manner as samples and analyzed for total metals alongside. Levels of any of the metals found in the filter blank samples will be subtracted from measured concentrations in the samples.

Sediment metals concentrations were compared to sediment quality guideline (SQG) concentrations developed by the CCME (2002). There are two levels of SQGs: Interim Sediment Quality Guidelines (ISQG) and Probably Effects Level (PEL) concentrations.

3.2.3. Laboratory (Toxicity) Effects Measurements

Water was collected in collapsible plastic carboys on September 19, 2009 at area EAS-BGE in Third Portage Lake and shipped to Nautilus Environmental (Burnaby, BC) for toxicity testing.

Acute toxicity tests were conducted on zooplankton (48-hr *Daphnia magna* survival) and fish (96-hr Rainbow trout survival). Chronic toxicity tests were also conducted on zooplankton (7-d *Ceriodaphnia dubia* survival and reproduction) and fish (7-d Rainbow trout embryo development and larva survival & growth). Both the embryonic and larval tests on trout were conducted on concentrations of 100 %, 50 %, 25 %, 12.5 %, 6.25 % and laboratory control of the test water. The embryonic development test was performed both with daily renewal of the test water and without renewal, the latter providing a "worst case" scenario for settling of suspended particulate matter on the embryos.

3.2.4. Statistical Analyses

All details regarding statistical methods used are provided in **Appendix B**.

3.2.5. Quality Assurance / Quality Control (QA/QC)

Laboratory QA/QC – see **Section 2.2.5**.

Field QA/QC: Water Sampling – Field QA/QC standards during water sampling were maintained for every sample. The standard QA/QC procedures included thoroughly flushing the flexible tubing and pump to prevent cross-contamination between areas and thoroughly rinsing the sample containers with site water prior to sample collection.

Two field duplicate samples per sampling event were collected to assess sampling variability and sample homogeneity; a RPD of 50% for concentrations that exceed 10x the MDL is considered acceptable. One equipment blank was also collected during each sampling event by pumping de-ionized water through the water sampling equipment (pump, tubing and inline filter) and filling the specified sample containers at the site; these samples are used to assess the potential introduction of any contamination accountable to sample handling and sampling techniques. One travel blank was also included with the sampling containers sent from the laboratory. These samples are not opened at all on site, but accompany the other samples through the sampling, shipping and analysis processes. Results from both the equipment and travel blanks are examined for detectable concentrations of any of the parameters measured; no parameter in either blank should exceed detection.

Field and Laboratory QA/QC: Biota Sampling – Standard procedures were used to collect biota samples. All sampling gear was thoroughly rinsed between sampling areas to ensure that there was no inadvertent introduction of biota from one area to another.

Two field duplicates were collected for phytoplankton during each sampling event in coordination with water sample duplicates and were taken in order to assess sampling variability and sample homogeneity. An RPD of 50% for density and biomass concentrations is considered acceptable. As a measure of QA/QC on the enumeration method replicate counts were preformed on ~10% of the samples. Replicate samples were chosen at random and processed at different times from the original analysis to reduce biases. Five field replicates of phytoplankton were also collected at each area during both events to determine natural variability and heterogeneity.

Two field duplicates were collected for zooplankton during each sampling event and were taken in order to assess sampling variability and sample homogeneity. An RPD of 50% for biomass is considered acceptable. Five field replicates of zooplankton were also collected at each area during both events to determine natural variability and heterogeneity. When estimating zooplankton biomass, the same technician performed wet and dry weight measurements and conversions and the digital scale was calibrated each time between weights. The QA/QC procedure for data entry consisted of technician #1 – entered data; technician #2 – checked every entry; and the senior biologist examines and finalizes the data file before delivery.

Nautilus Environmental follows a comprehensive QA/QC program to ensure that the data generated are of high quality and scientifically defensible. QA/QC for toxicity testing is summarized in their report (**Appendix J**).

3.3. Results

3.3.1. Quality Assurance / Quality Control (QA/QC)

QA/QC results for water sampling are shown in **Table 3-3** (raw data provided in **Appendix I**). Results are as follows:

- *Field Duplicates* – measured concentrations in the field duplicate samples showed a high level of consistency with the original samples. Two of the parameters exceeded the DQO (i.e., RPD > 50%) in the September 19 duplicate. Ammonia and TKN exceeded the RPD; however, the values were each less than 10 times the MDL, and thus meet the DQO. All other parameters were well under the DQO.
- *Laboratory duplicates* – internal QA/QC was performed by the laboratory on randomly chosen samples for select parameters (i.e., not all parameters are duplicated from individual samples). No parameters for laboratory duplicates exceeded the RPD of 25%.
- *Travel Blanks* – measured concentrations in travel blanks were also consistently below detection limits for both sample events.
- *Equipment Blanks* – results show a single detection of ammonia and turbidity in one equipment blank (September 19). Equipment blanks should not contain any measured parameters; the significance of the measured values is discussed below:

- Ammonia – the measured concentration on September 19 (0.047 mg/L) was well below CCME guidelines (see **Table 3-6**), so the equipment blank results, while not meeting the DQO, would not affect interpretation of monitoring data.
- Turbidity – the measured concentration on September 19 (0.14 NTU) was very low relative to actual sample results, barely above the MDL (0.10 NTU) and will not affect data interpretation.

Overall, the QA/QC results confirm that the data quality objectives were met.

Similar to water chemistry, the results for phytoplankton QA/QC below show a number of exceedances of the established DQOs. However, where density or biomass of a particular phytoplankton group is very small (i.e., about 1% of total), small differences in that metric between the original and the duplicate can cause very large differences in the RPD. Thus, we evaluate the quality of these data based on *total* density and *total* biomass both for field and laboratory duplicates. The results of the RPD analysis for all these parameters are presented in **Table 3-4** and is discussed below:

- *Field Duplicates* – The phytoplankton field duplicates from EAS-DT and EAS-SPC displayed greater than desired variability in both density (cells/L) and biomass (mg/m^3). Within-taxa variability was quite high; for example, rare groups may be present in one field sample but not another. For example, Cyanophytes were present in EAS-DT (Round 2) in the original sample but were not present in the duplicate sample. In such cases, where abundance or biomass is less than 1% of totals, RPD values are not calculated. Nevertheless, RPDs for *total* density and *total* biomass for all field duplicate samples were lower and met the DQO. RPD values were always much less than 50% for number of species and Simpson's diversity.
- *Laboratory Duplicates* – Duplicate re-counts were conducted on 10% of the samples analyzed. RPDs for *total* density and *total* biomass consistently met the DQOs (i.e., <25%), with two (of 12 RPDs) small exceptions (one just over 25% and one at 27%). Similar to field duplicates, laboratory duplicates showed high within-taxa variability.

Overall these results illustrate the inherently large difference in phytoplankton taxa composition because of the relatively small number of plankters enumerated relative to the very large number of plankters present in the sample. However, notwithstanding within replicate differences in taxonomic composition, total biomass did not differ in one direction or another for laboratory duplicates. These results are suitable for addressing whether elevated TSS in Second Portage Lake caused depressed primary productivity.

The field QA/QC results for zooplankton are shown in **Table 3-5**. While the Round 2 results met DQOs, the Round 1 results, which failed DQOs, simply did not make sense. First of all, the degree of among-replicate variation of the actual results (see **Section 3.3.3.2**) was much lower than the observed RPDs, so it seems unlikely that both field duplicates would be so different from their paired samples. A possible explanation is that the duplicate samples for zooplankton biomass were inadvertently mixed up at some point (i.e., the duplicate biomass samples were paired with the wrong areas). If that were the case, the results are much better, with only a slight exceedence of RPDs for the DT-1 sample (likely due to the very low biomass at that station). Given that this cannot be verified with certainty, these data should be viewed with greater caution.

Results of QA/QC for toxicity testing showed that all the tests met the acceptability criteria for test validity specified in their respective protocols, with the exception of a minor temperature exceedance in the rainbow trout embryo test on the final day. This minor exceedance is not expected to have had any effect on the outcome of the test.

The toxicity tests were conducted outside of the holding times specified in the test methods because of extended transportation time. Because the purpose of the tests was to evaluate the effect of TSS, rather than toxicants, and would therefore not be expected to degrade, volatilize or otherwise dissipate in the sample, this delay is not expected to have affected the outcome of the tests. Prior to testing, the samples were thoroughly mixed to re-suspend any particulate that may have settled. Further details are provided in the report prepared by Nautilus (**Appendix J**).

3.3.2. Limnology and Water Quality

Vertical temperature and oxygen profiles measured from the three areas in Third Portage Lake and the two areas in Second Portage Lake showed little difference (**Figures 3-3 and 3-4**) both among areas and sampling events. Temperature and dissolved oxygen profiles of all areas suggested a lack of stratification.

Water temperature at all areas ranged from about 6.5-8 °C for the first sampling event (September 17-19, 2009) and from about 5–7 °C for the second event (September 24-27, 2009). Dissolved oxygen ranged from 10.5–12 mg/L (Round 1) and from about 9–10 mg/L (Round 2), indicating high saturation throughout the water column.

Secchi depth (m) readings were highest (3-10 m) at the two reference areas during both sampling events and lowest (0.75-1.25 m) at the two exposure areas closest to Bay-Goose Dike construction (EAS-BGE, EAS-BGW).

Results for chemical and physical analyses are presented in **Table 3-6** (raw data presented in **Appendix I**). The pH of surface waters was for the most part circum-neutral (6.8–7.4), though one sample taken on September 24 at area EAS-DT was slightly more alkaline (7.7). Conductivity was lowest in Third Portage (14.9 and 15.1 µS/cm) and somewhat higher, but very similar, among Second Portage Lake areas (23.0 – 27.1 μS/cm), consistent with historic CREMP data.

Based on dike construction monitoring results (Azimuth, 2010a) and EAS sampling (**Table 3-6**), TSS concentrations in the east basin steadily decreasing from mid to late September 2009. Rather than relying solely on the EAS results, which are only a brief snapshot in time, we looked at all data in the week prior to sampling to gauge exposure concentrations. Estimated TSS concentrations in the exposure areas (EAS-BGE and EAS-BGW) were approximately 10 mg/L during the first event and 8 mg/L in the second event. TSS concentrations were much lower in Second Portage Lake, approximately 2 mg/L during the first event and 1.5 mg/L during the second.

Total dissolved solids (TDS) in surface waters at all areas was relatively low (< 15 mg/L) during the first sampling event, and even lower or held steady (< 12 mg/L) during the second, consistent with the overall decline observed for TSS concentrations.

Nitrogen and phosphorus at most areas were low, generally close to laboratory detection limits, and did not differ appreciably among areas or sampling events. Total phosphorus was above the CCME guideline for both sampling events at EAS-BGE and for the second sampling event at EAS-BGW; as discussed in the dike construction monitoring report (Azimuth, 2010a), this is likely a particulate effect due to the presence of phosphorus-containing minerals. At all other areas, total phosphorus was below detection limits.

Dissolved organic carbon concentration was fairly constant among all areas with the exception of the reference area EAS-TPS, which was elevated (4.5 mg/L) in the second sampling event, although total organic carbon remained low (1.3 mg/L).

Of the 29 metals for which concentration data were measured, all but three are consistently near or below method detection limits (MDLs). Concentrations of total aluminum, chromium and iron exceeded CCME (2007) guideline concentrations for the protection of aquatic life at the two near-field exposure monitoring areas (EAS-BGE and EAS-BGW) in Third Portage Lake. Concentrations of each of these metals were fairly similar among the two exposure areas and sampling events. This result is related to the elevated TSS concentrations that were measured for BGE and BGW, originating from sediment released into the east basin during the construction of the Bay-Goose dike. Dissolved metals concentrations were much lower (none higher than total metals concentrations for all areas, which suggests that the observed metals are in particulate form. None of the dissolved metals concentrations exceeded CCME guidelines.

3.3.3. Field Effects Measurements

3.3.3.1. Primary Production

Phytoplankton are microscopic, unicellular plant species that are suspended in the water column and, as primary producers, comprise the base of the food web. There are six major groups of phytoplankton present in these lakes: Cyanophytes (blue green algae), Chlorophytes (green algae), Chrysophytes (golden-brown algae), Diatoms, Cryptophytes and Dinoflagellates. Seasonal production of phytoplankton can vary widely depending upon water temperature, nutrient concentration, time of year, water clarity and amount of sunlight and predation by zooplankton.

Response variables used in this study were:

- Chlorophyll- α
- Phytoplankton biomass (mg/m^3 ww)
- Phytoplankton community diversity (Simpson's D Index).

Detailed results for statistical analyses are provided in **Appendix B**; results are summarized below by response variable.

Chlorophyll-α

Chlorophyll-α results are presented in **Table 3-6**. Concentrations at all areas were generally low and similar. Chlorophyll-α concentrations were generally higher in late September compared to mid-September, with area means ranging from 0.217 to 0.396 µg/L and from 0.395–0.754 µg/L in Round 2 (**Figure 3-5**; note units of mg/m^3 are equal to µg/L). The results of statistical analyses are shown in **Table 3-7**. Statistical differences were found between lakes (i.e., Second Portage Lake had higher chlorophyll-α concentrations than Third Portage Lake), so the control-impact comparisons were made separately for each lake. There were no significant differences between control and impact areas in Second Portage Lake. For Third Portage Lake, the two east basin impact areas had significantly lower chlorophyll-α concentrations relative to the south basin control area. This spatial difference was driven primarily by the results of the second event (i.e., there were much larger differences between the two impact areas and the control area during the second event relative to the first).

As discussed in detail in **Appendix B**, the EAS data alone make it difficult to conclude whether the observed differences in chlorophyll-α concentration are due to inherent spatial differences between basins or to exposure to elevated TSS. Long-term monitoring data from the CREMP were used to further explore spatial and temporal patterns in chlorophyll-α concentrations (**Figure 3-6**) within Second and Third Portage lakes in order to help discriminate between possible explanations (i.e., natural differences vs. TSS exposure). First of all, the results confirm that primary productivity is naturally higher in Second Portage Lake than in Third Portage Lake (i.e., suggesting that the inter-lake differences observed in the 2009 EAS results may be natural and not necessarily due to the lower TSS concentrations). Within Third Portage Lake, the CREMP data prior to onset of dike construction in late August 2009 do not show any consistent differences among basins. Indeed, the east basin area had the lowest chlorophyll-α concentrations in May 2009 and the highest the next sampling period (July 2009). In August 2009, concentrations were similar between the east and south basins. In September 2009, concentrations were lower in the east basin relative to the south basin, but the east basin results were within the range found at the north basin. The CREMP results confirm that there were no inherent differences between the east and south basins prior to dike constructions, so the observed differences found in the EAS results may well be due to exposure to elevated TSS. However, the magnitude of effect appears to be within the range of natural variability for Third Portage Lake (i.e., based on the north basin results). Furthermore, the CREMP data show that any difference between basins was no longer apparent by November 2009.

Phytoplankton Biomass

Phytoplankton data are reported on the basis of biomass and density (**Tables 3-8 and 3-9**; detailed taxa listing for both events is provided in **Appendix K**. While both can be useful in characterizing the community, biomass is more ecologically relevant for assessing potential TSS impacts to productivity. Mean total biomass results are shown in **Figure 3-7**.

Results for statistical analyses are provided in **Table 3-7**. Significant differences were seen between the two lakes (**Figure 3-7**), so the statistical model was applied to each lake separately. No significant differences were seen between the control and impact areas in Second Portage Lake. In Third Portage Lake, significant differences were found between the control area (159 mg/m^3) and the two impact areas (**Table 3-7** and **Figure 3-7**), with the latter two areas having approximately a third lower biomass (48 mg/ m^3 and 56 mg/ m^3).

As discussed for chlorophyll-α above (and in detail in **Appendix B**), the EAS data alone make it difficult to conclude whether the observed differences are due to inherent spatial differences between basins or to exposure to elevated TSS. Long-term monitoring data from the CREMP were used to further explore spatial and temporal patterns in phytoplankton biomass (**Figure 3-8**) within Third Portage Lakes in order to help discriminate between possible explanations (i.e., natural differences vs. TSS exposure). First of all, the data were used to determine whether there were inherent differences among basins prior to exposure to elevated TSS. Once seasonal (month) and year variance had been accounted for, the east basin (TPE) was found to naturally, consistently have significantly higher phytoplankton biomass than the two other basins. Thus, the decreases observed in the EAS data set are likely conservative estimates of actual effect size (i.e., rather than natural inherent differences between basins) and that the effects are very likely due to TSS exposure. Second, the CREMP data also independently corroborate the EAS conclusion that phytoplankton biomass was reduced in the east basin in September (i.e., note the large drop in phytoplankton biomass at TPE relative to the other basins in September 2009 in **Figure 3-8**). Finally, the CREMP data (**Figure 3-9**) suggest that, similar to the chlorophyll-α results, the effects observed in September are relatively short-lived and did not extend to November 2009, when TPE was higher than TPN as biomass dropped off in early winter.

The main reason for the observed changes was a depression in Chrysophyte biomass at the near-field exposure areas (**Figure 3-10**). Historically, the CREMP data show that Chrysophytes have always been the dominant species by biomass in Second and Third Portage Lakes, regardless of season (**Figure 3-11**).

Phytoplankton Diversity

Phytoplankton diversity results are shown in **Table 3-8**. As per the statistical results shown in **Table 3-7**, there were no trends seen between control-impact areas (shown in **Figure 3-12**). See **Appendix B** for more graphs and discussion.

3.3.3.2. Secondary Production

Zooplankton data are reported on the basis of wet and dry biomass per tow (**Table 3-10**) and relative abundance of taxa identified (**Table 3-11**) (a detailed list of taxa and biomass analyses are shown in **Appendix L**). Mean total biomass ranged from about 3–50 mg/m^3 dw (Round 1) and from about 21–42 mg/m^3 dw (Round 2) (**Figure 3-13**).

Results of statistical analyses are provided in **Table 3-7**. No significant differences were found between lakes (see **Figure 3-13**), so the model was applied to the whole data set. The results show significantly higher zooplankton biomass in impact areas relative to the control areas across lakes, but that is likely driven by the very low biomass found at the EAS-DT reference area. We did not observe any significant differences between control and impact areas in Third Portage Lake. In addition, while the CREMP data set did not include zooplankton, last year's EAS study for the East Dike (Azimuth 2009a) did examine zooplankton biomass in the east basin (area 3PL-EAS) in September 2008 in the absence of elevated TSS. Interestingly, zooplankton biomass in the east basin was actually lower in 2008 than the levels seen in 2009. Furthermore, last year's overall EAS results showed no apparent response of zooplankton biomass to elevated TSS concentrations in Second Portage Lake. Thus, all available evidence supports a conclusion that the observed zooplankton biomass levels are within the range natural variability and do not appear affected by elevated TSS. It may be that increased zooplankton biomass is due to lack of predation of zooplankton by fish because of the decrease in visibility, which would favor zooplankton in these normally very clear lakes with Secchi depths of 8 m or more. However, this possibility, where we would expect to see more of the larger zooplankters that are usually targeted by zooplanktivorous fish (e.g., cladocerans), does not seem obvious based on community composition results.

Zooplankton community composition results are presented in **Table 3-11**. There were strong community similarities among areas and sampling events. EAS-BGE, -BGW, -SPC and -TPS zooplankton community was dominated by copepods (90–98%), mostly evenly split between Cyclopoida (mostly *Cyclops scutifer*) and Calanoida (mostly *Diaptomus*). The remainder of the community at these 4 areas was cladocerans, represented primarily by *Bosmina longirostris*. Zooplankton community at area EAS-DT was different from the other areas as it was dominated by cladocerans (52–57%), represented primarily by *Daphnia longiremis* Sars and *Bosmina longirostris*. This station also had a dipteran presence (2–5%), and a relatively small amount of copepods (41–43%).

Based the similarities in community composition across control (except EAS-DT) and impact areas, the influence of reduced predation (e.g., in lower visibility water) and/or exposure to TSS were not apparent. This is consistent with the lack of significant differences in biomass.

3.3.3.3. Sediment Traps

Trap retrieval rates was lower than expected. For example, out of the 5 traps set in Tehek Lake, only one was retrieved; tubes from the other four sediment traps were lost during retrieval, prior to reaching the surface. Eight traps were set in Second Portage Lake for the summer, but one trap (SP-ST1) was found lying on its side up retrieval. Prior to deploying the traps over winter 2009-2010, the way individual traps were attached to the trap assembly was modified to avoid future trap losses.

Results for sediment deposition rates and estimated deposition thickness are presented in **Table 3-12** (**Appendix M**). Not surprisingly, the trap closest to the Bay-Goose Dike construction zone, BG-ST6, had the highest deposition rates (approximately 0.14 g wet/day); this deposition rate led to 1.1 mm of accumulated sediment over the entire period. Predicted deposition rates and accumulation at the areas further from the construction zone (BG-ST1 through BG-ST5) were much less (~ 6-17 times less) than the nearer area.

Sediment traps in Second Portage and Tehek Lakes accumulated much less sediment than those in Third Portage Lake; in all cases SP and TE sediment traps had <0.5 mm accumulation. Sediment traps SP-ST4 and SP-ST6 each accumulated about 0.5 mm and 0.4 mm, respectively, and were located downstream the outlet from Third Portage Lake, receiving sediment in water originating from Bay-Goose Dike construction. In 2008, sediment traps in Second Portage Lake closest to the East Dike accumulated between 1–2 mm over approximately the same number of days during East Dike construction.

While the primary goal of the sediment traps was to quantify deposition rates and accumulation in relation to dike construction, sediment was also submitted for total metals analyses. These results are presented in **Table 3-13** (**Appendix M**). Chromium and copper exceeded CCME ISQGs for all Second and Third Portage sediment trap samples; chromium also exceeded PELs for all but one sample and copper exceeded PELs for only one sample. Zinc exceeded CCME ISQGs for all Second Portage Lake samples and 2 Third Portage Lake samples. And cadmium and mercury ISQGs were exceeded on occasion.

Compared to sediment data (grab samples; 3-5 cm deep) collected from the Second and Third Portage Lakes CREMP (SP and TPE) areas, a few differences are apparent. Arsenic exceeds both the ISQG and PEL for the CREMP areas, but not in the sediment traps. The opposite is true for zinc concentrations, sediment trap concentrations from SP traps are greater than those measured in the grab samples from the SP CREMP area. The remaining metals concentrations are within range of those measured at both the SP and TPE CREMP areas.

3.3.4. Laboratory (Toxicity) Effects Measurements

Detailed results are provided in **Appendix J**. Key results were as follows:

- *Acute effects to zooplankton* – no adverse effects were observed in the 48-hr *Daphnia magna* survival test.
- *Acute effects to fish* – no effects were observed in the 96-hr rainbow trout survival test.
- *Chronic effects to zooplankton* – no adverse effects were observed for survival or reproduction in the 7-day test with *Ceriodaphnia dubia*.
- *Chronic effects to fish* – tests were conducted on two developmental stages:
    - *Embryo stage* – two tests were conducted using trout embryos: one where test water was renewed each day (renewal) and one without renewal (static). This test combination was used to provide insights into whether any observed effects were due to chemical or physical effects. No adverse effects were observed under either renewal or static exposure conditions.

- *Larval stage* - the larval test was conducted using live zooplankton as a food resource. No adverse effects were detected in the 7-day survival and growth test. The lack of growth or survival effects suggests that neither direct (e.g., impairment of gill functioning) or indirect (e.g., active feeding was not impaired by the reduced water clarity) effects would be expected in the field.

Table 3-1. Sample ID, date, UTM coordinates and sampling summary, Bay-Goose Dike TSS EAS, 2009.

Station	Event Date	Easting	Northing	Limnology	Water Quality	Phytoplankton Biomass	Chlorophyll-a	Zooplankton Biomass/Tax	Toxicity Testing
EAS-BGE	19-Sep-10	14W 639203	7212583	x	x	x	x	x	x
EAS-BGW	18-Sep-10	14W 638631	7212035	x	x	x	x	x	
EAS-SPC	19-Sep-10	14W 639850	7213914	x	x	x	x	x	
EAS-DT	18-Sep-10	14W 641280	7213630	x	x	x	x	x	
EAS-TPS	17-Sep-10	14W 633751	7207958	x	x	x	x	x	
EAS-BGE	26-Sep-10	14W 639203	7212583	x	x	x	x	x	
EAS-BGW	24-Sep-10	14W 638631	7212035	x	x	x	x	x	
EAS-SPC	26-Sep-10	14W 639850	7213914	x	x	x	x	x	
EAS-DT	26-Sep-10	14W 641280	7213630	x	x	x	x	x	
EAS-TPS	27-Sep-10	14W 633751	7207958	x	x	x	x	x	

Notes:
UTM coordinates in NAD83.

Table 3-2. Sample date, ID, and UTM coordinates for sediment traps, 2009.

Sample Type & Location		Date	Sample ID	UTM Location
HVH Sediment Traps	Second Portage Lake	26-Jul-09	SP-ST1	14 W 639649 7214045
		26-Jul-09	SP-ST5	14 W 640813 7213329
		26-Jul-09	SP-ST6	14 W 640377 7213082
		21-Sep-09	SP-ST2	14 W 640043 7213817
		12-Sep-09	SP-ST3	14 W 640775 7213208
		12-Sep-09	SP-ST4	14 W 639668 7214544
		12-Sep-09	SP-ST5	14 W 639819 7213911
		15-Sep-09	SP-ST6	14 W 640069 7212807
		12-Sep-09	SP-ST7	14 W 641452 7213873
		15-Sep-09	SP-ST8	14 W 639684 7213356
	Third Portage Lake	13-Sep-09	BG-ST1	14 W 638711 7211761
		13-Sep-09	BG-ST2	14 W 639016 7211788
		13-Sep-09	BG-ST3	14 W 639535 7211811
		13-Sep-09	BG-ST4	14 W 639521 7212410
		13-Sep-09	BG-ST5	14 W 639012 7211243
		16-Sep-09	BG-ST6	14 W 639355 7213333
	Tehek	17-Sep-09	TE-ST1	15 W 359929 7212109

Table 3-3. QA/QC data for water parameters, Second and Third Portage Lakes, September 2009.

		Second Portage Lake			Second Portage Lake			Second Portage Lake			Second Portage Lake			Second/Third Portage Lakes			Second/Third Portage Lakes			Travel Blanks		Equipment Blanks	
		EAS-DT-1	Field Dup-1	RPD	EAS-SPC-1	Field Dup-2	RPD	EAS-DT-1	Field Dup-1	RPD	EAS-SPC-1	Field Dup-2	RPD	Original	Laboratory Duplicate	RPD	Original	Laboratory Duplicate	RPD	1	2	EAS-EQ-1	EAS-EQ-1
	MDLs	18-Sep-09	19-Sep-09	(%)	19-Sep-09	19-Sep-09	(%)	24-Sep-09	24-Sep-09	(%)	26-Sep-09	26-Sep-09	(%)	Mid Sept.		(%)	Late Sept.		(%)	19-Sep-09	26-Sep-09	19-Sep-09	26-Sep-09
CONVENTIONAL PARAMETERS																							
Physical Tests																							
Conductivity (µS/cm)	2.0	27.1	27.0	0.37	-	-	-	27.0	26.8	0.74	-	-	-	<2.0	<2.0	0	-	-	-	<2.0	<2.0	<2.0	<2.0
Hardness (mg/L)	1.1	11.2	11.2	0	-	-	-	11.3	11.3	0	-	-	-	-	-	-	-	-	-	<1.1	<1.1	<1.1	<1.1
pH	0.10	6.95	6.83	1.74	-	-	-	7.67	7.20	6.32	-	-	-	5.71	5.64	1.23	-	-	-	5.70	5.63	5.71	5.70
Total Suspended Solids (mg/L)	1.0	<1.0	<1.0	0	-	-	-	<1.0	<1.0	0	-	-	-	-	-	-	-	-	-	<1.0	<1.0	<1.0	<1.0
Total Dissolved Solids (mg/L)	10	12	12	0	-	-	-	12	14	-15	-	-	-	12	<10	NA	-	-	-	<10	<10	<10	<10
Turbidity (NTU)	0.10	0.42	0.46	-9.1	-	-	-	0.49	0.52	-5.9	-	-	-	0.14	0.16	-13	<0.10	<0.10	0	<0.10	<0.10	0.14	<0.10
Anions & Nutrients (mg/L)																							
Alkalinity - Bicarbonate (as $CaCO_3$)	2.0	8.9	8.7	2.3	-	-	-	8.5	8.6	-1.2	-	-	-	-	-	-	-	-	-	<2.0	<2.0	<2.0	<2.0
Alkalinity - Carbonate (as $CaCO_3$)	2.0	<2.0	<2.0	0	-	-	-	<2.0	<2.0	0	-	-	-	-	-	-	-	-	-	<2.0	<2.0	<2.0	<2.0
Alkalinity - Hydroxide (as $CaCO_3$)	2.0	<2.0	<2.0	0	-	-	-	<2.0	<2.0	0	-	-	-	-	-	-	-	-	-	<2.0	<2.0	<2.0	<2.0
Alkalinity - Total (as $CaCO_3$)	2.0	8.9	8.7	2.3	-	-	-	8.5	8.6	-1.2	-	-	-	-	-	-	-	-	-	<2.0	<2.0	<2.0	<2.0
Ammonia (as N)	0.020	0.10	0.049	**72**	-	-	-	<0.020	<0.020	0	-	-	-	0.066	0.066	0	-	-	-	<0.020	<0.020	0.047	<0.020
Bromide	0.050	<0.050	<0.050	0	-	-	-	<0.050	<0.050	0	-	-	-	-	-	-	-	-	-	<0.050	<0.050	<0.050	<0.050
Chloride	0.50	0.52	0.50	3.9	-	-	-	0.73	<0.50	NA	-	-	-	-	-	-	-	-	-	<0.50	<0.50	<0.50	<0.50
Fluoride	0.020	0.050	0.053	-5.8	-	-	-	0.038	0.037	2.7	-	-	-	-	-	-	-	-	-	<0.020	<0.020	<0.020	<0.020
Nitrate (as N)	0.0050	<0.0050	<0.0050	0	-	-	-	<0.0050	<0.0050	0	-	-	-	-	-	-	-	-	-	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	-	-	-	-	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	0.050	0.16	0.082	**66**	-	-	-	0.118	0.124	-4.96	-	-	-	0.163	0.145	11.7	-	-	-	<0.050	<0.050	<0.050	<0.050
Ortho Phosphate (as P)	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphate (as P)	0.0020	<0.0020	0.0022	-9.52	-	-	-	<0.0020	0.0024	0	-	-	-	-	-	-	-	-	-	<0.0020	<0.0020	<0.0020	<0.0020
Silicate (as SiO_2)	1.0	<1.0	<1.0	0	-	-	-	<1.0	<1.0	0	-	-	-	-	-	-	-	-	-	<1.0	<1.0	<1.0	<1.0
Sulfate (SO_4)	0.50	2.67	2.67	0	-	-	-	2.4	2.4	0	-	-	-	-	-	-	-	-	-	<0.50	<0.50	<0.50	<0.50
ORGANIC / INORGANIC CARBON																							
Dissolved Organic Carbon (mg/L)	0.50	1.64	1.73	-5.34	-	-	-	1.73	1.75	-1.15	-	-	-	<0.50	<0.50	0	<0.50	<0.50	0	-	<0.50	<0.50	<0.50
Total Organic Carbon (mg/L)	0.50	1.68	1.70	-1.18	-	-	-	1.80	1.78	1.12	-	-	-	<0.50	<0.50	0	-	-	-	<0.50	<0.50	<0.50	<0.50
PLANT PIGMENTS																							
Chlorophyll a (µg/L)	0.010	0.331	0.334	-0.90	0.448	0.466	-3.94	0.666	0.639	4.14	0.996	0.929	6.96	-	-	-	-	-	-	-	-	-	-
TOTAL METALS (mg/L)																							
Aluminum	0.0050	0.0097	0.011	-16	-	-	-	0.0166	0.0219	-27.5	-	-	-	-	-	-	0.0166	0.0155	6.85	<0.0050	<0.0050	<0.0050	<0.0050
Antimony	0.00050	<0.00050	<0.00050	0	-	-	-	<0.00050	<0.00050	0	-	-	-	-	-	-	<0.00050	<0.00050	0	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00050	<0.00050	<0.00050	0	-	-	-	<0.00050	<0.00050	0	-	-	-	-	-	-	<0.00050	<0.00050	0	<0.00050	<0.00050	<0.00050	<0.00050
Barium	0.020	<0.020	<0.020	0	-	-	-	<0.020	<0.020	0	-	-	-	-	-	-	<0.020	<0.020	0	<0.020	<0.020	<0.020	<0.020
Beryllium	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.10	<0.10	<0.10	0	-	-	-	<0.10	<0.10	0	-	-	-	-	-	-	<0.10	<0.10	0	<0.10	<0.10	<0.10	<0.10
Cadmium	0.000017	<0.000017	<0.000017	0	-	-	-	<0.000017	<0.000017	0	-	-	-	-	-	-	<0.000017	<0.000010	-	<0.000017	<0.000017	<0.000017	<0.000017
Calcium	0.10	2.97	2.98	-0.34	-	-	-	2.96	2.95	0.34	-	-	-	-	-	-	2.96	2.95	0.34	<0.10	<0.10	<0.10	<0.10
Chromium	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00030	<0.00030	<0.00030	0	-	-	-	<0.00030	<0.00030	0	-	-	-	-	-	-	<0.00030	<0.00030	0	<0.00030	<0.00030	<0.00030	<0.00030
Copper	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	0.0011	-9.52	-	-	-	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	<0.0010	<0.0010
Iron	0.030	<0.030	<0.030	0	-	-	-	<0.030	<0.030	0	-	-	-	-	-	-	<0.030	<0.030	0	<0.030	<0.030	<0.030	<0.030
Lead	0.00050	<0.00050	<0.00050	0	-	-	-	<0.00050	<0.00050	0	-	-	-	-	-	-	<0.00050	<0.00050	0	<0.00050	<0.00050	<0.00050	<0.00050
Lithium	0.0050	<0.0050	<0.0050	0	-	-	-	<0.0050	<0.0050	0	-	-	-	-	-	-	<0.0050	<0.0050	0	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	0.10	0.92	0.93	-1.1	-	-	-	0.94	0.95	-1.1	-	-	-	-	-	-	0.94	0.93	1.1	<0.10	<0.10	<0.10	<0.10
Manganese	0.00030	0.00081	0.00086	-6.0	-	-	-	0.000920	0.00115	-22.2	-	-	-	-	-	-	0.00092	0.00086	6.7	<0.00030	<0.00030	<0.00030	<0.00030
Mercury	0.000020	<0.000020	<0.000020	0	-	-	-	<0.000020	<0.000020	0	-	-	-	<0.000020	<0.000020	0	-	-	-	<0.000020	<0.000020	<0.000020	<0.000020
Molybdenum	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	<0.0010	<0.0010
Potassium	2.0	<2.0	<2.0	0	-	-	-	<2.0	<2.0	0	-	-	-	-	-	-	<2.0	<2.0	0	<2.0	<2.0	<2.0	<2.0
Selenium	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	<0.0010	<0.0010
Silver	0.000020	<0.000020	<0.000020	0	-	-	-	<0.000020	<0.000020	0	-	-	-	-	-	-	<0.000020	<0.000020	0	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	2.0	<2.0	<2.0	0	-	-	-	<2.0	<2.0	0	-	-	-	-	-	-	<2.0	<2.0	0	<2.0	<2.0	<2.0	<2.0
Thallium	0.00020	<0.00020	<0.00020	0	-	-	-	<0.00020	<0.00020	0	-	-	-	-	-	-	<0.00020	<0.00020	0	<0.00020	<0.00020	<0.00020	<0.00020
Tin	0.00050	<0.00050	<0.00050	0	-	-	-	<0.00050	<0.00050	0	-	-	-	-	-	-	<0.00050	<0.00050	0	<0.00050	<0.00050	<0.00050	<0.00050
Titanium	0.010	<0.010	<0.010	0	-	-	-	<0.010	<0.010	0	-	-	-	-	-	-	<0.010	<0.010	0	<0.010	<0.010	<0.010	<0.010
Uranium	0.00020	<0.00020	<0.00020	0	-	-	-	<0.00020	<0.00020	0	-	-	-	-	-	-	<0.00020	<0.00020	0	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	<0.0010	<0.0010
Zinc	0.0050	<0.0050	<0.0050	0	-	-	-	<0.0050	<0.0050	0	-	-	-	-	-	-	<0.0050	<0.0050	0	<0.0050	<0.0050	<0.0050	<0.0050
DISSOLVED METALS (mg/L)																							
Aluminum	0.0050	<0.0050	<0.0050	0	-	-	-	<0.0050	<0.0050	0	-	-	-	<0.0050	<0.0050	0	<0.0050	<0.0050	0	-	-	<0.0050	<0.0050
Antimony	0.00050	<0.00050	<0.00050	0	-	-	-	<0.00050	<0.00050	0	-	-	-	<0.00050	<0.00050	0	<0.00050	<0.00050	0	-	-	<0.00050	<0.00050
Arsenic	0.00050	<0.00050	<0.00050	0	-	-	-	<0.00050	<0.00050	0	-	-	-	<0.00050	<0.00050	0	<0.00050	<0.00050	0	-	-	<0.00050	<0.00050
Barium	0.020	<0.020	<0.020	0	-	-	-	<0.020	<0.020	0	-	-	-	<0.020	<0.020	0	<0.020	<0.020	0	-	-	<0.020	<0.020
Beryllium	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	-	<0.0010	<0.0010
Boron	0.10	<0.10	<0.10	0	-	-	-	<0.10	<0.10	0	-	-	-	<0.10	<0.10	0	<0.10	<0.10	0	-	-	<0.10	<0.10
Cadmium	0.000017	<0.000017	<0.000017	0	-	-	-	<0.000017	<0.000017	0	-	-	-	<0.000017	<0.000010	-	<0.000017	<0.000010	-	-	-	<0.000017	<0.000017
Calcium	0.10	2.96	2.97	-0.34	-	-	-	2.96	2.97	-0.34	-	-	-	2.97	2.96	0.34	<0.10	<0.10	0	-	-	<0.10	<0.10
Chromium	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	-	<0.0010	<0.0010
Cobalt	0.00030	<0.00030	<0.00030	0	-	-	-	<0.00030	<0.00030	0	-	-	-	<0.00030	<0.00030	0	<0.00030	<0.00030	0	-	-	<0.00030	<0.00030
Copper	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	-	<0.0010	<0.0010
Iron	0.030	<0.030	<0.030	0	-	-	-	<0.030	<0.030	0	-	-	-	<0.030	<0.030	0	<0.030	<0.030	0	-	-	<0.030	<0.030
Lead	0.00050	<0.00050	<0.00050	0	-	-	-	<0.00050	<0.00050	0	-	-	-	<0.00050	<0.00050	0	<0.00050	<0.00050	0	-	-	<0.00050	<0.00050
Lithium	0.0050	<0.0050	<0.0050	0	-	-	-	<0.0050	<0.0050	0	-	-	-	<0.0050	<0.0050	0	<0.0050	<0.0050	0	-	-	<0.0050	<0.0050
Magnesium	0.10	0.92	0.93	-1.1	-	-	-	0.96	0.95	1.0	-	-	-	0.93	0.92	1.1	<0.10	<0.10	0	-	-	<0.10	<0.10
Manganese	0.00030	0.00041	0.00031	28	-	-	-	0.00037	0.00040	-7.8	-	-	-	0.00031	0.00032	-3.2	<0.00030	<0.00030	0	-	-	<0.00030	<0.00030
Mercury	0.000020	<0.000020	<0.000020	0	-	-	-	<0.000020	<0.000020	0	-	-	-	<0.000020	<0.000020	0	<0.000020	<0.000020	0	-	-	<0.000020	<0.000020
Molybdenum	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	-	<0.0010	<0.0010
Nickel	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	-	<0.0010	<0.0010
Potassium	2.0	<2.0	<2.0	0	-	-	-	<2.0	<2.0	0	-	-	-	<2.0	<2.0	0	<2.0	<2.0	0	-	-	<2.0	<2.0
Selenium	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	-	<0.0010	<0.0010
Silver	0.000020	<0.000020	<0.000020	0	-	-	-	<0.000020	<0.000020	0	-	-	-	<0.000020	<0.000020	0	<0.000020	<0.000020	0	-	-	<0.000020	<0.000020
Sodium	2.0	<2.0	<2.0	0	-	-	-	<2.0	<2.0	0	-	-	-	<2.0	<2.0	0	<2.0	<2.0	0	-	-	<2.0	<2.0
Thallium	0.00020	<0.00020	<0.00020	0	-	-	-	<0.00020	<0.00020	0	-	-	-	<0.00020	<0.00020	0	<0.00020	<0.00020	0	-	-	<0.00020	<0.00020
Tin	0.00050	<0.00050	<0.00050	0	-	-	-	<0.00050	<0.00050	0	-	-	-	<0.00050	<0.00050	0	<0.00050	<0.00050	0	-	-	<0.00050	<0.00050
Titanium	0.010	<0.010	<0.010	0	-	-	-	<0.010	<0.010	0	-	-	-	<0.010	<0.010	0	<0.010	<0.010	0	-	-	<0.010	<0.010
Uranium	0.00020	<0.00020	<0.00020	0	-	-	-	<0.00020	<0.00020	0	-	-	-	<0.00020	<0.00020	0	<0.00020	<0.00020	0	-	-	<0.00020	<0.00020
Vanadium	0.0010	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	-	-	-	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	-	<0.0010	<0.0010
Zinc	0.0050	<0.0050	<0.0050	0	-	-	-	<0.0050	<0.0050	0	-	-	-	<0.0050	<0.0050	0	<0.0050	<0.0050	0	-	-	<0.0050	<0.0050

Notes:

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

Shaded RPDs exceed 25% (lab duplicates) or 50% (field duplicates).

Bolded RPDs exceed 50% (field duplicates) or 25% (laboratory duplicates), but < 10 x MDL.

Shaded travel and equipment blanks exceed laboratory method detection limits.

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

Table 3-4. QA/QC data for phytoplankton, Second and Third Portage Lakes, September 2009.

	EAS-DT			EAS-SPC			EAS-DT			EAS-SPC			EAS-BGE		
	DT-1 18-Sep-09	**Round 1 Field Duplicate 1**	**RPD** (%)	**SPC-1** 19-Sep-09	**Round 1 Field Duplicate 2**	**RPD** (%)	**DT-1** 24-Sep-09	**Round 2 Field Duplicate**	**RPD** (%)	**SPC-1** 26-Sep-09	**Round 2 Field Duplicate**	**RPD** (%)	**REP #2** 19-Sep-09	**Lab Duplicate**	**RPD** (%)
Phytoplankton Density (cells/L)															
Cyanophyte	200	7984	-190	400	1400	-111	400	0	NA	2000	2000	0	2400	1000	82
Chlorophyte	116744	332864	-96	431840	345832	22	280776	223504	23	331064	317096	4.3	173016	107960	46
Chrysophyte	1376944	1482904	-7.4	964856	1108136	-14	1757496	1059448	50	1389112	1438000	-3.5	208936	215920	-3.3
Diatom	194184	229304	-17	482744	343248	34	255472	185016	32	367400	498112	-30	44704	24152	60
Cryptophyte	35536	40920	-14	16768	18368	-9	130128	61872	71	28952	92608	-105	23952	8584	94
Dinoflagellate	7984	14768	-60	600	21752	-189	400	200	67	22952	29136	-24	7184	200	189
Total	**1731592**	**2108744**	**-20**	**1897208**	**1838736**	**3.1**	**2424672**	**1530040**	**45**	**2141480**	**2376952**	**-10**	**460192**	**357816**	**25**
Phytoplankton Biomass (mg/m3)															
Cyanophyte	0.05	0.81	-178	0.09	0.29	-102	0.03	0	NA	0.57	0.67	-16	0.48	0.34	34
Chlorophyte	3.1	9.78	-103	12	7.5	45	6.7	5.6	17	6.7	8.3	-22	3.4	4.5	-27
Chrysophyte	109	128	-15	64	96	-40	107	69	44	113	110	1.9	18	22	-18
Diatom	16	17	-1.7	35	26	30	29	20	39	28	37	-29	3.5	3.8	-9.9
Cryptophyte	6.9	6.3	9.3	3.1	4.1	-30	14	7.3	61	9.5	11	-16	3.3	1.6	67
Dinoflagellate	5.7	5.5	3.9	11	13	-10	7.4	0.43	178	31	13	80	2.6	0.43	144
Total	**141**	**167**	**-16**	**125**	**146**	**-15**	**165**	**102**	**47**	**188**	**181**	**3.8**	**31**	**32**	**-3.4**
# Species	41	43	-4.8	39	38	2.6	40	38	5.1	42	42	0	25	26	-3.9
Simpsons Diversity	0.85	0.88	-3.8	0.89	0.90	-1.1	0.84	0.85	-1.1	0.87	0.88	-0.8	0.84	0.91	-8.2

Notes:

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

Shaded RPDs exceed 50% (field duplicates) or 25% (lab duplicates).

NA = Not Applicable for rare species.

Table 3-4. QA/QC data for phytoplankton, Second and Third Portage Lakes, September 2009.

	EAS-BGW			EAS-DT			EAS-BGW			EAS-SPC			EAS-TPS		
	REP #3 18-Sep-09	**Lab Duplicate**	**RPD** (%)	**REP #5** 18-Sep-09	**Lab Duplicate**	**RPD** (%)	**REP #2** 24-Sep-09	**Lab Duplicate**	**RPD** (%)	**REP #1** 26-Sep-09	**Lab Duplicate**	**RPD** (%)	**REP #2** 27-Sep-09	**Lab Duplicate**	**RPD** (%)
Phytoplankton Density (cells/L)															
Cyanophyte	0	200	NA	400	1200	-100	1800	1200	40	2600	2000	26	22752	79824	-111
Chlorophyte	129712	93992	32	324680	159848	68	238472	288160	-19	267808	332064	-21	266808	338848	-24
Chrysophyte	346032	309512	11	1561928	1482504	5.2	311112	317896	-2.2	1636168	1563128	4.6	547384	534216	2.4
Diatom	109360	75040	37	236488	171032	32	98192	63672	43	199784	198184	0.8	46304	39520	16
Cryptophyte	17568	1800	163	47704	71056	-39	9984	16568	-50	120960	77656	44	37320	8384	127
Dinoflagellate	200	200	0	7584	400	180	0	7384	NA	29136	7984	114	200	200	0
Total	**602872**	**480744**	**23**	**2178784**	**1886040**	**14**	**659560**	**694880**	**-5.2**	**2256456**	**2181016**	**3.4**	**920768**	**1000992**	**-8.3**
Phytoplankton Biomass (mg/m3)															
Cyanophyte	0	0.20	NA	0.06	0.18	-97	0.32	0.39	-21	0.75	0.45	51	0.80	1.9	-83
Chlorophyte	4.2	4.7	-10	5.6	4.2	29	13	6.8	60	6.1	5.4	11	6.2	6.8	-8.7
Chrysophyte	30	30	-0.87	111	100	10	28	23	17	116	109	6.6	56	39	35
Diatom	8.5	8.8	-3.7	18	13	31	9.8	8.0	20	28	21	30	9.0	8.0	13
Cryptophyte	3.7	1.7	75	5.8	8.3	-36	3.0	2.8	6.7	19	16	20	2.6	1.7	44
Dinoflagellate	3.1	3.1	0	5.6	5.3	6.3	0	7.4	NA	13	10	28	1.4	0.43	109
Total	**49**	**48**	**1.7**	**146**	**131**	**11**	**53**	**49**	**9.4**	**183**	**161**	**13**	**76**	**58**	**27**
# Species	29	28	3.5	40	39	2.5	26	28	-7.4	42	41	2.4	32	32	0
Simpsons Diversity	0.87	0.91	-3.8	0.86	0.83	4.1	0.90	0.89	1.9	0.87	0.86	0.94	0.87	0.85	2.4

Notes:

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

Shaded RPDs exceed 50% (field duplicates) or 25% (lab duplicates).

NA = Not Applicable for rare species.

Table 3-5. QA/QC data for zooplankton, Second Portage Lake, September 2009.

	EAS-DT			EAS-SPC			EAS-DT			EAS-SPC		
	DT-1 18-Sep-09	**Round 1 Field DUP-1**	**RPD** (%)	**SPC-1** 19-Sep-09	**Round 1 Field DUP-2**	**RPD** (%)	**DT-1** 24-Sep-09	**Round 2 Field DUP-1**	**RPD** (%)	**SPC-1** 26-Sep-09	**Round 2 Field DUP-2**	**RPD** (%)
Biomass Estimates (g)												
Wet Wt (g)	0.014	0.451	-188	0.715	0.030	184	0.326	0.232	34	0.455	0.612	-29
Dry Wt (g)	0.002	0.049	-184	0.068	0.004	178	0.044	0.015	98	0.042	0.036	15
Total	***0.016***	***0.500***	***-188***	***0.783***	***0.034***	***183***	***0.37***	***0.247***	***40***	***0.497***	***0.648***	***-26***
Species Identification												
Copepoda	85	252	-99				126	107	16			
Cladocera	117	164	-33				152	126	19			
Diptera	5	10	-67				14	9	43			
Total Abundance	***207***	***426***	***-69***				***292***	***242***	***19***			
Total Richness	***14***	***14***	***0***				***13***	***11***	***17***			

Notes:

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

Shaded RPDs exceed 50% (field duplicates).

NA = Not Applicable for rare species.

Table 3-6. Conventional water chemistry and total & dissolved metals (mg/L), Second & Third Portage Lakes, September 2009.

Lake & Basin		Third Portage Lake						Second Portage Lake			
		Bay-Goose Dike East		Bay-Goose Dike West		South Basin		SPC		Drilltrail arm	
Station ID		EAS-BGE		EAS-BGW		EAS-TPS		EAS-SPC		EAS-DT	
Depth (m)	**CCME (2007)**	3	3	3	3	3	3	3	3	3	3
Date	**Guideline[1]**	19-Sep-09	26-Sep-09	18-Sep-09	24-Sep-09	17-Sep-09	27-Sep-09	19-Sep-09	26-Sep-09	18-Sep-09	24-Sep-09
CONVENTIONAL PARAMETERS											
Physical Tests											
Conductivity (µS/cm)	NG	16.8	16.7	16.9	17.0	14.9	15.1	23.1	23.0	27.1	27.0
Hardness (mg/L)	NG	6.10	6.30	6.00	6.40	4.90	5.30	9.20	9.40	11.2	11.3
pH	6.5 - 9.0	6.91	6.92	7.00	6.97	6.88	6.92	6.77	7.41	6.95	7.67
Total Suspended Solids (mg/L)	NG	8.6	7.9	5.8	9.1	1.0	<1.0	1.8	1.3	<1.0	<1.0
Total Dissolved Solids (mg/L)	NG	<10	<10	10	10	15	<10	11	<10	12	12
Turbidity (NTU)	NG	12.5	16.3	9.47	11.2	0.30	0.53	2.06	2.70	0.42	0.49
Anions & Nutrients (mg/L)											
Alkalinity - Bicarbonate (as $CaCO_3$)	NG	4.4	5.1	4.9	4.5	3.7	4.2	6.9	7.6	8.9	8.5
Alkalinity - Carbonate (as $CaCO_3$)	NG	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity - Hydroxide (as $CaCO_3$)	NG	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity - Total (as $CaCO_3$)	NG	4.4	5.1	4.9	4.5	3.7	4.2	6.9	7.6	8.9	8.5
Ammonia (as N)[2]	0.274 - 81.6	0.092	<0.020	0.066	<0.020	0.094	0.024	0.020	<0.020	0.104	<0.020
Bromide	NG	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride	NG	0.58	<0.50	0.5	<0.50	0.55	<0.50	0.59	<0.50	0.52	0.73
Fluoride	NG	0.067	0.046	0.062	0.047	0.055	0.04	0.056	0.042	0.05	0.038
Nitrate (as N)	2.9	0.014	0.013	0.011	0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	0.06	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	NG	0.083	0.10	0.080	0.095	0.13	0.070	0.080	0.13	0.16	0.12
Ortho Phosphate (as P)	NG	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphate (as P)	0.004	0.0058	0.0071	0.0039	0.0064	<0.0020	<0.0020	<0.0020	0.0030	<0.0020	<0.0020
Silicate (as SiO_2)	NG	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sulfate (SO_4)	NG	1.51	1.22	1.45	1.27	1.44	1.14	2.19	1.91	2.67	2.4
ORGANIC / INORGANIC CARBON											
Dissolved Organic Carbon (mg/L)	NG	1.08	1.12	1.16	1.30	1.22	4.45	1.54	1.60	1.64	1.73
Total Organic Carbon (mg/L)	NG	1.11	1.17	1.06	1.08	1.21	1.31	1.47	1.47	1.68	1.80
PLANT PIGMENTS											
Chlorophyll a - standardized (µg/L)	**Rep 1**	0.268	0.697	0.308	0.715	0.159	0.728	0.448	0.996	0.331	0.666
Chlorophyll a - standardized (µg/L)	**Rep 2**	0.253	0.366	0.267	0.377	0.306	0.750	0.391	0.715	0.246	0.718
Chlorophyll a - standardized (µg/L)	**Rep 3**	0.388	0.305	0.238	0.244	0.238	0.780	0.345	0.681	0.336	0.804
Chlorophyll a - standardized (µg/L)	**Rep 4**	0.306	0.280	0.095	0.522	0.351	0.778	0.307	0.746	0.566	0.856
Chlorophyll a - standardized (µg/L)	**Rep 5**	0.286	0.327	0.179	0.523	0.366	0.734	0.295	0.473	0.500	0.632

Table 3-6. Conventional water chemistry and total & dissolved metals (mg/L), Second & Third Portage Lakes, September 2009.

Lake & Basin		Third Portage Lake						Second Portage Lake			
		Bay-Goose Dike East		Bay-Goose Dike West		South Basin		SPC		Drilltrail arm	
Station ID		EAS-BGE		EAS-BGW		EAS-TPS		EAS-SPC		EAS-DT	
Depth (m)	CCME (2007)	3	3	3	3	3	3	3	3	3	3
Date	Guideline[1]	19-Sep-09	26-Sep-09	18-Sep-09	24-Sep-09	17-Sep-09	27-Sep-09	19-Sep-09	26-Sep-09	18-Sep-09	24-Sep-09
TOTAL METALS (mg/L)											
Aluminum[3]	0.005 - 0.100	0.51	0.63	0.41	0.27	0.008	0.015	0.071	0.098	0.010	0.017
Antimony	NG	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0050	0.00061	0.00066	0.00054	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Barium	NG	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium	NG	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	NG	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium*	0.0000025 - 0.0000051	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017
Calcium	NG	1.44	1.49	1.42	1.56	1.17	1.20	2.41	2.42	2.97	2.96
Chromium[4]	0.0010	0.0021	0.0028	0.0017	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	NG	0.00032	0.00035	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Copper*	0.002 - 0.004	0.0013	0.0013	0.0010	<0.0010	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Iron	0.300	0.66	0.78	0.54	0.46	<0.030	0.031	0.087	0.12	<0.030	<0.030
Lead*	0.001 - 0.007	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Lithium	NG	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	NG	0.79	0.87	0.76	0.77	0.53	0.57	0.82	0.86	0.92	0.94
Manganese	NG	0.012	0.013	0.0094	0.0074	0.00070	0.0011	0.0021	0.0028	0.00081	0.00092
Mercury	0.000026	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Molybdenum	0.073	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel*	0.025 - 0.15	0.0016	0.0019	0.0013	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Potassium	NG	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silver	0.00010	0.00004	<0.000020	0.000036	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	NG	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Thallium	0.00080	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin	NG	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium	NG	0.022	0.025	0.019	0.016	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium	NG	0.00031	0.00029	0.00026	0.00021	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium	NG	<0.0010	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc	0.030	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Table 3-6. Conventional water chemistry and total & dissolved metals (mg/L), Second & Third Portage Lakes, September 2009.

Lake & Basin		Third Portage Lake						Second Portage Lake			
		Bay-Goose Dike East		Bay-Goose Dike West		South Basin		SPC		Drilltrail arm	
Station ID		EAS-BGE		EAS-BGW		EAS-TPS		EAS-SPC		EAS-DT	
Depth (m)	CCME (2007)	3	3	3	3	3	3	3	3	3	3
Date	Guideline[1]	19-Sep-09	26-Sep-09	18-Sep-09	24-Sep-09	17-Sep-09	27-Sep-09	19-Sep-09	26-Sep-09	18-Sep-09	24-Sep-09
DISSOLVED METALS (mg/L)[5]											
Aluminum[3]	0.005 - 0.100	0.0053	0.0057	<0.0050	0.0091	<0.0050	<0.0050	<0.0050	0.0053	<0.0050	<0.0050
Antimony	NG	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Barium	NG	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium	NG	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	NG	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium*	0.0000025 - 0.0000051	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017
Calcium	NG	1.43	1.47	1.43	1.50	1.14	1.19	2.40	2.44	2.96	2.96
Chromium[4]	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	NG	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Copper*	0.002 - 0.004	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Iron	0.300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead*	0.001 - 0.007	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Lithium	NG	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	NG	0.60	0.64	0.60	0.65	0.51	0.56	0.78	0.82	0.92	0.96
Manganese	NG	0.0013	0.0012	0.00090	0.00099	<0.00030	0.00031	<0.00030	0.00032	0.00041	0.00037
Mercury	0.000026	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Molybdenum	0.073	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel*	0.025 - 0.15	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Potassium	NG	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silver	0.00010	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	NG	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Thallium	0.00080	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin	NG	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium	NG	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium	NG	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium	NG	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc	0.030	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Notes:

NG = no guideline.

[1]CCME (Canadian Council of Ministers of the Environment) Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999, updated December 2007.

[2]Ammonia guidelines are for 10°C and are pH dependent.

[3]Aluminum guideline is pH dependent.

[4]Chromium guideline is for Cr VI.

[5]Guidelines have not yet been made for "Dissolved Metals," thus were screened against CCME guidelines for "Total Metals."

*Cadmium, copper, lead and nickel guidelines are hardness dependent.

Shaded concentrations exceed the CCME guideline.

Table 3-7. Statistical analysis results for primary productivity and zooplankton biomass, September 2009.

	Biomass (mg/m^3 ww)	Phytoplankton Diversity (Simpson's D)	Chlorophyll-α (mg/m^3 dw)	Zooplankton Biomass (mg/m^3 dw)
Transformation:	log10	None	None	log10
Lake Difference?	Yes (SPL>TPL)	No	Yes (SPL>TPL)	No
Control-Impact Difference?				
Across Lakes	NA	No	NA	Yes
p-value	NA	0.24	NA	0.02
Control Mean	NA	0.86	NA	17.1
Impact Mean	NA	0.87	NA	29.5
Third Portage Lake	Yes	NA	Yes	NA
p-value	<0.001	NA	0.0028	NA
Control Mean	78	NA	0.52	NA
Impact Mean	49	NA	0.35	NA
Second Portage Lake	No	NA	No	NA
p-value	0.53	NA	0.65	NA
Control Mean	175	NA	0.57	NA
Impact Mean	165	NA	0.54	NA
Date Difference?	No	No	Yes[1] (R1>R2)	No

Notes:
1. C & I means shown for pooled dates; R1 = round 1, R2 = round 2.
2. Impact areas have a higher mean zooplankton biomass.

Table 3-8. Phytoplankton biomass (mg/m^3) and diversity by major taxa group, Second & Third Portage Lakes, September 2009.

Station	Date	Phytoplankton Biomass (mg/m^3)								# Species	Simpsons Diversity
		Cyanophyte	Chlorophyte	Euglenophyte	Chrysophyte	Diatom	Cryptophyte	Dinoflagellate	Total		
EAS-BGE											
Rep 1	19-Sep-09	0.72	0.72	0.00	13.79	1.30	0.58	19.54	36.65	19	0.80
Rep 2		0.48	3.41	0.00	17.97	3.47	3.28	2.65	31.26	25	0.84
Rep 3		0.30	6.83	0.00	44.45	6.63	4.91	8.26	71.39	31	0.86
Rep 4		1.52	8.25	0.00	27.79	2.29	2.01	5.63	47.48	29	0.87
Rep 5		1.35	4.47	0.00	20.51	8.02	2.49	0.00	36.85	31	0.85
Rep 1	26-Sep-09	1.01	4.06	0.00	48.59	6.23	9.49	19.36	88.73	32	0.90
Rep 2		0.64	3.16	0.41	19.46	4.33	1.88	7.94	37.82	22	0.85
Rep 3		1.63	4.61	0.00	23.20	8.73	4.36	4.60	47.12	33	0.91
Rep 4		0.14	2.64	0.00	14.37	1.96	2.07	5.77	26.94	19	0.75
Rep 5		1.00	5.01	0.00	44.75	3.32	2.01	0.00	56.09	20	0.83
EAS-BGW											
Rep 1	18-Sep-09	1.21	4.90	0.00	24.09	5.83	3.59	8.65	48.26	29	0.84
Rep 2		0.28	2.25	0.00	18.57	4.28	2.07	0.00	27.44	22	0.86
Rep 3		0.00	4.21	0.00	29.52	8.52	3.75	3.12	49.13	29	0.87
Rep 4		0.40	5.48	0.00	36.63	10.14	1.01	12.84	66.51	28	0.88
Rep 5		1.12	3.50	0.00	42.16	18.93	2.50	2.45	70.65	33	0.89
Rep 1	24-Sep-09	1.88	6.56	0.00	40.48	17.76	6.02	6.90	79.59	35	0.89
Rep 2		0.32	12.66	0.00	27.71	9.77	2.99	0.00	53.45	26	0.90
Rep 3		0.29	3.66	0.00	31.17	5.89	2.71	10.55	54.26	24	0.84
Rep 4		0.63	3.17	0.87	26.31	9.78	4.47	0.00	45.24	27	0.86
Rep 5		0.29	7.15	0.00	41.28	10.31	4.34	3.12	66.48	36	0.88
EAS-SPC											
Rep 1	19-Sep-09	0.53	7.77	0.00	78.84	10.27	2.81	12.07	112.29	40	0.89
Rep 2		0.09	11.88	0.00	63.83	34.81	3.05	11.41	125.07	39	0.89
Rep 3		0.48	6.48	0.00	75.88	23.54	4.32	5.14	115.84	40	0.90
Rep 4		0.36	6.68	0.00	149.24	17.42	5.60	17.42	196.72	38	0.90
Rep 5		0.16	11.14	0.00	93.92	30.39	4.42	10.70	150.74	44	0.90
Rep 1	26-Sep-09	0.75	6.06	0.00	116.20	28.17	18.93	13.25	183.35	42	0.87
Rep 2		0.57	6.66	0.00	112.56	27.94	9.51	30.75	187.99	42	0.87
Rep 3		1.25	6.23	0.00	137.31	36.04	11.65	12.86	205.35	43	0.86
Rep 4		0.55	4.87	0.00	171.70	24.66	11.30	16.16	229.25	39	0.88
Rep 5		0.76	10.67	0.00	125.49	22.80	10.19	15.46	185.38	43	0.88

Table 3-8. Phytoplankton biomass (mg/m^3) and diversity by major taxa group, Second & Third Portage Lakes, September 2009.

Station	Date	Phytoplankton Biomass (mg/m^3)								# Species	Simpsons Diversity
		Cyanophyte	Chlorophyte	Euglenophyte	Chrysophyte	Diatom	Cryptophyte	Dinoflagellate	Total		
EAS-DT											
Rep 1	18-Sep-09	0.05	3.12	0.00	109.37	16.35	6.88	5.69	141.47	41	0.85
Rep 2		0.22	10.81	0.00	140.13	27.36	12.33	20.04	210.90	46	0.85
Rep 3		1.90	9.59	0.00	91.76	19.40	9.05	27.37	159.07	41	0.88
Rep 4		0.12	9.00	0.00	108.07	28.04	11.90	21.31	178.45	47	0.87
Rep 5		0.06	5.64	0.00	111.34	17.72	5.78	5.61	146.16	40	0.86
Rep 1	26-Sep-09	0.03	6.66	0.00	107.32	29.30	13.80	7.43	164.54	40	0.84
Rep 2		0.08	5.45	0.00	118.29	20.00	7.80	12.04	163.65	36	0.82
Rep 3		1.72	3.51	0.00	108.67	22.27	11.75	14.08	162.01	44	0.87
Rep 4		0.07	5.69	0.00	154.74	39.56	13.53	30.93	244.52	43	0.85
Rep 5		0.28	8.57	0.00	138.15	25.28	5.77	24.99	203.04	42	0.83
EAS-TPS											
Rep 1	17-Sep-09	0.11	6.86	0.00	38.12	4.61	2.79	26.23	78.72	35	0.88
Rep 2		0.39	6.06	0.00	59.85	7.01	1.90	2.30	77.50	35	0.85
Rep 3		0.43	4.94	0.00	29.57	6.23	1.39	14.98	57.54	35	0.88
Rep 4		0.42	4.36	0.00	85.89	7.38	0.89	1.45	100.39	31	0.84
Rep 5		0.91	6.45	0.00	66.12	6.61	2.11	9.30	91.50	33	0.88
Rep 1	27-Sep-09	0.35	5.34	0.00	60.24	7.75	0.65	2.50	76.84	29	0.87
Rep 2		0.80	6.20	0.00	56.20	9.03	2.64	1.45	76.32	32	0.87
Rep 3		0.13	4.08	0.00	41.95	8.65	0.75	14.84	70.41	28	0.88
Rep 4		0.24	7.29	0.00	61.57	8.51	1.19	9.93	88.73	35	0.88
Rep 5		0.33	5.68	0.00	41.93	9.08	3.26	7.33	67.60	32	0.78
Relative Biomass (%)		**0.55**	**5.68**	**0.02**	**65.1**	**13.7**	**5.00**	**9.95**			

Table 3-9. Phytoplankton density (cells/L) by major taxa group, Second & Third Portage Lakes, September 2009.

Station	Date	Phytoplankton Density (cells/L)							
		Cyanophyte	Chlorophyte	Euglenophyte	Chrysophyte	Diatom	Cryptophyte	Dinoflagellate	Total
EAS-BGE									
Rep 1	19-Sep-09	8584	21752	0	165632	14768	7584	800	219120
Rep 2		2400	173016	0	208936	44704	23952	7184	460192
Rep 3		2800	144680	0	575320	94792	24952	600	843144
Rep 4		8984	215920	0	337848	15968	15968	7784	602472
Rep 5		29936	94792	0	345832	116144	16568	0	603272
Rep 1	26-Sep-09	4200	194768	0	489512	60672	47904	15168	812224
Rep 2		3600	51488	200	316096	45104	1800	21552	439840
Rep 3		89208	194968	0	209136	68856	31736	400	594304
Rep 4		1600	86408	0	244656	7784	8384	7384	356216
Rep 5		87208	51688	0	165232	30936	36320	0	371384
EAS-BGW									
Rep 1	18-Sep-09	43504	274192	0	345432	59872	4400	7584	734984
Rep 2		7584	86408	0	281376	65256	23152	0	463776
Rep 3		0	129712	0	346032	109360	17568	200	602872
Rep 4		400	108560	0	380752	104776	1000	21952	617440
Rep 5		7584	108160	0	438824	190384	16568	200	761720
Rep 1	24-Sep-09	9584	295144	0	633792	227704	19568	800	1186592
Rep 2		1800	238472	0	311112	98192	9984	0	659560
Rep 3		1200	15368	0	310112	66056	9584	7584	409904
Rep 4		2400	123128	200	346232	151864	31936	0	655760
Rep 5		1200	124328	0	575120	116944	10784	200	828576
EAS-SPC									
Rep 1	19-Sep-09	8584	274392	0	921552	126128	2800	600	1334056
Rep 2		400	431840	0	964856	482744	16768	600	1897208
Rep 3		8584	338648	0	942304	322896	17568	14568	1644568
Rep 4		1400	395720	0	972240	227104	60472	22152	1679088
Rep 5		1000	763304	0	1036896	280392	11584	400	2093576
Rep 1	26-Sep-09	2600	267808	0	1636168	199784	120960	29136	2256456
Rep 2		2000	331064	0	1389112	367400	28952	22952	2141480
Rep 3		23352	196368	0	1683656	482344	52904	14968	2453592
Rep 4		2400	295744	0	1726560	327896	92608	29336	2474544
Rep 5		2000	504680	0	1353392	213352	57488	15168	2146080

Table 3-9. Phytoplankton density (cells/L) by major taxa group, Second & Third Portage Lakes, September 2009.

Station	Date	Phytoplankton Density (cells/L)							
		Cyanophyte	Chlorophyte	Euglenophyte	Chrysophyte	Diatom	Cryptophyte	Dinoflagellate	Total
EAS-DT									
Rep 1	18-Sep-09	200	116744	0	1376944	194184	35536	7984	1731592
Rep 2		400	576320	0	2164984	281608	68272	8984	3100568
Rep 3		115544	324480	0	1237848	222920	97992	15568	2014352
Rep 4		600	512864	0	1507256	326112	38936	15968	2401736
Rep 5		400	324680	0	1561928	236488	47704	7584	2178784
Rep 1	26-Sep-09	400	280776	0	1757496	255472	130128	400	2424672
Rep 2		800	230288	0	1813168	194600	76640	35920	2351416
Rep 3		87408	194568	0	1368360	234504	86024	29336	2000200
Rep 4		400	245856	0	2072192	434872	149680	22352	2925352
Rep 5		1200	138296	0	1827536	194000	26952	15968	2203952
EAS-TPS									
Rep 1	17-Sep-09	600	152864	0	510464	36920	16168	8184	725200
Rep 2		1600	166032	0	899200	44504	1800	200	1113336
Rep 3		2800	295144	0	402704	23952	8184	600	733384
Rep 4		8584	146080	0	999176	52888	1200	200	1208128
Rep 5		43104	403504	0	733968	52488	22952	400	1256416
Rep 1	27-Sep-09	2000	273992	0	862680	46104	7584	200	1192560
Rep 2		22752	266808	0	547384	46304	37320	200	920768
Rep 3		1200	245456	0	446208	47304	7584	29536	777288
Rep 4		1400	281776	0	683080	46704	14968	800	1028728
Rep 5		2200	468960	0	467960	46504	37120	7784	1030528
Relative Abundance (%)		**1.00**	**18.5**	**0.001**	**65.3**	**11.8**	**2.64**	**0.70**	

Table 3-10. Zooplankton biomass per tow (wet and dry weights), Second & Third Portage Lakes, September 2009.

Station	Date	Tow Depth (m)	Wet biomass (g ww)	Wet biomass/tow (mg/m³ ww)	Dry biomass (g dw)	Dry biomass/tow (mg/m³ dw)
EAS-BGE						
Rep 1	19-Sep-09	8	0.32	286	0.080	70.77
Rep 2		8	0.43	380	0.054	47.77
Rep 3		8	0.46	410	0.040	35.39
Rep 4		8	0.51	454	0.027	23.89
Rep 5		8	0.26	233	0.021	18.58
		Station Mean	***0.40***	***352***	***0.044***	***39.28***
Rep 1	26-Sep-09	8	0.55	486	0.037	32.73
Rep 2		8	0.30	264	0.018	15.92
Rep 3		8	0.31	276	0.021	18.58
Rep 4		8	0.27	240	0.017	15.04
Rep 5		8	0.61	539	0.035	30.96
		Station Mean	***0.41***	***361***	***0.026***	***22.65***
EAS-BGW						
Rep 1	18-Sep-09	8	0.39	346	0.031	27.42
Rep 2		8	0.58	513	0.027	23.89
Rep 3		8	0.52	459	0.027	23.89
Rep 4		8	0.48	426	0.023	20.35
Rep 5		8	0.35	309	0.017	15.04
		Station Mean	***0.46***	***411***	***0.025***	***22.12***
Rep 1	24-Sep-09	8	0.31	274	0.024	21.23
Rep 2		8	0.47	415	0.024	21.23
Rep 3		8	0.55	486	0.030	26.54
Rep 4		8	0.48	420	0.029	25.65
Rep 5		8	0.55	489	0.032	28.31
		Station Mean	***0.47***	***417***	***0.028***	***24.59***
EAS-SPC						
Rep 1	19-Sep-09	8	0.72	633	0.068	60.16
Rep 2		8	0.67	589	0.030	26.54
Rep 3		8	0.59	522	0.043	38.04
Rep 4		8	0.71	632	0.049	43.35
Rep 5		8	0.52	457	0.044	38.92
		Station Mean	***0.64***	***567***	***0.047***	***41.40***
Rep 1	26-Sep-09	8	0.46	403	0.042	37.15
Rep 2		8	0.73	649	0.054	47.77
Rep 3		8	0.65	575	0.039	34.50
Rep 4		8	0.76	674	0.044	38.92
Rep 5		8	0.93	818	0.059	52.19
		Station Mean	***0.71***	***624***	***0.048***	***42.11***

Table 3-10. Zooplankton biomass per tow (wet and dry weights), Second & Third Portage Lakes, September 2009.

Station	Date	Tow Depth (m)	Wet biomass (g ww)	Wet biomass/tow (mg/m^3 ww)	Dry biomass (g dw)	Dry biomass/tow (mg/m^3 dw)
EAS-DT						
Rep 1	18-Sep-09	8	0.01	12	0.002	1.77
Rep 2		8	0.03	27	0.003	2.65
Rep 3		8	0.06	53	0.004	3.54
Rep 4		8	0.05	46	0.004	3.54
Rep 5		8	0.12	105	0.007	6.19
		Station Mean	***0.06***	***49***	***0.004***	***3.54***
Rep 1	24-Sep-09	8	0.33	288	0.044	38.92
Rep 2		8	0.25	218	0.023	20.35
Rep 3		8	0.45	396	0.109	96.43
Rep 4		8	0.20	177	0.019	16.81
Rep 5		8	0.11	99	0.015	13.27
		Station Mean	***0.27***	***236***	***0.042***	***37.15***
EAS-TPS						
Rep 1	19-Sep-09	8	3.459	3060	0.071	62.81
Rep 2		8	3.237	2864	0.046	81.39
Rep 3		8	1.385	1225	0.023	40.69
Rep 4		8	0.720	637	0.016	28.31
Rep 5		8	1.515	1340	0.020	35.39
		Station Mean	***2.06***	***1825***	***0.035***	***49.7***
Rep 1	27-Sep-09	8	0.852	754	0.033	29.19
Rep 2		8	0.488	432	0.014	12.38
Rep 3		8	0.947	838	0.023	20.35
Rep 4		8	1.160	1026	0.032	28.31
Rep 5		8	0.659	583	0.019	16.81
		Station Mean	***0.82***	***726***	***0.024***	***21.41***

Table 3-11. Zooplankton relative abundance by major taxa group, Second & Third Portage Lakes, September 2009.

Station	EAS-BGE		EAS-BGW		EAS-SPC		EAS-DT		EAS-TPS	
Date	18-Sep-09	26-Sep-09	18-Sep-09	24-Sep-09	18-Sep-09	26-Sep-09	18-Sep-09	24-Sep-09	18-Sep-09	27-Sep-09
DIPTERA										
Unidentified Chironomidae larva		0.2%	0.3%			0.2%	2.4%	4.8%		
CLADOCERA										
Daphniidae										
Daphnia longiremis Sars	0%	0.1%	1.4%	0.03%		1.5%	29%	20%	0.3%	0.5%
Daphnia middendorffiana Fischer	0.4%	0.1%	2.7%	0.4%	1.0%	0.4%	0.5%	1.0%	8.4%	5.6%
Bosminidae										
Bosmina longirostris (O.F. Muller)	1.7%	0.5%	2.7%	5.0%	1%	3.5%	26%	29%	0.4%	
Chydoridae										
Alona guttata Sars		0.1%								
Chydorus					0.03%	0.2%	0.5%	2.1%		
Holopedidae										
Holopedium gibberum Zaddach	0.9%	0.2%	0.2%	0.03%	0.3%	0.4%			1.5%	2.6%
COPEPODA										
Calanoida										
Unidentified Calanoida*	4.5%	1.7%		10%		0.2%			2.2%	
Diaptomidae										
Diaptomus ashlandi Marsh	0.2%		0.7%	1.0%	0.2%	1.5%	1.0%	0.7%	0.2%	
Diaptomus minutus Lilljeborg	0.4%	2.6%	0.7%	3.0%	1.5%	2.8%	1.0%	1.4%	1.1%	6.2%
Diaptomus sicilis S.A. Forbes	27%	25%	25%	16%	24%	20%	4.3%	6.8%	13%	23%
Unidentified *Diaptomus* females*	38%	44%	31%	32%	50%	41%	24%	15%	42%	26%
Temoridae										
Heterocope septentrionalis Juday and Muttkowski		0.4%		0.03%	0.2%	0.5%	0.5%	1.4%	0.4%	1.5%
Cyclopoida										
Unidentified Cyclopoida*	2.6%	2.6%	4.1%	1.0%	1.9%	3.8%	2.4%	6.2%	7.3%	6.2%
Cyclopidae										
Acanthocyclops vernalis Fisher		1.7%	0.7%	3.0%		0.7%	0.5%	0.7%		
Cyclops scutifer Sars	25%	20%	31%	28%	19%	23%	7.2%	11%	23%	29%
Harpacticoida										
Unidentified Harpacticoida							0.5%			
Total Number of Organisms	**3724**	**3679**	**2347**	**3184**	**3306**	**2198**	**207**	**292**	**5700**	**1558**
Total Number of Taxa	**7**	**11**	**10**	**10**	**9**	**12**	**12**	**11**	**9**	**7**

Notes:

Relative abundance: calculated as [(ind. taxa zooplabkton abundance) / sum(station zooplankton abundance)] * 100.

* Taxa are not included in taxa richness counts.

Table 3-12. Sediment deposition rates and estimated accumulation for sediment traps, Second Portage, Third Portage, and Tehek Lakes, 2009.

Lake		**Second Portage Lake**									
Season		**Winter 2008-09**			**Summer 2009**						
Station	**Units**	SP-ST1	SP-ST5	SP-ST6	SP-ST2	SP-ST3	SP-ST4	SP-ST5	SP-ST6	SP-ST7	SP-ST8
Easting[1]	UTM	639649	640813	640377	640043	640775	639668	639819	640069	641452	639684
Northing	UTM	7214045	7213329	7213082	7213817	7213208	7214544	7213911	7212807	7213873	7213356
Set date		22-Sep-08	24-Sep-08	22-Sep-08	24-Jul-09	24-Jul-09	24-Jul-09	24-Jul-09	20-Jul-09	27-Jul-09	20-Jul-09
Retrieval date		26-Jul-09	26-Jul-09	26-Jul-09	21-Sep-09	12-Sep-09	12-Sep-09	12-Sep-09	15-Sep-09	12-Sep-09	15-Sep-09
Trap contents (dry)	(g dw)	0.035	0.013	0.043	0.051	0.058	0.66	0.033	0.45	0.054	0.17
Trap contents (wet)[2]	(g ww)	0.23	0.088	0.28	0.34	0.39	4.4	0.22	3.0	0.36	1.1
Set length	(days)	309	307	309	59	50	50	50	57	47	57
Deposition Rate	(g ww/d)	0.0007	0.0003	0.0009	0.006	0.008	0.088	0.004	0.052	0.008	0.020
Accumulation[3]	(mm)	0.028	0.011	0.035	0.042	0.048	0.54	0.027	0.37	0.044	0.14

Notes:

[1] NAD83 zone 14W

[2] Assumes 85% moisture content

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

Table 3-12. Sediment deposition rates and estimated accumulation for sediment traps, Second Portage, Third Portage, and Tehek Lakes, 2009.

Lake		Third Portage Lake						Tehek Lake
Season		Summer 2009						Summer 2009
Station	Units	BG-ST1	BG-ST2	BG-ST3	BG-ST4	BG-ST5	BG-ST6	TE-ST1
Easting[1]	UTM	638711	639016	639535	639521	639012	639355	359929
Northing	UTM	7211761	7211788	7211811	7212410	7211243	7213333	7212109
Set date		18-Jul-09	18-Jul-09	18-Jul-09	18-Jul-09	18-Jul-09	18-Jul-09	29-Jul-09
Retrieval date		13-Sep-09	13-Sep-09	13-Sep-09	13-Sep-09	13-Sep-09	16-Sep-09	17-Sep-09
Trap contents (dry)	(g dw)	0.20	0.077	0.089	0.081	0.12	1.3	0.087
Trap contents (wet)[2]	(g ww)	1.4	0.51	0.59	0.54	0.78	8.6	0.58
Set length	(days)	57	57	57	57	57	60	50
Deposition Rate	(g ww/d)	0.024	0.009	0.010	0.010	0.014	0.14	0.012
Accumulation[3]	(mm)	0.17	0.063	0.073	0.067	0.10	1.1	0.071

Notes:

[1] NAD83 zone 14W

[2] Assumes 85% moisture content

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

Table 3-13. Sediment chemistry results for sediment traps, Second and Third Portage Lakes, 2009.

Lake & Basin	Sediment Quality Guidelines (CCME 2002)[1]		Second Portage Lake						Third Portage Lake					
Station ID			SP-ST1-R1	SP-ST3-R3	SP-ST4-R2	SP-ST6-R1	SP-ST7-R2	SP-ST8-R2	BG-ST1-R4	BG-ST2-R3	BG-ST3-R4	BG-ST4-R4	BG-ST5-R1	BG-ST6-R1
Date	ISQG	PEL	26-Jul-09	12-Sep-09	12-Sep-09	15-Sep-09	12-Sep-09	15-Sep-09	13-Sep-09	13-Sep-09	13-Sep-09	13-Sep-09	13-Sep-09	16-Sep-09
TOTAL METALS (mg/kg dw)[2]														
Aluminum	NG	NG	28040	25440	26540	26440	19340	29640	26140	30440	28840	28440	29240	17840
Antimony	NG	NG	<20	<20	<10	<10	<20	<10	<10	<10	<10	<10	<10	<10
Arsenic	5.9	17.0	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Barium	NG	NG	74	103	99	87	30	85	49	50	50	44	92	17
Beryllium	NG	NG	1.20	1.50	1.86	2.34	1.30	2.10	1.73	1.33	1.24	1.18	1.56	1.38
Bismuth	NG	NG	<40	<40	<20	<20	<40	<20	<20	<20	<20	<20	<20	<20
Cadmium	0.6	3.5	<1.0	<1.0	0.60	0.70	<1.0	<0.50	<0.50	<0.50	<0.50	0.66	<0.50	<0.50
Calcium	NG	NG	<50	675	<50	<50	55	<50	<50	<50	<50	<50	<50	<50
Chromium	37.3	90.0	259	135	105	101	73	159	173	339	289	353	241	119
Cobalt	NG	NG	22.0	19.6	12.7	17.6	11.7	16.3	14.7	21.8	20.4	20.4	22.3	12.5
Copper	35.7	197	111	71	97	126	398	97	68	57	50	55	63	67
Iron	NG	NG	87854	52654	32254	75654	32154	49654	41654	54554	50554	50354	57354	105854
Lead	35.0	91.3	<60	<60	<30	<30	<60	<30	<30	<30	<30	<30	<30	<30
Lithium	NG	NG	40.3	46.6	45.9	44.9	37.4	51.6	46.7	50.1	48.5	43.8	51.6	32.0
Magnesium	NG	NG	18781	13881	11181	9881	9481	13481	13381	19881	18881	19581	16881	9381
Manganese	NG	NG	685	2886	591	1766	627	860	486	695	622	878	4896	403
Mercury	0.17	0.486	0.036	0.053	0.046	0.060	0.21	0.027	0.017	0.029	0.020	0.029	0.032	0.034
Molybdenum	NG	NG	14.6	<8.0	4.5	12.1	<8.0	5.9	<4.0	<4.0	<4.0	<4.0	4.6	5.6
Nickel	NG	NG	128	93	75.2	98.8	50	94.6	82.6	118	106	127	126	76.9
Phosphorus	NG	NG	1110	1130	874	1450	780	742	530	721	622	1200	596	1540
Potassium	NG	NG	4900	5330	5100	4660	3800	5320	4810	5290	5210	4660	5480	3160
Selenium	NG	NG	<4.0	<4.0	<2.0	<2.0	<4.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	4.3
Silver	NG	NG	<4.0	<4.0	<2.0	<2.0	<4.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Sodium	NG	NG	<400	<400	240	<200	<400	220	220	220	210	<200	230	<200
Strontium	NG	NG	<0.5	4.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
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	<1.0
Tin	NG	NG	10	<10	<5.0	<5.0	<10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Titanium	NG	NG	1038	1138	838	631	968	1038	1018	998	1018	824	1028	491
Vanadium	NG	NG	58.8	49.2	40.9	43.5	33.6	51.9	48.6	60.9	58.2	57.5	55.9	34.2
Zinc	123	315	502	131	151	161	159	137	128	105	97	133	118	117

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.

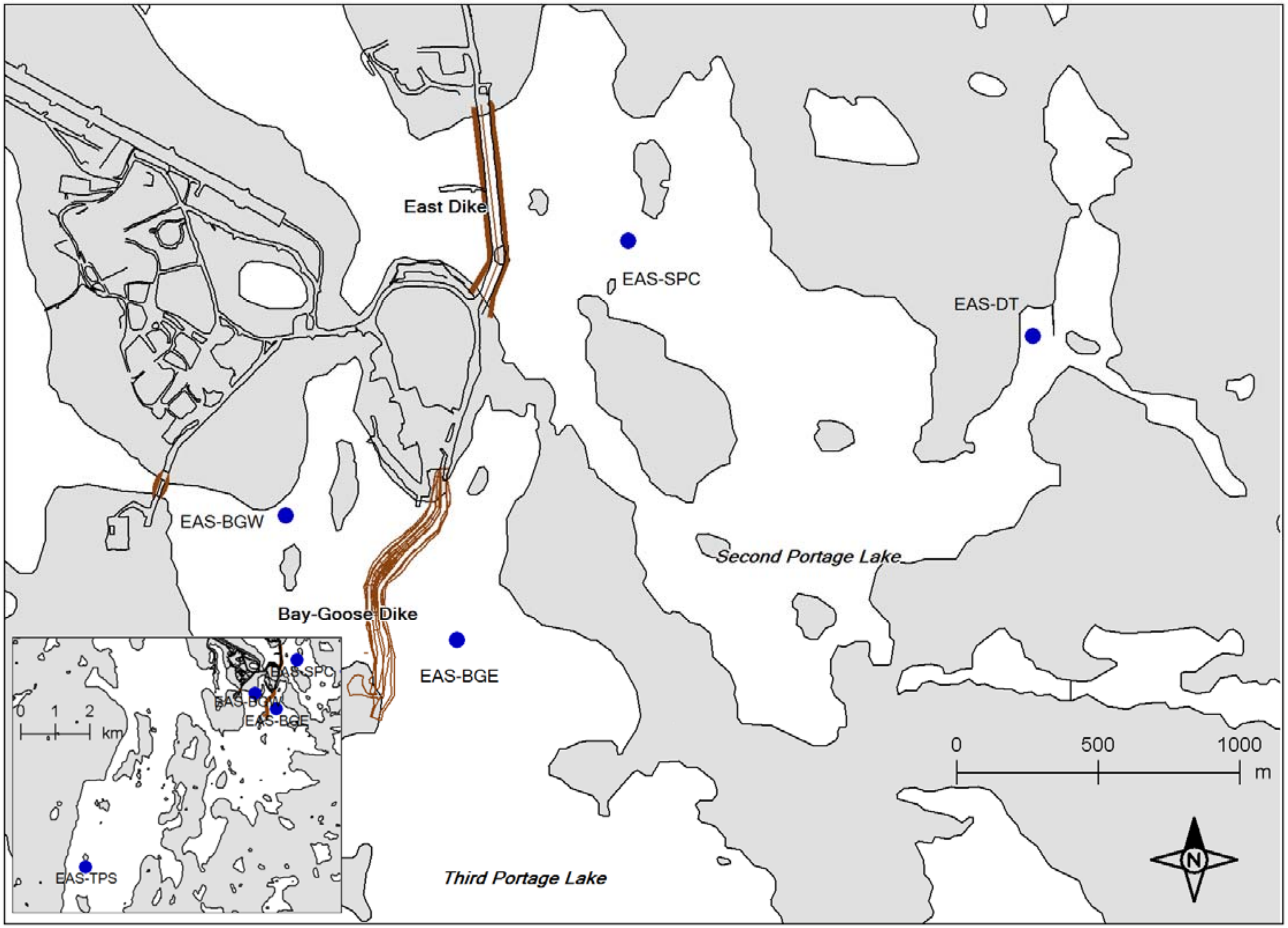
ISQG = Interim freshwater Sediment Quality Guideline, PEI = Probably Effects Level.

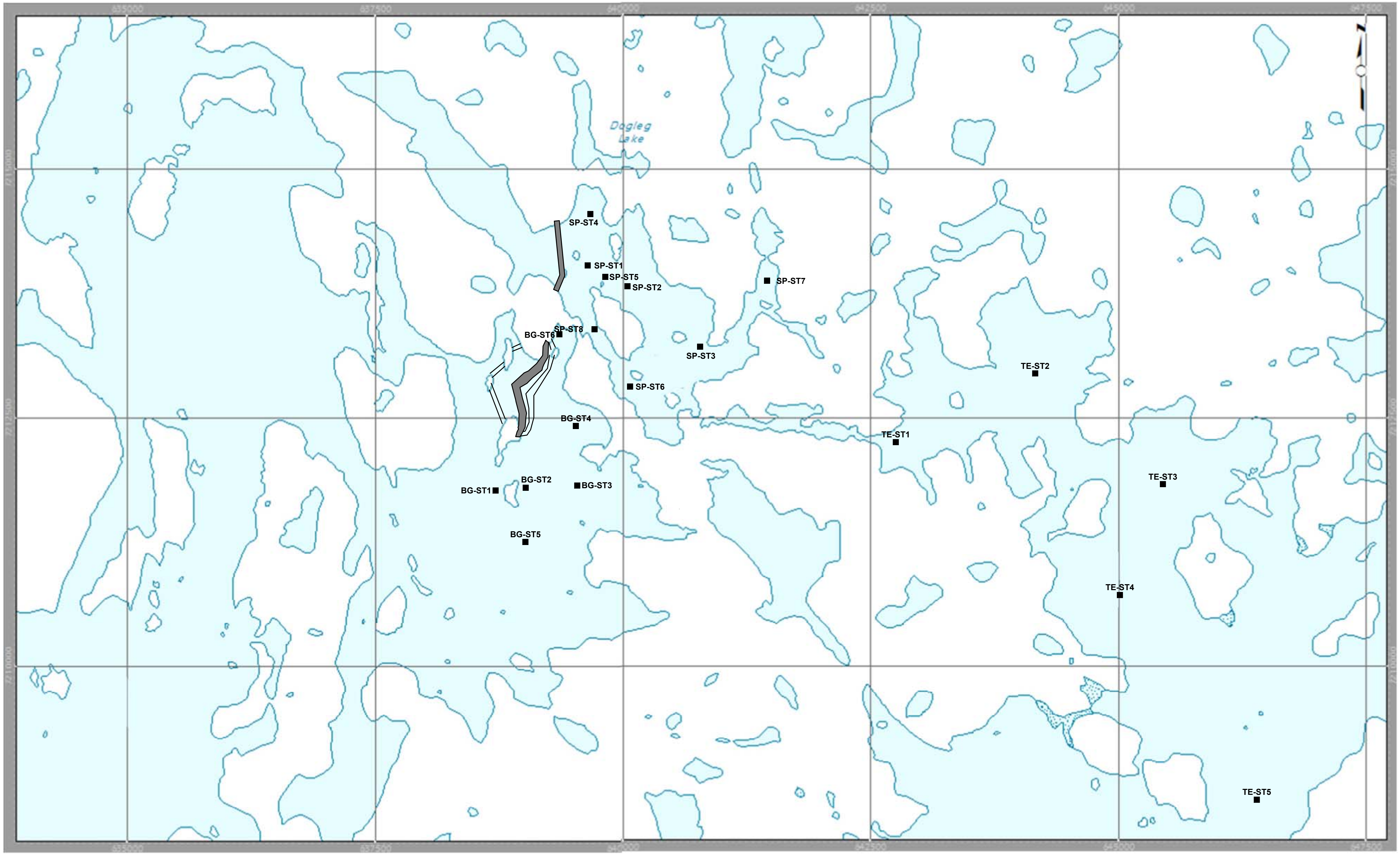
Shaded concentrations = or > ISQG.

Boxed concentration also > PEL.

[2] Reported total metals concentrations in the samples have been adjusted by substracting those concentrations detected in "blank" filters; arsenic, calcium, and strontium concentrations for some samples are shown as below detection because the concentrations in the filters were greater than in these samples.

Figure 3-1. Water quality / limnology areas and field effects areas.





Legend

- ▲ Broad Survey Stns
- ● BG Routine Stns
- ○ BG HVH Stns
- ■ TE Sed Trap Stns

BG = Bay-Goose Routine Stations
HVH = High Value Habitat Stations

n/a = data do not cover full duration
blank = no data available

TSS Trigger Values (mg/L)

Station	24-hr	30-day
Routine	50	15
HVH_a	50	15
HVH_b	25	6
a = prior to Sept 1		
b = after Sept 1		

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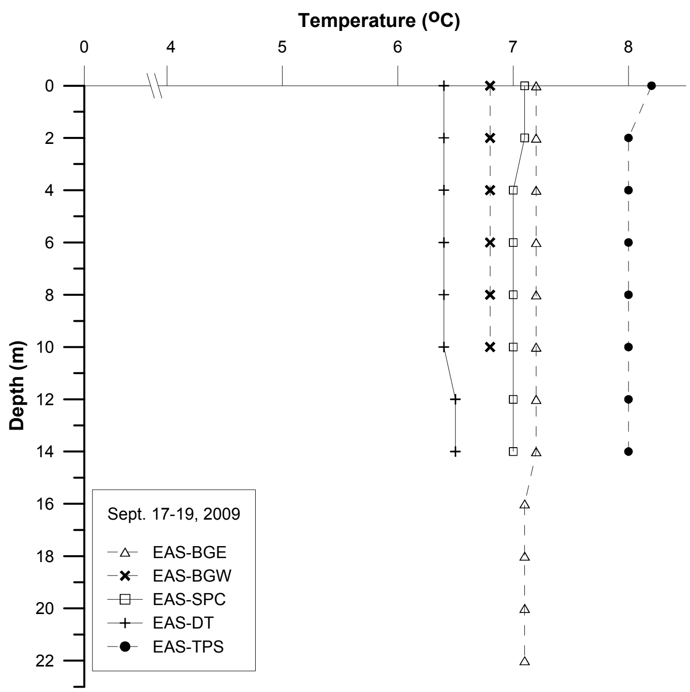
SEDIMENT TRAP LOCATIONS

SUMMER 2009

Figure 3-2

Figure 3-3. Temperature (°C) and dissolved oxygen (mg/L) profiles, Second & Third Portage Lakes, September 17-19, 2009.



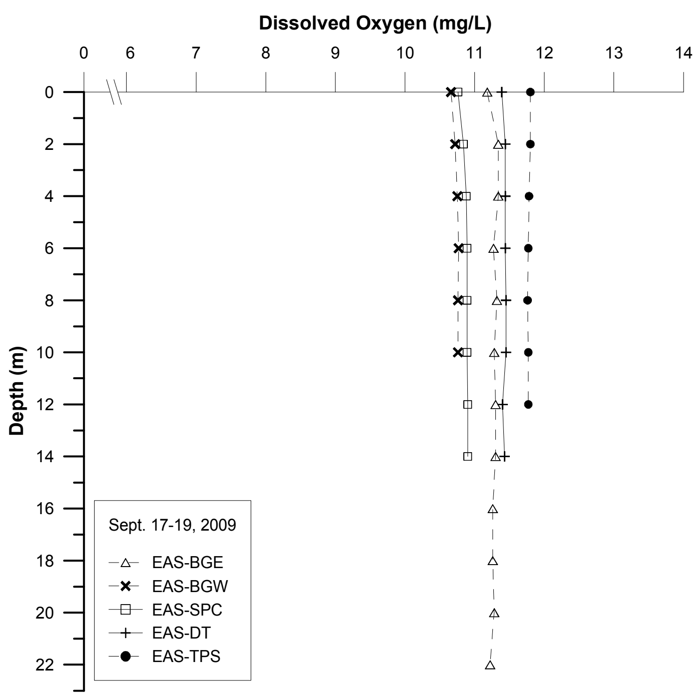
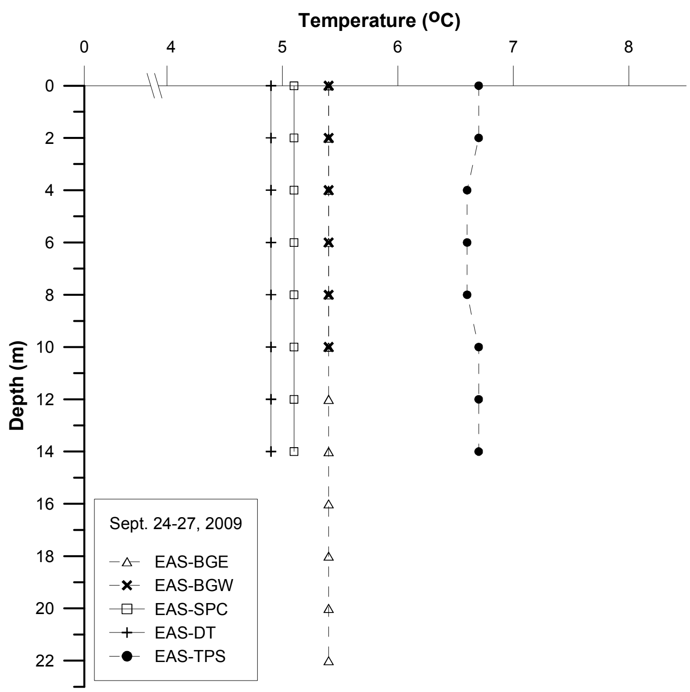


Figure 3-4. Temperature (°C) and dissolved oxygen (mg/L) profiles, Second & Third Portage Lakes, September 24-27, 2009.



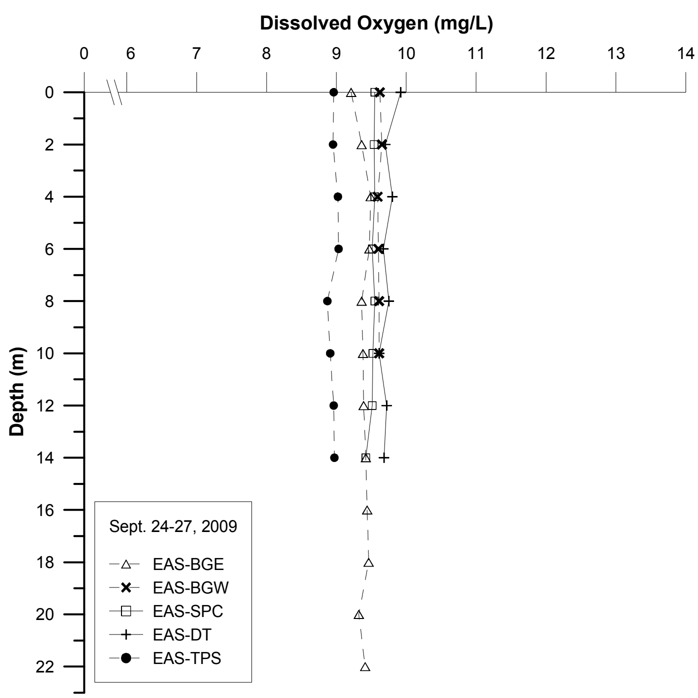


Figure 3-5. Mean total chlorophyll-α concentration (mg/m^3), Second & Third Portage Lakes, September 2009.

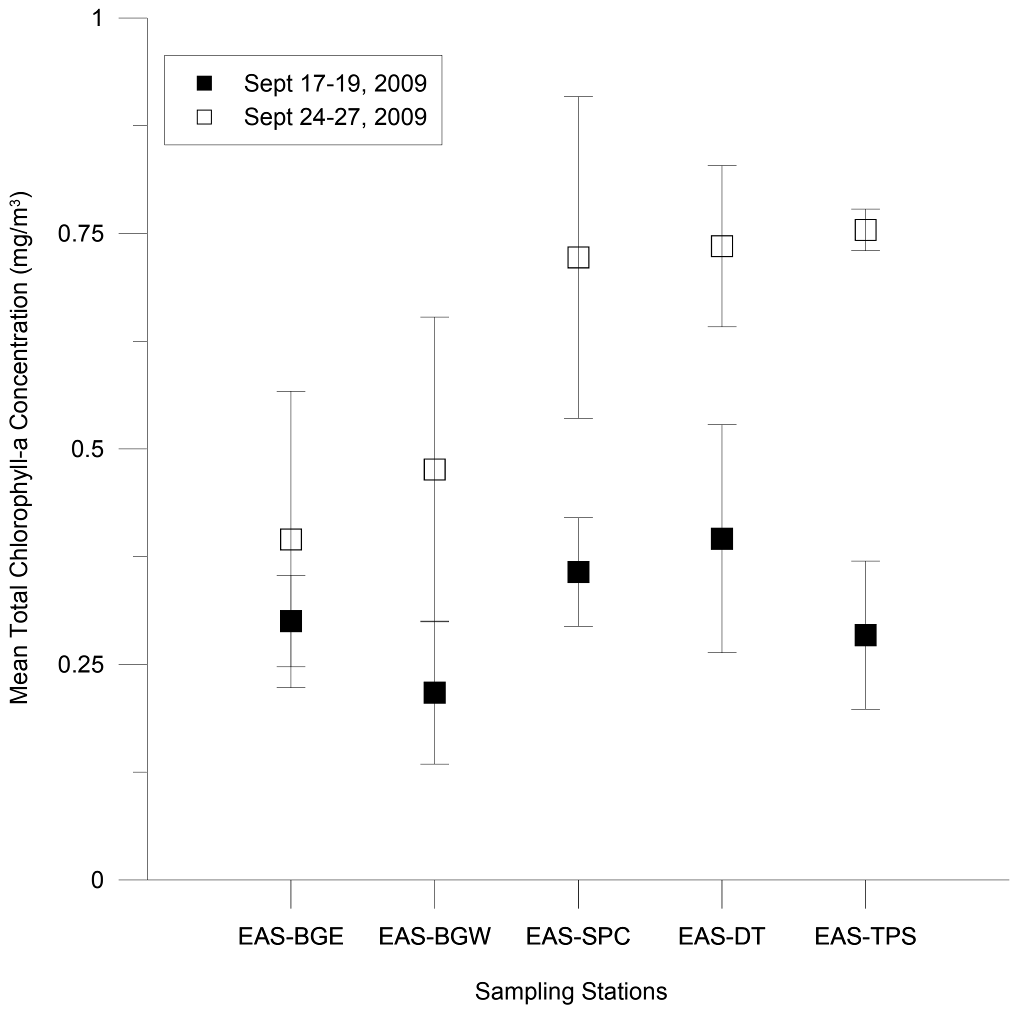


Figure 3-6. Seasonal chlorophyll-α concentrations (mg/m^3) from CREMP areas in Second Portage (SP) and Third Portage (TPN, TPS, TPE) Lakes, 2006–2009.

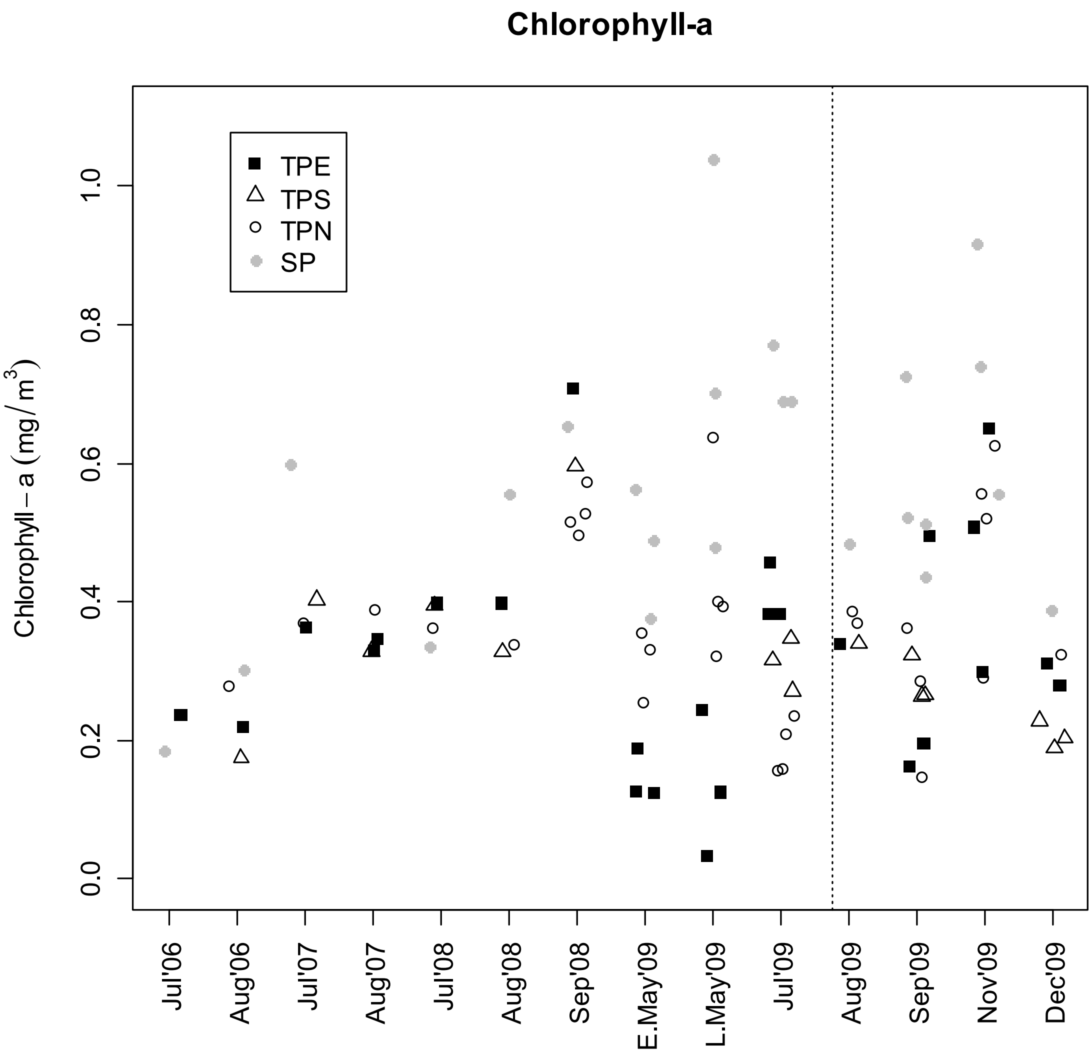


Figure 3-7. Mean total phytoplankton biomass (mg/m^3), Second & Third Portage Lakes, September 2009.

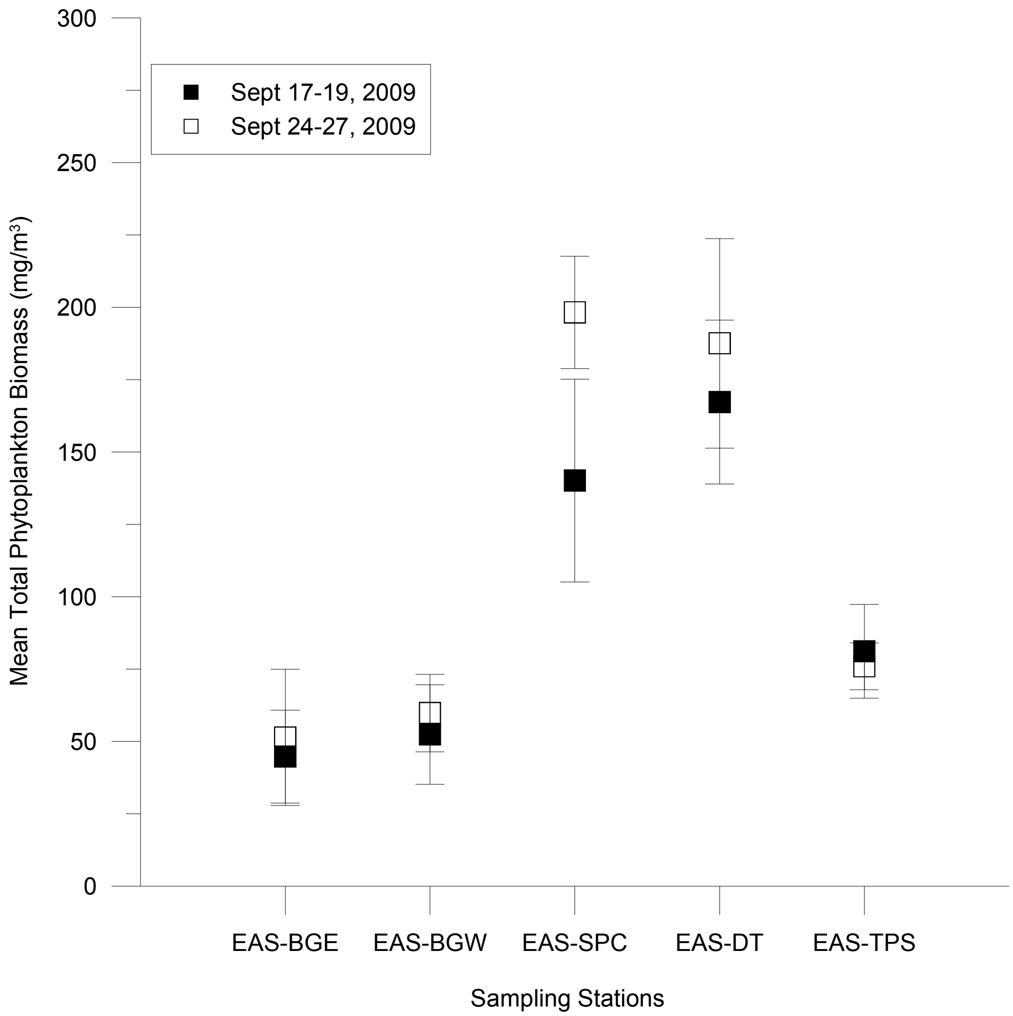


Figure 3-8. Phytoplankton biomass (ww) results for Third Portage Lake areas (TPE, TPN, TPS) from July 2006 to September 2009 (CREMP data set). Dashed line shows approximate onset of Bay-Goose Dike construction.

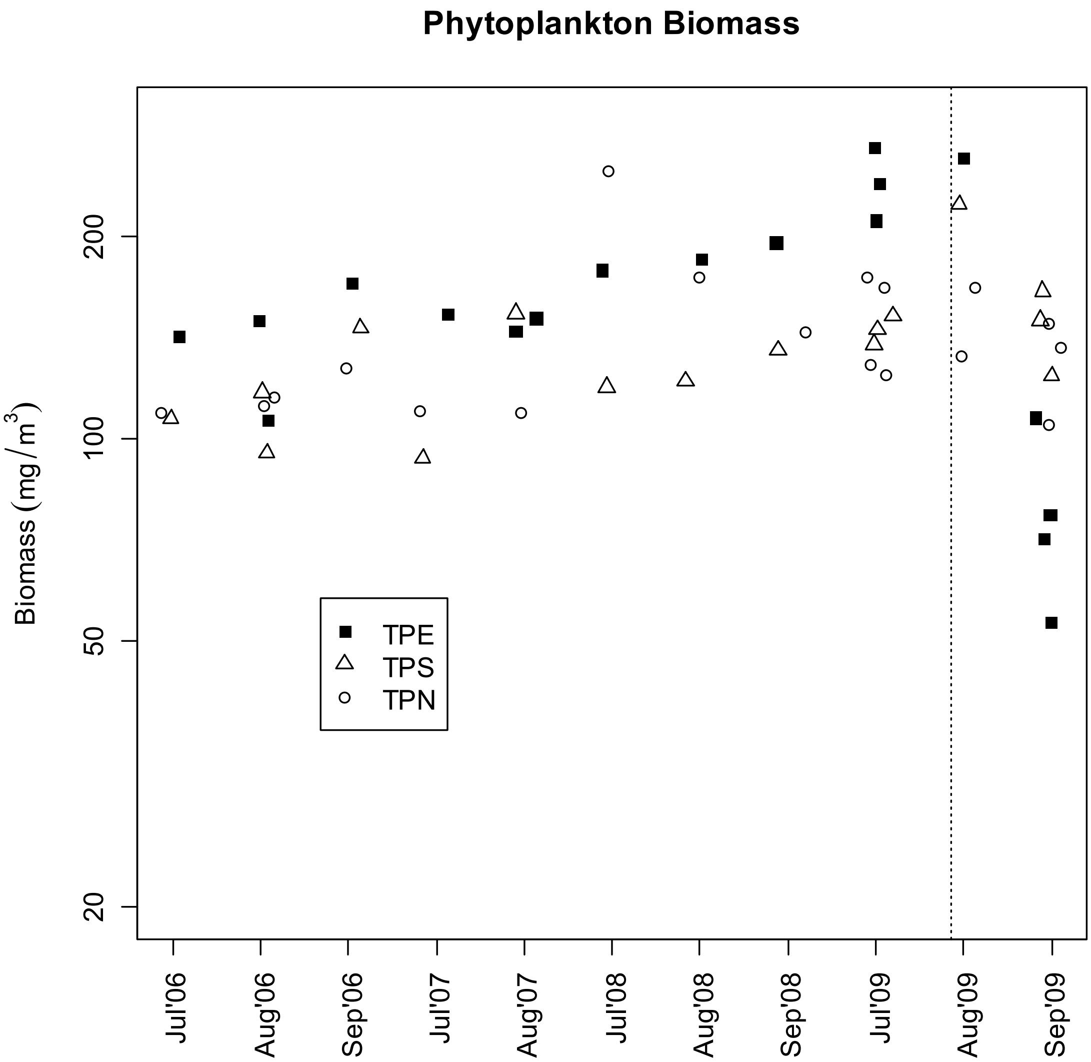


Figure 3-9. Phytoplankton biomass (ww) results for Third Portage Lake areas (TPE, TPN, TPS) from September 2009 to December 2009 (CREMP data set).

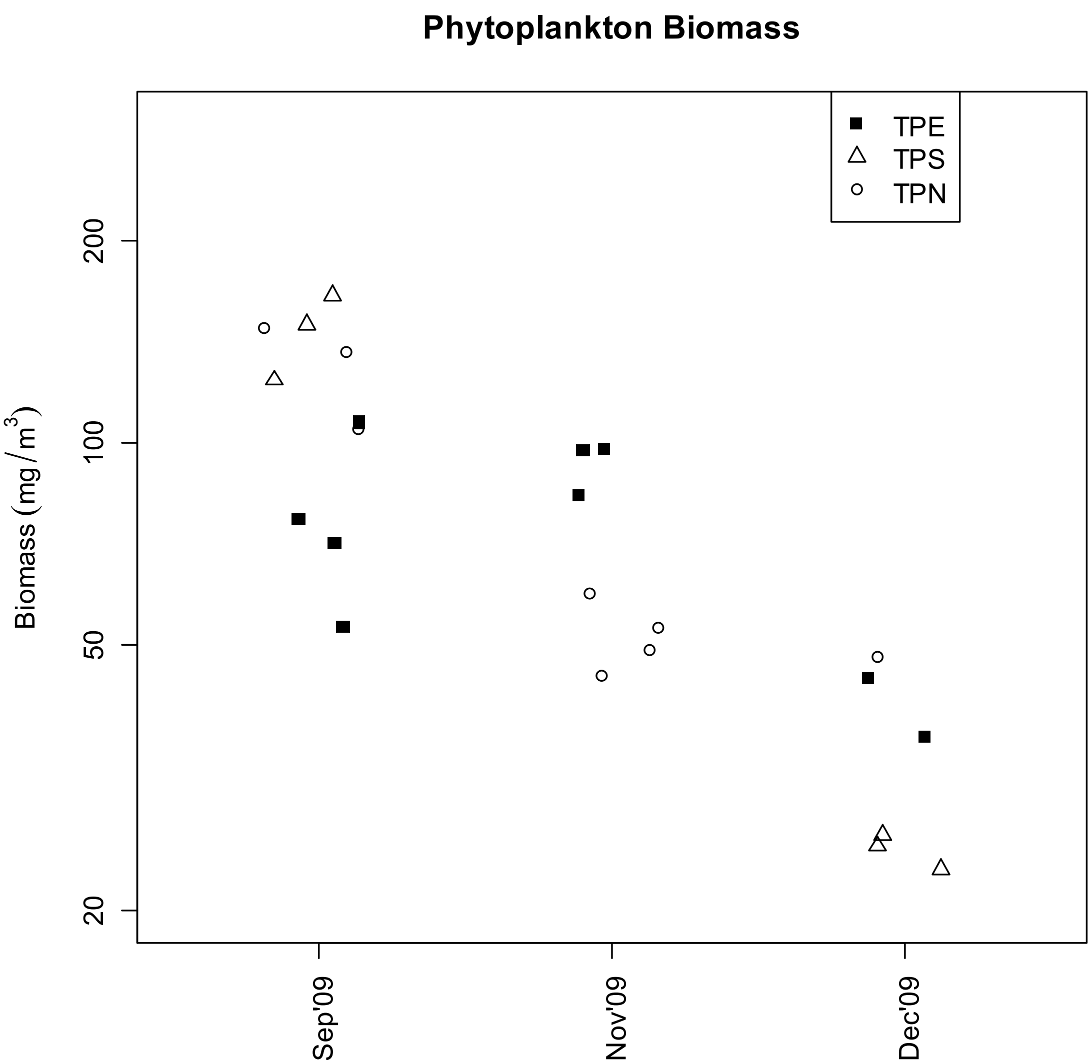


Figure 3-10. Phytoplankton biomass (mg/m^3) by major taxa group, Second & Third Portage Lakes, September 2009.

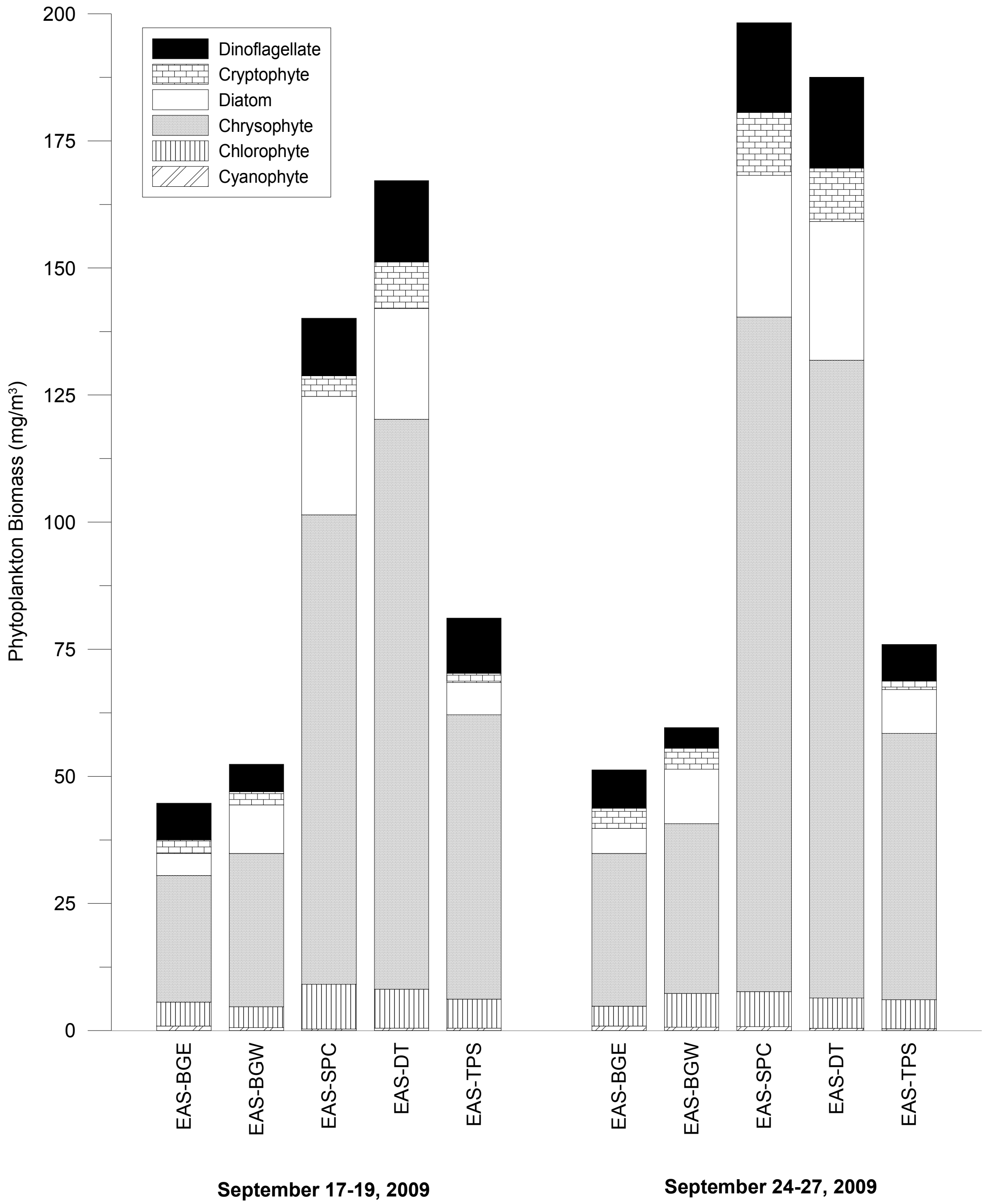


Figure 3-11. Seasonal phytoplankton biomass (mg/m^3) by major taxa group from CREMP areas, Second Portage, Tehek and Third Portage Lakes (east and south basins), 2006–2009.

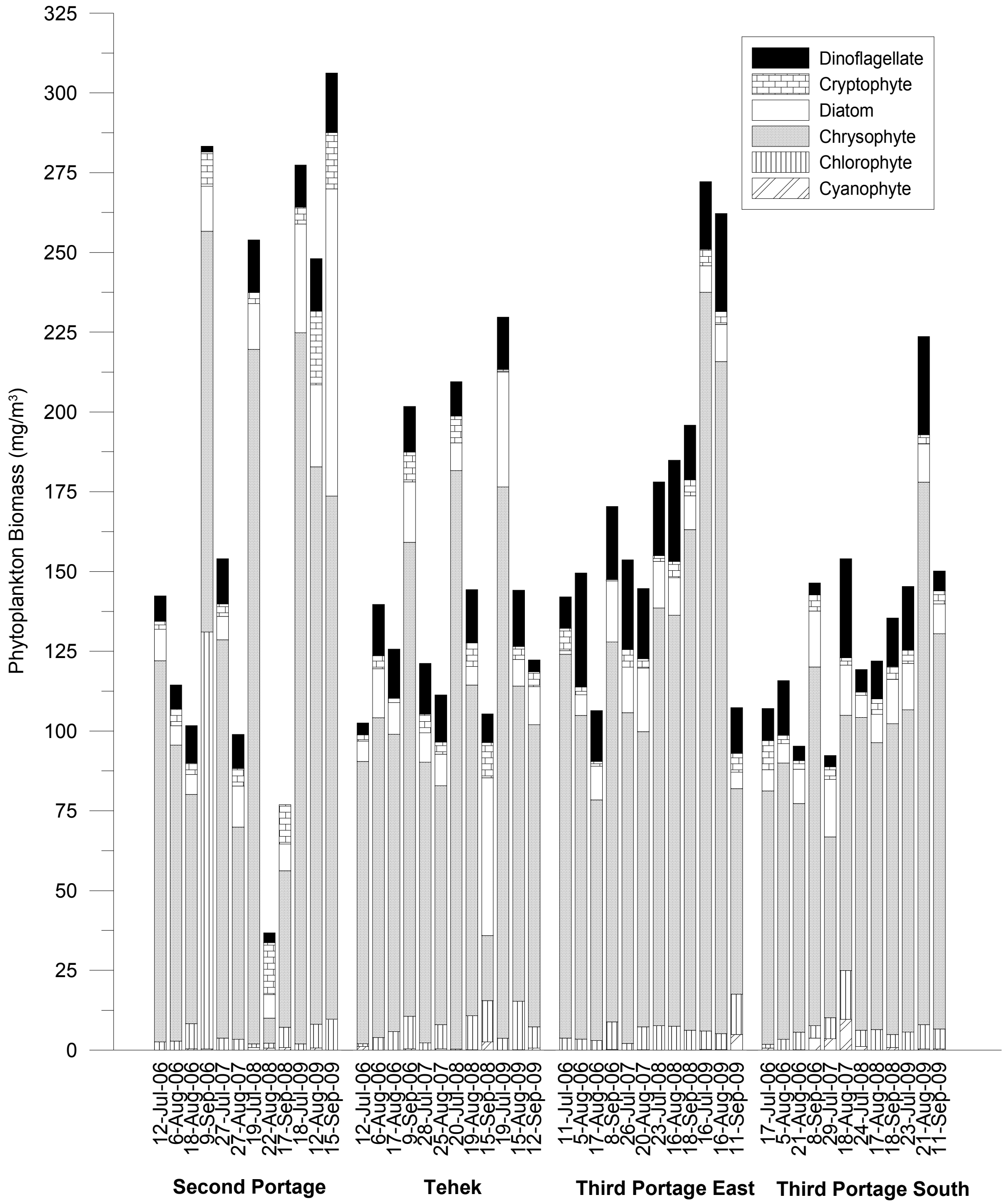


Figure 3-12. Phytoplankton diversity boxplots for Bay-Goose EAS areas (pooled dates) in Second and Third Portage lakes, September 2009.

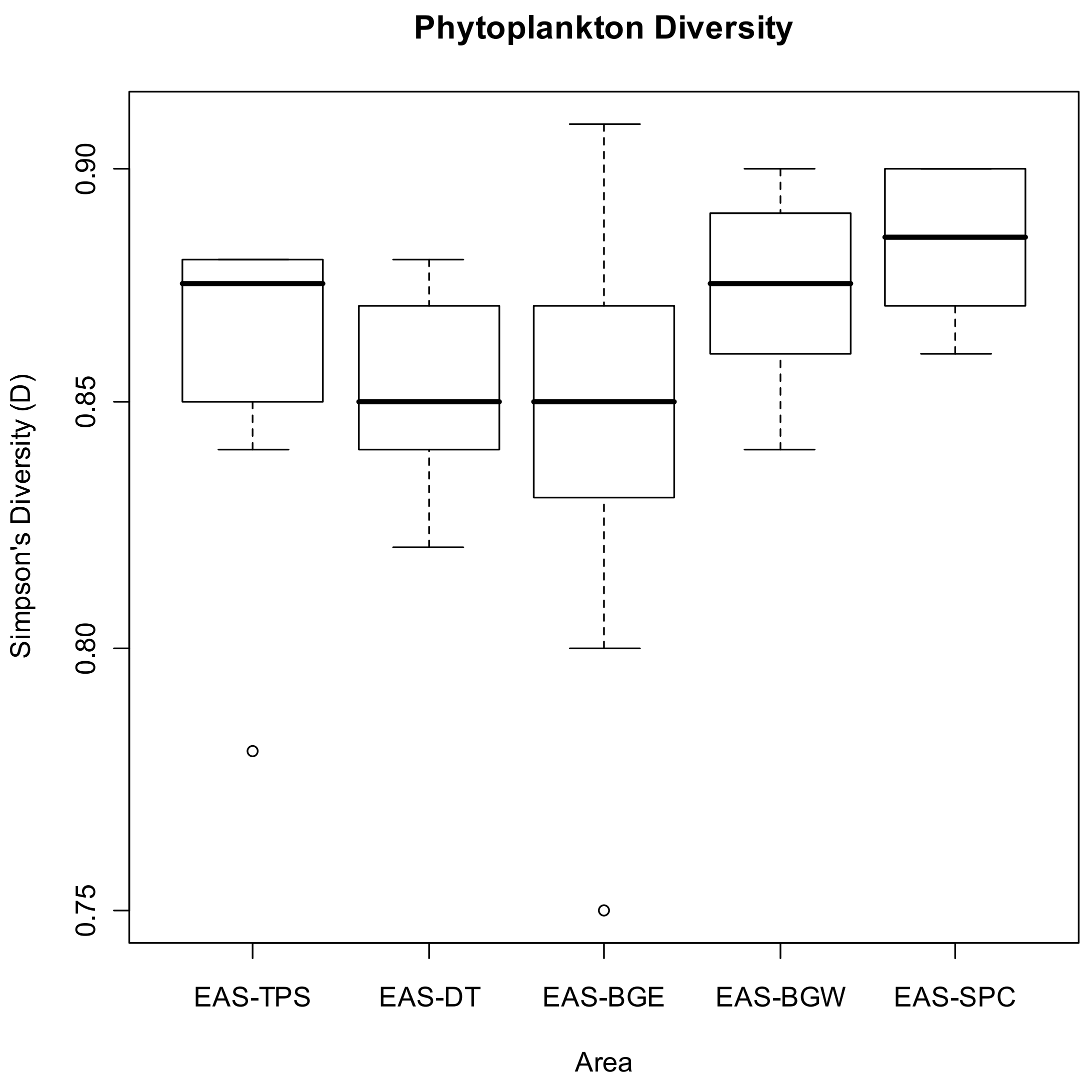
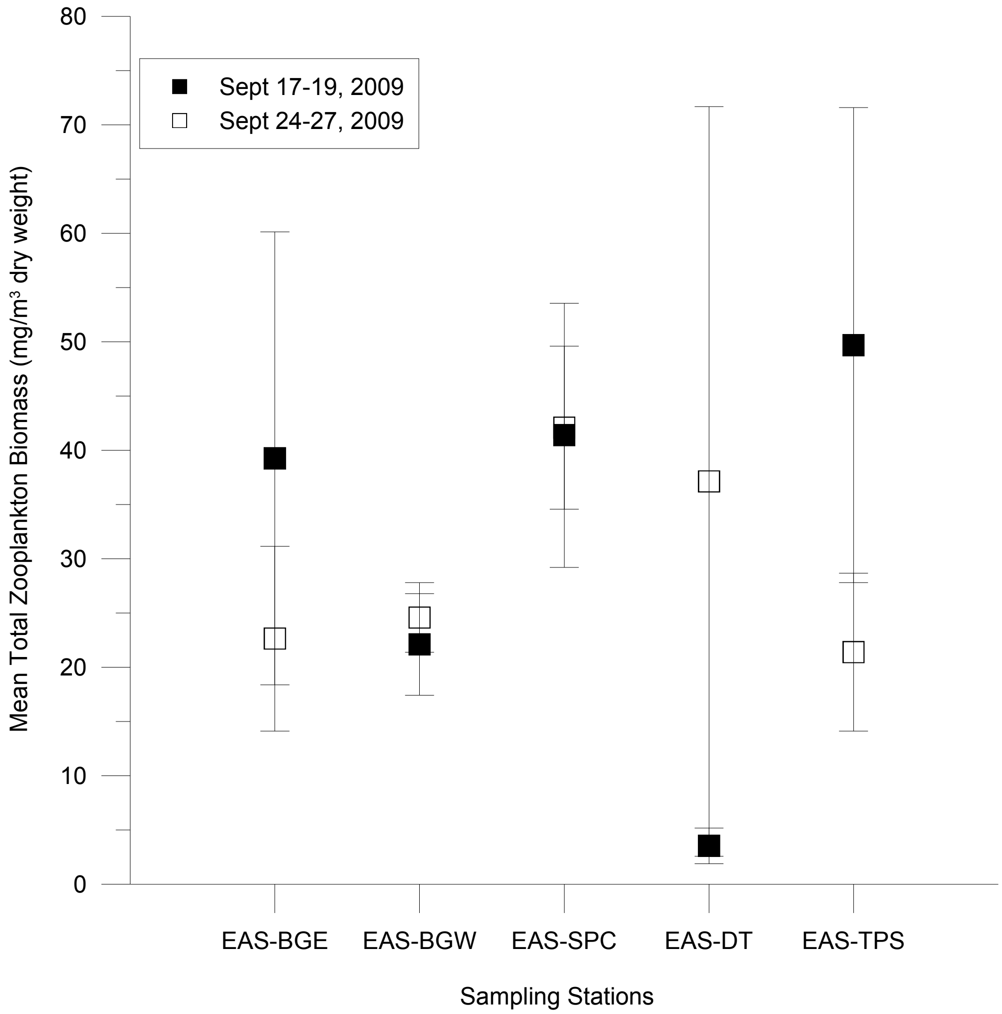


Figure 3-13. Mean total zooplankton biomass (mg/m^3 dry weight), Second & Third Portage Lakes, September 2009.



4. CONCLUSIONS AND RECOMMENDATIONS

AEM commissioned studies in each of the last two years (2008 and 2009) 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). This study continued in 2009 (as reported in Section 2) to implement some planned components as well as to address some new uncertainties raised by the 2008 results. Further work for 2010 is discussed below.

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 and others slated for either 2010 and/or 2011.

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** for both TSS EAS studies to provide a more holistic perspective.

TSS EAS studies 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 two years. 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.

From an 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. 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. Based on the CREMP data, it is apparent that even prior to the onset of construction activities studies, benthic communities in Second Portage and Tehek lakes had lower abundances relative to the other project lakes. More intensive sampling was conducted in Second Portage and Tehek lakes in 2009 (the EAS data set), but when viewed in the broader context (e.g., relative to other CREMP areas) the results only highlighted the above differences.

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 found more obvious signs of sediment accumulation than areas further away.

TSS EAS studies continue in 2010. **Table 4-1** highlights (in bold) activities to be conducted in 2010. Planned components include:

- Continued benthic invertebrate community monitoring for East Dike TSS EAS.
- Sediment trap deployment (after retrieval of winter traps) throughout study area for Bay-Goose Dike TSS EAS.

Recommended changes for 2010:

- Benthic invertebrate community monitoring for Bay-Goose Dike TSS EAS should be initiated in 2010 rather 2011, as originally planned.
- Periphyton studies should be conducted again in Second Portage Lake to document temporal changes and provided better spatial resolution of potential adverse effects. The quantitative sampling should be coupled with the sediment mass estimates; the live-dead component did not provide much value and should not be repeated. This study component will also be useful for making inferences regarding potential changes to high-value habitat areas.
- In light of the increased sediment metals concentrations in Second Portage Lake, toxicity testing should be initiated (comparing worst-case areas to reference areas) to assess metals bioavailability. This information will complement the detailed benthic community analysis currently being conducted by Ryan Vanengen (AEM) for his master's research.

Table 4-1. Conclusions to date from both TSS Effects Assessment Studies.

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 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.
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.	There was some indication of differences between the east and south basins of Third Portage Lake. However, biomass was actually higher in 2009 in the east basin than observed in 2008 in the absence of 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.	No direct effects were observed in toxicity tests.
<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.

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APPENDICES

APPENDIX A

SEDIMENT CORING TERMS OF REFERENCE MEMORANDUM, 2009

AZIMUTH

Technical Memorandum

Date: July 14, 2009

To: Rachel Gould (AEM)

cc: Ralph Turner, Maggie McConnell

From: Randy Baker and Gary Mann

RE: Meadowbank Gold Project: AEMP Sediment Coring Terms of Reference

---

This technical memorandum lays out the terms of reference for 2009 sediment coring as an addendum to the Aquatic Effects Monitoring Program (AEMP).

Objective:

The main objectives for 2009 are:

1. Characterization of spatial variability in sediment chemistry – Previous sediment sampling of the Meadowbank project lakes was conducted to characterize baseline conditions within discrete areas of the near-field, far-field and reference AEMP stations. This information will help determine the needs of future sampling events (e.g., sample size needed to detect specified effect size with known statistical power) to allow detection of potential mine-related changes to surface sediment chemistry.
2. Define very near-surface chemistry – Coring, unlike traditional tools such as a Petit Ponar, allows for precise and small depth ranges to be sampled. The corer will be used to sample the top 1.0 cm of sediment to define near-surface chemistry.

Sediment Coring Program:

Surface (top 1 cm) sediment chemistry at 4 AEMP stations (i.e., Tehek, Inuggugayualik, Second Portage, and Third Portage East) will be characterized using sediment cores. Note that this complements, rather than replaces, the grab samples (top 3 to 4 cm) collected synoptically with benthic community samples in late August. This is in addition to the traditional composite sample using the petite Ponar grab. Fifteen (15) independent cores are to be collected from each of the four (4) stations. Cores will be collected within a 250 m radius around the center of each sampling area. The intent is to collect cores over a wide area, targeting depths of 6-10 m within the basin being sampled. The protocol for collecting sediment cores is as follows:

1. Conduct the limnology, water and benthic sampling program prior to core sampling. Consideration can be given to identifying core sample locations prior to field collections.
2. Anchor the boat at least 25 m away from where sediment/benthos collections were made. If conditions are windy, anchor the boat. If calm, anchoring is not necessary. Survey the area to be sampled with the sonar to determine bottom type.
3. Deploy the corer from the boat and try to ensure that the core barrel is perpendicular with the surface before penetration. Depending on results, the corer can free-fall from 1 m above the surface. Avoid sampling over steep gradient slopes or over coarse grain substrate.
4. Raise the core to just below the water surface and cap prior to bringing above the water to ensure sediment is not lost out the bottom.
5. Check to make sure that the surface of the core is intact and is not mixed or disturbed and that the overlying water is clear. Record water depth and UTM location (NAD 83) of all successful core samples.
6. Process the core on the boat. Decant overlying water and collect only the top 1 cm of sediment.
7. Place the entire 1 cm slice into a 125 mL glass jar. Discard the remaining core sample.
8. Label the jars as per AEMP protocol (e.g., TE-x) but with a suffix indicating a core sample (e.g., TE-SC-01 to TE-SC-15).
9. Fill in the data sheet and record any observations about the core sample such as presence of varves, distinct changes in color, grain size, or any other unusual features.
10. Repeat the procedure above by re-positioning the boat and anchoring (if necessary), selecting a different random location within the 250 m radius around the station center, and targeting a depth of 6-10 m. Repeat again until all 15 core samples have been collected, randomly covering the general area depicted on the map.
11. Randomly from one of the 15 coring locations, take a duplicate core (independent deployment of corer) for QAQC purposes.
12. All core samples are to be analysed for total metals, pH and total organic carbon. Fill in CoCs as necessary.
13. Hold on ice or in the refrigerator until shipping to ALS, Vancouver.

Randy Baker and/or Gary Mann will be at Meadowbank Camp to help with any questions that may arise during implementation of this program.

APPENDIX B

STATISTICAL ANALYSES FOR TSS EFFECTS ASSESSMENT STUDY, 2009

Appendix B – Statistical Analyses for TSS Effects Assessment Study 2009

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TABLES AND FIGURES

APPENDICES

1. INTRODUCTION

This appendix documents the statistical analyses conducted to support the 2009 TSS Effects Assessment Study (EAS) for the Meadowbank Gold Project. The 2009 EAS included components targeting potential residual effects of East Dike construction in 2008 and new potential effects related to Bay-Goose Dike construction. 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 for follow-up studies related to East Dike construction.
- **Section 4** – presents the results of new studies addressing Bay-Goose Dike construction.

This appendix must be read along with the main report, because raw data and basic descriptive statistics and graphs presented in the report are not generally repeated in the appendix.

2. GENERAL STATISTICAL APPROACH

2.1. Overview

All statistical analyses were conducted using R software (v. 2.9.0). Further information on all the 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). They 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.

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[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 α = 0.05 (see **Section 2.3** for more information). Note that effect sizes 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. 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*

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):

```
Mod1 <- 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, and 2 = major) across years. This results in a three-factor additive model (i.e., response is a function of Area + Year + Effect + error). However, it is important to recognize that there can be considerable natural variability among Area-Year combinations (not just between the ones we are testing with the variable 'Effect'), therefore we also include a term for Area:Year interactions. 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: Mod2 <- lm (y ~ Area + Year + Effect)

Unbalanced Mod2 <- lmer (y ~ Area + Year + Effect + (1|Area:Year))

For balanced designs, both of these models yield the same results for the three factors.

2.3. Determining Statistical Significance

As described above, the determination of statistical significance in these analyses relied on evaluating p values relative to $\alpha = 0.05$. 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 independent application (or occurrence) of the same 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.

- *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 situation (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 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.

<u>Basic EAS CI Study Designs</u>

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.

<u>Basic EAS BACI-type Study Designs</u>

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.

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[2]. 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 time as an element [or an interaction term] unless multiple "after" times were sampled; model terms as per **Section 2.2**):

Term	Levels	Df	E[MS]
Effect (γ)	$r = 1, 2, \ldots, R$	$R-1$	$\sigma^2 + \mathrm{Q} + SK\sigma_\beta^2 + S\sigma_{\tau\beta}^2$
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 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 Effect as a fixed effect 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

[2] 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.

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. EAST DIKE TSS EAS FOLLOW-UP

3.1. Study Design Overview

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

- *Sediment Coring* – Baseline conditions were established for all Core Receiving Environment Monitoring Program (CREMP) stations in 2008 (prior to the start of East Dike construction activities) (Azimuth, 2009a). Follow-up sediment coring was conducted at four stations (INUG, SP, TE, and TPE [prior to start of construction activities on the Bay-Goose Dike]) in 2009. INUG and TPE are control (reference) stations. The spatial-temporal design was assessed using Model 2, focusing on all metals that consistently exceeded the laboratory method detection limit.

- *EAS Benthic Invertebrates* – This is the first of a two-year follow-up benthic community monitoring program targeting the potential effects of sedimentation related to construction of the East Dike. Consisting entirely of "after" sampling, the first year was analyzed using a CI design. 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). The EAS program targeted 5 areas (two control [SP-DT, TPL-HVH4] and three impact [SP-N1, SP-N3, SP-F1); this data set was further expanded by adding eight CREMP areas (six control [INUG, PDL, TPN, TPS, TEFF, TPE] and two impact [TE, SP])[3]. The "Effect" dummy variable was coded as "0" for controls and "1"for impact areas. Statistical differences were tested for using a variation of Model 1 with Effect as a fixed effect and Area as a random effect [i.e., lmer (Y ~ Effect + (1|Area)) in R].

- *CREMP Benthic Invertebrates* – This data set was explored in the 2008 TSS EAS report (Azimuth, 2009a) as it provided both temporal and spatial data on the benthic community. Key stations (INUG, TPN, TPS, SP, TE, TPE) were once again sampled in mid- to late-August, providing an opportunity to follow-up on last year's results; Model 2 was used. Details on Effect coding are provided in the results.

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[3] Three of the original control areas (TPN, TPE and TPL-HVH4) were designated as "unassigned" for the analyses due to limited or uncertain exposure to mine-related TSS. The "unassigned" areas were each coded with unique effect levels (e.g., 2, 3 and 4) to allow specific comparisons relative to control areas.

3.2. Results

3.2.1. Sediment Coring

Sediment chemistry results for all variables that consistently exceeded method detection limits are shown in **Figure 3-1** (the raw data file is provided in **Appendix A**). Mean concentrations by Area/Year combination and year-to-year changes for each Area are shown in **Table 3-1**. The expectation for year-to-year changes in a headwater system with low sediment inputs (i.e., normal conditions) would be that changes are small and that they are fairly equally balanced between increases and decreases. The results for Control Area INUG do not match this expectation, particularly for arsenic, which increased from 32 mg/kg dw in 2008 to 117 mg/kg dw in 2009. This suggests that sediment heterogeneity in metals concentrations is far larger than anticipated, likely due to the presence of localized zones of highly mineralized sediment. This has implications for this study in that this natural spatial variability could lead to large (positive or negative) changes that may mask or exacerbate mine-related effects; these should be considered in the overall interpretation of the findings below.

A simplified version of Model 2 (i.e., y ~ Area + Year + Effect) was used to determine whether significant increases in metals concentrations occurred at SP and TE in 2009 relative to other Areas and Years; the results of these analyses are summarized in **Table 3-2**. Note that certain metals did not meet one or more of the model's assumptions. However, based on sample size (n=15 per Area per Year) and visual examination of residuals for each model, the overall conclusions from these analyses should be fairly robust to departures from the assumptions (Gelman and Hill 2006).

Statistically significant increases in metals concentrations at SP and/or TE in 2009 relative to other Areas and Years were found for aluminum (SP and TE), beryllium (SP), vanadium (SP and TE), and zinc (SP and TE). As discussed above, some of these observations may be due to natural spatial variability (i.e., it is possible that sampling in 2009 included a localized zone of mineralization that was not sampled in 2008). This is unlikely for the following reasons:

- First of all, the pattern of year-to-year changes was heavily skewed to increases at both SP (all increased) and TE (all but one metal, arsenic, increased).
- Secondly, it is unlikely that such an occurrence could happen in both Impact Areas in the same year for the same metal.

Consequently, the observed results for aluminum, vanadium and zinc are likely related to sediment inputs during East Dike construction. This conclusion was independently corroborated by the sediment trap results (see main EAS report), which showed it plausible that the magnitude of effect seen for these metals could occur from deposition of the sediments retained in the traps deployed in 2008 (i.e., based on "mixing" the amount of trap sediments to the 2008 coring results).

3.2.2. EAS Benthic Invertebrates

Response variables for the benthic community analysis were selected to match the requirements 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 index (BC)

Summary data for these variables are presented in **Table 3-3** (the raw data file is provided in **Appendix B**). Results by Area for each variable are shown in **Figure 3-2**. Benthic communities are known to be strongly influenced by physical variables, such as grain size, total organic carbon (TOC) and depth. While the study was designed to minimize differences in these factors (e.g., by selecting areas with similar sediment characteristics and depth), formal comparisons were made between each response variable and these physical variables to determine the extent to which the latter were important in shaping the former. The results of linear regression analyses (i.e., predicted fit plus/minus confidence intervals) for these variables (mean per area) are shown in **Figure 3-3**. None of the relationships shown in the 12 plots were statistically significant. Consequently, physical differences among areas were unlikely to be responsible for any observed trends (see below) in benthic community metrics.

Statistical analyses focused on testing differences between control and impact areas. The "Effect" dummy variable for was coded with four levels: controls (INUG, PDL, TPS, TEFF, SP-DT), impact (TE, SP-F1, SP, SP-N3, SP-N1), TPE, TPL-HVH4, and TPN. The latter three areas were initially intended to be control areas, but were analyzed independently relative to the control areas for the following reasons:

- *TPE* – This area was sampled on August 13/14. Dike construction monitoring results for BG-HVH5 showed that 7-day average TSS concentrations had increased from approximately 0.25 mg/L prior to the onset of construction to approximately 1.3 mg/L (Azimuth, 2010a). While these TSS concentrations are within the range of background conditions (see Azimuth, 2010a for more details), we felt that this area warranted special attention.
- *TPL-HVH4* – This area was sampled on August 23. Dike construction monitoring results for BG-HVH4 showed that 7-day average TSS concentrations had increased from approximately 0.25 mg/L prior to the onset of construction to approximately 8 mg/L (Azimuth, 2010a). Given that the source of the latter was Bay-Goose Dike construction and that exposure was more recent, it did not seem appropriate to group with the other impact areas.

- *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.

Boxplots of response variables by Effect grouping are shown in **Figure 3-4**.

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)). Results of statistical analyses are presented in **Table 3-4**. Between two and five 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+400] for abundance) and with/without certain outliers removed. Results reported in **Table 3-4** are for the following combinations (unless otherwise noted): abundance (advanced transformation:no outlier removal), richness (advanced transformation:no outlier removal), Simpson's Diversity (no transformation:no outlier removal), and Bray Curtis Index (no transformation:no outlier removal). Where advanced transformations still failed to meet model assumptions in formal testing, one or more of the following was conducted:

- *Modeling of Heteroscedastic Variances* – Rather than assuming equal within-group variance across areas, the statistical model was modified to allow different variance within each group (see Pinheiro and Bates 2000 for more details). This frees the model of the assumption of equality among variances and provides a more appropriate model structure for assessing the data. Model structure in R was:*"lme (Y ~ Effect, random=list(Area=~1), weights = varIdent (form = ~1|Area))"*. This model was compared to the main model to see if accounting for differences in variance among groups significantly improved model performance. Where it did, the results of this model were reported in **Table 3-4**.
- *Visual Examination of Residuals* – Model residuals were plotted and examined for major patterns.

Key results from **Table 3-4** are as follows:

- *Total abundance* – Significant decreases in abundance were detected between C and I areas ($p<0.05$), with the latter about 30% lower. There were no significant differences in abundance between TPE, TPL-HVH4 or TPN and the control areas.
- *Total taxa richness* – Similar to abundance, significant decreases in total species richness were detected between C and I areas ($p=0.001$), with the latter about 30% lower. However, there were no significant differences in abundance between TPE, TPL-HVH4 or TPN and the control areas.
- *Simpson's Diversity* – Due to inequality among within-group variances, the variance-weighted model structure discussed above was used for this response

variable. Statistically significant differences were detected between the control and impact areas, with the latter having slightly lower Simpson's D. TPN was also significantly lower than the control areas. There were no statistically significant differences between controls and TPE or TPL-HVH4.

- *Bray Curtis Index* – A similar pattern to total abundance and taxa richness was observed for Bray Curtis Index. The impact areas were significantly "further" from the control areas, but no statistically significant differences were found for TPE, TPL-HVH4 or TPN.

It is important to note that the differences observed in these analyses are difficult to attribute to exposure to elevated TSS (i.e., increased sedimentation), primarily since there is evidence that benthic communities in Second Portage and Tehek lakes may be inherently different than most of the control areas (see next section). This is discussed more in the main EAS report.

3.2.3. CREMP Benthic Invertebrates

Response variables for the benthic community analysis were selected to match the requirements 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 index (BC)

Summary data for these variables are presented in **Table 3-5** (the raw data file is provided in **Appendix C**). Results by Area and Year for each variable are shown in **Figure 3-5**, 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. The "Effect" dummy variable was coded based on **Table 3-6** with 7 levels: one for the controls, then one level each for the impact Area-Year combinations. Rationale for designation of areas as impact was 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, they remain impact areas.
- *TPE* – As discussed in **Section 3.2.2**, in 2009 this area was sampled on August 13/14, which was during construction of the first phase of the Bay-Goose Dike. Dike construction monitoring results for BG-HVH5, the closest construction monitoring station, showed that 7-day average TSS concentrations had increased

from approximately 0.25 mg/L prior to the onset of construction to approximately 1.3 mg/L (Azimuth, 2010a) by August 13. While these TSS concentrations are within the range of background conditions (see Azimuth, 2010a for more details), the area is conservatively designated as an impact area for 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.

Model 2 (unbalanced design) was used to used to identify statistically significant ($p<0.05$) differences between the base Effect level (i.e., control Area-Year combinations) and each subsequent Effect level (i.e., each impact Area-Year 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).

Results reported in **Table 3-7** are for the following combinations (unless otherwise noted): abundance (advanced transformation:no outlier removal), richness (no transformation:no outlier removal), Simpson's Diversity[4] (no transformation:no outlier removal), and Bray Curtis Index (basic transformation:no outlier removal). Graphical representations of the analyses are shown in two ways: Area-Year interaction plots for each response variable (**Figures 3-6 through 3-9**) and box-whisker plots for the Effect grouping (**Figure 3-10**). Key results for each area are as follows (followed by a brief discussion of uncertainty):

- *SP (2008 and 2009)* – Last year's EAS study reported a marginal trend ($0.05<P<0.2$) for decreased total abundance at SP that did not extend to TE (see **Table 3-7**, which also includes the 2008 results). As shown in **Figures 3-6 and 3-10**, 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); not surprisingly, abundance was not significantly different in 2009 relative to control Area-Year combinations. Effect sizes for richness were similar in both 2008 and 2009 (**Figure 3-7**); both showed a predicted loss of about 2.5 taxa, but were not statistically significant. Interestingly, Simpson's Diversity actually showed a

[4] Despite attempts to transform the data, Simpson's Diversity did not fully meet model assumptions for normality and equality of variance. Readers should be somewhat cautious interpreting these data.

positive trend, despite the reduction in taxa richness[5]. There were no significant differences in Bray Curtis distance for either year. Overall, these results appear consistent with **Figure 3-5**, which shows the drop in abundance at SP in 2008, but fairly consistent grouping of 2006/2007 results with 2008/2009 results for the other response variables.

- *TE (2008 and 2009)* – 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 **Table 3-7**). The 2009 results confirm that finding and reaffirm that there does not appear to be any changes at TE related to mining activity. **Figure 3-5** probably shows this the best for all response variables. Note, with the exception of Simpson's Diversity, the fairly tight grouping of all response variables at TE relative to the control Area-Year combinations. 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.
- *TPE (2009)* – As discussed in **Section 3.2.2**, exposure to some TSS during the early stages of Bay-Goose Dike construction meant that it can no longer be considered a control area in 2009. Consequently, it was included as an impact Area-Year combination to test for adverse changes in response variables. Note that while this Area-Year is not related to East Dike construction, the response patterns observed are relevant to the overall assessment of the potential effects of dike construction on benthic communities. No statistically significant changes were identified at TPE in 2009. Again, **Figure 3-5** shows the data for all response variables in 2009 were similar to previous years.
- *TPN (2009)* – As discussed in **Section 3.2.2**, this area was potentially exposed to elevated TSS during dewatering of the NW arm of Second Portage Lake between March and July 2009. While the CREMP water quality data suggest that exposure to TSS was likely low, this area could no longer be considered among the control areas for 2009. Consequently, it was added as an impact Area-Year combination out of interest (i.e., since it doesn't directly relate to East Dike construction). As seen in **Figure 3-5**, there were no apparent (or statistically significant; results not reported in **Table 3-7**) adverse changes at TPN in 2009.

As discussed in **Section 2**, effect sizes and associated confidence intervals help to place the observed results in to perspective. As seen in **Table 3-7**, 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.

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

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 need 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 last year's EAS report (Azimuth 2009a), which highlighted the decrease in abundance at SP in 2008, trends have been identified 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.

Another key factor in the interpretation of results is causality, which pertains to the degree of association between cause and effect. These analyses were conducted to provide inferences regarding the potential for TSS-related effects (from East Dike construction) to benthic invertebrate communities. To explore the strength of association between cause and effect further, the mean response variable results per Area-Year combination were plotted against four physical variables:

- *Total suspended solids (TSS; mg/L)* – this water column parameter is an approximation of TSS concentrations prevalent in an area for the one-week period prior to sampling. All control Area-Year combinations were given a default value of 0.2 mg/L; impact Area-Year combinations were estimated using available dike construction monitoring data (Azimuth 2009b, 2010b) and/or CREMP monitoring results (Azimuth 2008b,c, 2009c,2010b). This should be a reasonable approximation of the relative degree of exposure to TSS for each Area-Year combination. However, the actual concentrations reported for TSS in the water column should not be taken literally, since exposure is a function of both concentration and time.
- *Depth (m)* – Benthic communities are known to be influenced by depth.
- *TOC (%)* – Organic carbon content is generally associated with productivity. Spatial or temporal differences in TOC can affect benthic community structure.
- *Fines (%)* – Percent fines is a combination of the silt and clay particle size fractions. Grain size is also known to affect benthic community structure.

The results of the response variable vs. physical variable plots are shown in **Figure 3-11**. The CREMP design targeted locations within each basin that controlled for depth, TOC and grain size. Overall, physical conditions are quite similar among areas. Only one regression was significant for relationships with Depth, TOC and % Fines: taxa richness was positively correlated with TOC (P=0.03). The general lack of relationships between response and standard physical variables suggests that the CREMP design has been fairly effective at controlling these factors. Consequently, exposure to TSS concentrations are unlikely to be confounded by the influence of the other physical factors, so response patterns should be clear.

The TSS plots must be cautiously interpreted as the data are highly skewed to very low TSS concentrations (and thus fail the assumptions of the regression analysis, so p values are not provided). The abundance (N) on TSS plot showed that the Area-Year combination with high TSS exposure (SP in 2008) did have the lowest abundance in the data set. The next highest exposure, TE in 2008, also showed fairly low abundance, but there were several other areas with lower abundance and much lower TSS exposure concentrations. This suggests that the importance of TSS as a factor in structuring the benthic invertebrate community drops off between the two highest exposure levels. This idea is supported by the Bray Curtis Index results, which again shows SP-2008 as the Area-Year most different from reference (i.e., control Area-Year combinations) conditions. TE in 2008, although the next highest in TSS exposure, is in the middle of the distance range for Area-Year combinations with negligible exposure. This data supports the conclusion of a marginal change in benthic abundance at SP in 2008 that did not extend to TE. None of the other TSS exposure concentrations appear sufficiently high to result in substantial changes to the benthic community.

Table 3-1. Mean sediment core metals concentrations (mg/kg) by year and actual year-to-year differences (%) for control and impact areas.

	Control Areas						Impact Areas					
	INUG	INUG		TPE	TPE		SP	SP		TE	TE	
Variable	**2008**	**2009**	**Δ**	**2008**	**2009**	**Δ**	**2008**	**2009**	**Δ**	**2008**	**2009**	**Δ**
Aluminum	21307	20607	-3%	24953	25020	0%	24320	28840	19%	21467	25040	17%
Arsenic	32	117	268%	19	20	8%	33	40	23%	28	27	-5%
Barium	114	147	29%	147	142	-3%	133	155	17%	129	157	22%
Beryllium	1.31	1.25	-4%	1.85	1.93	4%	1.93	2.25	16%	1.94	2.10	8%
Chromium	88	92	5%	76	88	16%	65	80	23%	48	54	13%
Cobalt	17.3	14.8	-15%	15.7	16.0	2%	15.2	17.4	14%	13.4	14.5	8%
Copper	45	48	8%	59	59	-1%	83	94	14%	65	70	8%
Mercury	0.0400	0.0471	18%	0.0336	0.0276	-18%	0.0454	0.0513	13%	0.0350	0.0414	18%
Molybdenum	5.19	8.03	55%	6.63	4.59	-31%	6.61	8.43	28%	7.98	8.26	4%
Nickel	75	80	7%	96	80	-16%	61	68	10%	47	57	21%
Vanadium	33.5	29.2	-13%	39.1	39.9	2%	34.1	43.6	28%	29.3	35.3	20%
Zinc	74	80	7%	105	112	7%	98	122	25%	90	107	19%

Notes: **Δ** = relative change (%) between 2008 and 2009 (relative to 2008).

Table 3-2. Model results testing the significance of the "Effect" on sediment core metals concentrations (mg/kg) at impact areas SP and TE**.**

			Impact Areas							
			SP				TE			
Variable/Transformation		**Note**	**Expected "No Effect" 2009**	**Actual 2009**	**Effect Size**	**Effect (%)**	**Expected "No Effect" 2009**	**Actual 2009**	**Effect Size**	**Effect (%)**
Aluminum	None	1	24010	28840	***4830***	***20%***	21157	25040	*3883*	*18%*
Arsenic	log10(x)	2,3	42	40	-1.4	-3%	28	27	-1.8	-6%
Barium	log10(x)	2	154	155	1	0.7%	156	157	1	0.7%
Beryllium	none	2	1.94	2.25	*0.30*	*16%*	1.95	2.10	0.15	8%
Chromium	X^0.5	1	80	80	0.2	0.2%	54	54	0.0	0%
Cobalt	log10(x)	2,3	16	17	1.2	7%	13	15	1.1	8%
Copper	log10(x)	2,3	93	94	1.1	1%	69	70	1.0	1%
Mercury	None	1	0.046	0.051	0.005	12%	0.036	0.041	0.006	16%
Molybdenum	None	2,3	7.0	8.4	1.4	20%	8.4	8.3	-0.13	-2%
Nickel	log10(x)	2,3	66	68	1.2	2%	56	57	1.3	2%
Vanadium	None	3	32	44	***11.3***	***35%***	28	35	***7.7***	***28%***
Zinc	None	1	104	122	***18.3***	***18%***	96	107	*10.6*	*11%*

Notes:

Effect Size = model predicted effect size (%) between 2008 and 2009 (relative to predicted "No Effect" value [i.e., in the absence of the Effect tested]).

value = 0.01 < p < 0.05

value = 0.001 < p < 0.01

value = p < 0.001

1 Assumptions met

2 Normality assumption not met (see text for more details)

3 Homogeneity of Variance assumption not met (see text for more details)

Table 3-3. Benthic invertebrate community descriptors by sampling area for East Dike EAS 2009.

		Control Areas					Impact Areas					Unassigned		
		INUG	**PDL**	**TPS**	**TEFF**	**SP-DT**	**TE**	**SP-F1**	**SP**	**SP-N1**	**SP-N3**	**TPE**	**TPL-HVH4**	**TPN**
Depth	Mean	7.3	7.7	7.8	7.1	7.3	7.5	7.0	7.4	7.2	7.4	7.1	7.3	8.2
(m)	SD	0.5	0.5	1.1	0.5	0.5	0.6	0.2	0.5	0.5	0.5	0.6	0.3	0.7
	Min	6.9	7.2	6.8	6.6	6.5	6.9	6.8	6.8	6.5	6.9	6.5	6.9	7.1
	Max	7.9	8.3	9.7	7.8	7.6	8.2	7.3	8.1	7.7	8.0	7.8	7.7	8.8
	Median	7.0	7.5	7.3	6.9	7.5	7.4	7.0	7.5	7.2	7.4	6.9	7.3	8.5
Abundance	Mean	1191	1726	1961	1235	1122	770	1474	778	1135	730	1713	987	1239
(#/m^2)	SD	407	999	1035	249	159	145	531	114	342	128	439	98	279
	Min	630	761	717	978	935	522	1043	630	891	565	1065	848	891
	Max	1630	3326	3326	1543	1304	870	2370	913	1739	913	2239	1087	1565
	Median	1130	1348	2022	1196	1174	848	1391	804	1022	696	1826	1000	1174
Richness	Mean	13.6	10.8	10.4	10.4	10.8	7	8.6	6.8	6.6	8.8	11.2	9.2	9.2
(# taxa/	SD	3.1	0.8	1.3	1.8	1.1	1.2	1.5	1.3	1.1	2.0	1.3	1.5	1.8
sample)	Min	8	10	8	8	9	5	7	5	5	7	9	7	7
	Max	15	12	11	12	12	8	11	8	8	11	12	11	11
	Median	15	11	11	11	11	7	8	7	7	8	12	9	9
Simp Div	Mean	0.85	0.78	0.82	0.84	0.78	0.69	0.78	0.78	0.72	0.78	0.83	0.83	0.79
(unitless)	SD	0.06	0.10	0.08	0.04	0.07	0.18	0.03	0.03	0.07	0.09	0.04	0.05	0.02
	Min	0.74	0.61	0.72	0.78	0.69	0.49	0.73	0.74	0.62	0.63	0.77	0.74	0.77
	Max	0.90	0.88	0.92	0.88	0.87	0.87	0.81	0.83	0.81	0.88	0.89	0.88	0.83
	Median	0.88	0.81	0.84	0.84	0.77	0.79	0.80	0.77	0.73	0.79	0.83	0.84	0.78
Bray Curtis	Mean	0.44	0.50	0.49	0.46	0.48	0.54	0.52	0.54	0.54	0.55	0.47	0.51	0.46
(unitless)	SD	0.04	0.10	0.05	0.04	0.03	0.07	0.06	0.08	0.06	0.04	0.05	0.07	0.01
	Min	0.39	0.38	0.40	0.43	0.45	0.45	0.45	0.46	0.46	0.49	0.41	0.44	0.44
	Max	0.50	0.65	0.54	0.52	0.53	0.62	0.60	0.65	0.62	0.60	0.54	0.60	0.47
	Median	0.44	0.50	0.50	0.44	0.47	0.55	0.52	0.55	0.53	0.55	0.46	0.50	0.46

Table 3-4. Results of statistical analyses of benthic invertebrate community descriptors for East Dike EAS 2009.

	Total Abundance (#/m^2)	Taxa Richness (# taxa/ sample)	Simpson's Diversity (unitless)	Bray Curtis Distance (unitless)
Data Transformation[1]	Log10	Log10	None	None
Advanced Transformation[2]	Log10(x-400)	Log10(x+15)	NA	NA
Tests relative to control [C]				
C-I Differences?	Yes	Yes	Yes[4]	Yes
p-value	0.049	0.001	0.01	0.005
Control Group Mean	1268	11.1	0.83	0.48
Impact Group Mean	880	7.5	0.77	0.54
Effect Size	-389	-3.6	-0.052	0.06
95% Upper CI[3] of Effect Size	-602	-5.1	-0.088	0.10
95% Lower CI[3] of Effect Size	-4	-2.0	-0.017	0.03
TPE Mean	1644	11.2	0.83	0.47
C-TPE Difference?	No	No	No	No
p-value	0.42	0.97	0.89	0.97
TPL-HVH4 Mean	980	9.2	0.83	0.51
C-TPL-HVH4 Difference?	No	No	No	No
p-value	0.39	0.17	0.98	0.32
TPN Mean	1200	9.1	0.79	0.46
C-TPN Difference?	No	No	Yes	No
p-value	0.86	0.17	0.046	0.49

Notes:

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

2. Advanced transformations determined using Box-Cox method (Venables & Ripley 2002).

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).

Table 3-5. Benthic invertebrate community 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	0.0	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	0.59	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	0.52	0.06	0.55	0.45	0.58
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	0.59	0.09	0.53	0.50	0.70
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	0.60
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	0.52	0.01	0.53	0.50	0.54
TPS	2006	8.7	0.0	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	1.0	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	0.56	0.05	0.57	0.49	0.61
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	0.53	0.06	0.52	0.44	0.59
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	0.72	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	0.53	0.03	0.53	0.49	0.57
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	0.61	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	0.54	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	0.60	0.06	0.64	0.54	0.65
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	0.06	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	0.60	0.05	0.61	0.54	0.68

Table 3-6. Area "effect" status by year for CREMP data set.

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

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

Table 3-7. Results of statistical analyses of benthic invertebrate community descriptors for the 2006 - 2009 CREMP data set.

	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?	No	No	No	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	No	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.

Figure 3-1. Sediment chemistry results comparing control (INUG, TPE) and impact (SP, TE) areas in 2008 and 2009.

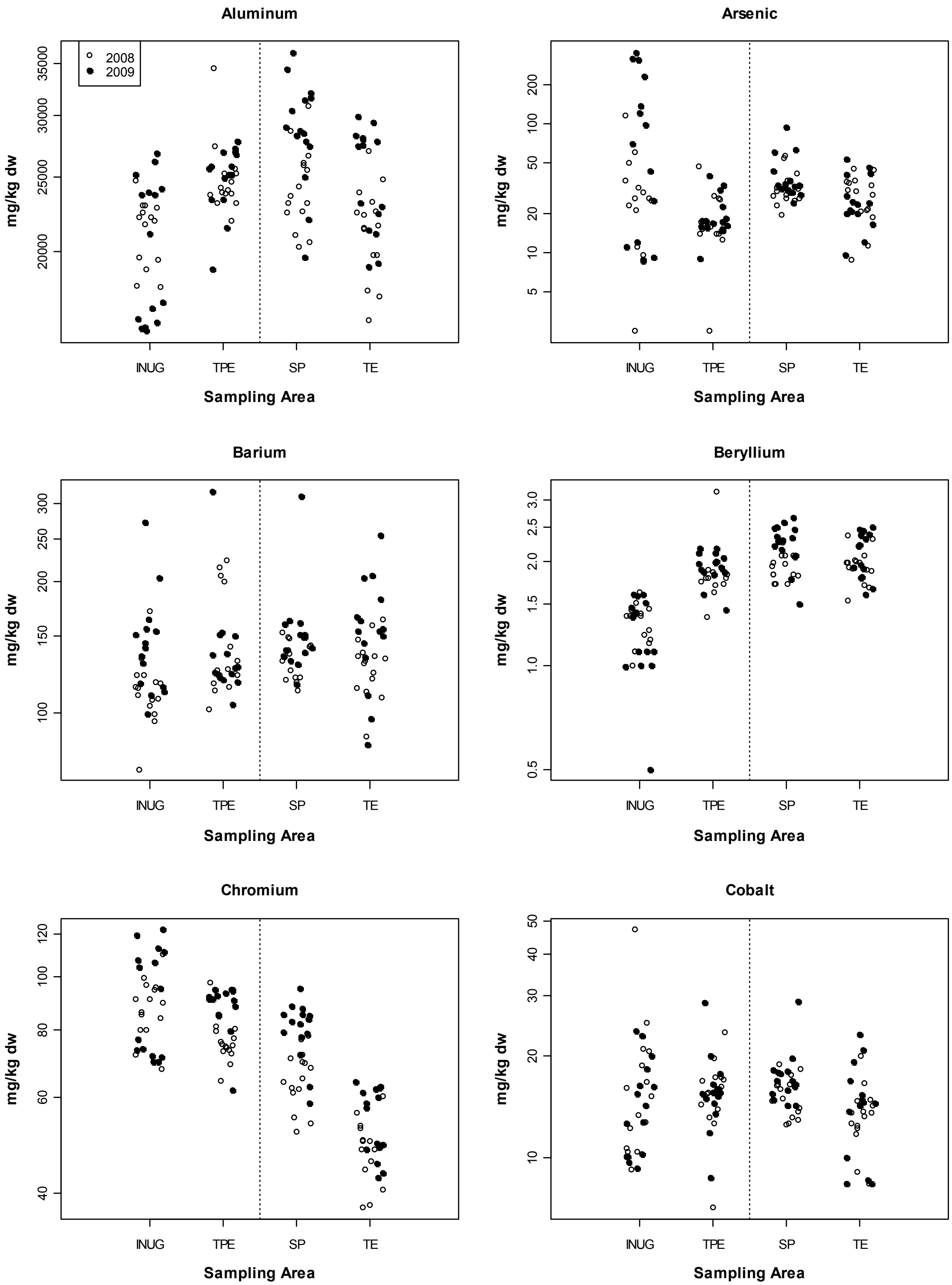


Figure 3-1 (con't). Sediment chemistry results comparing control (INUG, TPE) and impact (SP, TE) areas in 2008 and 2009.

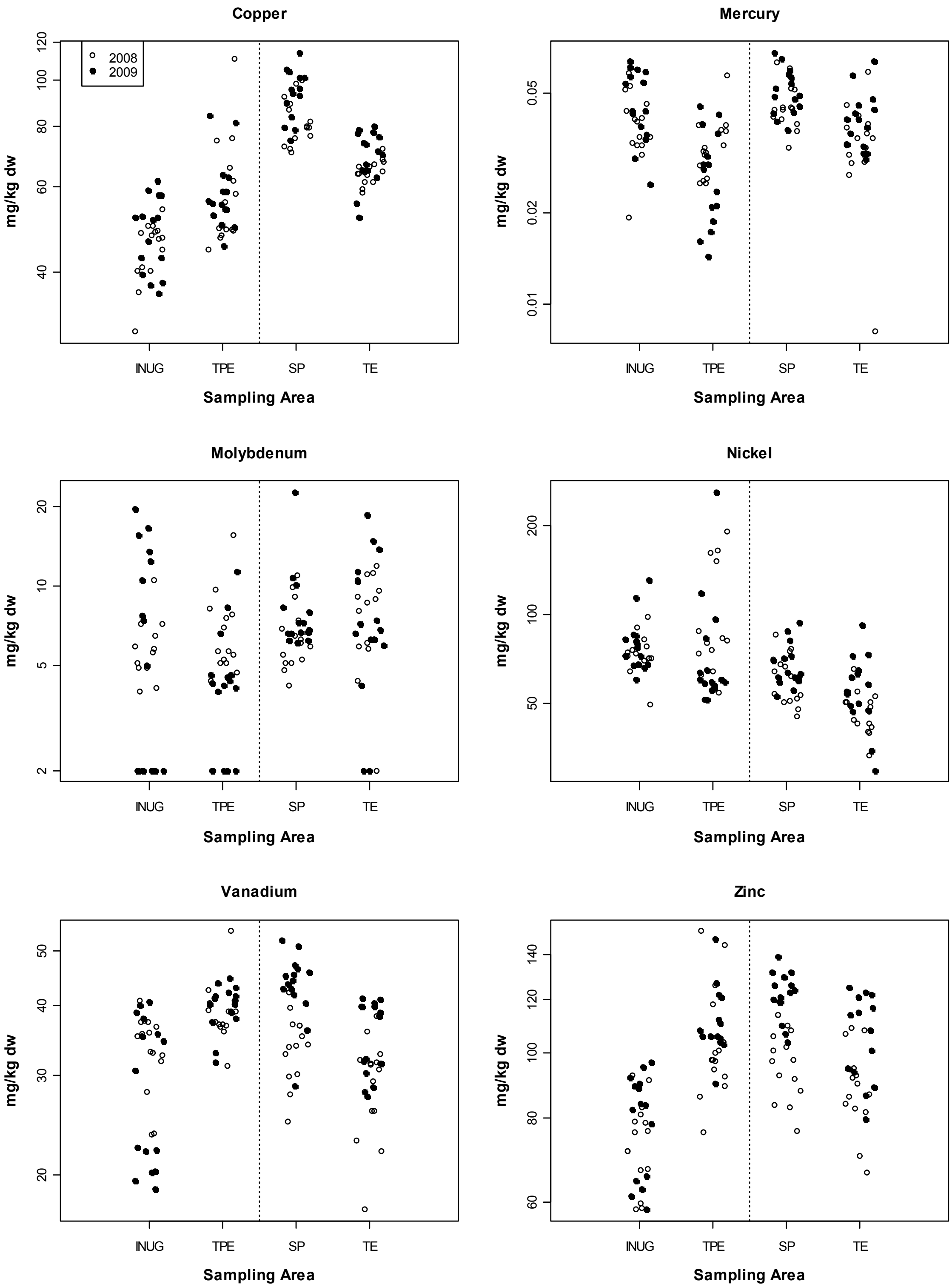


Figure 3-2. Benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) across Control, Impact and Unassigned areas for East Dike EAS 2009.

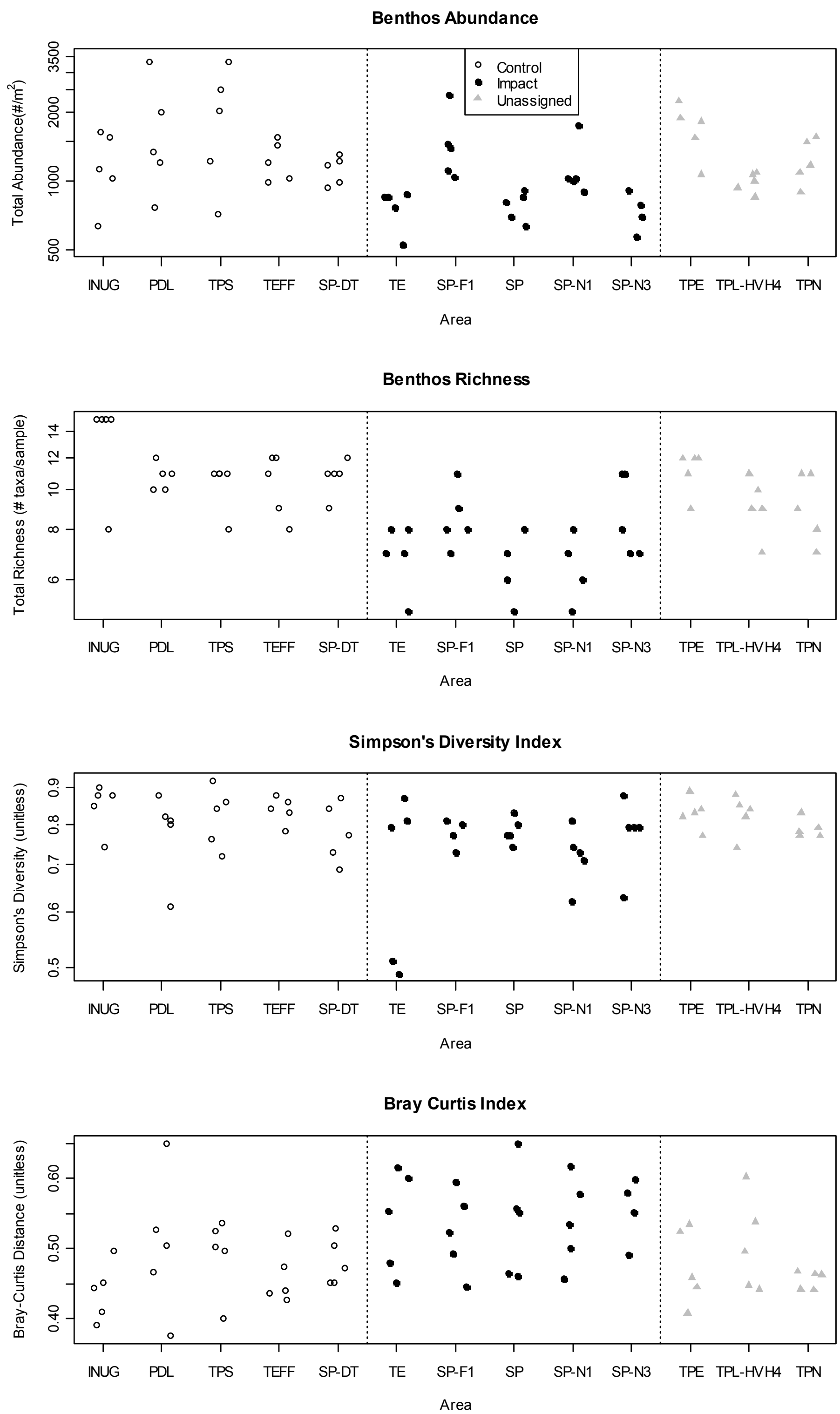


Figure 3-3. Key benthic community descriptors () as a function of sediment grain size (% fines), total organic carbon (% TOC) and depth (m) for East Dike EAS 2009.

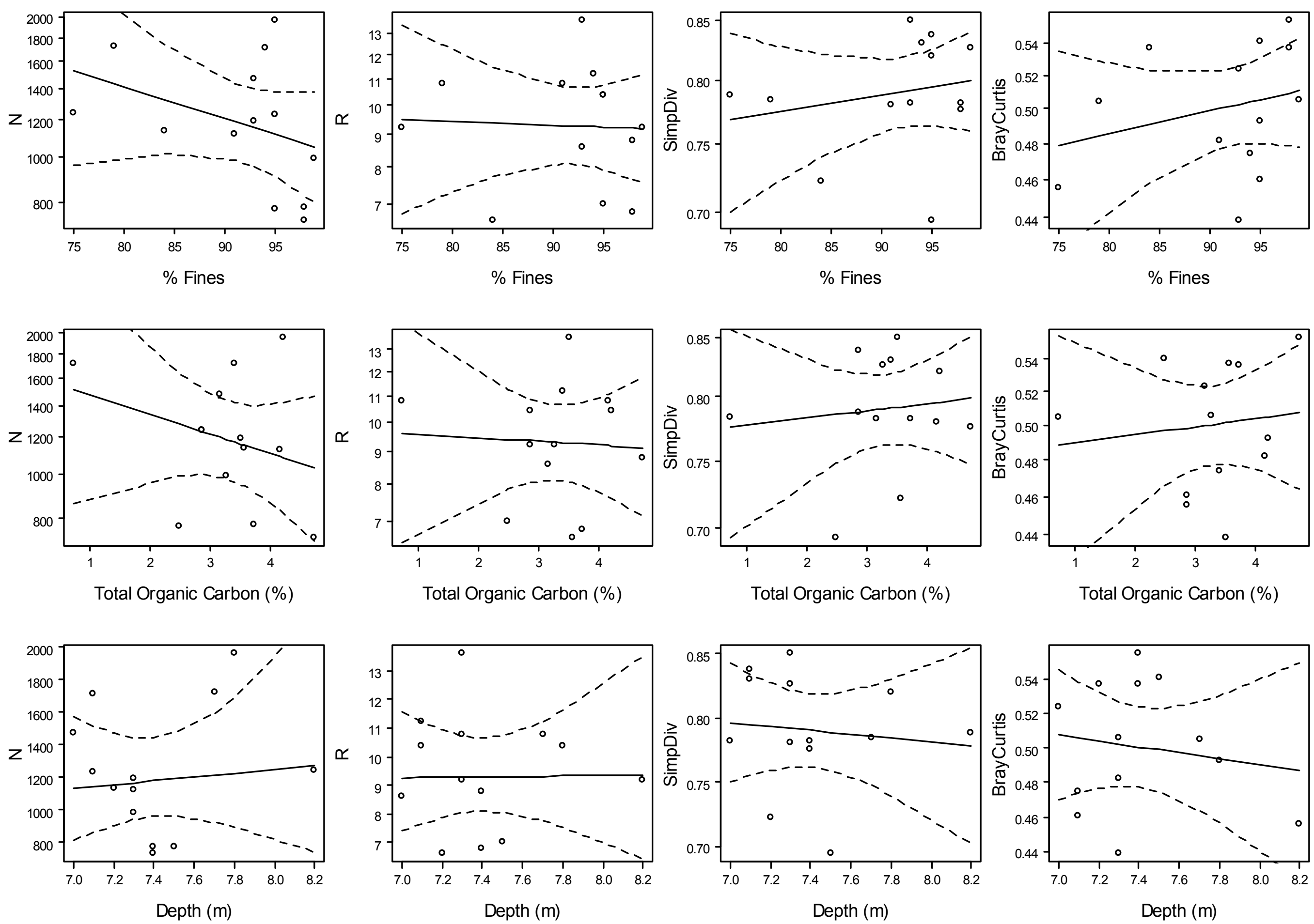


Figure 3-4. Boxplots of benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) by Effect grouping for East Dike EAS 2009.

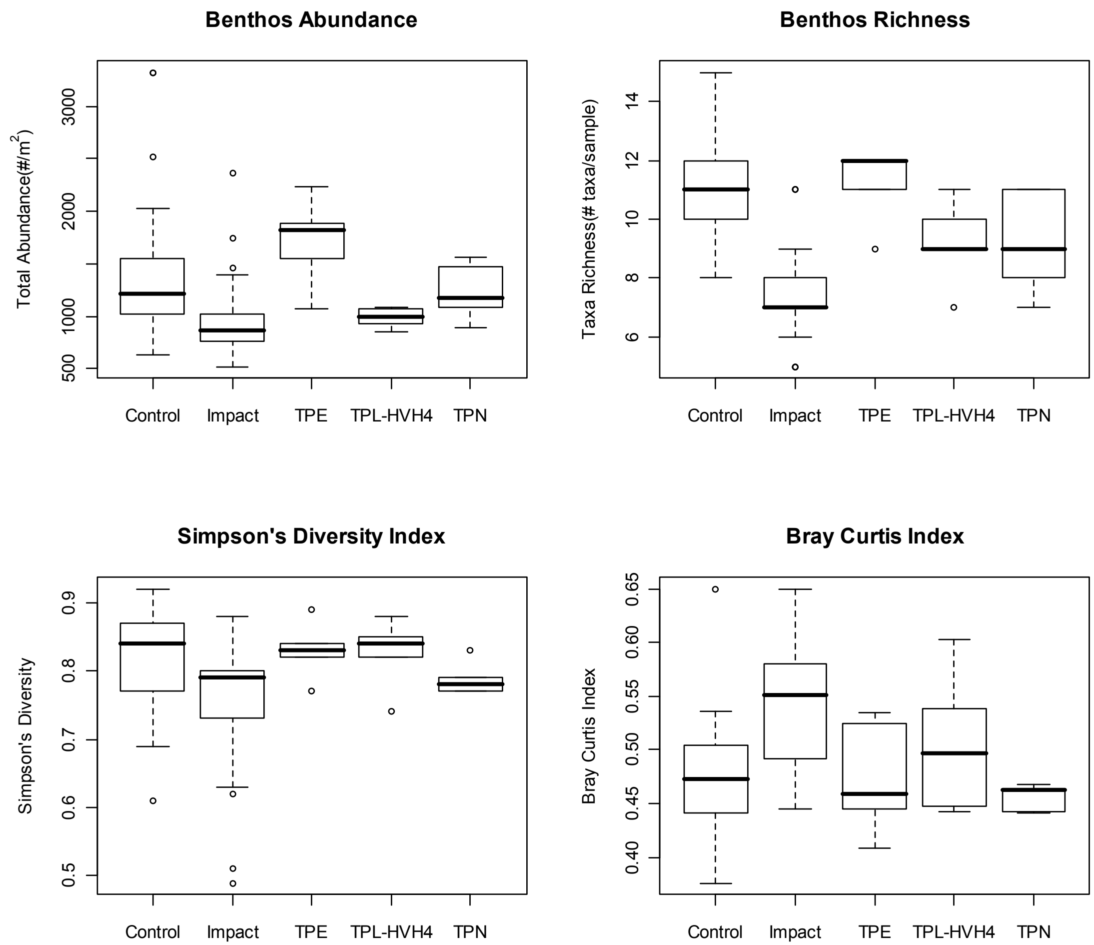


Figure 3-5. Benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) across areas for 2006 through 2009. Filled points are for areas considered potentially “impacted” by mine-related activities (see **Table 3-7**).

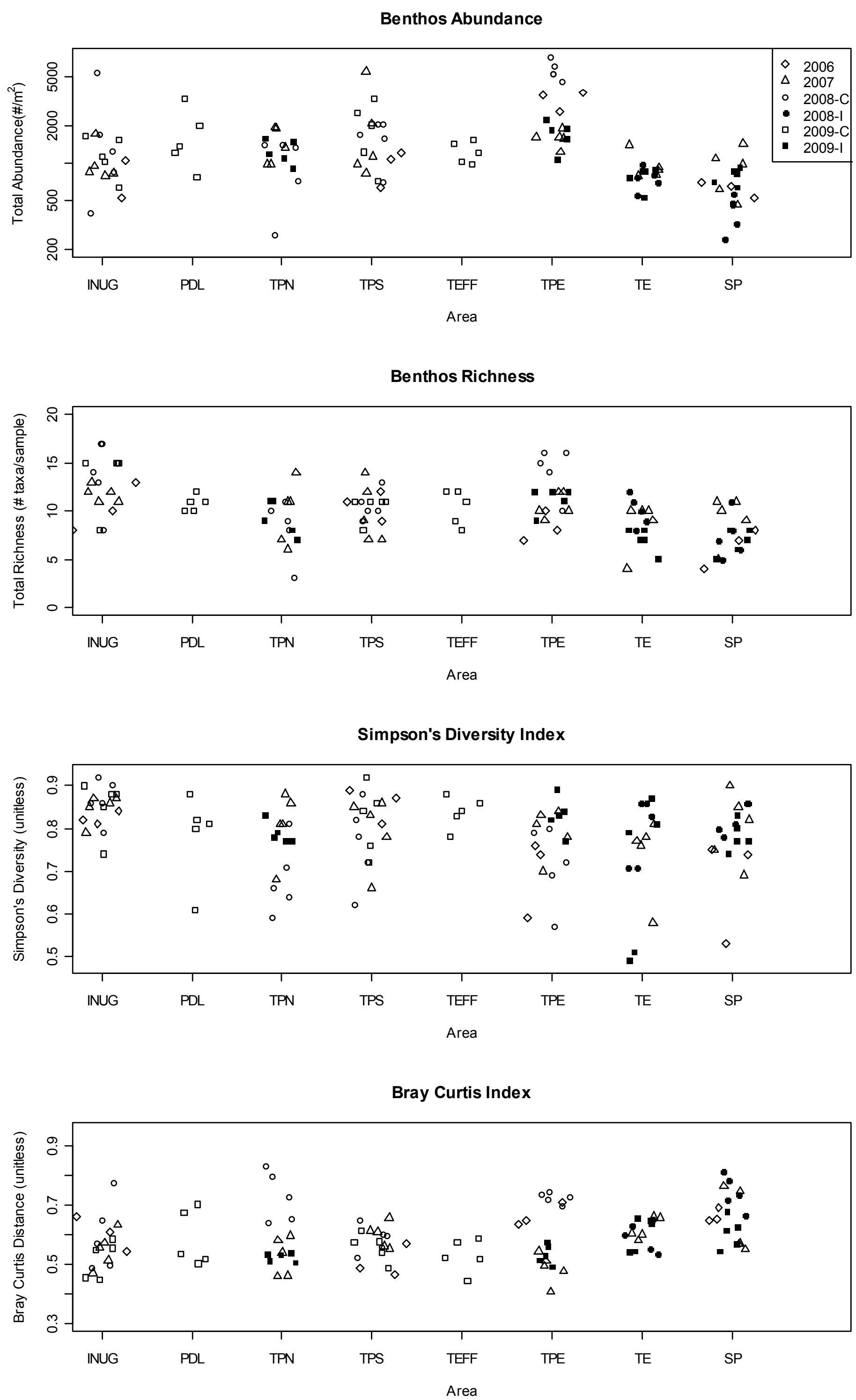
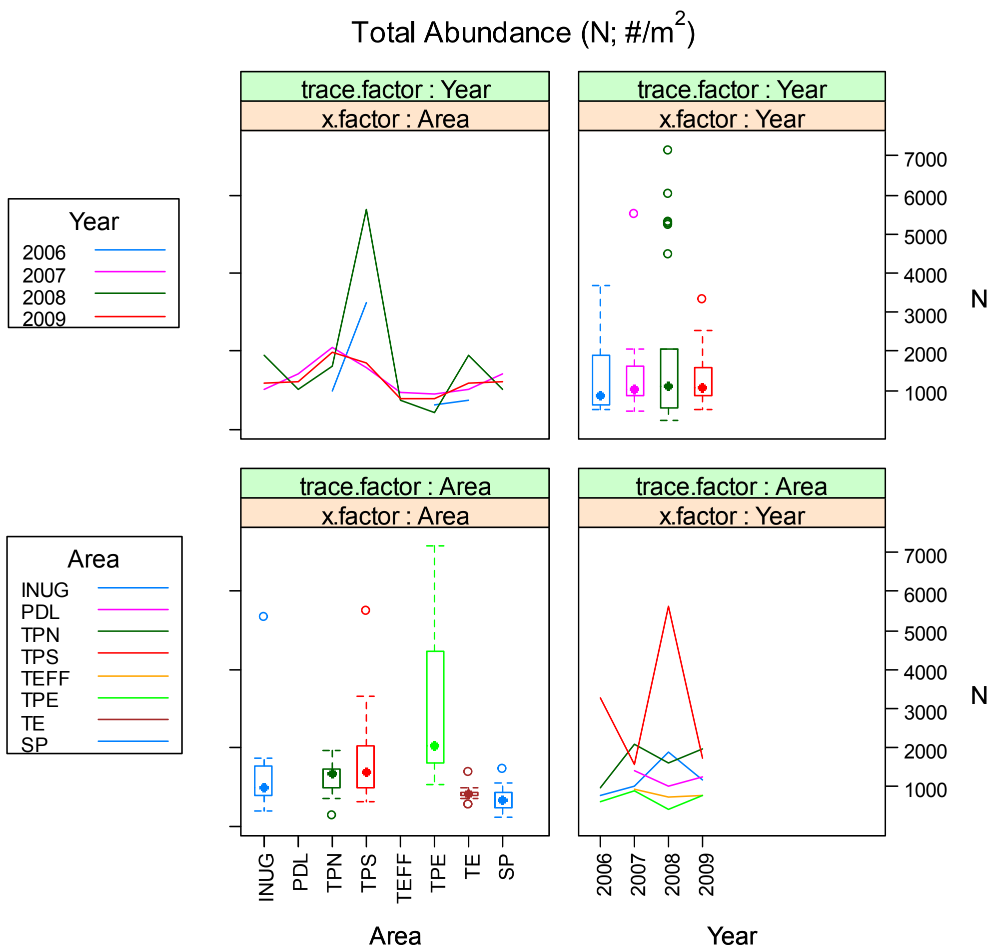


Figure 3-6. Interaction Plot for total benthic abundance by Area and Year for the CREMP data set.



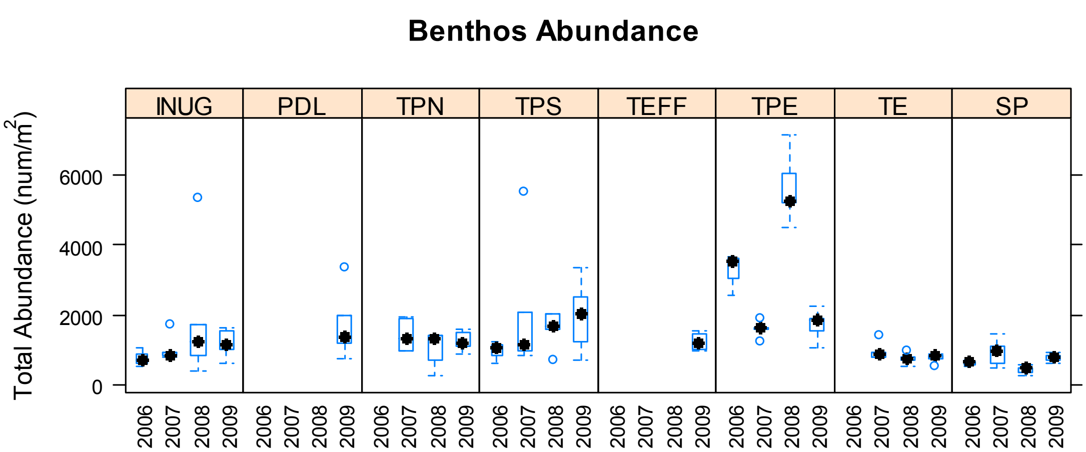
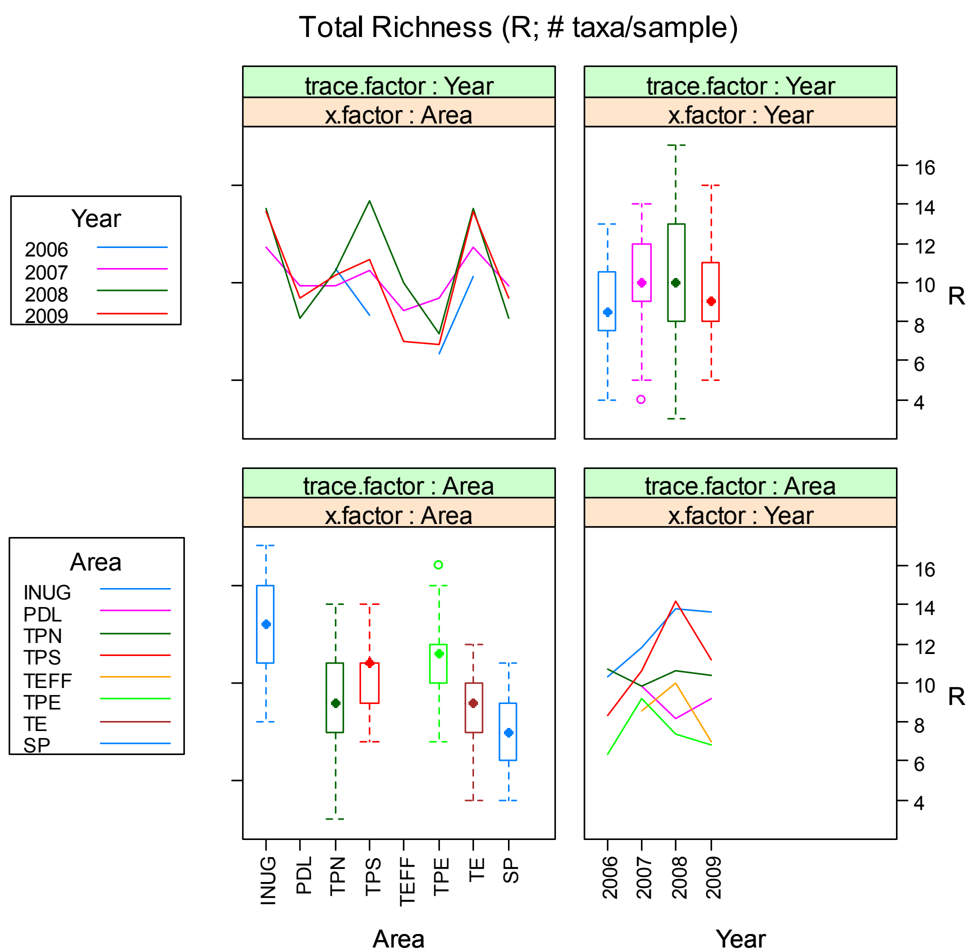


Figure 3-7. Interaction Plot for total benthic species richness by Area and Year for the CREMP data set.



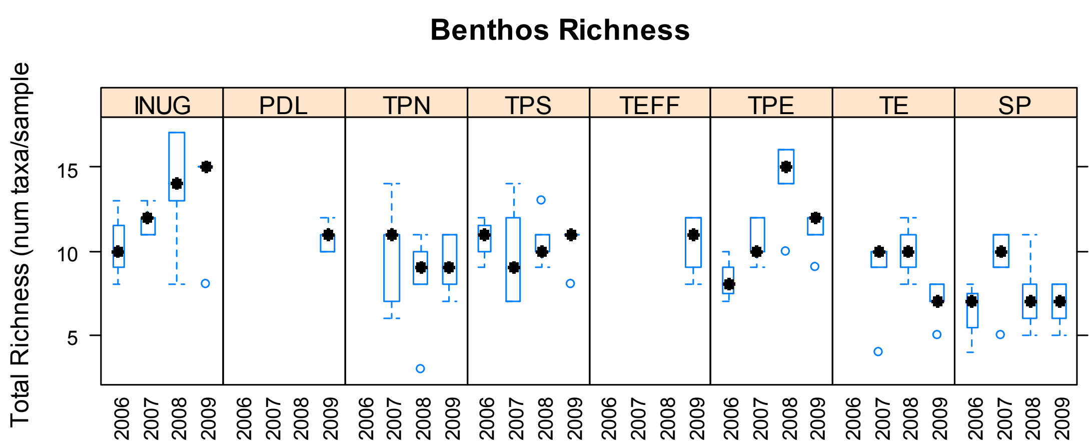
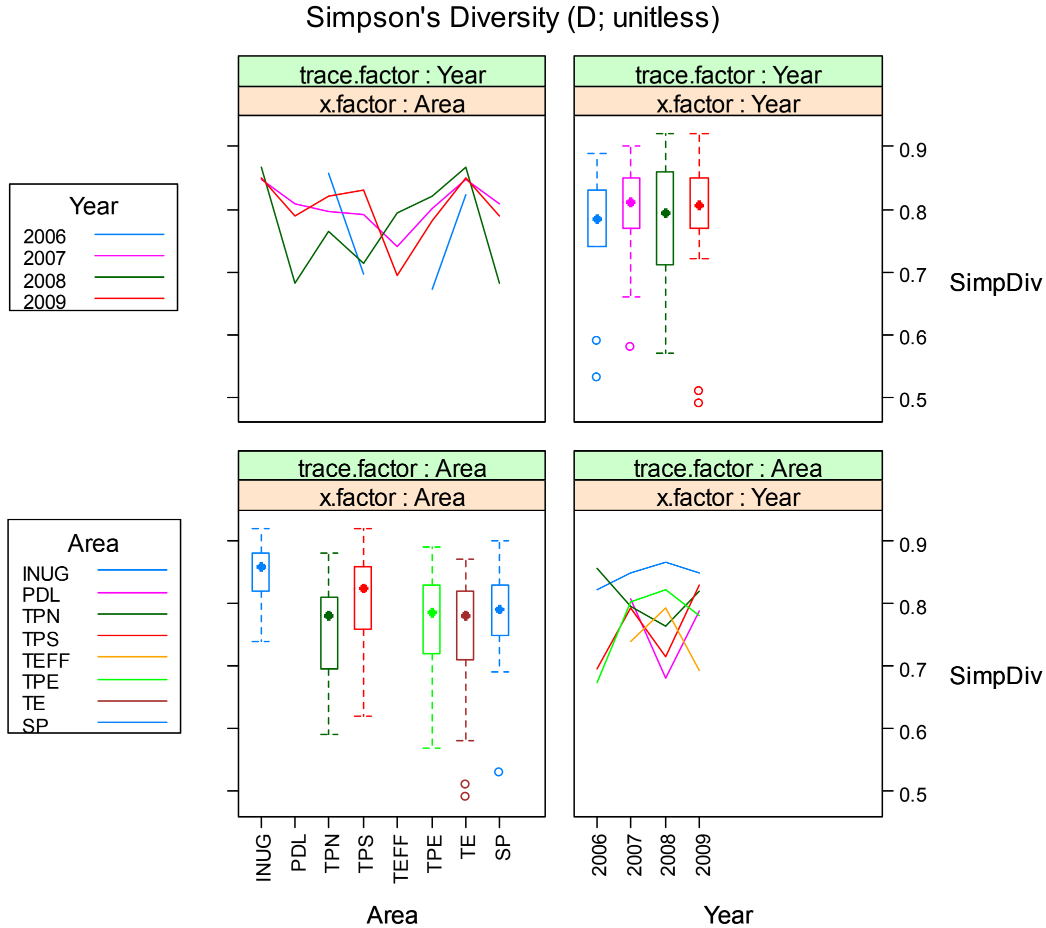


Figure 3-8. Interaction Plot for benthic community Simpson's diversity by Area and Year for the CREMP data set.



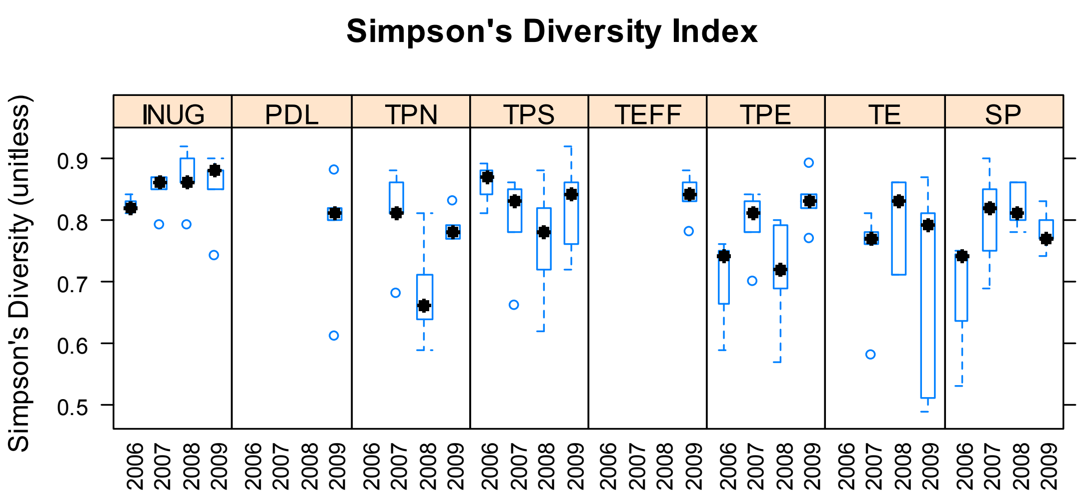
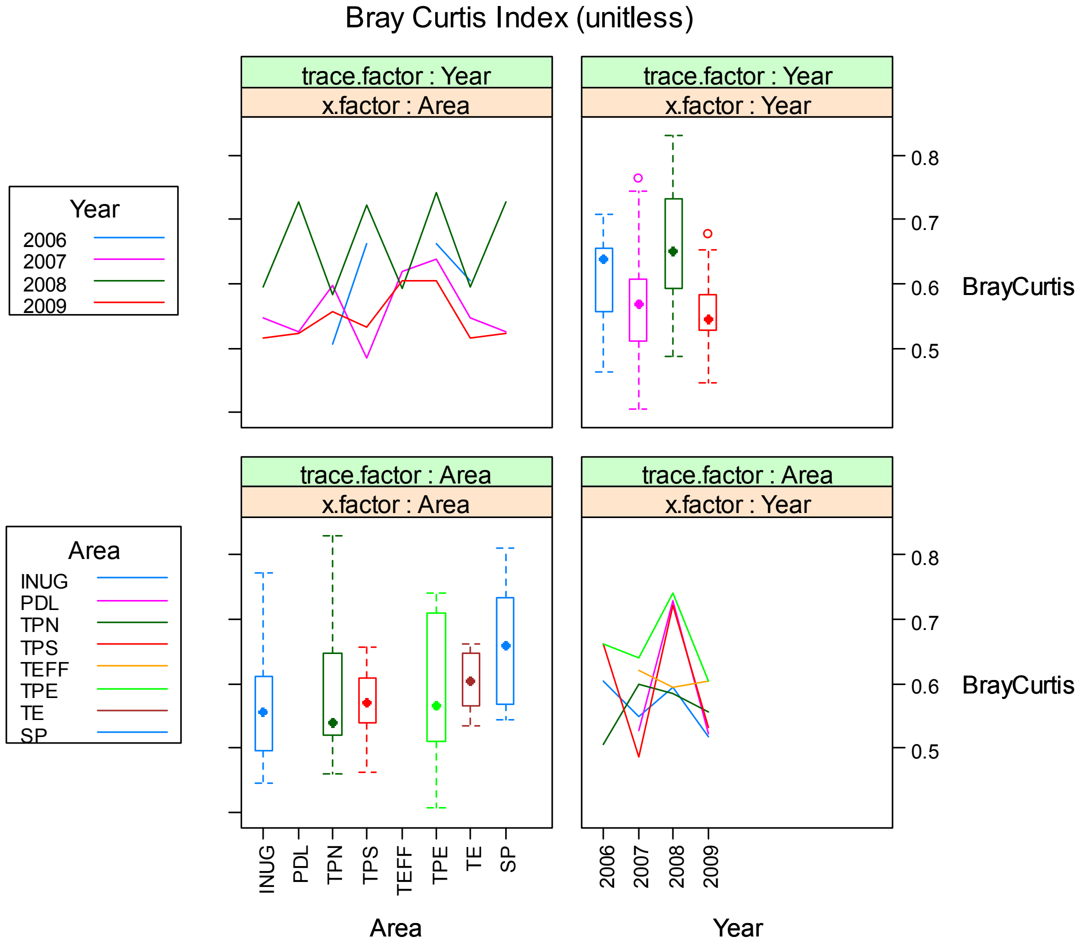


Figure 3-9. Interaction Plot for benthic community Bray Curtis Index by Area and Year for the CREMP data set.



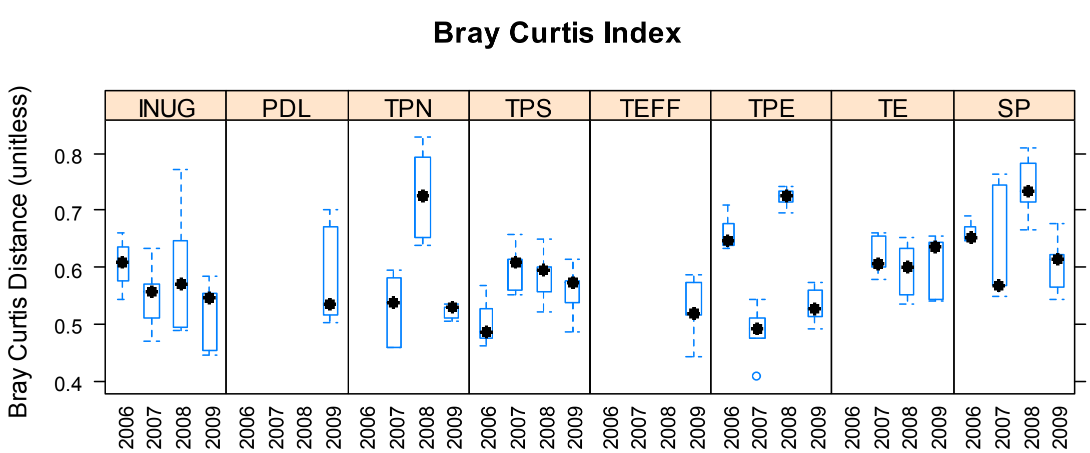


Figure 3-10. Boxplots of benthic community metrics (abundance, richness, Simpson's Diversity, and Bray Curtis distance) by Effect grouping for CREMP data set.

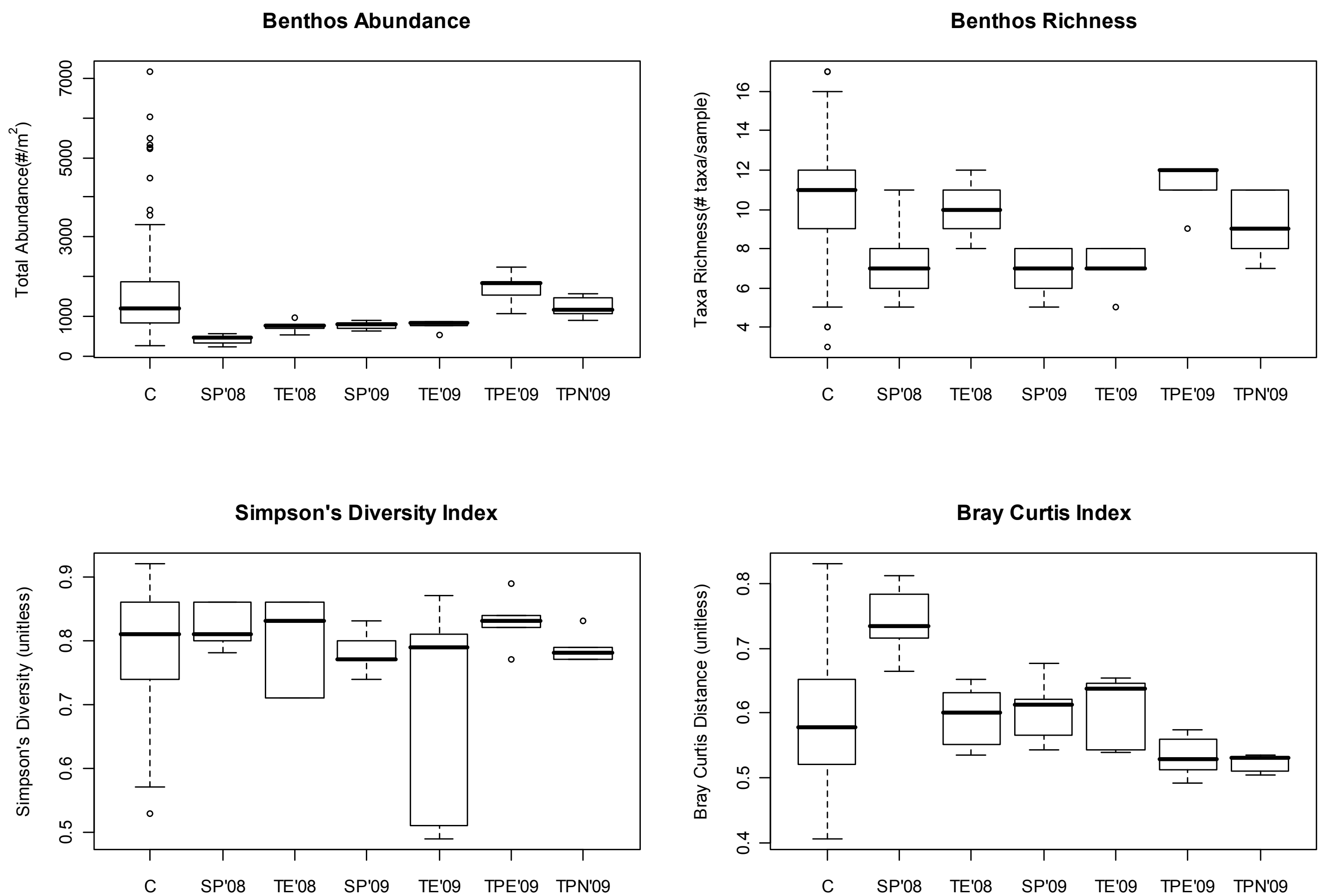
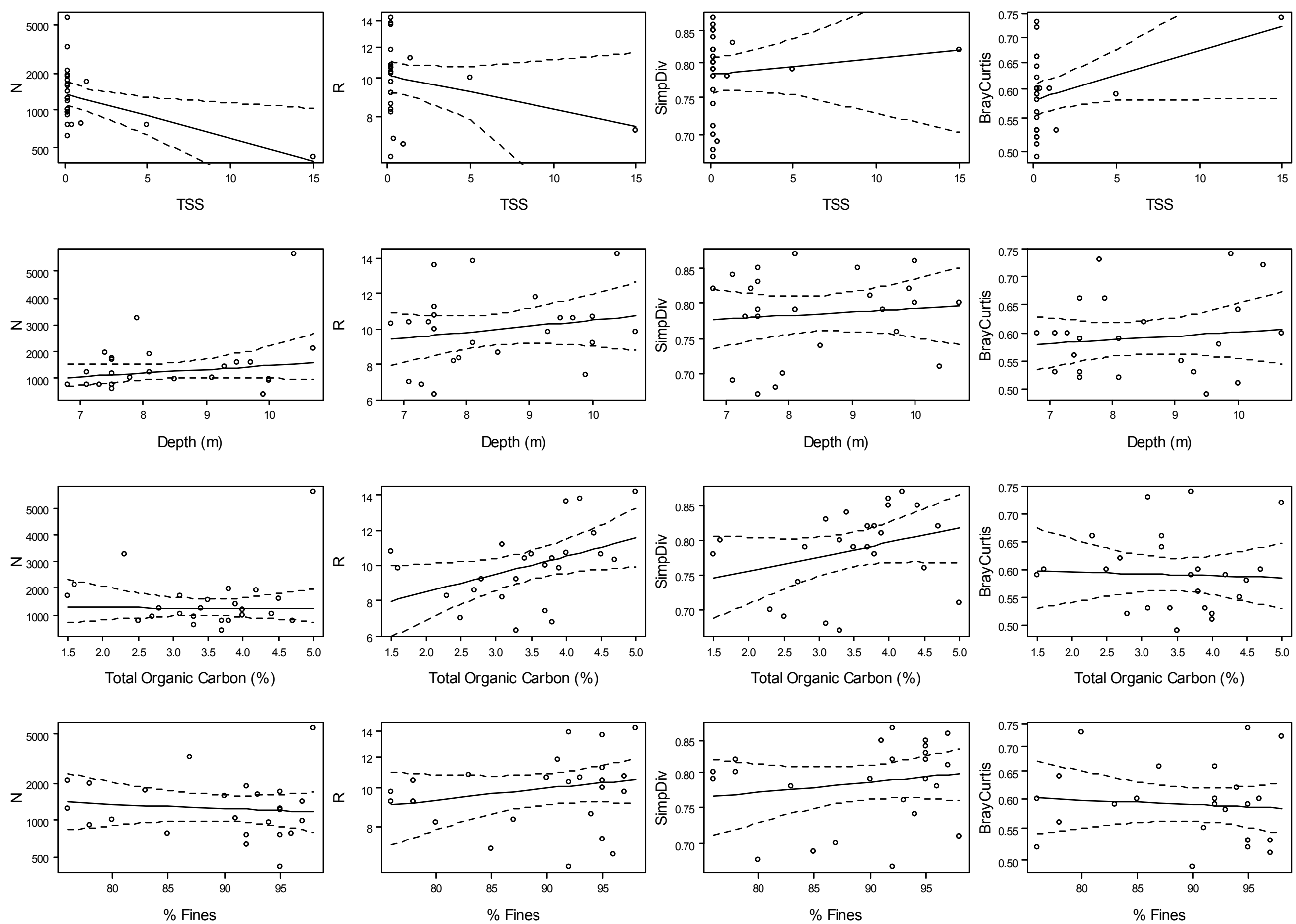


Figure 3-11. Key benthic community descriptors (N [abundance], R [richness], SimpDiv [Simpson's Diversity Index], and BrayCurtis [Bray Curtis Distance Index) as a function of TSS exposure, depth (m), total organic carbon (% TOC), and sediment grain size (% fines) for the CREMP data set.



4. BAY-GOOSE TSS EAS

4.1. Study Design Overview

The study components for the Bay-Goose Dike TSS EAS in 2009 followed the same general design:

- *Area* – Five different areas were sampled (see main document for maps): EAS-DT (control), EAS-TPS (control), EAS-BGE (impact – high exposure), EAS-BGW (impact – moderate exposure), and EAS-SPC (impact – low exposure). Five replicate samples were collected at each area.
- *Date* – Two dates (R1 [round 1] and R2 [round 2]) were sampled: 17-19 September (R1) and 24-27 September (R2). It should be noted that TSS concentrations were generally similar between the two events.
- *Effect* – A dummy variable was coded to reflect whether areas were control (i.e., background TSS concentrations) or impact (i.e., elevated TSS concentrations).

4.2. Results

Key response variables (units) assessed in this analysis included the following:

- Chlorophyll-α (mg/m^3 dw)
- Phytoplankton biomass (mg/m^3 ww)
- Phytoplankton diversity (Simpson's Diversity Index [D])
- Zooplankton biomass (mg/m^3 dw)

Summary data for these variables are presented in **Table 4-1** (the raw data file is provided in **Appendix D**). Results by Area and Date for each variable are shown in **Figure 4-1**.

The model structure used for the analyses was as follows: y ~ Effect + Date. While Date was included, there were no major changes in TSS exposure between sampling events. Consequently, that model term would be expected to indicate seasonal changes rather than TSS-related changes. In addition, initial review of the data suggested possible inherent differences between Second and Third Portage lakes. For example, **Figure 4-1** shows higher plankton biomass in both the control area (EAS-DT) and impact area (EAS-SPC) of Second Portage Lake relative to the other areas. Consequently, prior to running the aforementioned model, response variables were tested for differences between lakes (i.e., y = Lake). Where significant differences were found between lakes, the data set was split and analyzed separately for each lake.

The implication of this splitting was that, as per discussions in **Section 2.3**, the scale of inference moved from control-impact groupings to areas. Identified differences among or between areas, therefore, could potentially be due to natural inherent differences and/or to TSS exposure. Consequently, where available, data from CREMP monitoring (Azimuth 2010b, 2009c, 2008b, 2008c) or last year's EAS study (Azimuth 2009a) were used to assess relative conditions among areas prior to the onset of elevated TSS (see discussion below for each response variable). Based on the strength of available evidence, conclusions were made regarding uncertainties in attributing any observed differences to TSS exposure.

Results for the statistical analyses are provided in **Table 4-2** and described below for each response variable:

- *Phytoplankton Biomass* – Significant differences were seen between lakes (see **Figure 4-1**), so the model was applied to each lake. In Third Portage Lake, significant differences between the control area and the two impact areas were found (**Figure 4-2**), with no significant effect of Date. No significant differences were seen between the control and impact areas in Second Portage Lake (**Figure 4-3**). The results for Third Portage Lake were further assessed by examining the assumption of area similarity prior to the elevated TSS concentrations in the east basin. CREMP monitoring results prior to dike construction (**Figure 4-4**) were tested using the following model: log10(biomass) ~ Area + Month + Year (i.e., to look at spatial differences once seasonal and annual variation were accounted for). The east basin area (TPE) had significantly higher biomass than the other areas. Thus, the decreases observed in the EAS data set are likely conservative estimates of actual effect size. The CREMP data also independently corroborate the EAS conclusion that phytoplankton biomass was reduced in the east basin in September. Interestingly, the CREMP data (**Figure 4-5**) suggest this effect did not extend to November 2009, when TPE was higher than TPN as biomass dropped off in early winter.

- *Phytoplankton Diversity* – Not unexpected based on **Figures 4-1 and 4-6**, no significant trends were detected for plankton diversity relative to TSS exposure. This conclusion was also independently corroborated with the CREMP data (**Figures 4-7 and 4-8**).

- *Chlorophyll*-α – Similar to phytoplankton biomass, significant differences were found in chlorophyll-α between lakes, with higher concentrations in Second Portage Lake. Consequently, the model was applied separately to each lake. Within Third Portage Lake, significantly lower chlorophyll-α concentrations were found at the impact areas relative to the control area (**Figure 4-9**). No significant differences between the impact and control areas were observed within Second Portage Lake (**Figure 4-10**). Interestingly, there was a general increase in chlorophyll-α concentrations between sampling dates in both lakes (**Figures 4-9 and 4-10**). The CREMP data (**Figure 4-11**) did corroborate the observed differences between the two lakes (i.e., SP higher) and suggest no systematic differences among basins in Third Portage Lake. However, while the EAS data showed clear differences between the control and impact areas in Third Portage Lake, the CREMP data were less clear.

- *Zooplankton Biomass* – No significant differences were found between lakes (see **Figures 4-1 and 4-12**), so the model was applied to the whole data set. No significant differences were observed between control and impact areas across lakes. In addition, while the CREMP data set did not include zooplankton, last year's EAS study for the East Dike (Azimuth 2009a) did look at zooplankton biomass in the east basin (area 3PL-EAS) in September 2008 in the absence of elevated TSS. Interestingly, zooplankton biomass in the east basin was actually lower in 2008 than the levels seen in 2009. Furthermore, last year's overall EAS results showed no apparent response of zooplankton biomass to elevated TSS concentrations in Second Portage Lake. Thus, all available evidence supports a conclusion that the observed zooplankton biomass levels are within the range natural variability and do not appear affected by elevated TSS.

As discussed in **Section 2.3**, conclusions regarding the cause of observed differences between control and impact areas need to consider the available evidence supporting the assumption that the areas were similar prior to exposure to elevated TSS. Without such evidence, we are left only inferring that the areas are different and that exposure to elevated TSS may be cause.

For the reduced phytoplankton biomass in the east basin of Third Portage Lake, available data do support an assumption that the east basin does not generally contain lower biomass than other parts of the lake. In fact, the CREMP data actually indicate higher phytoplankton biomass in the east basin. Consequently, we can infer with some confidence that the observed differences in September were due to TSS exposure. The CREMP data also indicate that phytoplankton biomass was no longer lower in the east basin in November 2009 relative to the other basins.

For chlorophyll-α, reduced concentrations were found at the two east basin impact areas relative to the south basin control area in Third Portage Lake. The CREMP data supported the assumption of no inherent differences among basins in Third Portage Lake, so the observed differences could be attributable to elevated TSS. This result would not be unexpected given the reduced phytoplankton biomass also observed for the east basin.

Table 4-1. Primary and secondary productivity descriptors by sampling area for the 2009 Bay-Goose Dike EAS.

		Phytoplankton															Zooplankton				
		Biomass (mg/m^3 ww)					Diversity (Simpson's D)					Chlorophyll-α (mg/m^3 dw)					Biomass (mg/m^3 dw)				
Area	**Date**	**Mean**	**SD**	**Median**	**Min**	**Max**	**Mean**	**SD**	**Median**	**Min**	**Max**	**Mean**	**SD**	**Median**	**Min**	**Max**	**Mean**	**SD**	**Median**	**Min**	**Max**
EAS-TPS	R1	81.1	16.2	78.7	57.5	100.4	0.87	0.02	0.88	0.84	0.88	0.28	0.09	0.31	0.16	0.37	49.72	21.9	40.69	28.3	81.4
EAS-TPS	R2	76.0	8.1	76.3	67.6	88.7	0.86	0.04	0.87	0.78	0.88	0.75	0.02	0.75	0.73	0.78	21.41	7.28	20.35	12.4	29.2
EAS-DT	R1	167.2	28.3	159.1	141.5	210.9	0.86	0.01	0.86	0.85	0.88	0.40	0.13	0.34	0.25	0.57	3.538	1.65	3.54	1.77	6.19
EAS-DT	R2	187.6	36.2	164.5	162.0	244.5	0.84	0.02	0.84	0.82	0.87	0.74	0.09	0.72	0.63	0.86	37.16	34.6	20.35	13.3	96.4
EAS-BGE	R1	44.7	16.0	36.9	31.3	71.4	0.84	0.03	0.85	0.8	0.87	0.30	0.05	0.29	0.25	0.39	39.28	20.9	35.39	18.6	70.8
EAS-BGE	R2	51.3	23.5	47.1	26.9	88.7	0.85	0.06	0.85	0.75	0.91	0.40	0.17	0.33	0.28	0.70	22.65	8.52	18.58	15	32.7
EAS-BGW	R1	52.4	17.2	49.1	27.4	70.7	0.87	0.02	0.87	0.84	0.89	0.22	0.08	0.24	0.10	0.31	22.12	4.68	23.89	15	27.4
EAS-BGW	R2	59.8	13.4	54.3	45.2	79.6	0.87	0.02	0.88	0.84	0.9	0.48	0.18	0.52	0.24	0.72	24.59	3.21	25.65	21.2	28.3
EAS-SPC	R1	140.1	35.0	125.1	112.3	196.7	0.90	0.01	0.9	0.89	0.9	0.36	0.06	0.35	0.30	0.45	41.4	12.2	38.92	26.5	60.2
EAS-SPC	R2	198.3	19.4	188.0	183.4	229.3	0.87	0.01	0.87	0.86	0.88	0.72	0.19	0.72	0.47	1.00	42.11	7.52	38.92	34.5	52.2

Notes: Dates: R1 = Sept 17/18, 2009; R2 = Sept 24 - 27, 2009.

Table 4-2. Statistical model results for tests of significance of “Effect” on primary and secondary productivity for the 2009 Bay-Goose Dike EAS.

	Biomass (mg/m^3 ww)	Phytoplankton Diversity (Simpson's D)	Chlorophyll-α (mg/m^3 dw)	Zooplankton Biomass (mg/m^3 dw)
Transformation:	log10	None	None	log10
Lake Difference?	Yes (SPL>TPL)	No	Yes (SPL>TPL)	No
Control-Impact Difference?				
Across Lakes	NA	No	NA	Yes
p-value	NA	0.24	NA	0.02
Control Mean	NA	0.86	NA	17.1
Impact Mean	NA	0.87	NA	29.5
Third Portage Lake	Yes	NA	Yes	NA
p-value	<0.001	NA	0.0028	NA
Control Mean	78	NA	0.52	NA
Impact Mean	49	NA	0.35	NA
Second Portage Lake	No	NA	No	NA
p-value	0.53	NA	0.65	NA
Control Mean	175	NA	0.57	NA
Impact Mean	165	NA	0.54	NA
Date Difference?	No	No	Yes[1] (R1>R2)	No

Notes:
1. C & I means shown for pooled dates; R1 = round 1, R2 = round 2.
2. Impact areas have a higher mean zooplankton biomass.

Figure 4-1. Primary (phytoplankton biomass, diversity and chlorophyll-α) and secondary productivity metrics across control (EAS-TPS, EAS-DT) and impact (EAS-BGE, EAS-BGW, EAS-SPC) areas by event for the 2009 Bay-Goose EAS.

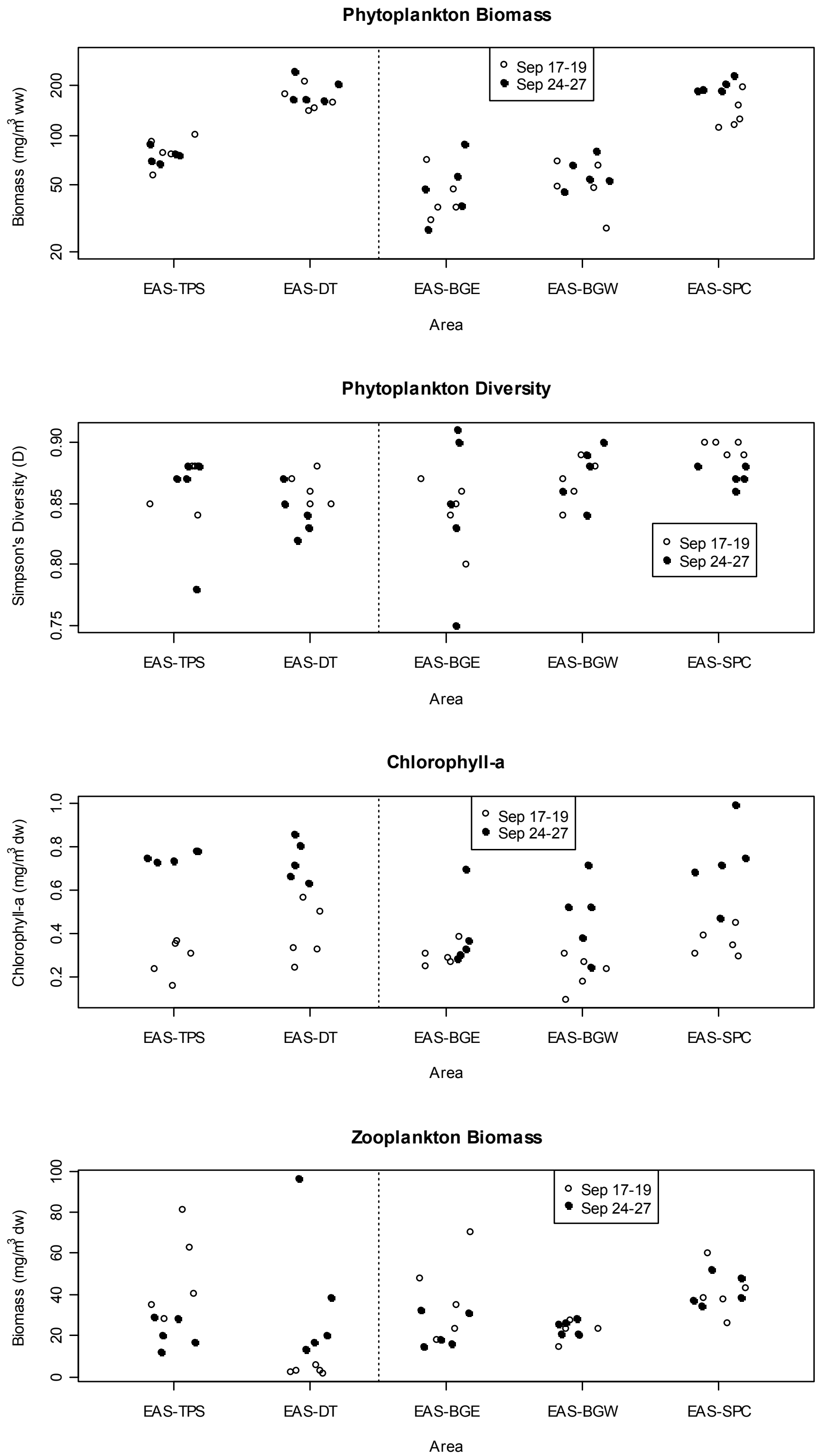


Figure 4-2. Phytoplankton biomass (ww) boxplots for Bay-Goose EAS areas (pooled dates) in Third Portage Lake, September 2009.

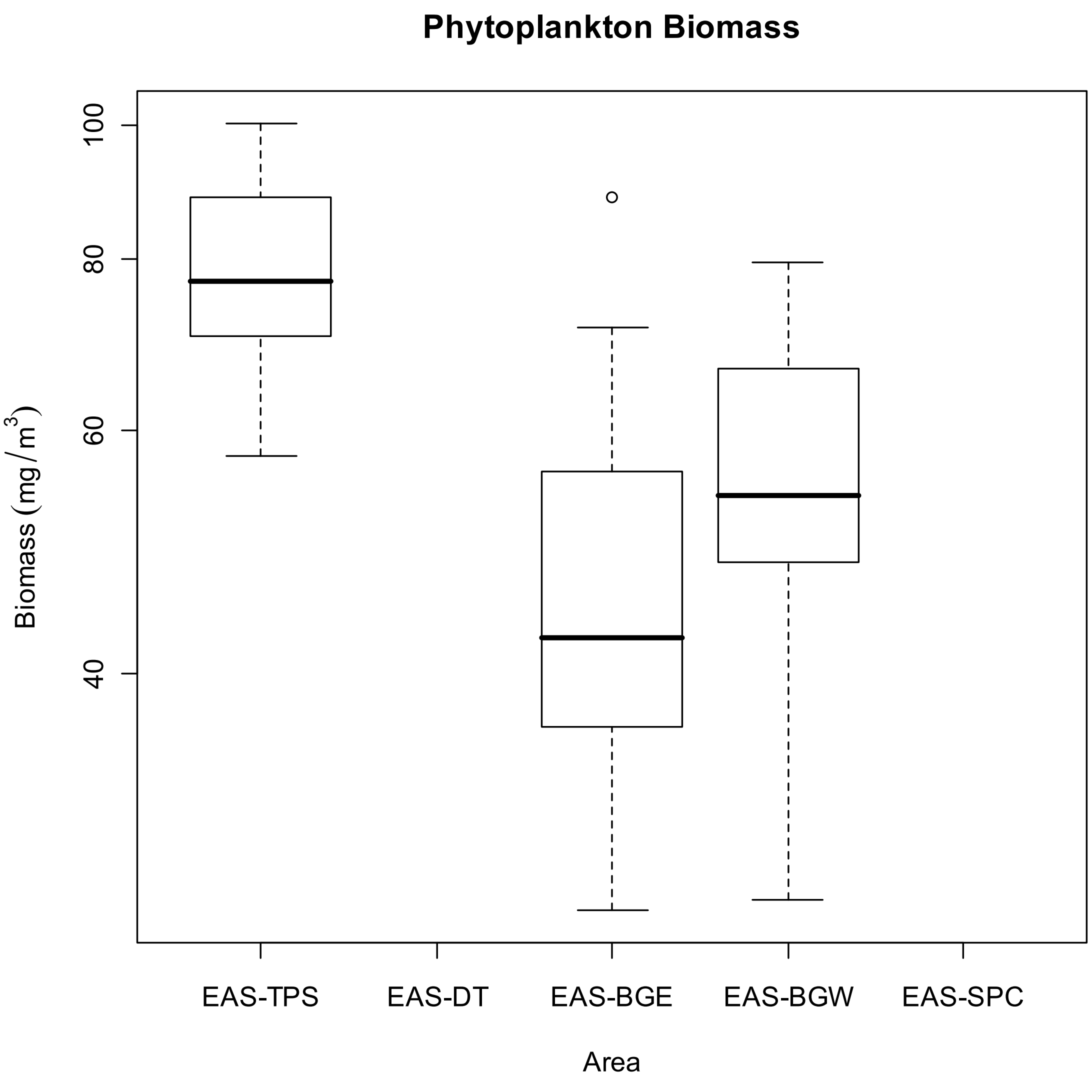


Figure 4-3. Phytoplankton biomass (ww) boxplots for Bay-Goose EAS areas (pooled dates) in Second Portage Lake, September 2009.

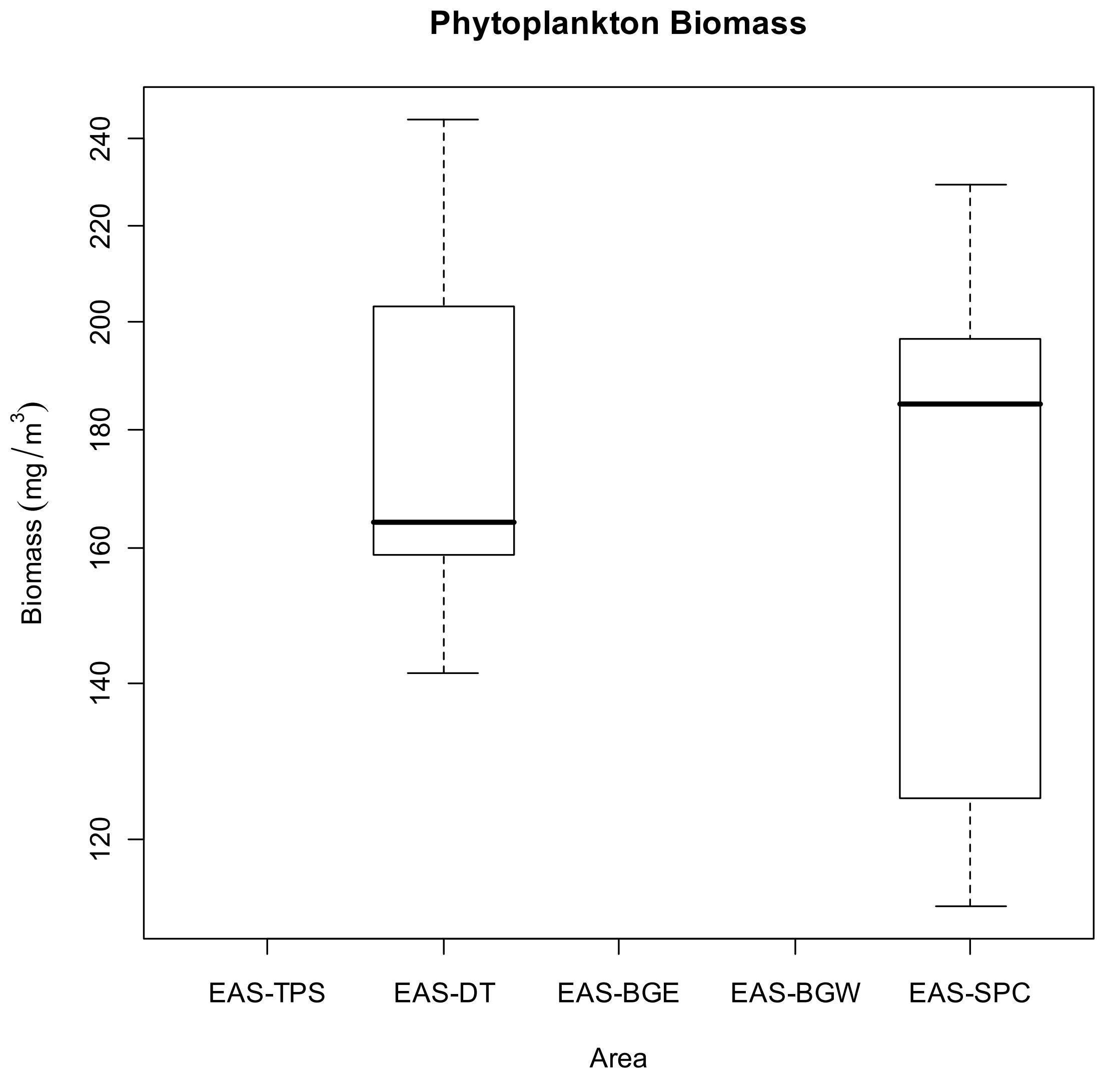


Figure 4-4. Phytoplankton biomass (ww) results for Third Portage Lake areas (TPE, TPN, TPS) from July 2006 to September 2009 (CREMP data set). Dashed line shows approximate onset of Bay-Goose Dike construction.

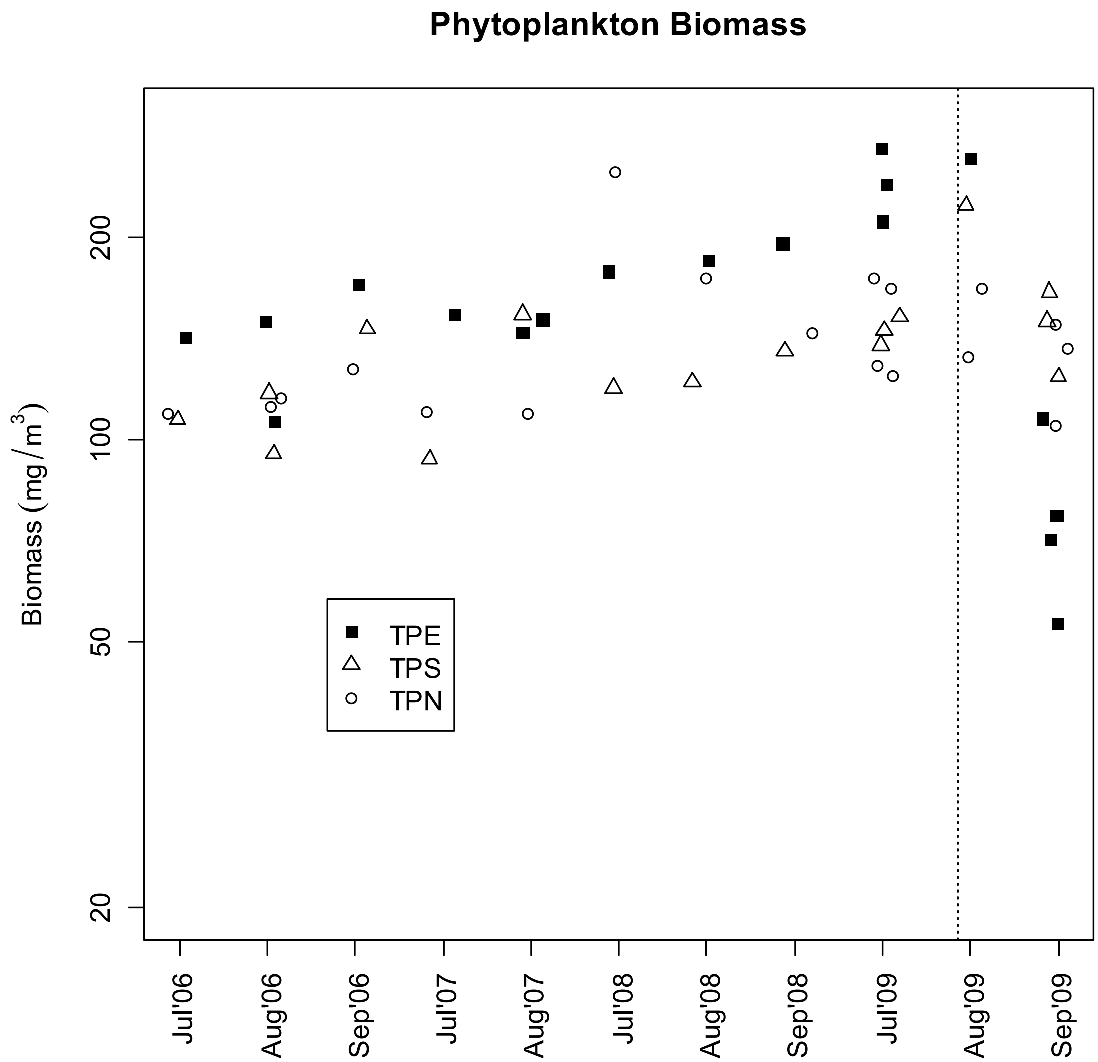


Figure 4-5. Phytoplankton biomass (ww) results for Third Portage Lake areas (TPE, TPN, TPS) from September 2009 to December 2009 (CREMP data set).

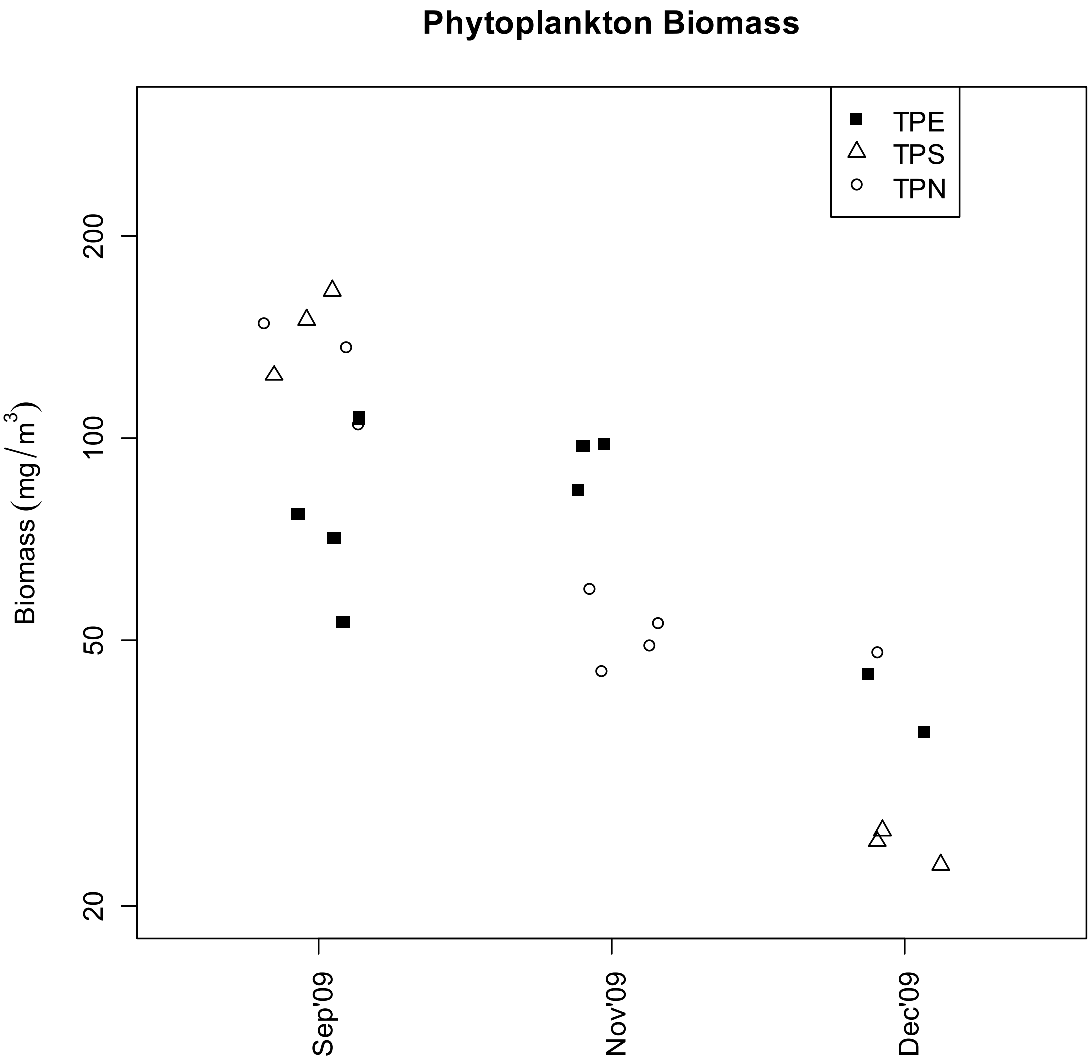


Figure 4-6. Phytoplankton diversity boxplots for Bay-Goose EAS areas (pooled dates) in Second and Third Portage lakes, September 2009.

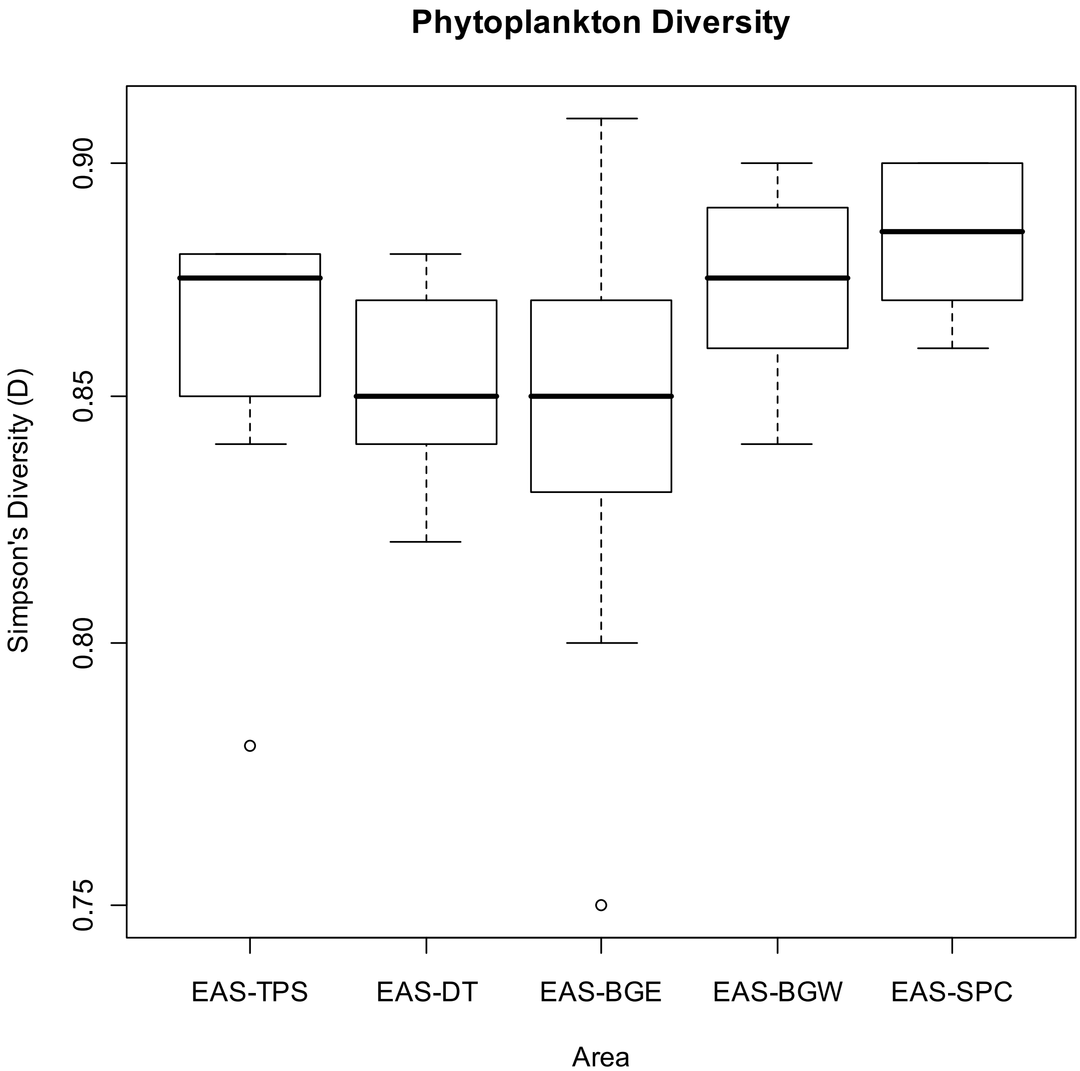


Figure 4-7. Phytoplankton diversity (Simpson's D) results for Third Portage Lake areas (TPE, TPN, TPS) from July 2006 to September 2009 (CREMP data set). Dashed line shows approximate onset of Bay-Goose Dike construction.

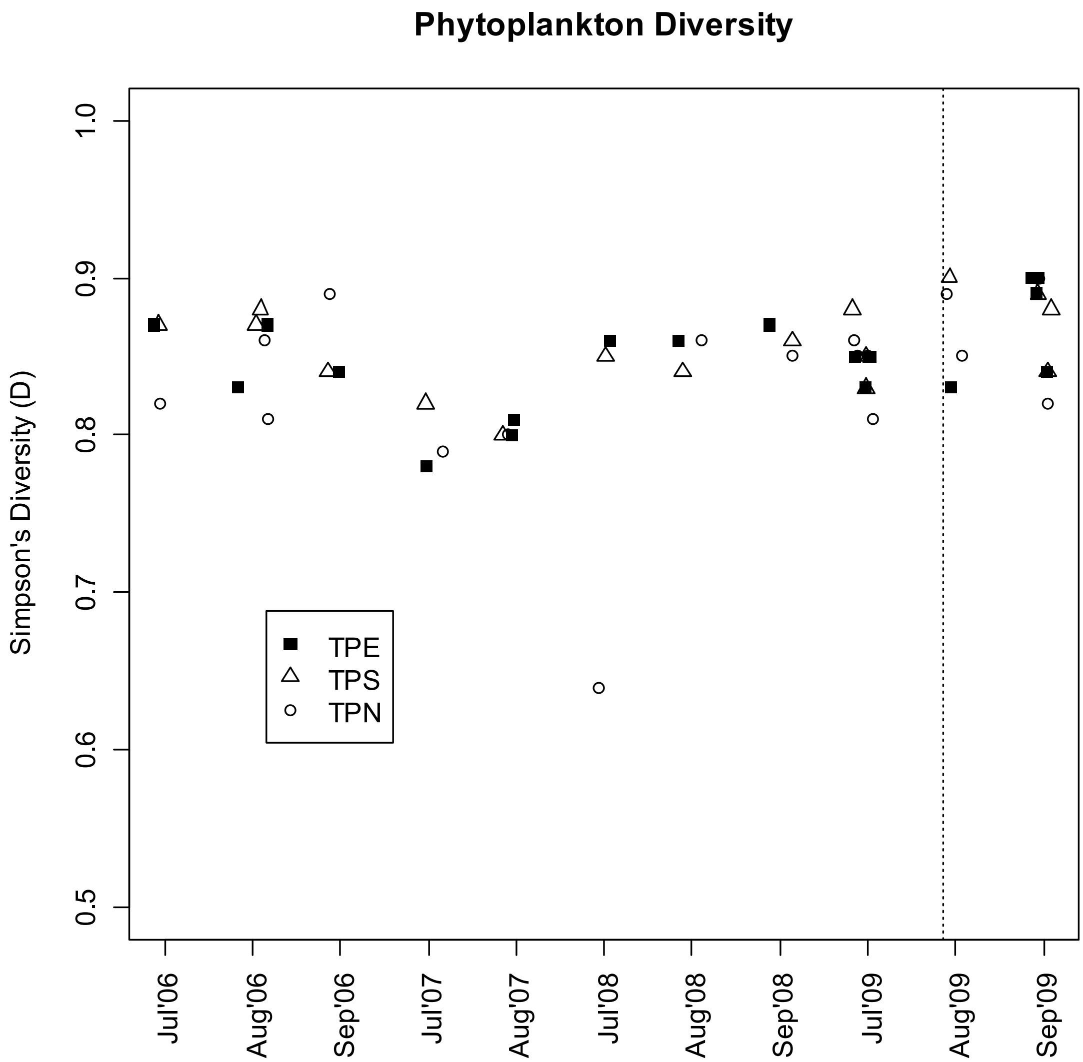


Figure 4-8. Phytoplankton diversity results for Third Portage Lake areas (TPE, TPN, TPS) from September 2009 to December 2009 (CREMP data set).

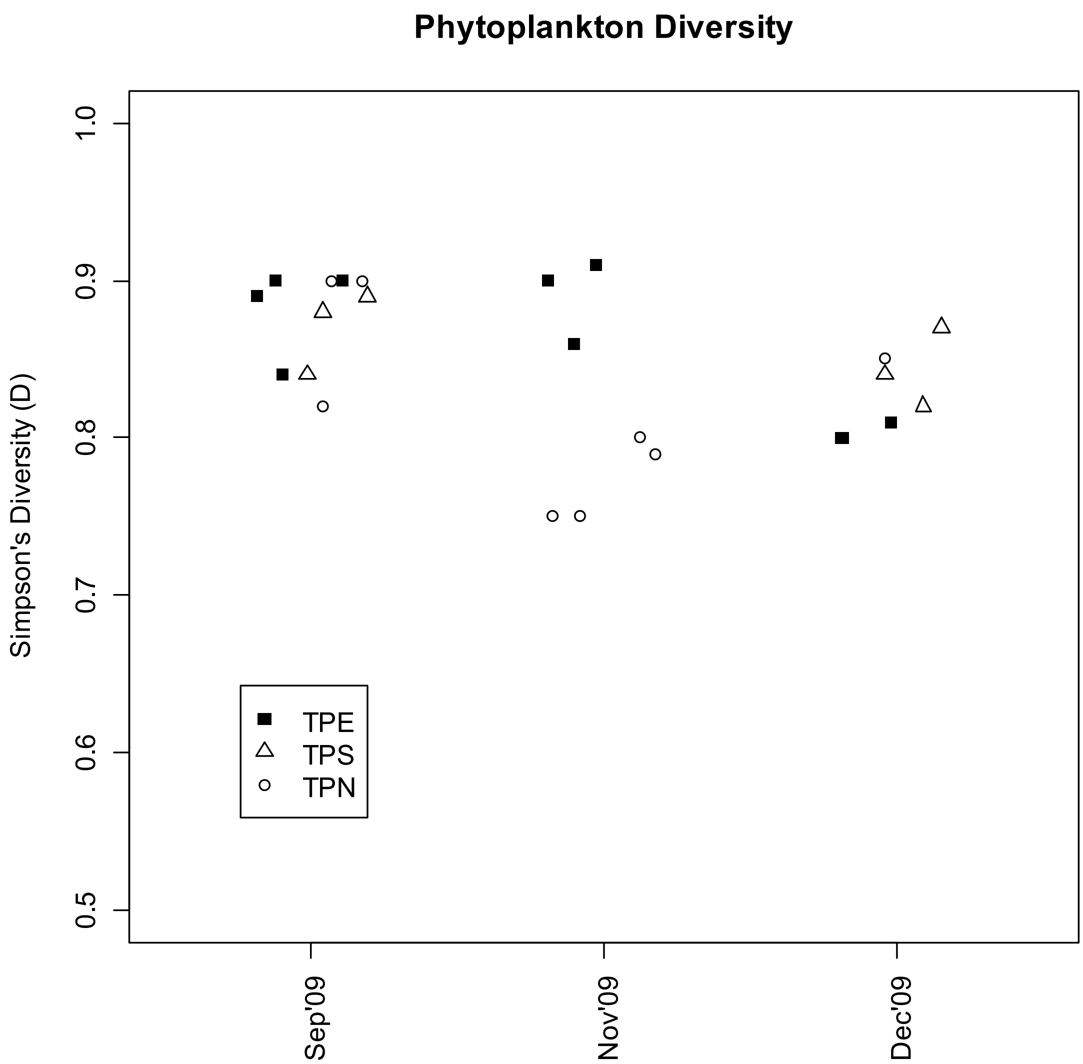


Figure 4-9. Chlorophyll-α (dw) boxplots for Bay-Goose EAS areas and sampling rounds (date) in Third Portage Lake, September 2009.

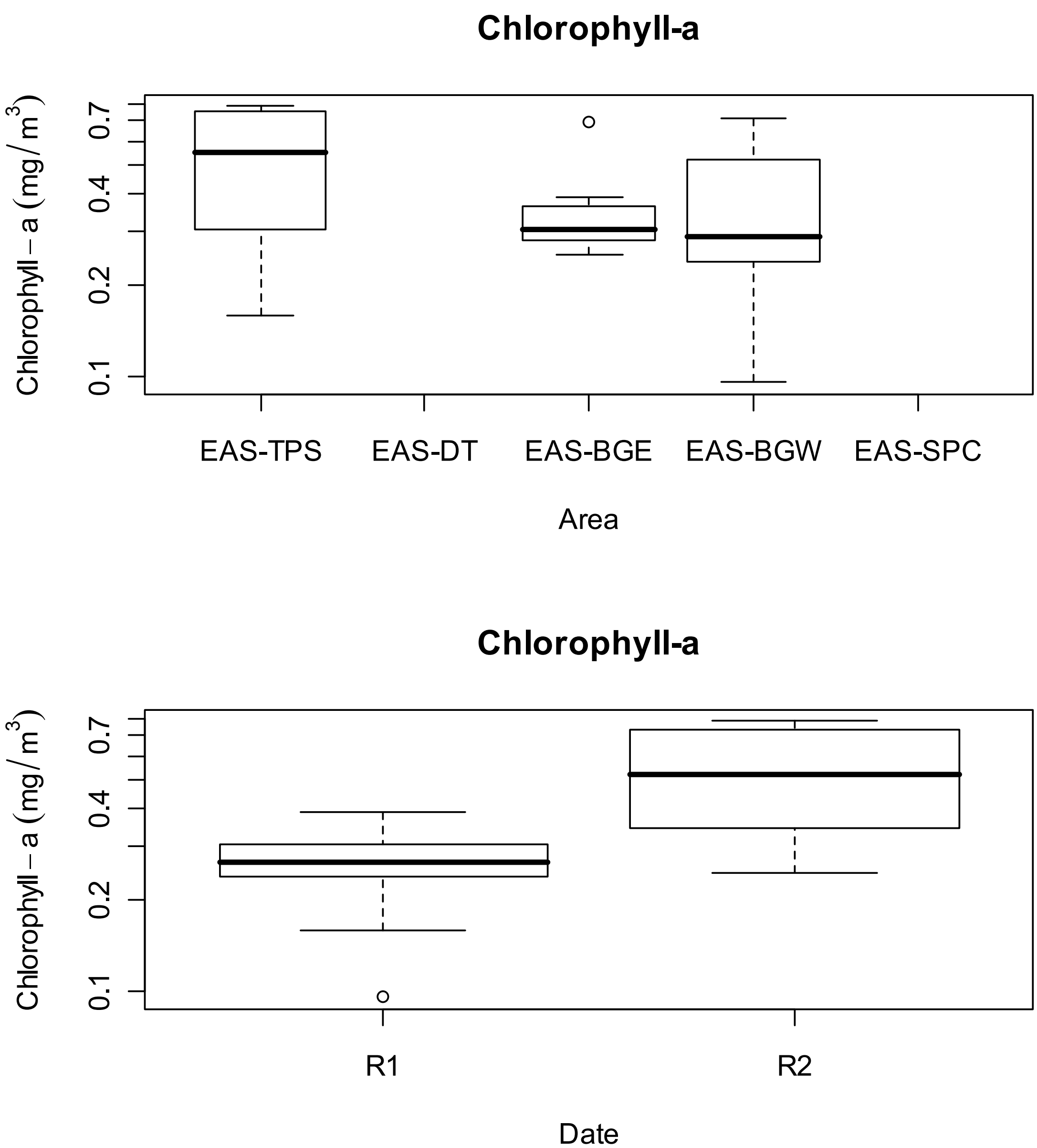
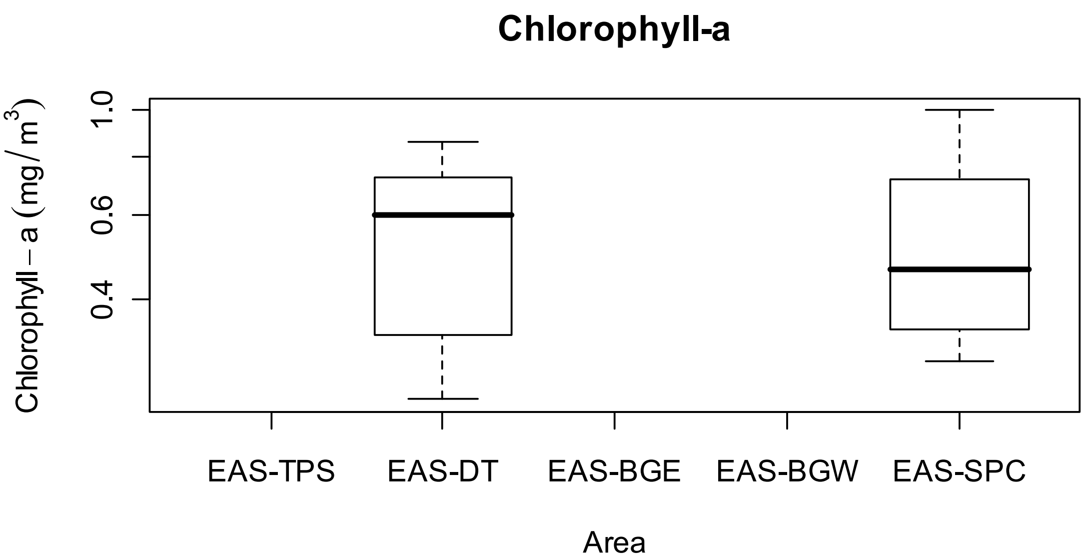


Figure 4-10. Chlorophyll-α (dw) boxplots for Bay-Goose EAS areas and sampling rounds (date) in Second Portage Lake, September 2009.



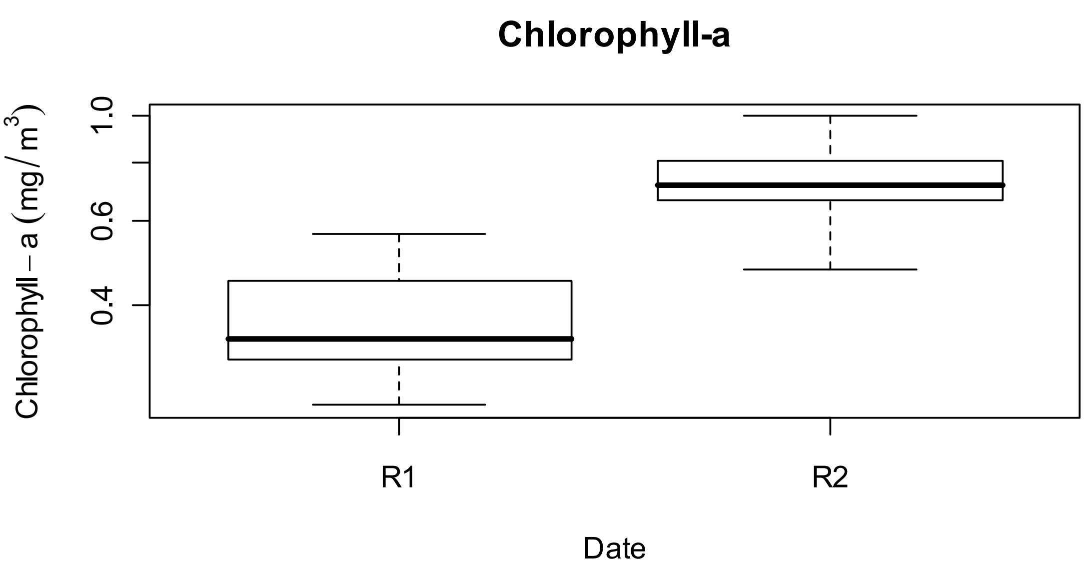


Figure 4-11. Chlorophyll-α (dw) results for Second and Third Portage lakes areas (SP, TPE, TPN, TPS) from July 2006 to September 2009 (CREMP data set). Dashed line shows approximate onset of Bay-Goose Dike construction.

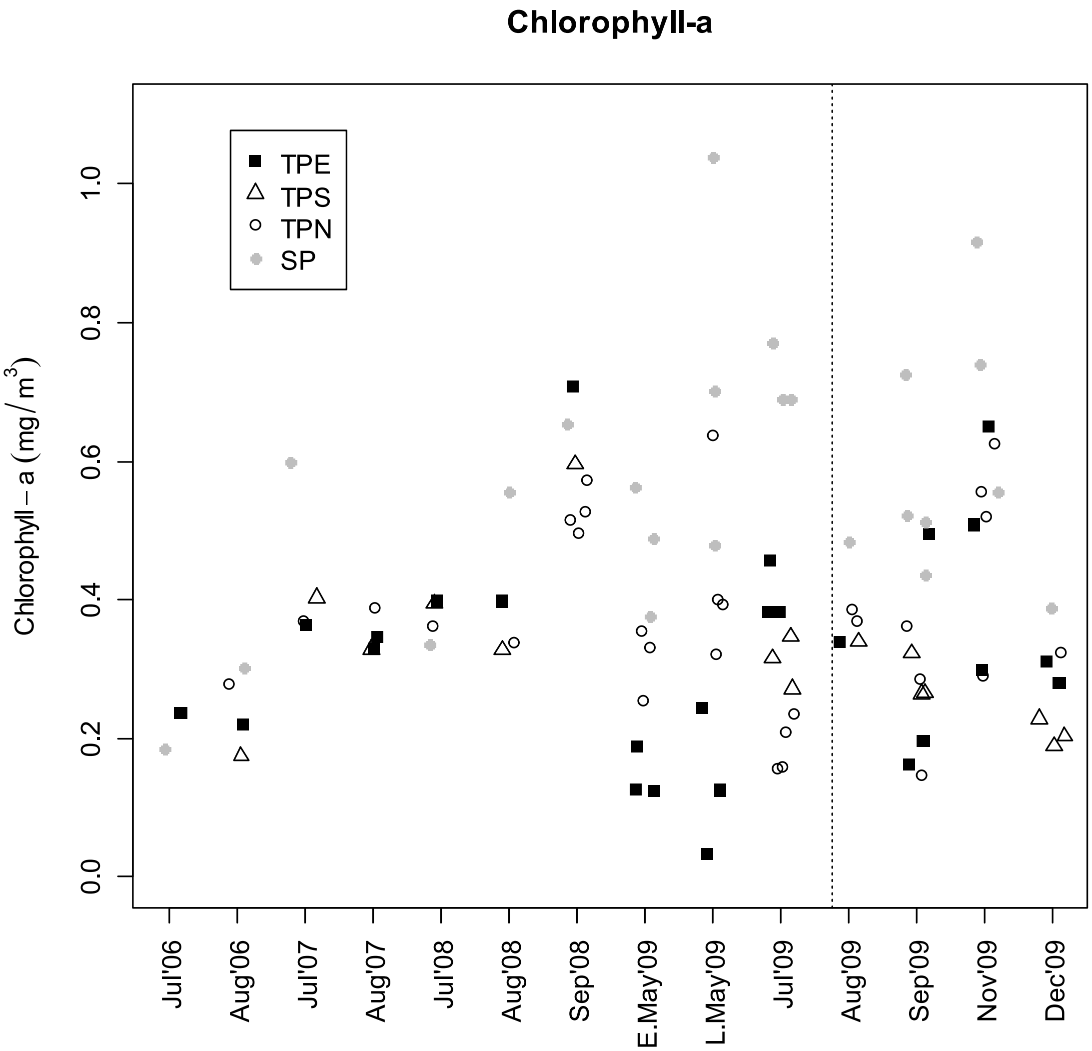
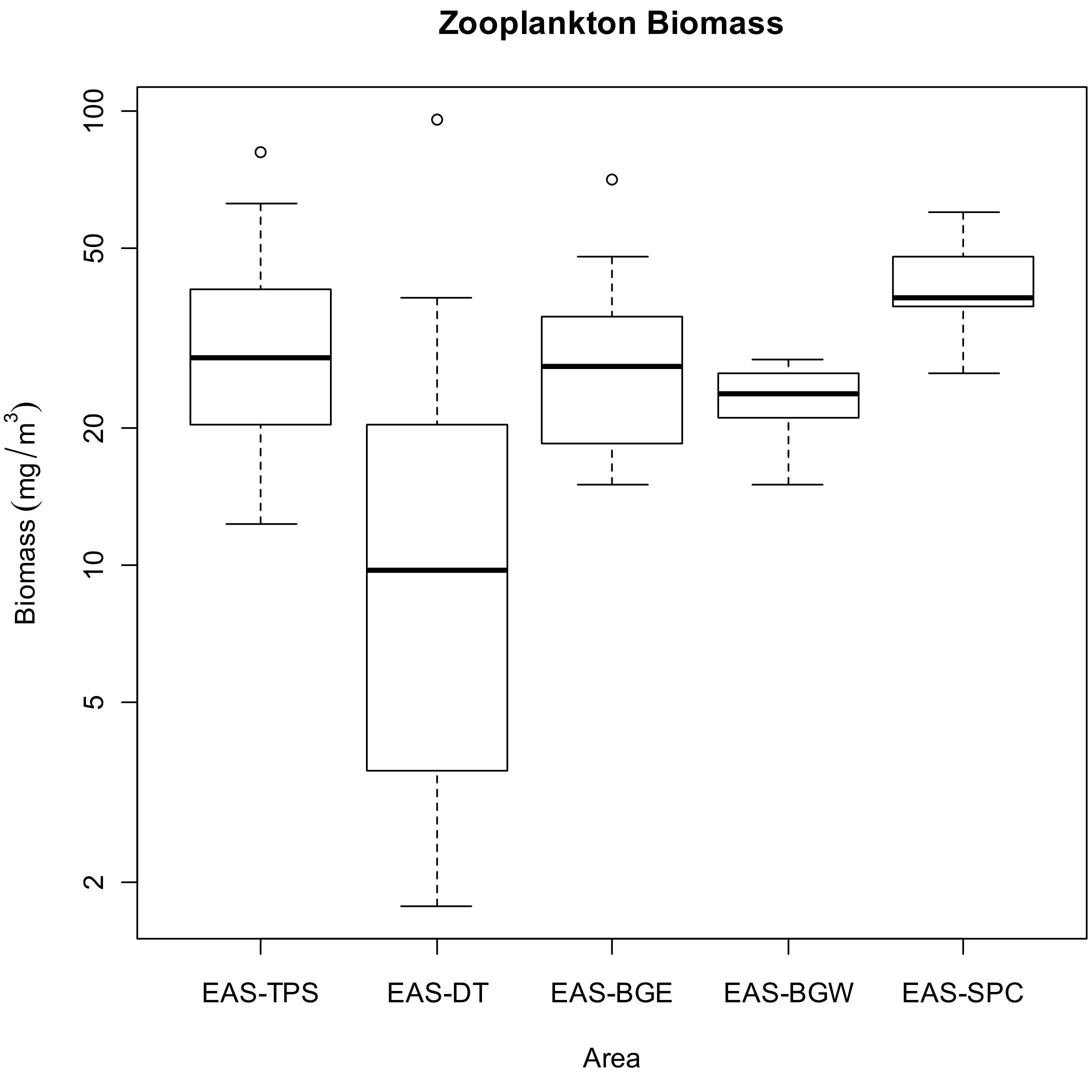


Figure 4-12. Zooplankton biomass boxplots for Bay-Goose EAS areas (pooled dates) in Second and Third Portage lakes, September 2009.



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APPENDIX A

RAW DATA FOR ANALYSIS OF SEDIMENT CORES – ED EAS 2009

Effect	Area	Areatype	Yeartype	StnNum	Rep	Year	Depth	pH	TOC	Aluminum	Arsenic	Barium	Beryllium	Chromium	Cobalt	Copper	Mercury	Molybdenum	Nickel	Vanadium	Zinc
0	TPE	0	0	2	1	2009	6.9	5.96	3.06	27200	16.9	127	2.1	94.1	16.4	56	0.0143	4.4	58.9	43.8	111
0	TPE	0	0	2	2	2009	10.7	6.3	3.72	25800	23	153	2	88.3	17.7	62.7	0.028	4	118	41.5	121
0	TPE	0	0	2	3	2009	6.3	6.26	4.97	25200	16.2	124	1.96	90.4	15	54	0.0213	2	58.7	40.3	106
0	TPE	0	0	2	4	2009	14.4	6.15	4.92	19000	30.8	321	1.44	61.9	28.6	63.6	0.0425	6.6	260	31.7	122
0	TPE	0	0	2	5	2009	6.6	6.34	5.07	23400	15.4	118	1.85	85.1	14.5	49.6	0.0211	2	59	37.9	103
0	TPE	0	0	2	6	2009	8.4	5.52	4.94	25200	39.2	137	2.18	91	19.9	81.5	0.0453	11.3	82.8	42.3	148
0	TPE	0	0	2	7	2009	9	5.75	4.65	25800	9.1	151	1.88	91.7	8.7	58.9	0.0309	4.6	63.6	40.3	112
0	TPE	0	0	2	8	2009	6.9	6.33	5.12	23400	16.1	121	1.86	92.3	15.2	50.2	0.029	4.1	60.4	38.8	108
0	TPE	0	0	2	9	2009	11	6.09	4.29	26700	33.4	150	2.18	94.5	15.9	84.5	0.037	8.3	96.1	44.7	127
0	TPE	0	0	2	10	2009	7.2	6.08	3.52	26900	17.6	123	2.11	94.7	16	55.2	0.0162	4.3	56.6	43.1	112
0	TPE	0	0	2	11	2009	7.2	6.01	3.47	25600	17.3	119	2.04	90.9	15.5	55.4	0.0173	4.6	55.3	41.5	106
0	TPE	0	0	2	12	2009	9.4	5.98	4.16	27800	18.6	128	1.91	94.6	15.4	58.7	0.0237	4.2	60.2	41.1	104
0	TPE	0	0	2	13	2009	9.4	6.2	4.88	24900	17.7	136	1.83	84.7	13.5	54.1	0.0397	4.5	64.5	37.4	105
0	TPE	0	0	2	14	2009	6.4	6.02	5.63	21500	15.9	105	1.6	79.5	11.8	45.4	0.029	2	51.2	32.9	89.9
0	TPE	0	0	2	15	2009	6.1	5.91	4.56	26900	15.7	123	1.97	93	15.6	52.6	0.0188	2	57.7	40.7	106
1	SP	1	0	3	1	2009	10	6.85	5.45	28500	33.2	141	2.28	81.7	15.4	92.8	0.049	6.7	59.7	42.9	120
1	SP	1	0	3	2	2009	10.6	6.57	4.59	31400	31.1	149	2.46	85.3	16.2	101	0.0429	6.2	61.2	45.8	124
1	SP	1	0	3	3	2009	11.6	6.46	5.57	31600	33.7	151	2.48	87.2	16.8	104	0.054	6.6	61.3	46.5	126
1	SP	1	0	3	4	2009	7.7	6.46	4.78	28700	60.4	135	2.29	78.9	18	94	0.0435	7.3	61.3	43.7	119
1	SP	1	0	3	5	2009	10.4	6.38	2.61	34500	34	161	2.58	84.6	17.7	104	0.0403	10.1	71.3	50.9	132
1	SP	1	0	3	6	2009	11.9	6.31	4.08	30400	30.9	138	2.33	85.1	15.8	101	0.0495	6.8	55.5	45.3	123
1	SP	1	0	3	7	2009	7.8	6.37	4.21	28300	28	139	2.35	82.7	16.5	95.5	0.048	6.1	70	44.4	130
1	SP	1	0	3	8	2009	12.1	6.31	4.96	27800	29.3	132	2.16	77.3	14.2	89.6	0.0596	6.6	59.3	41.8	119
1	SP	1	0	3	9	2009	10.9	6.36	4.05	32100	24.3	149	2.5	88	14.8	105	0.0581	6.2	72.1	47.3	132
1	SP	1	0	3	10	2009	11.6	6.29	3.18	36200	36.7	163	2.67	95	17.9	114	0.0378	8.3	63	52.2	139
1	SP	1	0	3	11	2009	9.2	6.38	4.38	27400	29.2	129	2.07	78.8	16.9	84.1	0.0453	6.7	63.4	42.8	121
1	SP	1	0	3	12	2009	12.8	6.42	5.78	19700	93	312	1.5	58.5	28.9	75	0.0684	22.8	94	28.7	107
1	SP	1	0	3	13	2009	12.6	6.47	4.95	29000	32.4	151	2.21	83.4	18.1	96.3	0.0565	7.3	87.6	45.1	126
1	SP	1	0	3	14	2009	10	6.26	5.69	22000	63.4	160	1.77	62.8	19.6	79.6	0.0651	10.8	81.4	36.1	104
1	SP	1	0	3	15	2009	8.7	6.28	4.69	25000	43	116	2.06	72	14.2	78.9	0.052	8	52.8	40.4	110
2	TE	1	0	4	1	2009	6.6	6	4.16	21300	40	206	1.8	45.4	16.8	76.4	0.0431	13.8	92	28.6	117
2	TE	1	0	4	2	2009	7.7	6.02	3.83	22900	25	203	1.9	49.2	23	66.9	0.0335	10.4	65	30.4	101
2	TE	1	0	4	3	2009	12.8	6.05	4.9	27800	16.6	166	2.36	62.7	10	79	0.064	4.2	49.9	39.9	115
2	TE	1	0	4	4	2009	7.3	6.08	3.74	29900	23.9	156	2.44	62.3	14.5	78.1	0.0316	6.8	72.6	41.1	121
2	TE	1	0	4	5	2009	12.9	6.05	5.01	28100	9.6	163	2.21	60.1	8.6	70.1	0.0577	2	46.9	38.8	108
2	TE	1	0	4	6	2009	8	6.06	4.05	22400	41.1	150	1.94	48.1	15.3	65	0.046	11.4	54.7	31.8	95.1
2	TE	1	0	4	7	2009	10.1	5.81	3.36	21100	12.1	97	1.79	48.6	8.4	55.6	0.0386	2	34.6	32.2	86.5
2	TE	1	0	4	8	2009	7.9	5.8	3.08	19100	27.6	85	1.6	43.5	8.4	51.8	0.0316	6.3	29.6	28	79.6
2	TE	1	0	4	9	2009	8.5	5.9	3.15	27400	20	254	2.23	58.6	19.2	73.6	0.034	7.4	61.3	39.9	114
2	TE	1	0	4	10	2009	8.6	5.94	4.43	28000	21.5	154	2.39	62.5	14.6	80.4	0.041	6	73.3	40.4	125
2	TE	1	0	4	11	2009	7	5.83	3.18	27500	24.2	182	2.31	57.4	20.8	71.2	0.0301	7.2	63.2	38.3	108
2	TE	1	0	4	12	2009	9.4	5.99	4.04	29400	20.8	154	2.5	64.1	14.3	77.7	0.037	6.6	58	41	123
2	TE	1	0	4	13	2009	7.2	6.15	4.65	28300	20.3	145	2.47	61.3	13.7	74	0.041	6.3	54.1	39.9	122
2	TE	1	0	4	14	2009	11.1	6.02	4.21	23100	45.4	134	1.92	49.3	14.8	64.9	0.0442	14.8	49.1	31.5	93.9
2	TE	1	0	4	15	2009	10.2	6.08	4.46	19300	52.6	110	1.66	42.8	15.3	62.8	0.048	18.7	47.4	27.5	88.9
0	INUG	0	0	1	1	2009	8	6.07	3.36	24100	8.7	115	1.47	111	10.2	51.8	0.0249	2	72.1	37.9	83.7
0	INUG	0	0	1	2	2009	8.4	5.53	4.54	21100	120	130	1.38	95.3	14.2	51.4	0.0389	7.7	80.5	30.6	84.1
0	INUG	0	0	1	3	2009	8	5.81	4.84	15900	318	117	1	71.4	16.2	36.2	0.0353	12.5	68	20.3	65.6
0	INUG	0	0	1	4	2009	12.5	6.05	4.96	25200	25.6	156	1.6	113	12.7	61.9	0.059	5	84.9	38.8	92
0	INUG	0	0	1	5	2009	10.2	5.84	4.86	16200	310	141	1	71.1	16.3	37.9	0.043	16.6	67	18.8	62.7
0	INUG	0	0	1	6	2009	8.2	5.84	5.18	16400	354	110	0.99	76.7	15.4	42.9	0.044	13.5	65.7	22	64.4
0	INUG	0	0	1	7	2009	11.5	5.84	2.83	17200	233	204	1.1	73.2	22.9	42.7	0.0539	19.6	114	22.3	78.3

Effect	Area	Areatype	Yeartype	StnNum	Rep	Year	Depth	pH	TOC	Aluminum	Arsenic	Barium	Beryllium	Chromium	Cobalt	Copper	Mercury	Molybdenum	Nickel	Vanadium	Zinc
0	INUG	0	0	1	8	2009	9.3	5.97	3.94	16900	43	99.7	1.1	73.5	18.3	39.6	0.0306	15.7	60	22.1	58.5
0	INUG	0	0	1	9	2009	12.5	5.69	5.02	23900	98.5	151	1.51	107	12.6	59	0.0568	7.4	85.5	34.5	95.5
0	INUG	0	0	1	10	2009	11.3	5.78	5.4	16000	137	273	1.1	69.9	20	46.2	0.0613	10.5	131	20.2	88.7
0	INUG	0	0	1	11	2009	8.6	5.93	4.87	15800	70	112	0.5	69.8	23.7	37.6	0.0364	2	68	19.5	61.3
0	INUG	0	0	1	12	2009	11.8	6.03	5.08	26800	8.8	164	1.6	122	10.1	57.8	0.044	2	82	40.6	96.7
0	INUG	0	0	1	13	2009	12.1	6	5.6	26200	11.2	154	1.59	119	10.1	57.7	0.0545	2	77.1	40.1	90
0	INUG	0	0	1	14	2009	12.4	5.78	6.81	23700	12.2	135	1.42	106	9.7	52.2	0.0644	2	72.1	35.6	82.2
0	INUG	0	0	1	15	2009	12.2	5.85	6.53	23700	9.2	145	1.4	104	9.3	51.9	0.06	2	79.4	35.3	89.3
0	TPE	0	1	2	1	2008	8.4	6.02	6.6	21900	2.5	125	1.38	74.6	7.1	44.5	0.0322	2	51.3	31.2	76.1
0	TPE	0	1	2	2	2008	6.8	5.52	4.5	23800	14	142	1.82	75.9	15.4	47.6	0.0314	5.5	62.5	37.3	97.8
0	TPE	0	1	2	3	2008	8.3	5.97	4.1	25600	12.6	132	1.85	80.2	13.1	48.6	0.0251	5.3	75.6	39.1	100
0	TPE	0	1	2	4	2008	10.6	5.97	4.9	23100	14.1	117	1.7	72.8	13.9	49	0.0288	4.7	79.9	35.9	97.3
0	TPE	0	1	2	5	2008	8	5.89	4.7	23800	15.9	126	1.79	75.1	15.8	49.8	0.0251	4.4	88.2	36.8	101
0	TPE	0	1	2	6	2008	10	5.97	4.7	23700	14.1	115	1.78	74.7	14.4	49	0.0261	5.1	64.4	36.6	94.5
0	TPE	0	1	2	7	2008	10.8	6.22	4	23900	17.4	102	1.71	74.1	12.6	49.3	0.0257	5.7	51.2	37	86.2
0	TPE	0	1	2	8	2008	9.7	6.01	4.9	23100	15.4	113	1.74	73.4	16.9	47.1	0.0376	5.7	54.5	37.1	89.2
0	TPE	0	1	2	9	2008	12.5	5.47	3.5	25300	14.6	200	1.84	76.9	17.3	65.7	0.0337	7.6	162	40.4	126
0	TPE	0	1	2	10	2008	12.8	5.85	4.3	24200	26.7	122	1.78	72.2	16.2	55.7	0.0392	8.2	73.6	39	92.1
0	TPE	0	1	2	11	2008	17.1	5.46	3.2	34600	46.3	150	3.18	97.6	17.3	111	0.0318	15.6	81.5	54.3	152
0	TPE	0	1	2	12	2008	15	5.78	3.6	27400	14.6	215	1.88	80.9	19.7	75.8	0.0392	7	190	42.7	145
0	TPE	0	1	2	13	2008	17	5.5	3.9	24600	26	223	1.81	69.2	17	74.8	0.0576	9.7	165	40.7	118
0	TPE	0	1	2	14	2008	12	5.96	3.9	24000	27.9	206	1.62	64.3	23.5	58.1	0.033	7.8	151	39.2	97.8
0	TPE	0	1	2	15	2008	14.7	5.91	6	25300	17.3	122	1.88	79.6	15.5	61.7	0.0378	5.1	82.9	39	104
0	SP	1	1	3	1	2008	11.7	6.12	4.2	28700	31.6	139	2.26	77.9	16	98.2	0.033	5.9	53.2	39.6	108
0	SP	1	1	3	2	2008	14	6.04	4.1	26100	28.2	142	1.96	69.6	16.4	89.4	0.0397	6.1	68	36.2	101
0	SP	1	1	3	3	2008	11.4	5.91	5.2	21000	30.5	125	1.72	55.2	12.6	75.9	0.0515	6.9	61.9	29.9	87.8
0	SP	1	1	3	4	2008	12.7	6.1	3.9	30900	36.5	153	2.26	76.5	18.3	100	0.042	9.1	66.7	42.2	114
0	SP	1	1	3	5	2008	9.3	6.08	4.6	20300	53.7	148	1.71	52	18.9	72.9	0.0445	11	70.6	24.9	76.5
0	SP	1	1	3	6	2008	9.6	6.24	5.6	20600	40.8	134	1.71	53.7	17.5	70.7	0.045	7.4	64.3	27.8	83.8
0	SP	1	1	3	7	2008	11.2	6.24	4.5	23100	25.3	118	1.81	62	13.1	72.2	0.0376	5.1	47.9	33.9	91.4
0	SP	1	1	3	8	2008	10.9	6.06	4.6	25500	19.9	132	2.08	70.9	14.7	86.9	0.0411	4.2	85.1	36.9	114
0	SP	1	1	3	9	2008	10.9	6.19	5.1	22500	26.4	113	1.82	62.4	12.9	76.5	0.0374	5.1	45.2	32.8	92.7
0	SP	1	1	3	10	2008	12.3	6.2	5.4	23600	26.7	119	1.93	65	14	80.4	0.0452	5.3	50.4	33.7	97.8
0	SP	1	1	3	11	2008	11.5	6.08	5.1	24300	27.6	121	1.97	68.1	13.7	82.1	0.0443	5.5	50.9	35.2	102
0	SP	1	1	3	12	2008	12.2	5.91	4.9	23100	23.4	121	1.82	64.2	12.5	79.8	0.0442	4.8	51.8	34	97.2
0	SP	1	1	3	13	2008	13	5.92	5.5	22600	56.2	137	1.82	61.2	14.9	79.8	0.0633	9.9	54	30.2	83
0	SP	1	1	3	14	2008	12.5	5.88	5.7	25900	29.8	149	2.07	69.5	16.5	89.1	0.0606	6.5	76.5	36.8	110
0	SP	1	1	3	15	2008	13	6.02	5	26600	31.8	143	2.07	72	16.3	92.4	0.0522	6.3	75.1	37	106
0	TE	1	1	4	1	2008	9.2	6.08	3.2	27000	21.3	135	2.36	60.3	13.7	72	0.0269	6.1	46.8	38.3	107
0	TE	1	1	4	2	2008	8.2	5.94	3.6	22600	30.2	120	1.99	49.8	12.6	64.4	0.0355	9.1	42.9	31.4	89.9
0	TE	1	1	4	3	2008	10.9	5.94	4.3	21400	33.4	133	1.98	48.2	14.7	66.8	0.0422	8.9	50.6	29.3	86.8
0	TE	1	1	4	4	2008	10.8	5.98	4.4	19800	35.6	138	1.9	45.8	16.6	63.5	0.0397	10.5	48.7	26	84.1
0	TE	1	1	4	5	2008	10.9	5.94	3.9	22500	28.4	147	2.01	50.1	13.6	66.2	0.0385	8.1	54.9	31.6	95.1
0	TE	1	1	4	6	2008	13.5	5.67	6.4	23900	8.8	164	2.07	53.1	8.4	67.7	0.0593	2	50.6	32.8	109
0	TE	1	1	4	7	2008	7.5	6.03	4.6	24800	20.9	135	2.31	56.1	12.4	68.6	0.0338	5.9	50.4	36	108
0	TE	1	1	4	8	2008	8.4	5.89	4.2	19800	45	132	1.87	44.3	14.8	63.8	0.0356	11.1	52.7	25.9	82.8
0	TE	1	1	4	9	2008	10.6	5.85	2.9	23200	30.9	130	1.98	52.6	13.2	66.3	0.0293	8.7	39.8	30.7	86.1
0	TE	1	1	4	10	2008	11.6	5.81	3.2	21500	11.3	114	1.89	48.1	9.1	64.6	0.0312	4.4	41.4	31.7	92.6
0	TE	1	1	4	11	2008	11.3	6.01	3.6	17800	43.7	88.8	1.67	40.6	12.2	59.3	0.0081	11.2	33.2	23	70.2
0	TE	1	1	4	12	2008	9.1	5.9	4.1	16300	34.6	112	1.54	37.6	13.6	58.5	0.0368	12	43.8	17.3	66.3
0	TE	1	1	4	13	2008	7.8	5.76	3.4	21600	19.1	109	1.97	49.8	11.7	61.5	0.0297	5.8	40.1	31.5	94.6
0	TE	1	1	4	14	2008	10	6.03	4.8	17500	36.6	159	1.7	38.1	20	61.6	0.0458	9.6	65.1	22	81.5

Effect	Area	Areatype	Yeartype	StnNum	Rep	Year	Depth	pH	TOC	Aluminum	Arsenic	Barium	Beryllium	Chromium	Cobalt	Copper	Mercury	Molybdenum	Nickel	Vanadium	Zinc
0	TE	1	1	4	15	2008	9.6	5.93	3.5	22300	21.7	124	1.91	48.4	14.3	63.9	0.0331	6.3	42.6	32	91.8
0	INUG	0	1	1	1	2008	7.4	5.8	4.5	23000	25.4	122	1.44	95.4	10.7	49.9	0.0336	4.9	72.3	35.8	78.6
0	INUG	0	1	1	2	2008	6.5	5.93	4.9	22500	21.5	104	1.39	94.8	15.2	46.9	0.0336	5.1	75.7	36.6	79.1
0	INUG	0	1	1	3	2008	7.6	6.01	4.8	19000	23.4	118	1.19	72	20.6	40.2	0.0402	5.9	82.5	33.1	67.1
0	INUG	0	1	1	4	2008	8.1	6.07	4.5		60	107	1.1	85.1	18.8	48.7	0.0344	4	70	23.6	58.8
0	INUG	0	1	1	5	2008	8.4	5.8	5.1	23000	9.7	133	1.41	99.4	10.4	48.5	0.0515	2	74.7	35.6	83
0	INUG	0	1	1	6	2008	6.9	5.85	4.3	24700	11.1	122	1.62	110	12.2	54	0.036	4.1	80.8	40.7	92.5
0	INUG	0	1	1	7	2008	11.5	5.96	4.6	19500	49.7	95.8	1.22	79.8	16.7	40.3	0.053	6.5	71.1	32.7	71.3
0	INUG	0	1	1	8	2008	10.4	5.95	4.3	19700	115	110	1.1	83.9	20.9	48.2	0.041	10.6	71	23.7	58.4
0	INUG	0	1	1	9	2008	9.8	6.15	2.7	18000	8.8	74.5	1	79.9	10.4	30.1	0.0193	2	49.7	28.1	59.6
0	INUG	0	1	1	10	2008	7.9	5.98	2.7	18100	26.3	117	1.16	67.8	25	40.9	0.044	5.8	98.6	32.9	67
0	INUG	0	1	1	11	2008	12.3	5.98	3.6	22200	36.7	171	1.39	86.1	47.2	44.5	0.0586	7.2	78.2	37.4	81.1
0	INUG	0	1	1	12	2008	12.5	6.06	3.6	21900	2.5	114	1.26	91	9.2	36.4	0.0313	2	74	31.9	76.3
0	INUG	0	1	1	13	2008	7.7	5.98	5	22200	31.7	108	1.39	91	12.7	47.6	0.0414	4.9	71	35.3	76.6
0	INUG	0	1	1	14	2008	6.4	5.54	5	22800	26.5	115	1.51	96.4	16.1	49.9	0.0462	5.6	90.1	37.5	91
0	INUG	0	1	1	15	2008	8.7	5.97	5.1	21700	29.6	99.5	1.45	89.6	13.4	47	0.0359	7.2	64.1	37.3	71.4

APPENDIX B

RAW DATA FOR ANALYSIS OF EAS BENTHIC INVERTEBRATES – ED EAS 2009

Program	AreaN	Area	Date	Effect	Rep	Depth	Year	Nolig	Ninsect	Nmoll	Nother	N	Rolig	Rinsect	Rmoll	Rother	R	SimpDiv	BrayCurtis	PSgravel	PSsand	PSsilt	PSclay
CREMP	1	INUG	20-Aug-09	0	1	7.6	2009	108.7	521.74	434.78	65.22	1130.43	2	7	3	3	15	0.85	0.391	<1.0	7	69	24
CREMP	1	INUG	20-Aug-09	0	2	7.9	2009	65.22	934.78	456.52	86.96	1543.48	1	9	3	2	15	0.88	0.452				
CREMP	1	INUG	20-Aug-09	0	3	7	2009	0	1086.96	456.52	86.96	1630.43	0	10	3	2	15	0.88	0.41				
CREMP	1	INUG	20-Aug-09	0	4	6.9	2009	0	304.35	326.09	0	630.43	0	6	2	0	8	0.74	0.496				
CREMP	1	INUG	20-Aug-09	0	5	6.9	2009	43.48	521.74	369.57	86.96	1021.74	2	8	3	2	15	0.9	0.444				
CREMP	2	PDL	17-Aug-09	0	1	7.2	2009	0	1347.83	630.43	21.74	2000	0	8	1	1	10	0.8	0.466	<1.0	20	46	33
CREMP	2	PDL	17-Aug-09	0	2	8	2009	21.74	695.65	456.52	21.74	1195.65	1	9	1	1	12	0.81	0.376				
CREMP	2	PDL	17-Aug-09	0	3	8.3	2009	21.74	500	195.65	43.48	760.87	1	7	1	2	11	0.88	0.504				
CREMP	2	PDL	17-Aug-09	0	4	7.3	2009	195.65	2478.26	543.48	108.7	3326.09	0	8	1	1	10	0.61	0.649				
CREMP	2	PDL	17-Aug-09	0	5	7.5	2009	326.09	847.83	152.17	21.74	1347.83	2	7	1	1	11	0.82	0.527				
CREMP	3	TPS	21-Aug-09	0	1	8	2009	86.96	956.52	173.91	0	1217.39	1	9	1	0	11	0.92	0.401	<1.0	5	62	33
CREMP	3	TPS	21-Aug-09	0	2	6.8	2009	21.74	2000	500	0	2521.74	1	9	1	0	11	0.86	0.525				
CREMP	3	TPS	21-Aug-09	0	3	7.3	2009	282.61	2130.43	913.04	0	3326.09	1	9	1	0	11	0.84	0.536				
CREMP	3	TPS	21-Aug-09	0	4	7.3	2009	0	1717.39	304.35	0	2021.74	0	10	1	0	11	0.76	0.503				
CREMP	3	TPS	21-Aug-09	0	5	9.7	2009	43.48	304.35	369.57	0	717.39	1	6	1	0	8	0.72	0.496				
CREMP	4	TEFF	14-Aug-09	0	1	6.9	2009	0	586.96	239.13	195.65	1021.74	0	9	1	1	11	0.86	0.436	<1.0	5	61	34
CREMP	4	TEFF	14-Aug-09	0	2	6.6	2009	21.74	1347.83	130.43	43.48	1543.48	1	9	1	1	12	0.78	0.522				
CREMP	4	TEFF	14-Aug-09	0	3	7.8	2009	0	1108.7	326.09	0	1434.78	0	7	1	0	8	0.83	0.441				
CREMP	4	TEFF	14-Aug-09	0	4	7.2	2009	0	608.7	326.09	43.48	978.26	0	10	1	1	12	0.84	0.427				
CREMP	4	TEFF	14-Aug-09	0	5	6.9	2009	0	934.78	217.39	43.48	1195.65	0	7	1	1	9	0.88	0.475				
ED EAS	5	SP-DT	19-Aug-09	0	1	6.5	2009	0	326.09	739.13	108.7	1173.91	0	8	2	1	11	0.69	0.529	<1.0	9	68	23
ED EAS	5	SP-DT	19-Aug-09	0	2	7.5	2009	0	434.78	456.52	86.96	978.26	0	6	2	1	9	0.77	0.504				
ED EAS	5	SP-DT	19-Aug-09	0	3	7.3	2009	86.96	543.48	630.43	43.48	1304.35	1	9	1	1	12	0.73	0.452				
ED EAS	5	SP-DT	19-Aug-09	0	4	7.6	2009	152.17	652.17	413.04	0	1217.39	1	8	2	0	11	0.84	0.451				
ED EAS	5	SP-DT	19-Aug-09	0	5	7.6	2009	86.96	456.52	239.13	152.17	934.78	2	6	2	1	11	0.87	0.473				
CREMP	6	TE	14-Aug-09	1	1	7	2009	21.74	152.17	586.96	86.96	847.83	1	4	1	1	7	0.51	0.616	<1.0	5	66	29
CREMP	6	TE	14-Aug-09	1	2	7.4	2009	108.7	391.3	195.65	65.22	760.87	0	5	1	1	7	0.87	0.554				
CREMP	6	TE	14-Aug-09	1	3	6.9	2009	0	130.43	391.3	0	521.74	0	3	2	0	5	0.49	0.6				
CREMP	6	TE	14-Aug-09	1	4	8.2	2009	0	391.3	347.83	130.43	869.57	0	5	1	2	8	0.79	0.452				
CREMP	6	TE	14-Aug-09	1	5	7.9	2009	0	413.04	304.35	130.43	847.83	0	6	1	1	8	0.81	0.48				
ED EAS	7	SP-F1	23-Aug-09	1	1	7	2009	108.7	565.22	347.83	86.96	1108.7	1	5	1	1	8	0.8	0.445	<1.0	7	67	26
ED EAS	7	SP-F1	23-Aug-09	1	2	7.2	2009	0	630.43	630.43	130.43	1391.3	0	5	1	1	7	0.73	0.56				
ED EAS	7	SP-F1	23-Aug-09	1	3	6.8	2009	21.74	1347.83	869.57	130.43	2369.57	1	8	1	1	11	0.77	0.595				
ED EAS	7	SP-F1	23-Aug-09	1	4	6.8	2009	0	673.91	282.61	86.96	1043.48	0	7	1	1	9	0.81	0.493				
ED EAS	7	SP-F1	23-Aug-09	1	5	7.3	2009	0	826.09	478.26	152.17	1456.52	0	6	1	1	8	0.8	0.523				
CREMP	8	SP	12-Aug-09	1	1	7.5	2009	65.22	347.83	260.87	130.43	804.35	1	2	1	1	5	0.74	0.65	<1.0	2	68	30
CREMP	8	SP	12-Aug-09	1	2	7.7	2009	21.74	391.3	260.87	21.74	695.65	1	4	1	1	7	0.77	0.551				
CREMP	8	SP	12-Aug-09	1	3	6.8	2009	65.22	413.04	326.09	108.7	913.04	0	5	2	1	8	0.83	0.461				
CREMP	8	SP	12-Aug-09	1	4	7.1	2009	43.48	434.78	326.09	43.48	847.83	0	6	1	1	8	0.77	0.464				
CREMP	8	SP	12-Aug-09	1	5	8.1	2009	21.74	369.57	239.13	0	630.43	0	5	1	0	6	0.8	0.557				
ED EAS	9	SP-N1	15-Aug-09	1	1	6.5	2009	21.74	369.57	478.26	152.17	1021.74	0	3	1	1	5	0.71	0.534	<1.0	16	64	20
ED EAS	9	SP-N1	15-Aug-09	1	2	7	2009	0	521.74	456.52	21.74	1000	0	4	2	1	7	0.74	0.5				
ED EAS	9	SP-N1	15-Aug-09	1	3	7.4	2009	21.74	347.83	565.22	86.96	1021.74	1	3	1	1	6	0.62	0.617				
ED EAS	9	SP-N1	15-Aug-09	1	4	7.7	2009	0	804.35	804.35	130.43	1739.13	0	5	2	1	8	0.73	0.578				
ED EAS	9	SP-N1	15-Aug-09	1	5	7.2	2009	86.96	347.83	369.57	86.96	891.3	0	4	2	1	7	0.81	0.457				
ED EAS	10	SP-N3	23-Aug-09	1	1	6.9	2009	43.48	413.04	413.04	43.48	913.04	1	7	2	1	11	0.79	0.492	<1.0	1	64	34
ED EAS	10	SP-N3	23-Aug-09	1	2	8	2009	0	304.35	217.39	43.48	565.22	0	4	2	1	7	0.79	0.58				
ED EAS	10	SP-N3	23-Aug-09	1	3	7.5	2009	21.74	369.57	173.91	130.43	695.65	1	7	2	1	11	0.88	0.551				
ED EAS	10	SP-N3	23-Aug-09	1	4	7.3	2009	0	369.57	239.13	173.91	782.61	0	6	1	1	8	0.79	0.598				
ED EAS	10	SP-N3	23-Aug-09	1	5		2009	0	260.87	391.3	43.48	695.65	0	5	1	1	7	0.63	0.551				
CREMP	11	TPE	13-Aug-09	2	1	6.9	2009	108.7	1130.43	217.39	86.96	1543.48	2	8	1	1	12	0.89	0.408	<1.0	6	58	36
CREMP	11	TPE	13-Aug-09	2	2	7.7	2009	0	1195.65	695.65	0	1891.3	0	10	1	0	11	0.82	0.445				
CREMP	11	TPE	14-Aug-09	2	3	7.8	2009	0	586.96	456.52	21.74	1065.22	0	7	1	1	9	0.77	0.459				
CREMP	11	TPE	14-Aug-09	2	4	6.5	2009	173.91	869.57	586.96	195.65	1826.09	0	10	1	1	12	0.84	0.535				
CREMP	11	TPE	14-Aug-09	2	5	6.5	2009	108.7	1326.09	717.39	86.96	2239.13	2	8	1	1	12	0.83	0.524				
ED EAS	12	TPL-HVH4	23-Aug-09	3	1	7.1	2009	43.48	521.74	239.13	195.65	1000	1	6	2	1	10	0.84	0.538	<1.0	1	65	34
ED EAS	12	TPL-HVH4	23-Aug-09	3	2	6.9	2009	108.7	695.65	195.65	86.96	1086.96	2	5	1	1	9	0.74	0.603				
ED EAS	12	TPL-HVH4	23-Aug-09	3	3	7.5	2009	21.74	521.74	260.87	43.48	847.83	0	7	1	1	9	0.85	0.448				
ED EAS	12	TPL-HVH4	23-Aug-09	3	4	7.7	2009	0	673.91	282.61	108.7	1065.22	0	5	1	1	7	0.82	0.496				
ED EAS	12	TPL-HVH4	23-Aug-09	3	5	7.3	2009	65.22	630.43	173.91	65.22	934.78	1	8	1	1	11	0.88	0.442				
CREMP	13	TPN	21-Aug-09	4	1	8.7	2009	21.74	1021.74	521.74	0	1565.22	1	9	1	0	11	0.83	0.468	<1.0	25	54	21
CREMP	13	TPN	21-Aug-09	4	2	7.1	2009	0	673.91	456.52	43.48	1173.91	0	7	1	1	9	0.77	0.464				
CREMP	13	TPN	21-Aug-09	4	3	8.5	2009	0	826.09	608.7	43.48	1478.26	0	6	1	1	8	0.78	0.442				
CREMP	13	TPN	21-Aug-09	4	4	7.8	2009	0	652.17	413.04	21.74	1086.96	0	5	1	1	7	0.79	0.463				
CREMP	13	TPN	21-Aug-09	4	5	8.8	2009	0	478.26	391.3	21.74	891.3	0	9	1	1	11	0.77	0.441				

APPENDIX C

RAW DATA FOR ANALYSIS OF CREMP BENTHIC INVERTEBRATES – ED EAS 2009

Program	Area	AreaN	Area.Year.NGF	Area.Year.NG	Area.Year.N	AreaN.Year	Area.Year	Date	Effect	TSS	Rep	Depth	Year	Nolig	Ninsect	Nmoll	Nother	N	Rolig	Rinsect	Rmoll	Rother	R	SimpDiv	BrayCurtis
AEMP	INUG	1	1	1	1	1 2006	INUG 2006	19-Aug-06	0	0.2	1	8	2006	0	239.13	217.39	65.22	521.74	0	5	2	1	8	0.82	0.66
AEMP	INUG	1	1	1	1	1 2006	INUG 2006	19-Aug-06	0	0.2	2	8	2006	43.48	347.83	282.61	43.48	717.39	2	5	2	1	10	0.81	0.61
AEMP	INUG	1	1	1	1	1 2006	INUG 2006	19-Aug-06	0	0.2	3	8	2006	65.22	630.43	326.09	21.74	1043.48	1	9	2	1	13	0.84	0.544
AEMP	INUG	1	2	2	2	1 2007	INUG 2007	28-Aug-07	0	0.2	1	9.8	2007	21.74	608.7	217.39	0	847.83	1	9	2	0	12	0.87	0.571
AEMP	INUG	1	2	2	2	1 2007	INUG 2007	28-Aug-07	0	0.2	2	7.8	2007	130.43	1130.43	369.57	86.96	1717.39	2	8	1	2	13	0.87	0.469
AEMP	INUG	1	2	2	2	1 2007	INUG 2007	28-Aug-07	0	0.2	3	10.1	2007	21.74	282.61	391.3	130.43	826.09	1	6	2	2	11	0.79	0.512
AEMP	INUG	1	2	2	2	1 2007	INUG 2007	28-Aug-07	0	0.2	4	9.6	2007	65.22	565.22	108.7	43.48	782.61	1	7	1	2	11	0.86	0.633
AEMP	INUG	1	2	2	2	1 2007	INUG 2007	28-Aug-07	0	0.2	5	8	2007	21.74	369.57	326.09	217.39	934.78	1	7	2	2	12	0.85	0.556
AEMP	INUG	1	3	3	3	1 2008	INUG 2008	20-Aug-08	0	0.2	1	8.1	2008	0	500	326.09	21.74	847.83	0	11	2	1	14	0.79	0.571
AEMP	INUG	1	3	3	3	1 2008	INUG 2008	20-Aug-08	0	0.2	2	8.7	2008	43.48	1260.87	326.09	65.22	1695.65	1	9	1	2	13	0.86	0.488
AEMP	INUG	1	3	3	3	1 2008	INUG 2008	20-Aug-08	0	0.2	3	9.8	2008	21.74	1021.74	152.17	43.48	1239.13	1	12	2	2	17	0.92	0.495
AEMP	INUG	1	3	3	3	1 2008	INUG 2008	20-Aug-08	0	0.2	4	12.6	2008	43.48	4565.22	652.17	65.22	5326.09	1	12	3	1	17	0.9	0.646
AEMP	INUG	1	3	3	3	1 2008	INUG 2008	20-Aug-08	0	0.2	5	8	2008	0	239.13	130.43	21.74	391.3	0	6	1	1	8	0.86	0.773
AEMP	INUG	1	4	4	4	1 2009	INUG 2009	20-Aug-09	0	0.2	1	7.6	2009	108.7	521.74	434.78	65.22	1130.43	2	7	3	3	15	0.85	0.454
AEMP	INUG	1	4	4	4	1 2009	INUG 2009	20-Aug-09	0	0.2	2	7.9	2009	65.22	934.78	456.52	86.96	1543.48	1	9	3	2	15	0.88	0.547
AEMP	INUG	1	4	4	4	1 2009	INUG 2009	20-Aug-09	0	0.2	3	7	2009	0	1086.96	456.52	86.96	1630.43	0	10	3	2	15	0.88	0.446
AEMP	INUG	1	4	4	4	1 2009	INUG 2009	20-Aug-09	0	0.2	4	6.9	2009	0	304.35	326.09	0	630.43	0	6	2	0	8	0.74	0.584
AEMP	INUG	1	4	4	4	1 2009	INUG 2009	20-Aug-09	0	0.2	5	6.9	2009	43.48	521.74	369.57	86.96	1021.74	2	8	3	2	15	0.9	0.554
AEMP	PDL	2	6	6	5	2 2009	PDL 2009	17-Aug-09	0	0.2	1	7.2	2009	0	1347.83	630.43	21.74	2000	0	8	1	1	10	0.8	0.534
AEMP	PDL	2	6	6	5	2 2009	PDL 2009	17-Aug-09	0	0.2	2	8	2009	21.74	695.65	456.52	21.74	1195.65	1	9	1	1	12	0.81	0.502
AEMP	PDL	2	6	6	5	2 2009	PDL 2009	17-Aug-09	0	0.2	3	8.3	2009	21.74	500	195.65	43.48	760.87	1	7	1	2	11	0.88	0.516
AEMP	PDL	2	6	6	5	2 2009	PDL 2009	17-Aug-09	0	0.2	4	7.3	2009	195.65	2478.26	543.48	108.7	3326.09	0	8	1	1	10	0.61	0.702
AEMP	PDL	2	6	6	5	2 2009	PDL 2009	17-Aug-09	0	0.2	5	7.5	2009	326.09	847.83	152.17	21.74	1347.83	2	7	1	1	11	0.82	0.672
AEMP	TPN	3	8	8	6	3 2007	TPN 2007	19-Aug-07	0	0.2	1	9.4	2007	0	978.26	326.09	21.74	1326.09	0	9	1	1	11	0.86	0.459
AEMP	TPN	3	8	8	6	3 2007	TPN 2007	19-Aug-07	0	0.2	2	9.2	2007	282.61	1108.7	521.74	21.74	1934.78	2	10	1	1	14	0.88	0.46
AEMP	TPN	3	8	8	6	3 2007	TPN 2007	19-Aug-07	0	0.2	3	8.6	2007	0	1173.91	695.65	21.74	1891.3	0	9	1	1	11	0.81	0.538
AEMP	TPN	3	8	8	6	3 2007	TPN 2007	19-Aug-07	0	0.2	4	8	2007	0	695.65	195.65	86.96	978.26	0	5	1	1	7	0.81	0.581
AEMP	TPN	3	8	8	6	3 2007	TPN 2007	19-Aug-07	0	0.2	5	9.4	2007	0	456.52	500	21.74	978.26	0	4	1	1	6	0.68	0.595
AEMP	TPN	3	10	10	7	3 2008	TPN 2008	18-Aug-08	0	0.2	1	7.8	2008	0	1326.09	65.22	0	1391.3	0	7	1	0	8	0.66	0.794
AEMP	TPN	3	10	10	7	3 2008	TPN 2008	18-Aug-08	0	0.2	2	9.2	2008	0	652.17	65.22	0	717.39	0	9	1	0	10	0.81	0.726
AEMP	TPN	3	10	10	7	3 2008	TPN 2008	18-Aug-08	0	0.2	3	8.4	2008	21.74	1021.74	260.87	21.74	1326.09	1	8	1	1	11	0.64	0.64
AEMP	TPN	3	10	10	7	3 2008	TPN 2008	18-Aug-08	0	0.2	4	8.4	2008	0	173.91	86.96	0	260.87	0	2	1	0	3	0.59	0.83
AEMP	TPN	3	10	10	7	3 2008	TPN 2008	18-Aug-08	0	0.2	5	7.8	2008	0	1260.87	130.43	0	1391.3	0	8	1	0	9	0.71	0.652
AEMP	TPN	3	10	10	8	3 2009	TPN 2009	21-Aug-09	6	0.2	1	8.7	2009	21.74	1021.74	521.74	0	1565.22	1	9	1	0	11	0.83	0.51
AEMP	TPN	3	10	10	8	3 2009	TPN 2009	21-Aug-09	6	0.2	2	7.1	2009	0	673.91	456.52	43.48	1173.91	0	7	1	1	9	0.77	0.53
AEMP	TPN	3	10	10	8	3 2009	TPN 2009	21-Aug-09	6	0.2	3	8.5	2009	0	826.09	608.7	43.48	1478.26	0	6	1	1	8	0.78	0.504
AEMP	TPN	3	10	10	8	3 2009	TPN 2009	21-Aug-09	6	0.2	4	7.8	2009	0	652.17	413.04	21.74	1086.96	0	5	1	1	7	0.79	0.531
AEMP	TPN	3	10	10	8	3 2009	TPN 2009	21-Aug-09	6	0.2	5	8.8	2009	0	478.26	391.3	21.74	891.3	0	9	1	1	11	0.77	0.536
AEMP	TPS	4	12	12	9	4 2006	TPS 2006	21-Aug-06	0	0.2	1	8.7	2006	0	717.39	456.52	43.48	1217.39	0	9	1	1	11	0.81	0.486
AEMP	TPS	4	12	12	9	4 2006	TPS 2006	21-Aug-06	0	0.2	2	8.7	2006	0	782.61	282.61	0	1065.22	0	11	1	0	12	0.87	0.463
AEMP	TPS	4	12	12	9	4 2006	TPS 2006	21-Aug-06	0	0.2	3	8.7	2006	0	478.26	152.17	0	630.43	0	8	1	0	9	0.89	0.569
AEMP	TPS	4	13	13	10	4 2007	TPS 2007	18-Aug-07	0	0.2	1	8.4	2007	0	782.61	195.65	0	978.26	0	6	1	0	7	0.83	0.608
AEMP	TPS	4	13	13	10	4 2007	TPS 2007	18-Aug-07	0	0.2	2	11.4	2007	0	826.09	304.35	0	1130.43	0	6	1	0	7	0.66	0.613
AEMP	TPS	4	13	13	10	4 2007	TPS 2007	18-Aug-07	0	0.2	3	8.3	2007	0	652.17	173.91	0	826.09	0	8	1	0	9	0.85	0.561
AEMP	TPS	4	13	13	10	4 2007	TPS 2007	18-Aug-07	0	0.2	4	9.3	2007	282.61	1000	739.13	43.48	2065.22	2	8	1	1	12	0.78	0.551
AEMP	TPS	4	13	13	10	4 2007	TPS 2007	18-Aug-07	0	0.2	5	8.3	2007	695.65	3456.52	1282.61	65.22	5500	1	11	1	1	14	0.86	0.657
AEMP	TPS	4	14	14	11	4 2008	TPS 2008	17-Aug-08	0	0.2	1	9.1	2008	21.74	1934.78	86.96	0	2043.48	1	11	1	0	13	0.82	0.649
AEMP	TPS	4	14	14	11	4 2008	TPS 2008	17-Aug-08	0	0.2	2	9.7	2008	21.74	478.26	195.65	0	695.65	1	7	2	0	10	0.88	0.556
AEMP	TPS	4	14	14	11	4 2008	TPS 2008	17-Aug-08	0	0.2	3	11.7	2008	43.48	1630.43	369.57	0	2043.48	1	8	1	0	10	0.72	0.594
AEMP	TPS	4	14	14	11	4 2008	TPS 2008	17-Aug-08	0	0.2	4	9.9	2008	0	1130.43	413.04	21.74	1565.22	0	9	1	1	11	0.78	0.521
AEMP	TPS	4	14	14	11	4 2008	TPS 2008	17-Aug-08	0	0.2	5	10	2008	0	1304.35	369.57	0	1673.91	0	8	1	0	9	0.62	0.6
AEMP	TPS	4	15	15	12	4 2009	TPS 2009	21-Aug-09	0	0.2	1	8	2009	86.96	956.52	173.91	0	1217.39	1	9	1	0	11	0.92	0.486
AEMP	TPS	4	15	15	12	4 2009	TPS 2009	21-Aug-09	0	0.2	2	6.8	2009	21.74	2000	500	0	2521.74	1	9	1	0	11	0.86	0.576
AEMP	TPS	4	15	15	12	4 2009	TPS 2009	21-Aug-09	0	0.2	3	7.3	2009	282.61	2130.43	913.04	0	3326.09	1	9	1	0	11	0.84	0.613
AEMP	TPS	4	15	15	12	4 2009	TPS 2009	21-Aug-09	0	0.2	4	7.3	2009	0	1717.39	304.35	0	2021.74	0	10	1	0	11	0.76	0.572
AEMP	TPS	4	15	15	12	4 2009	TPS 2009	21-Aug-09	0	0.2	5	9.7	2009	43.48	304.35	369.57	0	717.39	1	6	1	0	8	0.72	0.538
AEMP	TEFF	5	17	17	13	5 2009	TEFF 2009	14-Aug-09	0	0.2	1	6.9	2009	0	586.96	239.13	195.65	1021.74	0	9	1	1	11	0.86	0.574
AEMP	TEFF	5	17	17	13	5 2009	TEFF 2009	14-Aug-09	0	0.2	2	6.6	2009	21.74	1347.83	130.43	43.48	1543.48	1	9	1	1	12	0.78	0.586
AEMP	TEFF	5	17	17	13	5 2009	TEFF 2009	14-Aug-09	0	0.2	3	7.8	2009	0	1108.7	326.09	0	1434.78	0	7	1	0	8	0.83	0.516
AEMP	TEFF	5	17	17	13	5 2009	TEFF 2009	14-Aug-09	0	0.2	4	7.2	2009	0	608.7	326.09	43.48	978.26	0	10	1	1	12	0.84	0.442
AEMP	TEFF	5	17	17	13	5 2009	TEFF 2009	14-Aug-09	0	0.2	5	6.9	2009	0	934.78	217.39	43.48	1195.65	0	7	1	1	9	0.88	0.52
AEMP	TPE	6	19	19	14	6 2006	TPE 2006	17-Aug-06	0	0.2	1	8	2006	0	1869.57	673.91	21.74	2565.22	0	5	1	1	7	0.74	0.633
AEMP	TPE	6	19	19	14	6 2006	TPE 2006	17-Aug-06	0	0.2	2	8	2006	0	3260.87	413.04	0	3673.91	0	7	1	0	8	0.59	0.709
AEMP	TPE	6	19	19	14	6 2006	TPE 2006	17-Aug-06	0	0.2	3	8	2006	86.96	2739.13	673.91	43.48	3543.48	2	6	1	1	10	0.76	0.646
AEMP	TPE	6	20	20	15	6 2007	TPE 2007	21-Aug-07	0	0.2	1	9.5	2007	0	869.57	673.91	65.22	1608.7	0	8	1	1	10	0.78	0.51
AEMP	TPE	6	20	20	15	6 2007	TPE 2007	21-Aug-07	0	0.2	2	8.7	2007	21.74	760.87	413.04	21.74	1217.39	1	7	1	1	10	0.84	0.406
AEMP	TPE	6	20	20	15	6 2007	TPE 2007	21-Aug-07	0	0.2	3	7.8	2007	0	1152.17	413.04	0	1565.22	0	11	1	0	12	0.81	0.476
AEMP	TPE	6	20	20	15	6 2007	TPE 2007	21-Aug-07	0	0.2	4	7.6	2007	0	978.26	500	130.43	1608.7	0	7	1	1	9	0.83	0.493
AEMP	TPE	6	20	20	15	6 2007	TPE 2007	21-Aug-07	0	0.2	5	8.8	2007	86.96	782.61	978.26	43.48	1891.3	1	9	1	1	12	0.7	0.543
AEMP	TPE	6	21	21	16	6 2008	TPE 2008	16-Aug-08	0	0.2	1	8.7	2008	108.7	5369.57	239.13	304.35	6021.74	1	13	1	1	16	0.69	0.725

Program	Area	AreaN	Area.Year.NGF	Area.Year.NG	Area.Year.N	AreaN.Year	Area.Year	Date	Effect	TSS	Rep	Depth	Year	Nolig	Ninsect	Nmoll	Nother	N	Rolig	Rinsect	Rmoll	Rother	R	SimpDiv	BrayCurtis
AEMP	TPE	6	21	21	16	6 2008	TPE 2008	16-Aug-08	0	0.2	2	7.8	2008	0	4652.17	565.22	0	5217.39	0	9	1	0	10	0.72	0.742
AEMP	TPE	6	21	21	16	6 2008	TPE 2008	16-Aug-08	0	0.2	3	11.5	2008	0	6326.09	695.65	130.43	7152.17	0	11	1	2	14	0.57	0.735
AEMP	TPE	6	21	21	16	6 2008	TPE 2008	16-Aug-08	0	0.2	4	11.2	2008	21.74	4065.22	86.96	304.35	4478.26	1	11	1	3	16	0.79	0.695
AEMP	TPE	6	21	21	16	6 2008	TPE 2008	16-Aug-08	0	0.2	5	8.9	2008	86.96	4434.78	195.65	543.48	5260.87	2	10	1	2	15	0.8	0.715
AEMP	TPE	6	22	22	17	6 2009	TPE 2009	13-Aug-09	5	1.4	1	6.9	2009	108.7	1130.43	217.39	86.96	1543.48	2	8	1	1	12	0.89	0.513
AEMP	TPE	6	22	22	17	6 2009	TPE 2009	13-Aug-09	5	1.4	2	7.7	2009	0	1195.65	695.65	0	1891.3	0	10	1	0	11	0.82	0.491
AEMP	TPE	6	22	22	17	6 2009	TPE 2009	14-Aug-09	5	1.4	3	7.8	2009	0	586.96	456.52	21.74	1065.22	0	7	1	1	9	0.77	0.528
AEMP	TPE	6	22	22	17	6 2009	TPE 2009	14-Aug-09	5	1.4	4	6.5	2009	173.91	869.57	586.96	195.65	1826.09	0	10	1	1	12	0.84	0.573
AEMP	TPE	6	22	22	17	6 2009	TPE 2009	14-Aug-09	5	1.4	5	6.5	2009	108.7	1326.09	717.39	86.96	2239.13	2	8	1	1	12	0.83	0.559
AEMP	TE	7	24	24	18	7 2007	TE 2007	25-Aug-07	0	0.2	1	8.9	2007	43.48	456.52	369.57	0	869.57	1	2	1	0	4	0.58	0.656
AEMP	TE	7	24	24	18	7 2007	TE 2007	25-Aug-07	0	0.2	2	7.1	2007	43.48	630.43	543.48	173.91	1391.3	0	8	1	1	10	0.77	0.605
AEMP	TE	7	24	24	18	7 2007	TE 2007	25-Aug-07	0	0.2	3	10.7	2007	21.74	347.83	217.39	195.65	782.61	1	4	1	3	9	0.81	0.661
AEMP	TE	7	24	24	18	7 2007	TE 2007	25-Aug-07	0	0.2	4	9.9	2007	43.48	391.3	369.57	108.7	913.04	1	6	1	2	10	0.78	0.58
AEMP	TE	7	24	24	18	7 2007	TE 2007	25-Aug-07	0	0.2	5	9.1	2007	21.74	500	260.87	21.74	804.35	1	7	1	1	10	0.76	0.6
AEMP	TE	7	25	25	19	7 2008	TE 2008	19-Aug-08	2	5	1	7.5	2008	0	500	282.61	21.74	804.35	0	9	2	1	12	0.83	0.551
AEMP	TE	7	25	25	19	7 2008	TE 2008	19-Aug-08	2	5	2	9.4	2008	21.74	413.04	500	43.48	978.26	1	8	1	1	11	0.71	0.535
AEMP	TE	7	25	25	19	7 2008	TE 2008	19-Aug-08	2	5	3	11.7	2008	0	260.87	282.61	0	543.48	0	7	1	0	8	0.71	0.632
AEMP	TE	7	25	25	19	7 2008	TE 2008	19-Aug-08	2	5	4	13.1	2008	21.74	456.52	173.91	43.48	695.65	1	7	1	1	10	0.86	0.651
AEMP	TE	7	25	25	19	7 2008	TE 2008	19-Aug-08	2	5	5	12.6	2008	0	565.22	195.65	0	760.87	0	8	1	0	9	0.86	0.601
AEMP	TE	7	26	26	20	7 2009	TE 2009	14-Aug-09	4	0.4	1	7	2009	21.74	152.17	586.96	86.96	847.83	1	4	1	1	7	0.51	0.654
AEMP	TE	7	26	26	20	7 2009	TE 2009	14-Aug-09	4	0.4	2	7.4	2009	108.7	391.3	195.65	65.22	760.87	0	5	1	1	7	0.87	0.637
AEMP	TE	7	26	26	20	7 2009	TE 2009	14-Aug-09	4	0.4	3	6.9	2009	0	130.43	391.3	0	521.74	0	3	2	0	5	0.49	0.645
AEMP	TE	7	26	26	20	7 2009	TE 2009	14-Aug-09	4	0.4	4	8.2	2009	0	391.3	347.83	130.43	869.57	0	5	1	2	8	0.79	0.54
AEMP	TE	7	26	26	20	7 2009	TE 2009	14-Aug-09	4	0.4	5	7.9	2009	0	413.04	304.35	130.43	847.83	0	6	1	1	8	0.81	0.543
AEMP	SP	8	28	28	21	8 2006	SP 2006	18-Aug-06	0	0.2	1	7.8	2006	0	108.7	347.83	65.22	521.74	0	2	1	1	4	0.53	0.691
AEMP	SP	8	28	28	21	8 2006	SP 2006	18-Aug-06	0	0.2	2	7.8	2006	21.74	347.83	239.13	86.96	695.65	1	5	1	1	8	0.74	0.651
AEMP	SP	8	28	28	21	8 2006	SP 2006	18-Aug-06	0	0.2	3	7.8	2006	0	326.09	239.13	86.96	652.17	0	5	1	1	7	0.75	0.646
AEMP	SP	8	29	29	22	8 2007	SP 2007	27-Aug-07	0	0.2	1	9.6	2007	43.48	282.61	173.91	108.7	608.7	0	3	1	1	5	0.75	0.745
AEMP	SP	8	29	29	22	8 2007	SP 2007	27-Aug-07	0	0.2	2	10.6	2007	86.96	456.52	760.87	130.43	1434.78	1	8	1	1	11	0.69	0.569
AEMP	SP	8	29	29	22	8 2007	SP 2007	27-Aug-07	0	0.2	3	8	2007	21.74	608.7	260.87	86.96	978.26	1	8	1	1	11	0.85	0.568
AEMP	SP	8	29	29	22	8 2007	SP 2007	27-Aug-07	0	0.2	4	9.1	2007	65.22	239.13	21.74	130.43	456.52	1	5	1	2	9	0.9	0.763
AEMP	SP	8	29	29	22	8 2007	SP 2007	27-Aug-07	0	0.2	5	8.4	2007	65.22	543.48	347.83	130.43	1086.96	2	6	1	1	10	0.82	0.55
AEMP	SP	8	30	30	23	8 2008	SP 2008	23-Aug-08	1	15	1	9.9	2008	0	130.43	108.7	0	239.13	0	4	1	0	5	0.78	0.811
AEMP	SP	8	30	30	23	8 2008	SP 2008	23-Aug-08	1	15	2	7	2008	0	304.35	130.43	43.48	478.26	0	6	1	1	8	0.81	0.733
AEMP	SP	8	30	30	23	8 2008	SP 2008	23-Aug-08	1	15	3	13.2	2008	0	326.09	195.65	43.48	565.22	0	9	1	1	11	0.86	0.665
AEMP	SP	8	30	30	23	8 2008	SP 2008	23-Aug-08	1	15	4	7.8	2008	0	326.09	130.43	0	456.52	0	6	1	0	7	0.86	0.715
AEMP	SP	8	30	30	23	8 2008	SP 2008	23-Aug-08	1	15	5	10.1	2008	0	195.65	108.7	21.74	326.09	0	4	1	1	6	0.8	0.784
AEMP	SP	8	31	31	24	8 2009	SP 2009	12-Aug-09	3	1	1	7.5	2009	65.22	347.83	260.87	130.43	804.35	1	2	1	1	5	0.74	0.677
AEMP	SP	8	31	31	24	8 2009	SP 2009	12-Aug-09	3	1	2	7.7	2009	21.74	391.3	260.87	21.74	695.65	1	4	1	1	7	0.77	0.622
AEMP	SP	8	31	31	24	8 2009	SP 2009	12-Aug-09	3	1	3	6.8	2009	65.22	413.04	326.09	108.7	913.04	0	5	2	1	8	0.83	0.566
AEMP	SP	8	31	31	24	8 2009	SP 2009	12-Aug-09	3	1	4	7.1	2009	43.48	434.78	326.09	43.48	847.83	0	6	1	1	8	0.77	0.543
AEMP	SP	8	31	31	24	8 2009	SP 2009	12-Aug-09	3	1	5	8.1	2009	21.74	369.57	239.13	0	630.43	0	5	1	0	6	0.8	0.613

APPENDIX D

RAW DATA FOR ANALYSIS OF PRIMARY AND SECONDARY PRODUCTIVITY – BG EAS 2009

Date	Lake	Area	StationEve	Effect.CIIIP	Effect.CIII	Effect.CI	Station	Rep	Bcyano	Bchloro	Beugleno	Bchryso	Bdiat	Bcrypto	Bdino	B	Nspecies	SimpDiv	Dcyano	Dchloro	Deugleno	Dchryso	Ddiat	Dcrypto	Ddino	D	ChlrA	Bzoop
R1	TPL	EAS-TPS	1	0	0	0	R3	1	0.11	6.86	0	38.12	4.61	2.79	26.23	78.72	35	0.88	600	152864	0	510464	36920	16168	8184	725200	0.159	62.81
R1	TPL	EAS-TPS	1	0	0	0	R3	2	0.39	6.06	0	59.85	7.01	1.9	2.3	77.5	35	0.85	1600	166032	0	899200	44504	1800	200	1113336	0.306	81.39
R1	TPL	EAS-TPS	1	0	0	0	R3	3	0.43	4.94	0	29.57	6.23	1.39	14.98	57.54	35	0.88	2800	295144	0	402704	23952	8184	600	733384	0.238	40.69
R1	TPL	EAS-TPS	1	0	0	0	R3	4	0.42	4.36	0	85.89	7.38	0.89	1.45	100.39	31	0.84	8584	146080	0	999176	52888	1200	200	1208128	0.351	28.31
R1	TPL	EAS-TPS	1	0	0	0	R3	5	0.91	6.45	0	66.12	6.61	2.11	9.3	91.5	33	0.88	43104	403504	0	733968	52488	22952	400	1256416	0.366	35.39
R1	SPL	EAS-DT	3	0	0	0	RD	1	0.05	3.12	0	109.37	16.35	6.88	5.69	141.47	41	0.85	200	116744	0	1376944	194184	35536	7984	1731592	0.331	1.77
R1	SPL	EAS-DT	3	0	0	0	RD	2	0.22	10.81	0	140.13	27.36	12.33	20.04	210.9	46	0.85	400	576320	0	2164984	281608	68272	8984	3100568	0.246	2.65
R1	SPL	EAS-DT	3	0	0	0	RD	3	1.9	9.59	0	91.76	19.4	9.05	27.37	159.07	41	0.88	115544	324480	0	1237848	222920	97992	15568	2014352	0.336	3.54
R1	SPL	EAS-DT	3	0	0	0	RD	4	0.12	9	0	108.07	28.04	11.9	21.31	178.45	47	0.87	600	512864	0	1507256	326112	38936	15968	2401736	0.566	3.54
R1	SPL	EAS-DT	3	0	0	0	RD	5	0.06	5.64	0	111.34	17.72	5.78	5.61	146.16	40	0.86	400	324680	0	1561928	236488	47704	7584	2178784	0.5	6.19
R1	TPL	EAS-BGE	5	1	1	1	E1	1	0.72	0.72	0	13.79	1.3	0.58	19.54	36.65	19	0.8	8584	21752	0	165632	14768	7584	800	219120	0.268	70.77
R1	TPL	EAS-BGE	5	1	1	1	E1	2	0.48	3.41	0	17.97	3.47	3.28	2.65	31.26	25	0.84	2400	173016	0	208936	44704	23952	7184	460192	0.253	47.77
R1	TPL	EAS-BGE	5	1	1	1	E1	3	0.3	6.83	0	44.45	6.63	4.91	8.26	71.39	31	0.86	2800	144680	0	575320	94792	24952	600	843144	0.388	35.39
R1	TPL	EAS-BGE	5	1	1	1	E1	4	1.52	8.25	0	27.79	2.29	2.01	5.63	47.48	29	0.87	8984	215920	0	337848	15968	15968	7784	602472	0.306	23.89
R1	TPL	EAS-BGE	5	1	1	1	E1	5	1.35	4.47	0	20.51	8.02	2.49	0	36.85	31	0.85	29936	94792	0	345832	116144	16568	0	603272	0.286	18.58
R1	TPL	EAS-BGW	7	2	2	1	E2	1	1.21	4.9	0	24.09	5.83	3.59	8.65	48.26	29	0.84	43504	274192	0	345432	59872	4400	7584	734984	0.308	27.42
R1	TPL	EAS-BGW	7	2	2	1	E2	2	0.28	2.25	0	18.57	4.28	2.07	0	27.44	22	0.86	7584	86408	0	281376	65256	23152	0	463776	0.267	23.89
R1	TPL	EAS-BGW	7	2	2	1	E2	3	0	4.21	0	29.52	8.52	3.75	3.12	49.13	29	0.87	0	129712	0	346032	109360	17568	200	602872	0.238	23.89
R1	TPL	EAS-BGW	7	2	2	1	E2	4	0.4	5.48	0	36.63	10.14	1.01	12.84	66.51	28	0.88	400	108560	0	380752	104776	1000	21952	617440	0.095	20.35
R1	TPL	EAS-BGW	7	2	2	1	E2	5	1.12	3.5	0	42.16	18.93	2.5	2.45	70.65	33	0.89	7584	108160	0	438824	190384	16568	200	761720	0.179	15.04
R1	SPL	EAS-SPC	9	3	3	1	E3	1	0.53	7.77	0	78.84	10.27	2.81	12.07	112.29	40	0.89	8584	274392	0	921552	126128	2800	600	1334056	0.448	60.16
R1	SPL	EAS-SPC	9	3	3	1	E3	2	0.09	11.88	0	63.83	34.81	3.05	11.41	125.07	39	0.89	400	431840	0	964856	482744	16768	600	1897208	0.391	26.54
R1	SPL	EAS-SPC	9	3	3	1	E3	3	0.48	6.48	0	75.88	23.54	4.32	5.14	115.84	40	0.9	8584	338648	0	942304	322896	17568	14568	1644568	0.345	38.04
R1	SPL	EAS-SPC	9	3	3	1	E3	4	0.36	6.68	0	149.24	17.42	5.6	17.42	196.72	38	0.9	1400	395720	0	972240	227104	60472	22152	1679088	0.307	43.35
R1	SPL	EAS-SPC	9	3	3	1	E3	5	0.16	11.14	0	93.92	30.39	4.42	10.7	150.74	44	0.9	1000	763304	0	1036896	280392	11584	400	2093576	0.295	38.92
R2	TPL	EAS-TPS	1	0	0	0	R3	1	0.35	5.34	0	60.24	7.75	0.65	2.5	76.84	29	0.87	2000	273992	0	862680	46104	7584	200	1192560	0.728	29.19
R2	TPL	EAS-TPS	1	0	0	0	R3	2	0.8	6.2	0	56.2	9.03	2.64	1.45	76.32	32	0.87	22752	266808	0	547384	46304	37320	200	920768	0.75	12.38
R2	TPL	EAS-TPS	1	0	0	0	R3	3	0.13	4.08	0	41.95	8.65	0.75	14.84	70.41	28	0.88	1200	245456	0	446208	47304	7584	29536	777288	0.78	20.35
R2	TPL	EAS-TPS	1	0	0	0	R3	4	0.24	7.29	0	61.57	8.51	1.19	9.93	88.73	35	0.88	1400	281776	0	683080	46704	14968	800	1028728	0.778	28.31
R2	TPL	EAS-TPS	1	0	0	0	R3	5	0.33	5.68	0	41.93	9.08	3.26	7.33	67.6	32	0.78	2200	468960	0	467960	46504	37120	7784	1030528	0.734	16.81
R2	SPL	EAS-DT	3	0	0	0	RD	1	0.03	6.66	0	107.32	29.3	13.8	7.43	164.54	40	0.84	400	280776	0	1757496	255472	130128	400	2424672	0.666	38.92
R2	SPL	EAS-DT	3	0	0	0	RD	2	0.08	5.45	0	118.29	20	7.8	12.04	163.65	36	0.82	800	230288	0	1813168	194600	76640	35920	2351416	0.718	20.35
R2	SPL	EAS-DT	3	0	0	0	RD	3	1.72	3.51	0	108.67	22.27	11.75	14.08	162.01	44	0.87	87408	194568	0	1368360	234504	86024	29336	2000200	0.804	96.43
R2	SPL	EAS-DT	3	0	0	0	RD	4	0.07	5.69	0	154.74	39.56	13.53	30.93	244.52	43	0.85	400	245856	0	2072192	434872	149680	22352	2925352	0.856	16.81
R2	SPL	EAS-DT	3	0	0	0	RD	5	0.28	8.57	0	138.15	25.28	5.77	24.99	203.04	42	0.83	1200	138296	0	1827536	194000	26952	15968	2203952	0.632	13.27
R2	TPL	EAS-BGE	5	4	1	1	E1	1	1.01	4.06	0	48.59	6.23	9.49	19.36	88.73	32	0.9	4200	194768	0	489512	60672	47904	15168	812224	0.697	32.73
R2	TPL	EAS-BGE	5	4	1	1	E1	2	0.64	3.16	0.41	19.46	4.33	1.88	7.94	37.82	22	0.85	3600	51488	200	316096	45104	1800	21552	439840	0.366	15.92
R2	TPL	EAS-BGE	5	4	1	1	E1	3	1.63	4.61	0	23.2	8.73	4.36	4.6	47.12	33	0.91	89208	194968	0	209136	68856	31736	400	594304	0.305	18.58
R2	TPL	EAS-BGE	5	4	1	1	E1	4	0.14	2.64	0	14.37	1.96	2.07	5.77	26.94	19	0.75	1600	86408	0	244656	7784	8384	7384	356216	0.28	15.04
R2	TPL	EAS-BGE	5	4	1	1	E1	5	1	5.01	0	44.75	3.32	2.01	0	56.09	20	0.83	87208	51688	0	165232	30936	36320	0	371384	0.327	30.96
R2	TPL	EAS-BGW	7	5	2	1	E2	1	1.88	6.56	0	40.48	17.76	6.02	6.9	79.59	35	0.89	9584	295144	0	633792	227704	19568	800	1186592	0.715	21.23
R2	TPL	EAS-BGW	7	5	2	1	E2	2	0.32	12.66	0	27.71	9.77	2.99	0	53.45	26	0.9	1800	238472	0	311112	98192	9984	0	659560	0.377	21.23
R2	TPL	EAS-BGW	7	5	2	1	E2	3	0.29	3.66	0	31.17	5.89	2.71	10.55	54.26	24	0.84	1200	15368	0	310112	66056	9584	7584	409904	0.244	26.54
R2	TPL	EAS-BGW	7	5	2	1	E2	4	0.63	3.17	0.87	26.31	9.78	4.47	0	45.24	27	0.86	2400	123128	200	346232	151864	31936	0	655760	0.522	25.65
R2	TPL	EAS-BGW	7	5	2	1	E2	5	0.29	7.15	0	41.28	10.31	4.34	3.12	66.48	36	0.88	1200	124328	0	575120	116944	10784	200	828576	0.523	28.31
R2	SPL	EAS-SPC	9	6	3	1	E3	1	0.75	6.06	0	116.2	28.17	18.93	13.25	183.35	42	0.87	2600	267808	0	1636168	199784	120960	29136	2256456	0.996	37.15
R2	SPL	EAS-SPC	9	6	3	1	E3	2	0.57	6.66	0	112.56	27.94	9.51	30.75	187.99	42	0.87	2000	331064	0	1389112	367400	28952	22952	2141480	0.715	47.77
R2	SPL	EAS-SPC	9	6	3	1	E3	3	1.25	6.23	0	137.31	36.04	11.65	12.86	205.35	43	0.86	23352	196368	0	1683656	482344	52904	14968	2453592	0.681	34.50
R2	SPL	EAS-SPC	9	6	3	1	E3	4	0.55	4.87	0	171.7	24.66	11.3	16.16	229.25	39	0.88	2400	295744	0	1726560	327896	92608	29336	2474544	0.746	38.92
R2	SPL	EAS-SPC	9	6	3	1	E3	5	0.76	10.67	0	125.49	22.8	10.19	15.46	185.38	43	0.88	2000	504680	0	1353392	213352	57488	15168	2146080	0.473	52.19

APPENDIX C

PHOTOS OF UNDERWATER VIDEO IMAGERY

Photo C-1. (SP HVH1) Periphyton coverage on fines and cobble. Green colour of periphyton may be muted due to settled sediment.

Photo C-2. (SP HVH3) Green, luxurious periphyton covering boulders as a dense continuous mat.

Photo C-3. (SP HVH4) Patchy periphyton mat on boulder in shallow water may indicate ice scour.

Photo C-4. (SP HVH2) Flat surface with periphyton mat that is considerably less green, dense and luxuriant as that on vertical sides of boulders. May be due to smothering by sediment.

Photo C-5. (TPE HVH4) Periphyton on fines are highly textured and form a continuous mat.

Photo C-6. (TPE HVH2) Boulder covered with a very dense mat of periphyton with raised fronds.

Photo C-7. (TPE HVH3) Boulders in shallow water (<2 m) covered in a continuous mat of green periphyton.

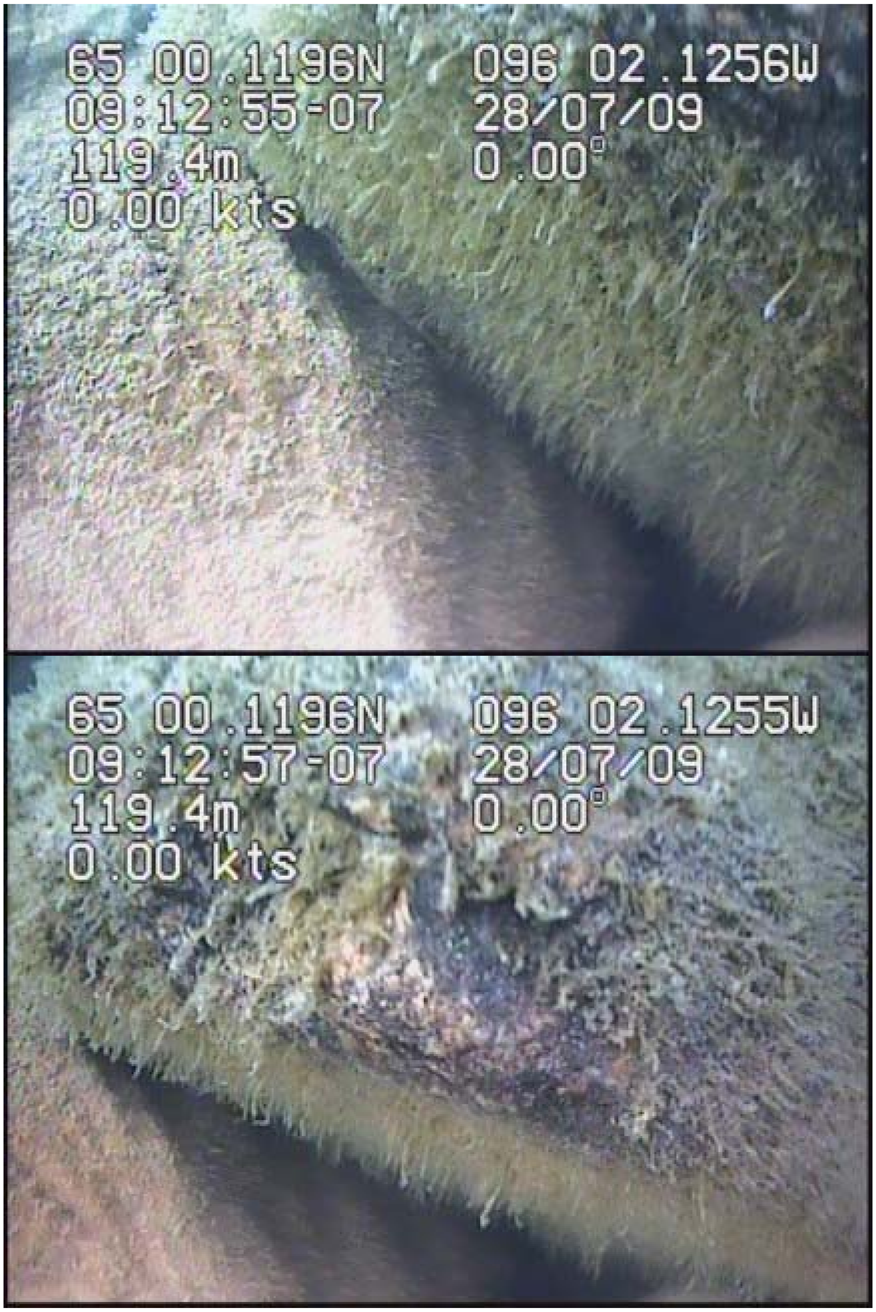

Photo C-8. (TPE HVH3) A continuous mat of periphyton with raised green fronds, covering the side of a boulder.

Photo C-9. (TPE HVH2) Continuous mat of periphyton covering all substrates.

Photo C-10. (TPE HVH2) Large boulders with patchy periphyton coverage which may be from ice scour (depth < 2m).

Photo C-11. (East Dike, north end) Heavy sedimentation and gravel debris from East Dike construction cover natural boulder substrate. While periphyton mats are evident on rock sides, sediment covers the top surface, giving the periphyton a grey colour.

APPENDIX D

PHOTOS OF QUANTITATIVE PERIPHYTON SAMPLING, 2009

Photo D-1. Preparing the scrubber for removing periphyton from a rock.

Photo D-2. Scrubber in action.

Photo D-3. Natural substrate with thick periphyton mat removed in prescribed area by scrubber.

Photo D-4. Removal of periphyton outside of prescribed area for live/dead analysis.

APPENDIX E

ALS SURFACE SEDIMENT CHEMISTRY LABORATORY REPORTS, 2009

Certificate of Analysis

AZIMUTH CONSULTING GROUP INC.
ATTN: RANDY BAKER
218 - 2902 WEST BROADWAY
VANCOUVER BC V6K 2G8

Report Date: 01-SEP-09 15:41 (MT)
Version: FINAL REV. 2

Lab Work Order #: **L797346** **Date Received:** **27-JUL-09**

Project P.O. #:
Job Reference: MEADOWBANK MINE AEMP
Legal Site Desc:
CofC Numbers:

Other Information:

Comments: Please note that certain metals detection limits have been increased for some of the samples due to the interferences encountered during the analysis.
Please note that this report has been revised since its initial approval. Mercury and Phosphorus have been analyzed for samples #19 to #66. All other data remains unchanged.

Lindsay Jones
LINDSAY JONES
Account Manager

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L797346-19	L797346-20	L797346-21	L797346-22	L797346-23
	Description					
	Sampled Date	18-JUL-09	18-JUL-09	18-JUL-09	18-JUL-09	18-JUL-09
	Sampled Time					
	Client ID	SP-SC-1	SP-SC-2	SP-SC-3	SP-SC-4	SP-SC-5
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (pH)	6.85	6.57	6.46	6.46	6.38
Organic / Inorganic Carbon	Total Organic Carbon (%)	5.45	4.59	5.57	4.78	2.61
Metals	Aluminum (Al) (mg/kg)	28500	31400	31600	28700	34500
	Antimony (Sb) (mg/kg)	<10	<10	<10	<10	<10
	Arsenic (As) (mg/kg)	33.2	31.1	33.7	60.4	34.0
	Barium (Ba) (mg/kg)	141	149	151	135	161
	Beryllium (Be) (mg/kg)	2.28	2.46	2.48	2.29	2.58
	Cadmium (Cd) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Chromium (Cr) (mg/kg)	81.7	85.3	87.2	78.9	84.6
	Cobalt (Co) (mg/kg)	15.4	16.2	16.8	18.0	17.7
	Copper (Cu) (mg/kg)	92.8	101	104	94.0	104
	Lead (Pb) (mg/kg)	30	<30	<30	<30	31
	Mercury (Hg) (mg/kg)	0.0490	0.0429	0.0540	0.0435	0.0403
	Molybdenum (Mo) (mg/kg)	6.7	6.2	6.6	7.3	10.1
	Nickel (Ni) (mg/kg)	59.7	61.2	61.3	61.3	71.3
	Phosphorus (P) (mg/kg)	766	730	782	665	567
	Selenium (Se) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<3.0
	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
	Vanadium (V) (mg/kg)	42.9	45.8	46.5	43.7	50.9
	Zinc (Zn) (mg/kg)	120	124	126	119	132

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L797346-24	L797346-25	L797346-26	L797346-27	L797346-28
	Description					
	Sampled Date	18-JUL-09	18-JUL-09	18-JUL-09	18-JUL-09	18-JUL-09
	Sampled Time					
	Client ID	SP-SC-6	SP-SC-7	SP-SC-8	SP-SC-9	SP-SC-10
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (pH)	6.31	6.37	6.31	6.36	6.29
Organic / Inorganic Carbon	Total Organic Carbon (%)	4.08	4.21	4.96	4.05	3.18
Metals	Aluminum (Al) (mg/kg)	30400	28300	27800	32100	36200
	Antimony (Sb) (mg/kg)	<10	<10	<10	<10	<10
	Arsenic (As) (mg/kg)	30.9	28.0	29.3	24.3	36.7
	Barium (Ba) (mg/kg)	138	139	132	149	163
	Beryllium (Be) (mg/kg)	2.33	2.35	2.16	2.50	2.67
	Cadmium (Cd) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Chromium (Cr) (mg/kg)	85.1	82.7	77.3	88.0	95.0
	Cobalt (Co) (mg/kg)	15.8	16.5	14.2	14.8	17.9
	Copper (Cu) (mg/kg)	101	95.5	89.6	105	114
	Lead (Pb) (mg/kg)	<30	<30	<30	<30	<30
	Mercury (Hg) (mg/kg)	0.0495	0.048	0.0596	0.0581	0.0378
	Molybdenum (Mo) (mg/kg)	6.8	6.1	6.6	6.2	8.3
	Nickel (Ni) (mg/kg)	55.5	70.0	59.3	72.1	63.0
	Phosphorus (P) (mg/kg)	666	610	668	707	659
	Selenium (Se) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.5
	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
	Vanadium (V) (mg/kg)	45.3	44.4	41.8	47.3	52.2
	Zinc (Zn) (mg/kg)	123	130	119	132	139

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L797346-29	L797346-30	L797346-31	L797346-32	L797346-33
	Description					
	Sampled Date	18-JUL-09	18-JUL-09	18-JUL-09	18-JUL-09	18-JUL-09
	Sampled Time					
	Client ID	SP-SC-11	SP-SC-12	SP-SC-13	SP-SC-14	SP-SC-15
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (pH)	6.38	6.42	6.47	6.26	6.28
Organic / Inorganic Carbon	Total Organic Carbon (%)	4.38	5.78	4.95	5.69	4.69
Metals	Aluminum (Al) (mg/kg)	27400	19700	29000	22000	25000
	Antimony (Sb) (mg/kg)	<10	<20	<10	<10	<10
	Arsenic (As) (mg/kg)	29.2	93	32.4	63.4	43.0
	Barium (Ba) (mg/kg)	129	312	151	160	116
	Beryllium (Be) (mg/kg)	2.07	1.5	2.21	1.77	2.06
	Cadmium (Cd) (mg/kg)	<0.50	1.1	<0.50	<0.50	<0.50
	Chromium (Cr) (mg/kg)	78.8	58.5	83.4	62.8	72.0
	Cobalt (Co) (mg/kg)	16.9	28.9	18.1	19.6	14.2
	Copper (Cu) (mg/kg)	84.1	75.0	96.3	79.6	78.9
	Lead (Pb) (mg/kg)	<30	<60	<30	<30	<30
	Mercury (Hg) (mg/kg)	0.0453	0.0684	0.0565	0.0651	0.052
	Molybdenum (Mo) (mg/kg)	6.7	22.8	7.3	10.8	8.0
	Nickel (Ni) (mg/kg)	63.4	94	87.6	81.4	52.8
	Phosphorus (P) (mg/kg)	587	890	745	747	596
	Selenium (Se) (mg/kg)	<2.5	<2.5	<2.0	<2.0	<2.0
	Silver (Ag) (mg/kg)	<2.0	<4.0	<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	<10	<5.0	<5.0	<5.0
	Vanadium (V) (mg/kg)	42.8	28.7	45.1	36.1	40.4
	Zinc (Zn) (mg/kg)	121	107	126	104	110

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L797346-34	L797346-35	L797346-36	L797346-37	L797346-38
	Description					
	Sampled Date	18-JUL-09	17-JUL-09	17-JUL-09	17-JUL-09	17-JUL-09
	Sampled Time					
	Client ID	SP-SC-DUP	TPE-SC-1	TPE-SC-2	TPE-SC-3	TPE-SC-4
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (pH)	6.36	5.96	6.30	6.26	6.15
Organic / Inorganic Carbon	Total Organic Carbon (%)	4.83	3.06	3.72	4.97	4.92
Metals	Aluminum (Al) (mg/kg)	28700	27200	25800	25200	19000
	Antimony (Sb) (mg/kg)	<10	<10	<20	<10	<10
	Arsenic (As) (mg/kg)	32.5	16.9	23	16.2	30.8
	Barium (Ba) (mg/kg)	141	127	153	124	321
	Beryllium (Be) (mg/kg)	2.36	2.10	2.0	1.96	1.44
	Cadmium (Cd) (mg/kg)	<0.50	<0.50	<1.0	<0.50	<0.50
	Chromium (Cr) (mg/kg)	84.9	94.1	88.3	90.4	61.9
	Cobalt (Co) (mg/kg)	16.8	16.4	17.7	15.0	28.6
	Copper (Cu) (mg/kg)	94.6	56.0	62.7	54.0	63.6
	Lead (Pb) (mg/kg)	<30	<30	<60	<30	<30
	Mercury (Hg) (mg/kg)	0.047	0.0143	0.028	0.0213	0.0425
	Molybdenum (Mo) (mg/kg)	6.0	4.4	<8.0	<4.0	6.6
	Nickel (Ni) (mg/kg)	64.3	58.9	118	58.7	260
	Phosphorus (P) (mg/kg)	684	362	460	409	548
	Selenium (Se) (mg/kg)	<2.0	<3.0	<2.5	<2.0	<2.5
	Silver (Ag) (mg/kg)	<2.0	<3.0	<4.0	<2.0	<3.0
	Thallium (Tl) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Tin (Sn) (mg/kg)	<5.0	<5.0	<10	<5.0	<5.0
	Vanadium (V) (mg/kg)	45.0	43.8	41.5	40.3	31.7
	Zinc (Zn) (mg/kg)	127	111	121	106	122

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L797346-39	L797346-40	L797346-41	L797346-42	L797346-43
	Description					
	Sampled Date	17-JUL-09	17-JUL-09	17-JUL-09	17-JUL-09	17-JUL-09
	Sampled Time					
	Client ID	TPE-SC-5	TPE-SC-6	TPE-SC-7	TPE-SC-8	TPE-SC-9
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (pH)	6.34	5.52	5.75	6.33	6.09
Organic / Inorganic Carbon	Total Organic Carbon (%)	5.07	4.94	4.65	5.12	4.29
Metals	Aluminum (Al) (mg/kg)	23400	25200	25800	23400	26700
	Antimony (Sb) (mg/kg)	<10	<10	<10	<10	<10
	Arsenic (As) (mg/kg)	15.4	39.2	9.1	16.1	33.4
	Barium (Ba) (mg/kg)	118	137	151	121	150
	Beryllium (Be) (mg/kg)	1.85	2.18	1.88	1.86	2.18
	Cadmium (Cd) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Chromium (Cr) (mg/kg)	85.1	91.0	91.7	92.3	94.5
	Cobalt (Co) (mg/kg)	14.5	19.9	8.7	15.2	15.9
	Copper (Cu) (mg/kg)	49.6	81.5	58.9	50.2	84.5
	Lead (Pb) (mg/kg)	<30	<30	<30	<30	<30
	Mercury (Hg) (mg/kg)	0.0211	0.0453	0.0309	0.029	0.037
	Molybdenum (Mo) (mg/kg)	<4.0	11.3	4.6	4.1	8.3
	Nickel (Ni) (mg/kg)	59.0	82.8	63.6	60.4	96.1
	Phosphorus (P) (mg/kg)	405	478	362	434	1060
	Selenium (Se) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.5
	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
	Vanadium (V) (mg/kg)	37.9	42.3	40.3	38.8	44.7
	Zinc (Zn) (mg/kg)	103	148	112	108	127

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	L797346-44	L797346-45	L797346-46	L797346-47	L797346-48
	Description					
	Sampled Date	17-JUL-09	17-JUL-09	17-JUL-09	17-JUL-09	17-JUL-09
	Sampled Time					
	Client ID	TPE-SC-10	TPE-SC-11	TPE-SC-12	TPE-SC-13	TPE-SC-14
SOIL						
Physical Tests	pH (pH)	6.08	6.01	5.98	6.20	6.02
Organic / Inorganic Carbon	Total Organic Carbon (%)	3.52	3.47	4.16	4.88	5.63
Metals	Aluminum (Al) (mg/kg)	26900	25600	27800	24900	21500
	Antimony (Sb) (mg/kg)	<10	<10	<10	<10	<10
	Arsenic (As) (mg/kg)	17.6	17.3	18.6	17.7	15.9
	Barium (Ba) (mg/kg)	123	119	128	136	105
	Beryllium (Be) (mg/kg)	2.11	2.04	1.91	1.83	1.60
	Cadmium (Cd) (mg/kg)	<0.50	<0.50	<0.50	0.65	<0.50
	Chromium (Cr) (mg/kg)	94.7	90.9	94.6	84.7	79.5
	Cobalt (Co) (mg/kg)	16.0	15.5	15.4	13.5	11.8
	Copper (Cu) (mg/kg)	55.2	55.4	58.7	54.1	45.4
	Lead (Pb) (mg/kg)	<30	<30	<30	<30	<30
	Mercury (Hg) (mg/kg)	0.0162	0.0173	0.0237	0.0397	0.029
	Molybdenum (Mo) (mg/kg)	4.3	4.6	4.2	4.5	<4.0
	Nickel (Ni) (mg/kg)	56.6	55.3	60.2	64.5	51.2
	Phosphorus (P) (mg/kg)	380	365	469	451	429
	Selenium (Se) (mg/kg)	<2.0	<2.0	<2.5	<2.5	<2.0
	Silver (Ag) (mg/kg)	<2.0	<3.0	<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
	Vanadium (V) (mg/kg)	43.1	41.5	41.1	37.4	32.9
	Zinc (Zn) (mg/kg)	112	106	104	105	89.9

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L797346-49	L797346-50	L797346-51	L797346-52	L797346-53
	Description					
	Sampled Date	17-JUL-09	17-JUL-09	20-JUL-09	20-JUL-09	20-JUL-09
	Sampled Time					
	Client ID	TPE-SC-15	TPE-SC-DUP	TE-SC-1	TE-SC-2	TE-SC-3
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (pH)	5.91	5.13	6.00	6.02	6.05
Organic / Inorganic Carbon	Total Organic Carbon (%)	4.56	4.83	4.16	3.83	4.90
Metals	Aluminum (Al) (mg/kg)	26900	28400	21300	22900	27800
	Antimony (Sb) (mg/kg)	<10	<10	<20	<20	<10
	Arsenic (As) (mg/kg)	15.7	33.0	40	25	16.6
	Barium (Ba) (mg/kg)	123	142	206	203	166
	Beryllium (Be) (mg/kg)	1.97	2.22	1.8	1.9	2.36
	Cadmium (Cd) (mg/kg)	<0.50	0.77	1.3	<1.0	0.63
	Chromium (Cr) (mg/kg)	93.0	99.6	45.4	49.2	62.7
	Cobalt (Co) (mg/kg)	15.6	26.1	16.8	23.0	10.0
	Copper (Cu) (mg/kg)	52.6	89.1	76.4	66.9	79.0
	Lead (Pb) (mg/kg)	<30	<30	<60	<60	<30
	Mercury (Hg) (mg/kg)	0.0188	0.045	0.0431	0.0335	0.064
	Molybdenum (Mo) (mg/kg)	<4.0	9.6	13.8	10.4	4.2
	Nickel (Ni) (mg/kg)	57.7	85.7	92	65	49.9
	Phosphorus (P) (mg/kg)	411	675	770	710	1140
	Selenium (Se) (mg/kg)	<2.0	<2.0	<2.5	<1.3	<3.0
	Silver (Ag) (mg/kg)	<2.0	<3.0	<4.0	<6.0	<2.0
	Thallium (Tl) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Tin (Sn) (mg/kg)	<5.0	<5.0	<10	<10	<5.0
	Vanadium (V) (mg/kg)	40.7	42.3	28.6	30.4	39.9
	Zinc (Zn) (mg/kg)	106	145	117	101	115

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	L797346-54	L797346-55	L797346-56	L797346-57	L797346-58
	Description					
	Sampled Date	20-JUL-09	20-JUL-09	20-JUL-09	20-JUL-09	20-JUL-09
	Sampled Time					
	Client ID	TE-SC-4	TE-SC-5	TE-SC-6	TE-SC-7	TE-SC-8
SOIL						
Physical Tests	pH (pH)	6.08	6.05	6.06	5.81	5.80
Organic / Inorganic Carbon	Total Organic Carbon (%)	3.74	5.01	4.05	3.36	3.08
Metals	Aluminum (Al) (mg/kg)	29900	28100	22400	21100	19100
	Antimony (Sb) (mg/kg)	<10	<10	<10	<10	<10
	Arsenic (As) (mg/kg)	23.9	9.6	41.1	12.1	27.6
	Barium (Ba) (mg/kg)	156	163	150	97.0	84.9
	Beryllium (Be) (mg/kg)	2.44	2.21	1.94	1.79	1.60
	Cadmium (Cd) (mg/kg)	0.77	<0.50	0.74	<0.50	<0.50
	Chromium (Cr) (mg/kg)	62.3	60.1	48.1	48.6	43.5
	Cobalt (Co) (mg/kg)	14.5	8.6	15.3	8.4	8.4
	Copper (Cu) (mg/kg)	78.1	70.1	65.0	55.6	51.8
	Lead (Pb) (mg/kg)	<30	<30	<30	<30	<30
	Mercury (Hg) (mg/kg)	0.0316	0.0577	0.046	0.0386	0.0316
	Molybdenum (Mo) (mg/kg)	6.8	<4.0	11.4	<4.0	6.3
	Nickel (Ni) (mg/kg)	72.6	46.9	54.7	34.6	29.6
	Phosphorus (P) (mg/kg)	629	707	696	704	673
	Selenium (Se) (mg/kg)	<2.0	<2.0	<2.5	<2.0	<2.0
	Silver (Ag) (mg/kg)	<3.0	<2.0	<5.0	<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
	Vanadium (V) (mg/kg)	41.1	38.8	31.8	32.2	28.0
	Zinc (Zn) (mg/kg)	121	108	95.1	86.5	79.6

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	Sample ID	L797346-59	L797346-60	L797346-61	L797346-62	L797346-63
	Description					
	Sampled Date	20-JUL-09	20-JUL-09	20-JUL-09	20-JUL-09	20-JUL-09
	Sampled Time					
	Client ID	TE-SC-9	TE-SC-10	TE-SC-11	TE-SC-12	TE-SC-13
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (pH)	5.90	5.94	5.83	5.99	6.15
Organic / Inorganic Carbon	Total Organic Carbon (%)	3.15	4.43	3.18	4.04	4.65
Metals	Aluminum (Al) (mg/kg)	27400	28000	27500	29400	28300
	Antimony (Sb) (mg/kg)	<10	<10	<10	<10	<10
	Arsenic (As) (mg/kg)	20.0	21.5	24.2	20.8	20.3
	Barium (Ba) (mg/kg)	254	154	182	154	145
	Beryllium (Be) (mg/kg)	2.23	2.39	2.31	2.50	2.47
	Cadmium (Cd) (mg/kg)	0.53	0.71	0.60	0.54	0.59
	Chromium (Cr) (mg/kg)	58.6	62.5	57.4	64.1	61.3
	Cobalt (Co) (mg/kg)	19.2	14.6	20.8	14.3	13.7
	Copper (Cu) (mg/kg)	73.6	80.4	71.2	77.7	74.0
	Lead (Pb) (mg/kg)	<30	<30	<30	<30	<30
	Mercury (Hg) (mg/kg)	0.034	0.041	0.0301	0.037	0.041
	Molybdenum (Mo) (mg/kg)	7.4	6.0	7.2	6.6	6.3
	Nickel (Ni) (mg/kg)	61.3	73.3	63.2	58.0	54.1
	Phosphorus (P) (mg/kg)	604	690	567	687	721
	Selenium (Se) (mg/kg)	<2.5	<2.5	<2.5	<2.5	<3.0
	Silver (Ag) (mg/kg)	<6.0	<3.0	<5.0	<2.0	<3.0
	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
	Vanadium (V) (mg/kg)	39.9	40.4	38.3	41.0	39.9
	Zinc (Zn) (mg/kg)	114	125	108	123	122

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	Sample ID	L797346-64	L797346-65	L797346-66		
	Description					
	Sampled Date	20-JUL-09	20-JUL-09	20-JUL-09		
	Sampled Time					
	Client ID	TE-SC-14	TE-SC-15	TE-SC-DUP		
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (pH)	6.02	6.08	6.10		
Organic / Inorganic Carbon	Total Organic Carbon (%)	4.21	4.46	3.79		
Metals	Aluminum (Al) (mg/kg)	23100	19300	22900		
	Antimony (Sb) (mg/kg)	<10	<10	<10		
	Arsenic (As) (mg/kg)	45.4	52.6	30.1		
	Barium (Ba) (mg/kg)	134	110	135		
	Beryllium (Be) (mg/kg)	1.92	1.66	1.87		
	Cadmium (Cd) (mg/kg)	0.71	0.85	0.52		
	Chromium (Cr) (mg/kg)	49.3	42.8	51.0		
	Cobalt (Co) (mg/kg)	14.8	15.3	12.7		
	Copper (Cu) (mg/kg)	64.9	62.8	61.6		
	Lead (Pb) (mg/kg)	<30	<30	<30		
	Mercury (Hg) (mg/kg)	0.0442	0.048	0.0400		
	Molybdenum (Mo) (mg/kg)	14.8	18.7	9.3		
	Nickel (Ni) (mg/kg)	49.1	47.4	43.2		
	Phosphorus (P) (mg/kg)	722	1050	624		
	Selenium (Se) (mg/kg)	<2.5	<2.5	<2.5		
	Silver (Ag) (mg/kg)	<4.0	<4.0	<4.0		
	Thallium (Tl) (mg/kg)	<1.0	<1.0	<1.0		
	Tin (Sn) (mg/kg)	<5.0	<5.0	<5.0		
	Vanadium (V) (mg/kg)	31.5	27.5	32.4		
	Zinc (Zn) (mg/kg)	93.9	88.9	90.7		

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	Sample ID	L797346-1	L797346-2	L797346-3	L797346-4	L797346-5
	Description					
	Sampled Date	16-JUL-09	16-JUL-09	16-JUL-09	18-JUL-09	18-JUL-09
	Sampled Time					
	Client ID	TPE-4-S	TPE-5-S	TPE-6-S	SP-4-S	SP-5-S
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	17.0	14.7	14.8	23.3	22.1
	Hardness (as CaCO3) (mg/L)	5.4	5.3	5.2	9.6	8.8
	pH (pH)	6.73	6.74	6.75	6.89	6.96
	Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Dissolved Solids (mg/L)	<10	<10	<10	14	<10
	Turbidity (NTU)	0.39	0.37	0.44	0.68	1.12
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	4.5	4.3	4.3	7.3	6.8
	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)	4.5	4.3	4.3	7.3	6.8
	Ammonia as N (mg/L)	<0.020	<0.020	0.030	<0.020	<0.020
	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)	0.054	0.054	0.054	0.047	0.050
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.0066	0.0064
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.101	0.094	0.101	0.119	0.186
	Ortho Phosphate as P (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Phosphate as P (mg/L)	<0.0020	<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)	1.39	1.37	1.38	2.31	2.06
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.47	1.40	1.33	1.57	1.69
	Total Organic Carbon (mg/L)	1.43	1.33	1.42	1.81	1.57
Total Metals	Aluminum (Al)-Total (mg/L)	0.0081	0.0081	0.0082	0.0250	0.0341
	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)	1.26	1.24	1.25	2.48	2.31
	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	<0.0010
	Iron (Fe)-Total (mg/L)	<0.030	<0.030	<0.030	0.031	0.045
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Lithium (Li)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium (Mg)-Total (mg/L)	0.55	0.54	0.55	0.80	0.75
	Manganese (Mn)-Total (mg/L)	0.00168	0.00154	0.00155	0.00168	0.00209
	Mercury (Hg)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020

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	Sample ID	L797346-6	L797346-7	L797346-8	L797346-9	L797346-10
	Description					
	Sampled Date	18-JUL-09	19-JUL-09	19-JUL-09	19-JUL-09	19-JUL-09
	Sampled Time					
	Client ID	SP-6-S	TE-4-S	TE-4-INT	TE-4-D	TE-5-S
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	23.3	18.8	18.9	18.7	18.6
	Hardness (as CaCO3) (mg/L)	9.4	7.1	7.1	7.1	7.1
	pH (pH)	7.02	6.91	6.88	6.87	6.88
	Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Dissolved Solids (mg/L)	14	12	12	10	<10
	Turbidity (NTU)	0.77	0.56	0.51	0.50	0.53
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	7.0	5.9	5.7	5.4	5.9
	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)	7.0	5.9	5.7	5.4	5.9
	Ammonia as N (mg/L)	<0.020	0.024	<0.020	0.056	0.024
	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)	0.048	0.049	0.049	0.049	0.053
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	0.0086
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	0.0021
	Total Kjeldahl Nitrogen (mg/L)	<0.050	0.158	0.130	0.087	0.123
	Ortho Phosphate as P (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Phosphate as P (mg/L)	<0.0020	<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)	2.26	1.88	1.87	1.89	2.06
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.99	1.66	1.71	1.67	1.70
	Total Organic Carbon (mg/L)	1.64	1.68	1.67	1.79	1.77
Total Metals	Aluminum (Al)-Total (mg/L)	0.0253	0.0142	0.0143	0.0162	0.0169
	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)	2.47	1.80	1.80	1.73	1.74
	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	<0.0010
	Iron (Fe)-Total (mg/L)	0.037	<0.030	<0.030	0.032	<0.030
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Lithium (Li)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium (Mg)-Total (mg/L)	0.79	0.63	0.63	0.61	0.61
	Manganese (Mn)-Total (mg/L)	0.00174	0.00160	0.00168	0.00201	0.00182
	Mercury (Hg)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020

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	Sample ID	L797346-11	L797346-12	L797346-13	L797346-14	L797346-15
	Description					
	Sampled Date	19-JUL-09	19-JUL-09	20-JUL-09	20-JUL-09	20-JUL-09
	Sampled Time					
	Client ID	TE-5-INT	TE-5-D	TE-6-S	TEFF-1-S	TEFF-2-S
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	18.8	18.7	18.6	15.3	18.1
	Hardness (as CaCO3) (mg/L)	7.1	7.0	7.0	5.3	6.7
	pH (pH)	6.85	6.70	6.94	6.84	6.77
	Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Dissolved Solids (mg/L)	16	14	16	11	11
	Turbidity (NTU)	0.54	0.52	0.50	0.24	0.43
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	5.6	5.6	5.3	4.1	5.1
	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)	5.6	5.6	5.3	4.1	5.1
	Ammonia as N (mg/L)	0.023	0.020	0.022	0.021	0.022
	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	0.049	0.045	0.048
	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)	0.196	0.196	0.207	0.150	0.251
	Ortho Phosphate as P (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Phosphate as P (mg/L)	<0.0020	<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)	1.86	1.90	1.84	1.71	1.89
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.56	1.57	1.49	1.35	1.37
	Total Organic Carbon (mg/L)	1.64	1.71	1.56	1.20	1.40
Total Metals	Aluminum (Al)-Total (mg/L)	0.0170	0.0144	0.0172	<0.0050	0.0102
	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)	1.76	1.80	1.77	1.29	1.65
	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	<0.0010
	Iron (Fe)-Total (mg/L)	<0.030	<0.030	0.038	<0.030	<0.030
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Lithium (Li)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium (Mg)-Total (mg/L)	0.63	0.63	0.63	0.52	0.61
	Manganese (Mn)-Total (mg/L)	0.00186	0.00169	0.00198	0.00098	0.00142
	Mercury (Hg)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L797346-16	L797346-17	L797346-18		
	Description					
	Sampled Date	19-JUL-09	20-JUL-09			
	Sampled Time					
	Client ID	JULY AEMP DUP-1	JULY AEMP EB-1	TRAVEL BLANKS		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	18.7	<2.0	<2.0		
	Hardness (as CaCO3) (mg/L)	7.0	<1.1	<1.1		
	pH (pH)	6.85	5.69	5.60		
	Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0		
	Total Dissolved Solids (mg/L)	<10	<10	<10		
	Turbidity (NTU)	0.53				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	5.5	<2.0	<2.0		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0		
	Alkalinity, Total (as CaCO3) (mg/L)	5.5	<2.0	<2.0		
	Ammonia as N (mg/L)	<0.020	<0.020	<0.020		
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050		
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50		
	Fluoride (F) (mg/L)	0.049	<0.020	<0.020		
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050		
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010		
	Total Kjeldahl Nitrogen (mg/L)	0.127	<0.050	<0.050		
	Ortho Phosphate as P (mg/L)	<0.0010	<0.0010	<0.0010		
	Total Phosphate as P (mg/L)	<0.0020	<0.0020	<0.0020		
	Silicate (as SIO2) (mg/L)	<1.0	<1.0	<1.0		
	Sulfate (SO4) (mg/L)	1.84	<0.50	<0.50		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.54	<0.50	<0.50		
	Total Organic Carbon (mg/L)	1.74	<0.50	<0.50		
Total Metals	Aluminum (Al)-Total (mg/L)	0.0158	<0.0050	<0.0050		
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Arsenic (As)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Barium (Ba)-Total (mg/L)	<0.020	<0.020	<0.020		
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10		
	Cadmium (Cd)-Total (mg/L)	<0.000017	<0.000017	<0.000017		
	Calcium (Ca)-Total (mg/L)	1.79	<0.10	<0.10		
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Cobalt (Co)-Total (mg/L)	<0.00030	<0.00030	<0.00030		
	Copper (Cu)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Iron (Fe)-Total (mg/L)	<0.030	<0.030	<0.030		
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Lithium (Li)-Total (mg/L)	<0.0050	<0.0050	<0.0050		
	Magnesium (Mg)-Total (mg/L)	0.63	<0.10	<0.10		
	Manganese (Mn)-Total (mg/L)	0.00165	<0.00030	<0.00030		
	Mercury (Hg)-Total (mg/L)	<0.000020	<0.000020	<0.000020		

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L797346-1	L797346-2	L797346-3	L797346-4	L797346-5
	Description					
	Sampled Date	16-JUL-09	16-JUL-09	16-JUL-09	18-JUL-09	18-JUL-09
	Sampled Time					
	Client ID	TPE-4-S	TPE-5-S	TPE-6-S	SP-4-S	SP-5-S
Grouping	**Analyte**					
WATER						
Total Metals	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)	1.27	1.23	1.23	2.55	2.31
	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)	0.55	0.53	0.53	0.79	0.74
	Manganese (Mn)-Dissolved (mg/L)	0.00138	0.00128	0.00127	0.00097	0.00113
	Mercury (Hg)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	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
	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

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	Sample ID	L797346-6	L797346-7	L797346-8	L797346-9	L797346-10
	Description					
	Sampled Date	18-JUL-09	19-JUL-09	19-JUL-09	19-JUL-09	19-JUL-09
	Sampled Time					
	Client ID	SP-6-S	TE-4-S	TE-4-INT	TE-4-D	TE-5-S
Grouping	**Analyte**					
WATER						
Total Metals	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)	2.48	1.80	1.80	1.79	1.79
	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)	0.78	0.63	0.63	0.63	0.63
	Manganese (Mn)-Dissolved (mg/L)	0.00093	0.00115	0.00119	0.00115	0.00112
	Mercury (Hg)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	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
	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

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	Sample ID	L797346-11	L797346-12	L797346-13	L797346-14	L797346-15
	Description					
	Sampled Date	19-JUL-09	19-JUL-09	20-JUL-09	20-JUL-09	20-JUL-09
	Sampled Time					
	Client ID	TE-5-INT	TE-5-D	TE-6-S	TEFF-1-S	TEFF-2-S
Grouping	**Analyte**					
WATER						
Total Metals	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)	1.80	1.79	1.79	1.28	1.67
	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)	0.64	0.63	0.63	0.52	0.62
	Manganese (Mn)-Dissolved (mg/L)	0.00115	0.00113	0.00110	0.00083	0.00106
	Mercury (Hg)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	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
	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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L797346-16	L797346-17	L797346-18		
	Description					
	Sampled Date	19-JUL-09	20-JUL-09			
	Sampled Time					
	Client ID	JULY AEMP DUP-1	JULY AEMP EB-1	TRAVEL BLANKS		
Grouping	**Analyte**					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Nickel (Ni)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0		
	Selenium (Se)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Silver (Ag)-Total (mg/L)	<0.000020	<0.000020	<0.000020		
	Sodium (Na)-Total (mg/L)	<2.0	<2.0	<2.0		
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.00020	<0.00020		
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010		
	Uranium (U)-Total (mg/L)	<0.00020	<0.00020	<0.00020		
	Vanadium (V)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Zinc (Zn)-Total (mg/L)	<0.0050	<0.0050	<0.0050		
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050			
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050			
	Arsenic (As)-Dissolved (mg/L)	<0.00050	<0.00050			
	Barium (Ba)-Dissolved (mg/L)	<0.020	<0.020			
	Beryllium (Be)-Dissolved (mg/L)	<0.0010	<0.0010			
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10			
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017	<0.000017			
	Calcium (Ca)-Dissolved (mg/L)	1.79	<0.10			
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010			
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030			
	Copper (Cu)-Dissolved (mg/L)	<0.0010	<0.0010			
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030			
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050			
	Lithium (Li)-Dissolved (mg/L)	<0.0050	<0.0050			
	Magnesium (Mg)-Dissolved (mg/L)	0.63	<0.10			
	Manganese (Mn)-Dissolved (mg/L)	0.00114	<0.00030			
	Mercury (Hg)-Dissolved (mg/L)	<0.000020	<0.000020			
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010			
	Nickel (Ni)-Dissolved (mg/L)	<0.0010	<0.0010			
	Potassium (K)-Dissolved (mg/L)	<2.0	<2.0			
	Selenium (Se)-Dissolved (mg/L)	<0.0010	<0.0010			
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020			
	Sodium (Na)-Dissolved (mg/L)	<2.0	<2.0			
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020			
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050			
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010			
	Uranium (U)-Dissolved (mg/L)	<0.00020	<0.00020			
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010			
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050			

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L797346-1	L797346-2	L797346-3	L797346-4	L797346-5
	Description					
	Sampled Date	16-JUL-09	16-JUL-09	16-JUL-09	18-JUL-09	18-JUL-09
	Sampled Time					
	Client ID	TPE-4-S	TPE-5-S	TPE-6-S	SP-4-S	SP-5-S
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)	0.382	0.457	0.383	0.771	0.690

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L797346-6	L797346-7	L797346-8	L797346-9	L797346-10
	Description					
	Sampled Date	18-JUL-09	19-JUL-09	19-JUL-09	19-JUL-09	19-JUL-09
	Sampled Time					
	Client ID	SP-6-S	TE-4-S	TE-4-INT	TE-4-D	TE-5-S
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)	0.689	0.587	0.440	0.357	0.434

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L797346-11	L797346-12	L797346-13	L797346-14	L797346-15
	Description					
	Sampled Date	19-JUL-09	19-JUL-09	20-JUL-09	20-JUL-09	20-JUL-09
	Sampled Time					
	Client ID	TE-5-INT	TE-5-D	TE-6-S	TEFF-1-S	TEFF-2-S
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)	0.487	0.565	0.509	0.288	0.365

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L797346-16	L797346-17	L797346-18		
	Description					
	Sampled Date	19-JUL-09	20-JUL-09			
	Sampled Time					
	Client ID	JULY AEMP DUP-1	JULY AEMP EB-1	TRAVEL BLANKS		
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)	0.528				

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
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.

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.

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".

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".

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".

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.

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.

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".

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:

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

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

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

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

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

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

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

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

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

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

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.

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-CCME-CVAFS-VA	Water	Diss. Mercury in Water by CVAFS (CCME)	EPA 3005A/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).

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
HG-TOT-CCME-CVAFS-VA	Water	Total Mercury in Water by CVAFS (CCME)	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).

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).

NH3-SIE-VA	Water	Ammonia by SIE	APHA 4500 D. - NH3 NITROGEN (AMMONIA)

This analysis is carried out, on sulphuric acid preserved samples, using procedures adapted from APHA Method 4500-NH3 "Nitrogen (Ammonia)". Ammonia is determined using an ammonia selective electrode.

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.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
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.

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.

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.

SE-SALM-HVAF-VA	Soil	Se in Soil by HVAFS (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 "Water Quality - Determination of As/Se/Sb, Part 1 - Hydride Generation Atomic Fluorescence Spectrometry (HG-AFS)", by the International Organization for Standardization (ISO). 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.

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.

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.

TKN-COL-VA	Water	Total Kjeldahl Nitrogen by Auto. Colour	APHA 4500-Norg (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg "Nitrogen (Organic)". Total kjeldahl nitrogen is determined by sample digestion at 380 celcius with analysis using an automated colourimetric finish.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
TKN-SIE-VA	Water	Total Kjeldahl Nitrogen by SIE	APHA 4500-Norg (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg "Nitrogen (Organic)". Total kjeldahl nitrogen is determined by sample digestion at 367 celcius with analysis using an ammonia selective electrode.

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
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 (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.

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
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.

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

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

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
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.

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA	SK	ALS LABORATORY GROUP - SASKATOON, SASKATCHEWAN, CANADA

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

Certificate of Analysis

AZIMUTH CONSULTING GROUP INC.
ATTN: RANDY BAKER
218 - 2902 WEST BROADWAY
VANCOUVER BC V6K 2G8

Report Date: 01-SEP-09 17:00 (MT)
Version: FINAL REV. 2

Lab Work Order #: **L800548** **Date Received:** **04-AUG-09**

Project P.O. #:
Job Reference: AEMP MEADOWBANK MINE
Legal Site Desc:
CofC Numbers:

Other Information:

Comments:
Please note that this report has been revised since its initial approval. Phorphorus is not being reported for all samples as per the client's request.

NATASHA MARKOVIC-MIROVIC
Account Manager

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L800548-1	L800548-2	L800548-3	L800548-4	L800548-5
	Description					
	Sampled Date	24-JUL-09	24-JUL-09	24-JUL-09	24-JUL-09	24-JUL-09
	Sampled Time					
	Client ID	INUG-SC-1	INUG-SC-2	INUG-SC-3	INUG-SC-4	INUG-SC-5
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (pH)	6.07	5.53	5.81	6.05	5.84
Organic / Inorganic Carbon	Total Organic Carbon (%)	3.36	4.54	4.84	4.96	4.86
Metals	Aluminum (Al) (mg/kg)	24100	21100	15900	25200	16200
	Antimony (Sb) (mg/kg)	<10	<10	<20	<10	<20
	Arsenic (As) (mg/kg)	8.7	120	318	25.6	310
	Barium (Ba) (mg/kg)	115	130	117	156	141
	Beryllium (Be) (mg/kg)	1.47	1.38	1.0	1.60	1.0
	Cadmium (Cd) (mg/kg)	<0.50	0.96	1.1	0.62	1.4
	Chromium (Cr) (mg/kg)	111	95.3	71.4	113	71.1
	Cobalt (Co) (mg/kg)	10.2	14.2	16.2	12.7	16.3
	Copper (Cu) (mg/kg)	51.8	51.4	36.2	61.9	37.9
	Lead (Pb) (mg/kg)	<30	<30	<60	<30	<60
	Mercury (Hg) (mg/kg)	0.0249	0.0389	0.0353	0.059	0.0430
	Molybdenum (Mo) (mg/kg)	<4.0	7.7	12.5	5.0	16.6
	Nickel (Ni) (mg/kg)	72.1	80.5	68	84.9	67
	Phosphorus (P) (mg/kg)	931	3170	4240	1520	3060
	Selenium (Se) (mg/kg)	<2.0	<2.0	<4.0	<2.0	<4.0
	Silver (Ag) (mg/kg)	<2.0	<2.0	<4.0	<2.0	<4.0
	Thallium (Tl) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Tin (Sn) (mg/kg)	<5.0	<5.0	<10	<5.0	<10
	Vanadium (V) (mg/kg)	37.9	30.6	20.3	38.8	18.8
	Zinc (Zn) (mg/kg)	83.7	84.1	65.6	92.0	62.7

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L800548-6	L800548-7	L800548-8	L800548-9	L800548-10
	Description					
	Sampled Date	24-JUL-09	24-JUL-09	24-JUL-09	24-JUL-09	24-JUL-09
	Sampled Time					
	Client ID	INUG-SC-6	INUG-SC-7	INUG-SC-8	INUG-SC-9	INUG-SC-10
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (pH)	5.84	5.84	5.97	5.69	5.78
Organic / Inorganic Carbon	Total Organic Carbon (%)	5.18	2.83	3.94	5.02	5.40
Metals	Aluminum (Al) (mg/kg)	16400	17200	16900	23900	16000
	Antimony (Sb) (mg/kg)	<10	<20	<20	<10	<20
	Arsenic (As) (mg/kg)	354	233	43	98.5	137
	Barium (Ba) (mg/kg)	110	204	99.7	151	273
	Beryllium (Be) (mg/kg)	0.99	1.1	1.1	1.51	1.1
	Cadmium (Cd) (mg/kg)	1.10	1.5	1.1	0.68	1.3
	Chromium (Cr) (mg/kg)	76.7	73.2	73.5	107	69.9
	Cobalt (Co) (mg/kg)	15.4	22.9	18.3	12.6	20.0
	Copper (Cu) (mg/kg)	42.9	42.7	39.6	59.0	46.2
	Lead (Pb) (mg/kg)	<30	<60	<60	<30	<60
	Mercury (Hg) (mg/kg)	0.044	0.0539	0.0306	0.0568	0.0613
	Molybdenum (Mo) (mg/kg)	13.5	19.6	15.7	7.4	10.5
	Nickel (Ni) (mg/kg)	65.7	114	60	85.5	131
	Phosphorus (P) (mg/kg)	3080	2310	870	2980	2850
	Selenium (Se) (mg/kg)	<2.0	<4.0	<4.0	<2.0	<4.0
	Silver (Ag) (mg/kg)	<2.0	<4.0	<4.0	<2.0	<4.0
	Thallium (Tl) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Tin (Sn) (mg/kg)	<5.0	<10	<10	<5.0	<10
	Vanadium (V) (mg/kg)	22.0	22.3	22.1	34.5	20.2
	Zinc (Zn) (mg/kg)	64.4	78.3	58.5	95.5	88.7

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L800548-11	L800548-12	L800548-13	L800548-14	L800548-15
	Description					
	Sampled Date	24-JUL-09	24-JUL-09	24-JUL-09	24-JUL-09	24-JUL-09
	Sampled Time					
	Client ID	INUG-SC-11	INUG-SC-12	INUG-SC-13	INUG-SC-14	INUG-SC-15
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (pH)	5.93	6.03	6.00	5.78	5.85
Organic / Inorganic Carbon	Total Organic Carbon (%)	4.87	5.08	5.60	6.81	6.53
Metals	Aluminum (Al) (mg/kg)	15800	26800	26200	23700	23700
	Antimony (Sb) (mg/kg)	<20	<10	<10	<10	<10
	Arsenic (As) (mg/kg)	70	8.8	11.2	12.2	9.2
	Barium (Ba) (mg/kg)	112	164	154	135	145
	Beryllium (Be) (mg/kg)	<1.0	1.60	1.59	1.42	1.40
	Cadmium (Cd) (mg/kg)	1.1	<0.50	<0.50	<0.50	<0.50
	Chromium (Cr) (mg/kg)	69.8	122	119	106	104
	Cobalt (Co) (mg/kg)	23.7	10.1	10.1	9.7	9.3
	Copper (Cu) (mg/kg)	37.6	57.8	57.7	52.2	51.9
	Lead (Pb) (mg/kg)	<60	<30	<30	<30	<30
	Mercury (Hg) (mg/kg)	0.0364	0.044	0.0545	0.0644	0.0600
	Molybdenum (Mo) (mg/kg)	<8.0	<4.0	<4.0	<4.0	<4.0
	Nickel (Ni) (mg/kg)	68	82.0	77.1	72.1	79.4
	Phosphorus (P) (mg/kg)	950	1070	1150	1130	917
	Selenium (Se) (mg/kg)	<4.0	<2.0	<2.0	<3.0	<2.0
	Silver (Ag) (mg/kg)	<4.0	<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)	<10	<5.0	<5.0	<5.0	<5.0
	Vanadium (V) (mg/kg)	19.5	40.6	40.1	35.6	35.3
	Zinc (Zn) (mg/kg)	61.3	96.7	90.0	82.2	89.3

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L800548-16				
	Description					
	Sampled Date	24-JUL-09				
	Sampled Time					
	Client ID	INUG-SC-DUP				
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (pH)	5.98				
Organic / Inorganic Carbon	Total Organic Carbon (%)	4.53				
Metals	Aluminum (Al) (mg/kg)	16000				
	Antimony (Sb) (mg/kg)	<20				
	Arsenic (As) (mg/kg)	90				
	Barium (Ba) (mg/kg)	106				
	Beryllium (Be) (mg/kg)	1.1				
	Cadmium (Cd) (mg/kg)	1.3				
	Chromium (Cr) (mg/kg)	70.0				
	Cobalt (Co) (mg/kg)	16.6				
	Copper (Cu) (mg/kg)	38.0				
	Lead (Pb) (mg/kg)	<60				
	Mercury (Hg) (mg/kg)	0.0318				
	Molybdenum (Mo) (mg/kg)	16.8				
	Nickel (Ni) (mg/kg)	66				
	Phosphorus (P) (mg/kg)	790				
	Selenium (Se) (mg/kg)	<4.0				
	Silver (Ag) (mg/kg)	<4.0				
	Thallium (Tl) (mg/kg)	<1.0				
	Tin (Sn) (mg/kg)	<10				
	Vanadium (V) (mg/kg)	19.7				
	Zinc (Zn) (mg/kg)	60.7				

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
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

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.

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.

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.

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 (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.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA	SK	ALS LABORATORY GROUP - SASKATOON, SASKATCHEWAN, CANADA

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

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: Randy Baker	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address: Vancouver	Email 1: rbaker@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
	Email 2: gmann@azimuthgroup.ca , mmcconnell@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	
Address:	PO/AFE:	
Sample	Legal Site Description:	
Phone: Fax:	Quote #: ALSEQ09-077	
Lab Work Order # (lab use only) L820549	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 (CCME + Al)	TOC	PSA	PAH	O&G	EPH					Hazardous?	Highly Contaminated?	Number of Containers
	INUG-SC-1	24-Jul-09		Sediment	X	X											
	INUG-SC-2	24-Jul-09		Sediment	X	X											
	INUG-SC-3	24-Jul-09		Sediment	X	X											
	INUG-SC-4	24-Jul-09		Sediment	X	X											
	INUG-SC-5	24-Jul-09		Sediment	X	X											
	INUG-SC-6	24-Jul-09		Sediment	X	X											
	INUG-SC-7	24-Jul-09		Sediment	X	X											
	INUG-SC-8	24-Jul-09		Sediment	X	X											
	INUG-SC-9	24-Jul-09		Sediment	X	X											
	INUG-SC-10	24-Jul-09		Sediment	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:	09/08/04 11:05	Date & Time:	SDU	Sample Condition (lab use only)	
Relinquished By:		Date & Time:		Received By:		Date & Time:		Temperature: 24	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:	Randy Baker	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address:	Vancouver	Email 1: rbaker@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2: gmann@azimuthgroup.ca , mmcconnell@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	
Address:		PO/AFE:	
Sample		Legal Site Description:	
Phone:	Fax:	Quote #: ALSEQ09-077	
Lab Work Order # (lab use only)	L800548	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 (CCME + Al)	TOC	PSA	PAH	O&G	EPH					Hazardous?	Highly Contaminated?	Number of Containers
	INUG-SC-11	24-Jul-09		Sediment	X	X											
	INUG-SC-12	24-Jul-09		Sediment	X	X											
	INUG-SC-13	24-Jul-09		Sediment	X	X											
	INUG-SC-14	24-Jul-09		Sediment	X	X											
	INUG-SC-15	24-Jul-09		Sediment	X	X											
	INUG-SC-DUP	24-Jul-09		Sediment	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:	[signature]	Date & Time:	09/08/04 11:05	Sample Condition (lab use only)	
Relinquished By:		Date & Time:		Received By:		Date & Time:		Temperature 24 °C	Samples Received in Good Condition? Y / N (if no provided details)

APPENDIX F

BENTHIC INVERTEBRATE RAW DATA, 2009

Appendix F. Benthic invertebrate raw data (total number of organisms in two 0.023m2 grabs), August 2009.

Station	SP-N1					SP-N3					SP-F1					SP-DT					TPL-HVH-4				
Replicate	**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**
ROUNDWORMS																									
P. Nemata	2	-	2	-	1	1	1	1	-	-	1	8	8	-	3	1	5	1	-	1	-	2	2	2	1
ANNELIDS																									
P. Annelida																									
WORMS																									
Cl. Oligochaeta																									
F. Lumbriculidae																									
Lumbriculus	-	-	1	-	-	-	-	-	-	-	2	-	1	-	-	-	-	1	-	1	-	2	-	-	2
F. Tubificidae																									
Rhyacodrilus coccineus	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	1	2	2	3	-	-	-
immatures with hair chaetae	1	-	-	-	4	-	-	-	-	-	3	-	-	-	-	-	-	3	6	1	-	-	1	-	1
ARTHROPODS																									
P. Arthropoda																									
MITES																									
Cl. Arachnida																									
O. Acarina	7	1	4	6	4	2	2	6	8	2	4	6	6	4	7	5	4	2	-	7	9	4	2	5	3
SEED SHRIMPS																									
Cl. Ostracoda	2	2	7	21	4	9	2	1	4	5	9	10	6	12	43	7	1	-	3	3	7	5	13	12	13
INSECTS																									
Cl. Insecta																									
CADDISFLIES																									
O. Trichoptera																									
F. Limnephilidae																									
Grensia praeterita	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-

Appendix F. Benthic invertebrate raw data (total number of organisms in two 0.023m2 grabs), August 2009.

Station	**SP-N1**					**SP-N3**					**SP-F1**					**SP-DT**					**TPL-HVH-4**				
Replicate	**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**
TRUE FLIES																									
O. Diptera																									
MIDGES																									
F. Chironomidae																									
S.F. Chironominae																									
Corynocera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Micropsectra	-	4	-	3	-	5	-	1	1	-	1	-	1	2	-	-	-	-	1	2	-	1	-	-	2
Paratanytarsus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Stictochironomus	7	8	1	24	4	-	2	1	1	1	7	12	24	13	15	2	4	8	10	8	6	-	6	6	7
Tanytarsus	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	1	-	-	1	1	3	3	3
S.F. Diamesinae																									
Protanypus	1	-	2	1	2	-	1	-	-	1	-	3	1	-	1	-	3	2	1	-	1	-	-	-	-
S.F. Orthocladiinae																									
Abiskomyia	-	-	-	-	-	-	-	-	-	-	-	1	3	-	3	-	-	-	-	-	-	-	1	-	-
Heterotrissocladius	-	2	-	-	-	1	3	4	-	-	2	2	6	1	11	-	-	-	-	-	2	23	3	13	4
Paracladius	-	-	-	-	-	1	-	1	-	1	-	-	2	-	-	1	1	1	-	-	-	-	-	-	-
Psectrocladius	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	1	1	3	-	-	-	4	1	1
Zalutschia	-	-	-	-	-	2	-	1	2	1	-	-	-	-	-	-	1	1	-	1	-	-	1	-	1
S.F. Prodiamesinae																									
Monodiamesa	-	-	-	1	2	2	-	2	2	-	1	-	-	2	1	1	-	1	3	3	-	-	-	-	1
S.F. Tanypodinae																									
Ablabesmyia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	3	-	1	-	-	-	-
Procladius	9	10	13	8	8	6	8	7	10	8	15	11	24	11	7	5	10	9	8	6	13	6	6	8	10
Thienemannimyia complex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-
MOLLUSCS																									
P. Mollusca																									
CLAMS																									
Cl. Bivalvia																									
F. Sphaeriidae																									
Sphaerium nitidum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Cyclocalyx/Neopisidium	22	20	26	33	15	18	9	6	11	18	16	29	40	13	22	29	19	29	18	10	9	9	12	13	8
Cyclocalyx	-	1	-	4	2	1	1	2	-	-	-	-	-	-	-	5	2	-	1	-	2	-	-	-	-
TOTAL NUMBER OF ORGANISMS[1]	**47**	**46**	**47**	**80**	**41**	**42**	**26**	**32**	**36**	**32**	**51**	**64**	**109**	**48**	**67**	**54**	**45**	**60**	**56**	**43**	**46**	**50**	**39**	**49**	**43**
TOTAL NUMBER OF TAXA[2]	**5**	**6**	**6**	**7**	**6**	**10**	**6**	**10**	**8**	**7**	**8**	**7**	**11**	**9**	**8**	**10**	**8**	**12**	**10**	**11**	**9**	**9**	**9**	**7**	**11**

Notes:

[1] Number of organisms totals exclude nematodes (P. Nemata) & ostracods (Cl. Ostracoda).

[2] Number of taxa totals exclude nematodes & ostracods, and immatures of Tubificidae.

APPENDIX G

PRESENCE (+) / ABSENCE (-) MATRIX OF PERIPHYTON SPECIES, 2009

Appendix G. Presence (+) / Absence (-) Matrix of Periphyton Species, 2009.

		SP-BL					SP-CREMP					SP-DT				
	Species and Code	**001Q**	**002Q**	**003Q**	**004Q**	**005Q**	**P1Q**	**P2Q**	**P3Q**	**P4Q**	**P5Q**	**P1Q**	**P2Q**	**P3Q**	**P4Q**	**P5Q**
	Cyanophyte															
1014	*Chroococcus limneticus Lemmermann*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1070	*Anabaenopsis sp.*	-	+	+	-	-	-	+	-	+	+	-	-	-	+	-
1077	*Pseudoanabaena sp.*	+	-	+	-	-	+	+	+	-	+	-	-	-	+	-
1081	*Nostoc sp.*	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-
1084	*Gloeocapsa punctata*	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+
1122	*Phormidium autumnale Agardh*	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
1124	*Petalonema alatum Berk*	-	-	-	-	+	+	+	+	+	+	+	+	-	-	-
1135	*Anabaena mendotae*	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
1136	*Lyngbya mucicola Lemmermann*	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+
1219	*Stigonema mamillosum Gardner*	-	-	-	-	-	-	+	-	-	-	+	-	+	+	+
1220	*Rivularia dura Roth*	-	+	-	-	+	+	+	+	+	+	+	+	+	+	+
1226	*Chlorogloea sp*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Chlorophyte															
2178	*Cosmarium sp.*	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
2193	*Staurodesmus paradoxum Meyen*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2199	*Spondylosium planum (Wolle) W. and G.S. West*	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
2205	*Mougeotia sp.*	+	-	-	-	+	+	+	-	+	-	-	+	+	+	-
2216	*Zygnema sp.*	-	-	-	-	-	+	+	-	+	+	+	-	-	-	-
2226	*Ulothrix sp.*	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-
2228	*Oedogonium sp.*	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-
2231	*Bulbochaete sp.*	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
2235	*Ankistrodesmus spiralis Lemmermann*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2247	*Oocystis gigas Archer*	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-
	Diatom															
5507	*Cyclotella stelligera Cleve and Grunow*	+	+	-	-	+	+	-	-	+	+	-	-	-	+	+
5513	*Tabellaria fenestrata (Lyngbye) Kutzing*	+	+	-	-	-	-	-	-	+	-	-	+	+	+	+
5514	*Tabellaria flocculsa (Roth) Kutzing*	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+
5515	*Fragilaria crotonensis Kitton*	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
5518	*Synedra acus Kutzing*	-	+	+	-	-	-	-	-	-	-	-	+	-	-	-
5523	*Synedra ulna (Nitzsch) Ehrenberg*	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
5538	*Penate diatoms*	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
5546	*Gyrosigma sp*	+	-	+	+	-	-	-	-	+	-	-	-	-	+	+
5547	*Frustulia rhomboides (Ehrenberg) de Toni*	-	-	-	+	-	+	-	-	-	+	+	+	+	-	+
5551	*Cyclotella michiganiana Skvortzow*	-	+	+	+	-	+	+	+	-	-	+	+	-	-	-
5702	*Achnanthes minutissima Kutzing*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5726	*Eucocconeis sp.*	-	+	+	-	-	-	+	-	+	+	+	-	-	-	+
5728	*Epithemia argus Kutzing*	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-
5733	*Eunotia pectinalis (Kutzing) Rabenhorst*	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
5751	*Navicula incerta Grunow*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
5753	*Navicula sp.*	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
5781	*Eunotia sp.*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
5792	*Neidium iridis (Ehrenberg) Cleve*	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
5794	*Pinnularia flexuosa Cleve*	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
5821	*Eunotia exigua (Brebisson) Grunow*	-	-	-	+	-	-	-	-	-	+	-	-	-	+	-
5825	*Fragilaria pinata Ehrenberg*	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-
5826	*Cymbella gracilis (Rabhorst) Cleve*	+	-	-	+	+	+	+	+	-	-	-	-	+	-	-
5833	*Pinnularia biceps Gregory*	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
5834	*Cymbella microcephala Grunow*	+	-	+	+	-	-	-	-	-	+	+	+	-	-	+
5836	*Encyonema silesiacum (Bleisch) D.G. Mann*	-	-	-	+	+	+	-	-	+	+	-	+	-	-	-
5854	*Pinnularia borealis Ehrenberg*	+	+	-	-	-	+	-	-	-	-	-	-	-	-	-
5857	*Nitzschia filiformis (W. Smith) Hustedt*	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-
5860	*Diatoma vulgare Bory*	+	-	-	+	-	-	-	+	-	+	-	-	+	-	+
5864	*Neidium gracile Hustedt*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
5865	*Cymbella prostata (Berkeley) Cleve*	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-
5866	*Surirella ovata Kutzing*	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
5870	*Navicula radiosa Kutzing*	-	-	+	-	-	-	-	+	+	-	-	-	+	-	+
5873	*Gomphonema minutum*	-	+	-	-	-	-	-	-	-	-	-	-	+	+	-
5874	*Nitzschia palea (Kutzing) W. Smith*	-	+	-	-	-	-	-	+	+	+	-	+	-	-	+
5875	*Cocconies disculus Schum.*	-	-	-	-	-	-	-	-	+	-	+	-	+	-	-
5882	*Anomoenies vitrea Ross*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5884	*Gomphonema angustum Agardh*	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+
5887	*Navicula pupula Kutzing*	-	+	+	+	+	-	-	-	-	-	+	-	-	+	-
5908	*Diatoma tenue Agardh*	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
5916	*Fragilaria capucina Grunow*	+	+	+	+	+	-	+	-	-	-	-	+	+	-	-

APPENDIX H

ALS PERIPHYTON WEIGHTS LABORATORY REPORT, 2009

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Certificate of Analysis

AZIMUTH CONSULTING GROUP INC.
ATTN: RANDY BAKER
218 - 2902 WEST BROADWAY
VANCOUVER BC V6K 2G8

Report Date: 13-OCT-09 20:43 (MT)
Version: FINAL

Lab Work Order #: **L816567**
Date Received: **10-SEP-09**

Project P.O. #:
Job Reference: MEADOWBANK MINE HABITAT
Legal Site Desc:
CofC Numbers:

Other Information:

Comments:

Natasha Markovic-Mirovic
Account Manager

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L816567-1	L816567-2	L816567-3	L816567-4	L816567-5
	Description					
	Sampled Date	27-AUG-09	27-AUG-09	27-AUG-09	27-AUG-09	27-AUG-09
	Sampled Time					
	Client ID	SP-BL-001	SP-BL-002	SP-BL-003	SP-BL-004	SP-BL-005
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.437	0.814	0.952	1.21	0.710
	Ash Weight (g)	0.398	0.630	0.889	1.13	0.677
	Ash Free Dry Weight (g)	0.0393	0.184	0.0629	0.0776	0.0328

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L816567-6	L816567-7	L816567-8	L816567-9	L816567-10
	Description					
	Sampled Date	28-AUG-09	28-AUG-09	28-AUG-09	28-AUG-09	28-AUG-09
	Sampled Time					
	Client ID	SP-REF-P1	SP-REF-P2	SP-REF-P3	SP-REF-P4	SP-REF-P5
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.559	0.839	0.354	0.341	0.575
	Ash Weight (g)	0.299	0.417	0.225	0.232	0.315
	Ash Free Dry Weight (g)	0.260	0.422	0.129	0.110	0.260

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L816567-11	L816567-12	L816567-13	L816567-14	L816567-15
	Description					
	Sampled Date	30-AUG-09	30-AUG-09	30-AUG-09	30-AUG-09	30-AUG-09
	Sampled Time					
	Client ID	SP-DT-P1	SP-DT-P2	SP-DT-P3	SP-DT-P4	SP-DT-P5
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.205	0.433	0.205	0.319	0.330
	Ash Weight (g)	0.0747	0.190	0.0720	0.136	0.150
	Ash Free Dry Weight (g)	0.130	0.243	0.133	0.183	0.179

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
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.

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA		

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

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: Randy Baker	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address: Vancouver	Email 1: rbaker@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
	Email 2: gmann@azimuthgroup.ca , mmcconnell@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 HABITAT	
Address:	PO/AFE:	
Sample	Legal Site Description:	
Phone: Fax:	Quote #: ALSEQ09-077	
Lab Work Order # (lab use only): L816567	**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 %	LOI (in dry weight, not %)	Hazardous?	Highly Contaminated?	Number of Containers
	SP-BL-001	27-Aug-09		Other	x	x			
	SP-BL-002	27-Aug-09		Other	x	x			
	SP-BL-003	27-Aug-09		Other	x	x			
	SP-BL-004	27-Aug-09		Other	x	x			
	SP-BL-005	27-Aug-09		Other	x	x			
	SP-REF-P1	28-Aug-09		Other	x	x			
	SP-REF-P2	28-Aug-09		Other	x	x			
	SP-REF-P3	28-Aug-09		Other	x	x			
	SP-REF-P4	28-Aug-09		Other	x	x			
	SP-REF-P5	28-Aug-09		Other	x	x			

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): Temperature	Samples Received in Good Condition? Y / N (if no provided details)
Ryan Hill	5-Sep-09	HD		17	
		09/09/10	8:50		

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: Randy Baker	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address: Vancouver	Email 1: rbaker@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
	Email 2: gmann@azimuthgroup.ca , mmcconnell@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 HABITAT	
Address:	PO/AFE:	
Sample	Legal Site Description:	
Phone: Fax:	Quote #: ALSEQ09-077	
Lab Work Order # (lab use only) L816567	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 %	LOI (in dry weight, not %)									Hazardous?	Highly Contaminated?	Number of Containers
	SP-DT-P1	30-Aug-09		Other	x	x											
	SP-DT-P2	30-Aug-09		Other	x	x											
	SP-DT-P3	30-Aug-09		Other	x	x											
	SP-DT-P4	30-Aug-09		Other	x	x											
	SP-DT-P5	30-Aug-09		Other	x	x											

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:	Ryan Hill	Date & Time:	5-Sep-09	Received By:	HD	Date & Time:		Sample Condition (lab use only)
Relinquished By:		Date & Time:		Received By:	09/09/10	Date & Time:	8:59	Temperature: 17 — Samples Received in Good Condition? Y / N (if no provided details)

APPENDIX I

ALS WATER CHEMISTRY LABORATORY REPORTS, BAY-GOOSE DIKE TSS EAS, SEPTEMBER 2009

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Certificate of Analysis

AZIMUTH CONSULTING GROUP INC.
ATTN: RANDY BAKER
218 - 2902 WEST BROADWAY
VANCOUVER BC V6K 2G8

Report Date: 14-OCT-09 18:32 (MT)
Version: FINAL

Lab Work Order #: L824494 **Date Received:** 29-SEP-09

Project P.O. #:
Job Reference: MEADOWBANK MINE BG-EAS
Legal Site Desc:
CofC Numbers:

Other Information:

Comments:

Natasha Markovic-Mirovic
Account Manager

ALS Canada Ltd.
Part of the **ALS Laboratory Group**
1988 Triumph Street, Vancouver, BC V5L 1K5
Phone: +1 604 253 4188 Fax: +1 604 253 6700 www.alsglobal.com
A Campbell Brothers Limited Company

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-1	L824494-2	L824494-3	L824494-4	L824494-5
	Description					
	Sampled Date	17-SEP-09	17-SEP-09	17-SEP-09	17-SEP-09	17-SEP-09
	Sampled Time					
	Client ID	EAS-TPS-1	EAS-TPS-2	EAS-TPS-3	EAS-TPS-4	EAS-TPS-5
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	14.9				
	Hardness (as CaCO3) (mg/L)	4.9				
	pH (pH)	6.88				
	Total Suspended Solids (mg/L)	1.0				
	Total Dissolved Solids (mg/L)	15				
	Turbidity (NTU)	0.30				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	3.7				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	3.7				
	Ammonia as N (mg/L)	0.094				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	0.55				
	Fluoride (F) (mg/L)	0.055				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	0.128				
	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)	1.44				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.22				
	Total Organic Carbon (mg/L)	1.21				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0075				
	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)	1.17				
	Chromium (Cr)-Total (mg/L)	<0.0010				
	Cobalt (Co)-Total (mg/L)	<0.00030				
	Copper (Cu)-Total (mg/L)	0.0013				
	Iron (Fe)-Total (mg/L)	<0.030				
	Lead (Pb)-Total (mg/L)	<0.00050				
	Lithium (Li)-Total (mg/L)	<0.0050				
	Magnesium (Mg)-Total (mg/L)	0.53				
	Manganese (Mn)-Total (mg/L)	0.00070				
	Mercury (Hg)-Total (mg/L)	<0.000020				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-6	L824494-7	L824494-8	L824494-9	L824494-10
	Description					
	Sampled Date	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09
	Sampled Time					
	Client ID	EAS-DT-1	EAS-DT-2	EAS-DT-3	EAS-DT-4	EAS-DT-5
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	27.1				
	Hardness (as CaCO3) (mg/L)	11.2				
	pH (pH)	6.95				
	Total Suspended Solids (mg/L)	<1.0				
	Total Dissolved Solids (mg/L)	12				
	Turbidity (NTU)	0.42				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	8.9				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	8.9				
	Ammonia as N (mg/L)	0.104				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	0.52				
	Fluoride (F) (mg/L)	0.050				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	0.163				
	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)	2.67				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.64				
	Total Organic Carbon (mg/L)	1.68				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0097				
	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)	2.97				
	Chromium (Cr)-Total (mg/L)	<0.0010				
	Cobalt (Co)-Total (mg/L)	<0.00030				
	Copper (Cu)-Total (mg/L)	<0.0010				
	Iron (Fe)-Total (mg/L)	<0.030				
	Lead (Pb)-Total (mg/L)	<0.00050				
	Lithium (Li)-Total (mg/L)	<0.0050				
	Magnesium (Mg)-Total (mg/L)	0.92				
	Manganese (Mn)-Total (mg/L)	0.00081				
	Mercury (Hg)-Total (mg/L)	<0.000020				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-11	L824494-12	L824494-13	L824494-14	L824494-15
	Description					
	Sampled Date	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09
	Sampled Time					
	Client ID	EAS-BGW-1	EAS-BGW-2	EAS-BGW-3	EAS-BGW-4	EAS-BGW-5
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	16.9				
	Hardness (as CaCO3) (mg/L)	6.0				
	pH (pH)	7.00				
	Total Suspended Solids (mg/L)	5.8				
	Total Dissolved Solids (mg/L)	10				
	Turbidity (NTU)	9.47				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	4.9				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	4.9				
	Ammonia as N (mg/L)	0.066				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	0.50				
	Fluoride (F) (mg/L)	0.062				
	Nitrate (as N) (mg/L)	0.0112				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	0.080				
	Ortho Phosphate as P (mg/L)	<0.0010				
	Total Phosphate as P (mg/L)	0.0039				
	Silicate (as SIO2) (mg/L)	<1.0				
	Sulfate (SO4) (mg/L)	1.45				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.16				
	Total Organic Carbon (mg/L)	1.06				
Total Metals	Aluminum (Al)-Total (mg/L)	0.414				
	Antimony (Sb)-Total (mg/L)	<0.00050				
	Arsenic (As)-Total (mg/L)	0.00054				
	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)	1.42				
	Chromium (Cr)-Total (mg/L)	0.0017				
	Cobalt (Co)-Total (mg/L)	<0.00030				
	Copper (Cu)-Total (mg/L)	0.0010				
	Iron (Fe)-Total (mg/L)	0.540				
	Lead (Pb)-Total (mg/L)	<0.00050				
	Lithium (Li)-Total (mg/L)	<0.0050				
	Magnesium (Mg)-Total (mg/L)	0.76				
	Manganese (Mn)-Total (mg/L)	0.00942				
	Mercury (Hg)-Total (mg/L)	<0.000020				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L824494-16 19-SEP-09 EAS-SPC-1	L824494-17 19-SEP-09 EAS-SPC-2	L824494-18 19-SEP-09 EAS-SPC-3	L824494-19 19-SEP-09 EAS-SPC-4	L824494-20 19-SEP-09 EAS-SPC-5
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	23.1				
	Hardness (as CaCO3) (mg/L)	9.2				
	pH (pH)	6.77				
	Total Suspended Solids (mg/L)	1.8				
	Total Dissolved Solids (mg/L)	11				
	Turbidity (NTU)	2.06				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	6.9				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	6.9				
	Ammonia as N (mg/L)	0.020				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	0.59				
	Fluoride (F) (mg/L)	0.056				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	0.080				
	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)	2.19				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.54				
	Total Organic Carbon (mg/L)	1.47				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0709				
	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)	2.41				
	Chromium (Cr)-Total (mg/L)	<0.0010				
	Cobalt (Co)-Total (mg/L)	<0.00030				
	Copper (Cu)-Total (mg/L)	<0.0010				
	Iron (Fe)-Total (mg/L)	0.087				
	Lead (Pb)-Total (mg/L)	<0.00050				
	Lithium (Li)-Total (mg/L)	<0.0050				
	Magnesium (Mg)-Total (mg/L)	0.82				
	Manganese (Mn)-Total (mg/L)	0.00210				
	Mercury (Hg)-Total (mg/L)	<0.000020				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-21	L824494-22	L824494-23	L824494-24	L824494-25
	Description					
	Sampled Date	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09
	Sampled Time					
	Client ID	EAS-BGE-1	EAS-BGE-2	EAS-BGE-3	EAS-BGE-4	EAS-BGE-5
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	16.8				
	Hardness (as CaCO3) (mg/L)	6.1				
	pH (pH)	6.91				
	Total Suspended Solids (mg/L)	8.6				
	Total Dissolved Solids (mg/L)	<10				
	Turbidity (NTU)	12.5				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	4.4				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	4.4				
	Ammonia as N (mg/L)	0.092				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	0.58				
	Fluoride (F) (mg/L)	0.067				
	Nitrate (as N) (mg/L)	0.0141				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	0.083				
	Ortho Phosphate as P (mg/L)	<0.0010				
	Total Phosphate as P (mg/L)	0.0058				
	Silicate (as SIO2) (mg/L)	<1.0				
	Sulfate (SO4) (mg/L)	1.51				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.08				
	Total Organic Carbon (mg/L)	1.11				
Total Metals	Aluminum (Al)-Total (mg/L)	0.513				
	Antimony (Sb)-Total (mg/L)	<0.00050				
	Arsenic (As)-Total (mg/L)	0.00061				
	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)	1.44				
	Chromium (Cr)-Total (mg/L)	0.0021				
	Cobalt (Co)-Total (mg/L)	0.00032				
	Copper (Cu)-Total (mg/L)	0.0013				
	Iron (Fe)-Total (mg/L)	0.664				
	Lead (Pb)-Total (mg/L)	<0.00050				
	Lithium (Li)-Total (mg/L)	<0.0050				
	Magnesium (Mg)-Total (mg/L)	0.79				
	Manganese (Mn)-Total (mg/L)	0.0119				
	Mercury (Hg)-Total (mg/L)	<0.000020				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-26	L824494-27	L824494-28	L824494-29
	Description				
	Sampled Date	19-SEP-09	19-SEP-09	19-SEP-09	19-SEP-09
	Sampled Time				
	Client ID	EAS-DUP 1	EAS-DUP 2	TRAVEL BLANK	EAS-EQ-1
Grouping	**Analyte**				
WATER					
Physical Tests	Conductivity (uS/cm)	27.0		<2.0	<2.0
	Hardness (as CaCO3) (mg/L)	11.2		<1.1	<1.1
	pH (pH)	6.83		5.70	5.71
	Total Suspended Solids (mg/L)	<1.0		<1.0	<1.0
	Total Dissolved Solids (mg/L)	12		<10	<10
	Turbidity (NTU)	0.46		<0.10	0.14
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	8.7		<2.0	<2.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0		<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0		<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	8.7		<2.0	<2.0
	Ammonia as N (mg/L)	0.049		<0.020	0.047
	Bromide (Br) (mg/L)	<0.050		<0.050	<0.050
	Chloride (Cl) (mg/L)	0.50		<0.50	<0.50
	Fluoride (F) (mg/L)	0.053		<0.020	<0.020
	Nitrate (as N) (mg/L)	<0.0050		<0.0050	<0.0050
	Nitrite (as N) (mg/L)	<0.0010		<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.082		<0.050	<0.050
	Ortho Phosphate as P (mg/L)	<0.0010		<0.0010	<0.0010
	Total Phosphate as P (mg/L)	0.0022		<0.0020	<0.0020
	Silicate (as SIO2) (mg/L)	<1.0		<1.0	<1.0
	Sulfate (SO4) (mg/L)	2.67		<0.50	<0.50
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.73			<0.50
	Total Organic Carbon (mg/L)	1.70		<0.50	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	0.0114		<0.0050	<0.0050
	Antimony (Sb)-Total (mg/L)	<0.00050		<0.00050	<0.00050
	Arsenic (As)-Total (mg/L)	<0.00050		<0.00050	<0.00050
	Barium (Ba)-Total (mg/L)	<0.020		<0.020	<0.020
	Beryllium (Be)-Total (mg/L)	<0.0010		<0.0010	<0.0010
	Boron (B)-Total (mg/L)	<0.10		<0.10	<0.10
	Cadmium (Cd)-Total (mg/L)	<0.000017		<0.000017	<0.000017
	Calcium (Ca)-Total (mg/L)	2.98		<0.10	<0.10
	Chromium (Cr)-Total (mg/L)	<0.0010		<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	<0.00030		<0.00030	<0.00030
	Copper (Cu)-Total (mg/L)	<0.0010		<0.0010	<0.0010
	Iron (Fe)-Total (mg/L)	<0.030		<0.030	<0.030
	Lead (Pb)-Total (mg/L)	<0.00050		<0.00050	<0.00050
	Lithium (Li)-Total (mg/L)	<0.0050		<0.0050	<0.0050
	Magnesium (Mg)-Total (mg/L)	0.93		<0.10	<0.10
	Manganese (Mn)-Total (mg/L)	0.00086		<0.00030	<0.00030
	Mercury (Hg)-Total (mg/L)	<0.000020		<0.000020	<0.000020

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-1	L824494-2	L824494-3	L824494-4	L824494-5
	Description					
	Sampled Date	17-SEP-09	17-SEP-09	17-SEP-09	17-SEP-09	17-SEP-09
	Sampled Time					
	Client ID	EAS-TPS-1	EAS-TPS-2	EAS-TPS-3	EAS-TPS-4	EAS-TPS-5
Grouping	**Analyte**					
WATER						
Total Metals	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)	<0.0050				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.00050				
	Barium (Ba)-Dissolved (mg/L)	<0.020				
	Beryllium (Be)-Dissolved (mg/L)	<0.0010				
	Boron (B)-Dissolved (mg/L)	<0.10				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017				
	Calcium (Ca)-Dissolved (mg/L)	1.14				
	Chromium (Cr)-Dissolved (mg/L)	<0.0010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00030				
	Copper (Cu)-Dissolved (mg/L)	<0.0010				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	<0.00050				
	Lithium (Li)-Dissolved (mg/L)	<0.0050				
	Magnesium (Mg)-Dissolved (mg/L)	0.51				
	Manganese (Mn)-Dissolved (mg/L)	<0.00030				
	Mercury (Hg)-Dissolved (mg/L)	<0.000020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0010				
	Potassium (K)-Dissolved (mg/L)	<2.0				
	Selenium (Se)-Dissolved (mg/L)	<0.0010				
	Silver (Ag)-Dissolved (mg/L)	<0.000020				
	Sodium (Na)-Dissolved (mg/L)	<2.0				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.00050				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-6	L824494-7	L824494-8	L824494-9	L824494-10
	Description					
	Sampled Date	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09
	Sampled Time					
	Client ID	EAS-DT-1	EAS-DT-2	EAS-DT-3	EAS-DT-4	EAS-DT-5
Grouping	**Analyte**					
WATER						
Total Metals	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)	<0.0050				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.00050				
	Barium (Ba)-Dissolved (mg/L)	<0.020				
	Beryllium (Be)-Dissolved (mg/L)	<0.0010				
	Boron (B)-Dissolved (mg/L)	<0.10				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017				
	Calcium (Ca)-Dissolved (mg/L)	2.96				
	Chromium (Cr)-Dissolved (mg/L)	<0.0010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00030				
	Copper (Cu)-Dissolved (mg/L)	<0.0010				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	<0.00050				
	Lithium (Li)-Dissolved (mg/L)	<0.0050				
	Magnesium (Mg)-Dissolved (mg/L)	0.92				
	Manganese (Mn)-Dissolved (mg/L)	0.00041				
	Mercury (Hg)-Dissolved (mg/L)	<0.000020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0010				
	Potassium (K)-Dissolved (mg/L)	<2.0				
	Selenium (Se)-Dissolved (mg/L)	<0.0010				
	Silver (Ag)-Dissolved (mg/L)	<0.000020				
	Sodium (Na)-Dissolved (mg/L)	<2.0				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.00050				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-11	L824494-12	L824494-13	L824494-14	L824494-15
	Description					
	Sampled Date	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09
	Sampled Time					
	Client ID	EAS-BGW-1	EAS-BGW-2	EAS-BGW-3	EAS-BGW-4	EAS-BGW-5
Grouping	**Analyte**					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)	<0.0010				
	Nickel (Ni)-Total (mg/L)	0.0013				
	Potassium (K)-Total (mg/L)	<2.0				
	Selenium (Se)-Total (mg/L)	<0.0010				
	Silver (Ag)-Total (mg/L)	0.000036				
	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)	0.019				
	Uranium (U)-Total (mg/L)	0.00026				
	Vanadium (V)-Total (mg/L)	<0.0010				
	Zinc (Zn)-Total (mg/L)	<0.0050				
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	<0.0050				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.00050				
	Barium (Ba)-Dissolved (mg/L)	<0.020				
	Beryllium (Be)-Dissolved (mg/L)	<0.0010				
	Boron (B)-Dissolved (mg/L)	<0.10				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017				
	Calcium (Ca)-Dissolved (mg/L)	1.43				
	Chromium (Cr)-Dissolved (mg/L)	<0.0010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00030				
	Copper (Cu)-Dissolved (mg/L)	<0.0010				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	<0.00050				
	Lithium (Li)-Dissolved (mg/L)	<0.0050				
	Magnesium (Mg)-Dissolved (mg/L)	0.60				
	Manganese (Mn)-Dissolved (mg/L)	0.00090				
	Mercury (Hg)-Dissolved (mg/L)	<0.000020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0010				
	Potassium (K)-Dissolved (mg/L)	<2.0				
	Selenium (Se)-Dissolved (mg/L)	<0.0010				
	Silver (Ag)-Dissolved (mg/L)	<0.000020				
	Sodium (Na)-Dissolved (mg/L)	<2.0				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.00050				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-16	L824494-17	L824494-18	L824494-19	L824494-20
	Description					
	Sampled Date	19-SEP-09	19-SEP-09	19-SEP-09	19-SEP-09	19-SEP-09
	Sampled Time					
	Client ID	EAS-SPC-1	EAS-SPC-2	EAS-SPC-3	EAS-SPC-4	EAS-SPC-5
Grouping	**Analyte**					
WATER						
Total Metals	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)	<0.0050				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.00050				
	Barium (Ba)-Dissolved (mg/L)	<0.020				
	Beryllium (Be)-Dissolved (mg/L)	<0.0010				
	Boron (B)-Dissolved (mg/L)	<0.10				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017				
	Calcium (Ca)-Dissolved (mg/L)	2.40				
	Chromium (Cr)-Dissolved (mg/L)	<0.0010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00030				
	Copper (Cu)-Dissolved (mg/L)	<0.0010				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	<0.00050				
	Lithium (Li)-Dissolved (mg/L)	<0.0050				
	Magnesium (Mg)-Dissolved (mg/L)	0.78				
	Manganese (Mn)-Dissolved (mg/L)	<0.00030				
	Mercury (Hg)-Dissolved (mg/L)	<0.000020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0010				
	Potassium (K)-Dissolved (mg/L)	<2.0				
	Selenium (Se)-Dissolved (mg/L)	<0.0010				
	Silver (Ag)-Dissolved (mg/L)	<0.000020				
	Sodium (Na)-Dissolved (mg/L)	<2.0				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.00050				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-21	L824494-22	L824494-23	L824494-24	L824494-25
	Description					
	Sampled Date	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09
	Sampled Time					
	Client ID	EAS-BGE-1	EAS-BGE-2	EAS-BGE-3	EAS-BGE-4	EAS-BGE-5
Grouping	**Analyte**					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)	<0.0010				
	Nickel (Ni)-Total (mg/L)	0.0016				
	Potassium (K)-Total (mg/L)	<2.0				
	Selenium (Se)-Total (mg/L)	<0.0010				
	Silver (Ag)-Total (mg/L)	0.000040				
	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)	0.022				
	Uranium (U)-Total (mg/L)	0.00031				
	Vanadium (V)-Total (mg/L)	<0.0010				
	Zinc (Zn)-Total (mg/L)	<0.0050				
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.0053				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.00050				
	Barium (Ba)-Dissolved (mg/L)	<0.020				
	Beryllium (Be)-Dissolved (mg/L)	<0.0010				
	Boron (B)-Dissolved (mg/L)	<0.10				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017				
	Calcium (Ca)-Dissolved (mg/L)	1.43				
	Chromium (Cr)-Dissolved (mg/L)	<0.0010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00030				
	Copper (Cu)-Dissolved (mg/L)	<0.0010				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	<0.00050				
	Lithium (Li)-Dissolved (mg/L)	<0.0050				
	Magnesium (Mg)-Dissolved (mg/L)	0.60				
	Manganese (Mn)-Dissolved (mg/L)	0.00125				
	Mercury (Hg)-Dissolved (mg/L)	<0.000020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0010				
	Potassium (K)-Dissolved (mg/L)	<2.0				
	Selenium (Se)-Dissolved (mg/L)	<0.0010				
	Silver (Ag)-Dissolved (mg/L)	<0.000020				
	Sodium (Na)-Dissolved (mg/L)	<2.0				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.00050				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-26	L824494-27	L824494-28	L824494-29	
	Description					
	Sampled Date	19-SEP-09	19-SEP-09	19-SEP-09	19-SEP-09	
	Sampled Time					
	Client ID	EAS-DUP 1	EAS-DUP 2	TRAVEL BLANK	EAS-EQ-1	
Grouping	**Analyte**					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)	<0.0010		<0.0010	<0.0010	
	Nickel (Ni)-Total (mg/L)	<0.0010		<0.0010	<0.0010	
	Potassium (K)-Total (mg/L)	<2.0		<2.0	<2.0	
	Selenium (Se)-Total (mg/L)	<0.0010		<0.0010	<0.0010	
	Silver (Ag)-Total (mg/L)	<0.000020		<0.000020	<0.000020	
	Sodium (Na)-Total (mg/L)	<2.0		<2.0	<2.0	
	Thallium (Tl)-Total (mg/L)	<0.00020		<0.00020	<0.00020	
	Tin (Sn)-Total (mg/L)	<0.00050		<0.00050	<0.00050	
	Titanium (Ti)-Total (mg/L)	<0.010		<0.010	<0.010	
	Uranium (U)-Total (mg/L)	<0.00020		<0.00020	<0.00020	
	Vanadium (V)-Total (mg/L)	<0.0010		<0.0010	<0.0010	
	Zinc (Zn)-Total (mg/L)	<0.0050		<0.0050	<0.0050	
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	<0.0050			<0.0050	
	Antimony (Sb)-Dissolved (mg/L)	<0.00050			<0.00050	
	Arsenic (As)-Dissolved (mg/L)	<0.00050			<0.00050	
	Barium (Ba)-Dissolved (mg/L)	<0.020			<0.020	
	Beryllium (Be)-Dissolved (mg/L)	<0.0010			<0.0010	
	Boron (B)-Dissolved (mg/L)	<0.10			<0.10	
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017			<0.000017	
	Calcium (Ca)-Dissolved (mg/L)	2.97			<0.10	
	Chromium (Cr)-Dissolved (mg/L)	<0.0010			<0.0010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00030			<0.00030	
	Copper (Cu)-Dissolved (mg/L)	<0.0010			<0.0010	
	Iron (Fe)-Dissolved (mg/L)	<0.030			<0.030	
	Lead (Pb)-Dissolved (mg/L)	<0.00050			<0.00050	
	Lithium (Li)-Dissolved (mg/L)	<0.0050			<0.0050	
	Magnesium (Mg)-Dissolved (mg/L)	0.93			<0.10	
	Manganese (Mn)-Dissolved (mg/L)	0.00031			<0.00030	
	Mercury (Hg)-Dissolved (mg/L)	<0.000020			<0.000020	
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010			<0.0010	
	Nickel (Ni)-Dissolved (mg/L)	<0.0010			<0.0010	
	Potassium (K)-Dissolved (mg/L)	<2.0			<2.0	
	Selenium (Se)-Dissolved (mg/L)	<0.0010			<0.0010	
	Silver (Ag)-Dissolved (mg/L)	<0.000020			<0.000020	
	Sodium (Na)-Dissolved (mg/L)	<2.0			<2.0	
	Thallium (Tl)-Dissolved (mg/L)	<0.00020			<0.00020	
	Tin (Sn)-Dissolved (mg/L)	<0.00050			<0.00050	
	Titanium (Ti)-Dissolved (mg/L)	<0.010			<0.010	
	Uranium (U)-Dissolved (mg/L)	<0.00020			<0.00020	
	Vanadium (V)-Dissolved (mg/L)	<0.0010			<0.0010	
	Zinc (Zn)-Dissolved (mg/L)	<0.0050			<0.0050	

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-1	L824494-2	L824494-3	L824494-4	L824494-5
	Description					
	Sampled Date	17-SEP-09	17-SEP-09	17-SEP-09	17-SEP-09	17-SEP-09
	Sampled Time					
	Client ID	EAS-TPS-1	EAS-TPS-2	EAS-TPS-3	EAS-TPS-4	EAS-TPS-5
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug/L)	0.159	0.306	0.238	0.351	0.366

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-6	L824494-7	L824494-8	L824494-9	L824494-10
	Description					
	Sampled Date	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09
	Sampled Time					
	Client ID	EAS-DT-1	EAS-DT-2	EAS-DT-3	EAS-DT-4	EAS-DT-5
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug/L)	0.331	0.246	0.336	0.566	0.500

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-11	L824494-12	L824494-13	L824494-14	L824494-15
	Description					
	Sampled Date	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09
	Sampled Time					
	Client ID	EAS-BGW-1	EAS-BGW-2	EAS-BGW-3	EAS-BGW-4	EAS-BGW-5
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug/L)	0.308	0.267	0.238	0.095	0.179

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-16	L824494-17	L824494-18	L824494-19	L824494-20
	Description					
	Sampled Date	19-SEP-09	19-SEP-09	19-SEP-09	19-SEP-09	19-SEP-09
	Sampled Time					
	Client ID	EAS-SPC-1	EAS-SPC-2	EAS-SPC-3	EAS-SPC-4	EAS-SPC-5
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug/L)	0.448	0.391	0.345	0.307	0.295

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-21	L824494-22	L824494-23	L824494-24	L824494-25
	Description					
	Sampled Date	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09	18-SEP-09
	Sampled Time					
	Client ID	EAS-BGE-1	EAS-BGE-2	EAS-BGE-3	EAS-BGE-4	EAS-BGE-5
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug/L)	0.268	0.253	0.388	0.306	0.286

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L824494-26	L824494-27	L824494-28	L824494-29	
	Description					
	Sampled Date	19-SEP-09	19-SEP-09	19-SEP-09	19-SEP-09	
	Sampled Time					
	Client ID	EAS-DUP 1	EAS-DUP 2	TRAVEL BLANK	EAS-EQ-1	
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug/L)	0.334	0.466			

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
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.

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".

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".

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".

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.

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.

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".

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

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

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

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

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

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

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

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

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
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.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness is calculated from Calcium and Magnesium concentrations, and is expressed as calcium carbonate equivalents.

HG-DIS-CCME-CVAFS-VA	Water	Diss. Mercury in Water by CVAFS (CCME)	EPA 3005A/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-CCME-CVAFS-VA	Water	Total Mercury in Water by CVAFS (CCME)	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).

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).

NH3-SIE-VA	Water	Ammonia by SIE	APHA 4500 D. - NH3 NITROGEN (AMMONIA)

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

This analysis is carried out, on sulphuric acid preserved samples, using procedures adapted from APHA Method 4500-NH3 "Nitrogen (Ammonia)". Ammonia is determined using an ammonia selective electrode.

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.

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.

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

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

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.

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.

TKN-SIE-VA	Water	Total Kjeldahl Nitrogen by SIE	APHA 4500-Norg (TKN)

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg "Nitrogen (Organic)". Total kjeldahl nitrogen is determined by sample digestion at 367 celcius with analysis using an ammonia selective electrode.

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.

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA		

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

Short Holding Time
CHL-A
Rush Processing

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: Randy Baker	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address: Vancouver	Email 1: rbaker@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
	Email 2: gmann@azimuthgroup.ca , mmcconnell@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 BG-EAS	
Address:	PO/AFE:	
Sample	Legal Site Description:	
Phone: Fax:	Quote #: ALSEQ09-077	
Lab Work Order # (lab use only) L824494	ALS Contact: Natasha MM; Sampler (Initials): SH/NW/RT	

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 (CCME)	D-Metals (CCME)	TOC, DOC	TKN, Ammonia	TDS, TSS-low	Alk (SPECIATED)	Anion Scan, Si, pH, EC	T-PO4, ortho-PO4	Chlorophyll-a (filters)	Turbididty	Hazardous?	Highly Contaminated?	Number of Containers
	EAS-TPS-1	17-Sep-09		Water	x	x	x	x	x	x	x	x	x	x			
	EAS-TPS-2	17-Sep-09		Water									x				
	EAS-TPS-3	17-Sep-09		Water									x				
	EAS-TPS-4	17-Sep-09		Water									x				
	EAS-TPS-5	17-Sep-09		Water									x				
	EAS-DT-1	18-Sep-09		Water	x	x	x	x	x	x	x	x	x	x			
	EAS-DT-2	18-Sep-09		Water									x				
	EAS-DT-3	18-Sep-09		Water									x				
	EAS-DT-4	18-Sep-09		Water									x				
	EAS-DT-5	18-Sep-09		Water									x				

Guidelines / Regulations	Special Instructions / Hazardous Details
	1L filtered for chlor-a unless otherwise noted.

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)	
Relinquished By:	Gary Mann	Date & Time:	19-Sep-09	Received By:		Date & Time:	09/09/29 11:46	Temperature: 14	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By:		Date & Time:		Received By:		Date & Time:			

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: Randy Baker	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address: Vancouver	Email 1: rbaker@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
	Email 2: gmann@azimuthgroup.ca , mmcconnell@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 BG-EAS	
Address:	PO/AFE:	
Sample	Legal Site Description:	
Phone: Fax:	Quote #: ALSEQ09-077	
Lab Work Order # (lab use only): L824494	ALS Contact: Natasha MM — Sampler (Initials): SH/NW/RT	

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 (CCME)	D-Metals (CCME)	TOC, DOC	TKN, Ammonia	TDS, TSS-low	Alk (SPECIATED)	Anion Scan, Si, pH, EC	T-PO4, ortho-PO4	Chlorophyll-a (filters)	Turbididty	Hazardous?	Highly Contaminated?	Number of Containers
	EAS-BGW-1 (500 ml filtered for chlor-a)	18-Sep-09		Water	x	x	x	x	x	x	x	x	x	x			
	EAS-BGW-2 (500 ml filtered for chlor-a)	18-Sep-09		Water									x				
	EAS-BGW-3 (500 ml filtered for chlor-a)	18-Sep-09		Water									x				
	EAS-BGW-4 (500 ml filtered for chlor-a)	18-Sep-09		Water									x				
	EAS-BGW-5 (500 ml filtered for chlor-a) ~~B2~~	18-Sep-09		Water									x				
	EAS-SPC-1 (500 ml filtered for chlor-a)	19-Sep-09		Water	x	x	x	x	x	x	x	x	x	x			
	EAS-SPC-2 (500 ml filtered for chlor-a)	19-Sep-09		Water									x				
	EAS-SPC-3 (500 ml filtered for chlor-a)	19-Sep-09		Water									x				
	EAS-SPC-4 (500 ml filtered for chlor-a)	19-Sep-09		Water									x				
	EAS-SPC-5 (500 ml filtered for chlor-a)	19-Sep-09		Water									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)	
Gary Mann	19-Sep-09	[signature]	09/09/29 11:46	Temperature: 14	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By:	Date & Time:	Received By:	Date & Time:		

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**
Company:	Azimuth Consulting Group Inc.
Contact:	Randy Baker
Address:	Vancouver
Phone:	604-730-1220 Fax:
Invoice To:	☑ Same as Report
Company:	
Contact:	
Address:	
Sample	
Phone:	Fax:
Lab Work Order # (lab use only)	L824494

Report Format / Distribution	
☑ Standard ☐ Other	
☑ PDF ☑ Excel ☐ Fax	
Email 1:	rbaker@azimuthgroup.ca
Email 2:	gmann@azimuthgroup.ca , mmcconnell@azimuthgroup.ca
Client / Project Information:	
Job #:	Meadowbank Mine BG-EAS
PO/AFE:	
Legal Site Description:	
Quote #:	ALSEQ09-077
ALS Contact:	Natasha MM
Sampler (Initials):	SH/NW/RT

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)	T-Metals (CCME)	D-Metals (CCME)	TOC, DOC	TKN, Ammonia	TDS, TSS-low	Alk (SPECIATED)	Anion Scan, Si, pH, EC	T-PO4, ortho-PO4	Chlorophyll-a (filters)	Turbididty	Hazardous?	Highly Contaminated?	Number of Containers
	EAS-BGE-1 (500 ml filtered for chlor-a)	18-Sep-09		Water	x	x	x	x	x	x	x	x	x	x			
	EAS-BGE-2 (500 ml filtered for chlor-a)	18-Sep-09		Water									x				
	EAS-BGE-3 (250 ml filtered for chlor-a)	18-Sep-09		Water									x				
	EAS-BGE-4 (250 ml filtered for chlor-a)	18-Sep-09		Water									x				
	EAS-BGE-5 (250 ml filtered for chlor-a)	18-Sep-09		Water									x				
	EAS-DUP1	19-Sep-09		Water	x	x	x	x	x	x	x	x	x	x			
	EAS-DUP2 (500 ml filtered for chlor-a)	19-Sep-09		Water									x				
	TRAVEL BLANK	19-Sep-09		Water	x		x	x	x	x	x	x		x			
	EAS-EQ-1	19-Sep-09		Water	x	x	x	x	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)	
Gary Mann	19-Sep-09	[signature]	09/09/29 11:40	Temperature	Samples Received in Good Condition? Y / N (if no provided details)
				14	

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Certificate of Analysis

AZIMUTH CONSULTING GROUP INC.
ATTN: RANDY BAKER
218 - 2902 WEST BROADWAY
VANCOUVER BC V6K 2G8

Report Date: 15-OCT-09 16:05 (MT)
Version: FINAL

Lab Work Order #: **L826904** **Date Received:** **06-OCT-09**

Project P.O. #:
Job Reference: MEADOWBANK MINE BG-EAS
Legal Site Desc:
CofC Numbers:

Other Information:

Comments:

Lindsay Jones
Lindsay Jones
Account Manager

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L826904-1	L826904-2	L826904-3	L826904-4	L826904-5
	Description					
	Sampled Date	27-SEP-09	27-SEP-09	27-SEP-09	27-SEP-09	27-SEP-09
	Sampled Time					
	Client ID	EAS-TPS-1	EAS-TPS-2	EAS-TPS-3	EAS-TPS-4	EAS-TPS-5
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	15.1				
	Hardness (as CaCO3) (mg/L)	5.3				
	pH (pH)	6.92				
	Total Suspended Solids (mg/L)	<1.0				
	Total Dissolved Solids (mg/L)	<10				
	Turbidity (NTU)	0.53				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	4.2				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	4.2				
	Ammonia as N (mg/L)	0.024				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	<0.50				
	Fluoride (F) (mg/L)	0.040				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	0.070				
	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)	1.14				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	4.45				
	Total Organic Carbon (mg/L)	1.31 *				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0147				
	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)	1.20				
	Chromium (Cr)-Total (mg/L)	<0.0010				
	Cobalt (Co)-Total (mg/L)	<0.00030				
	Copper (Cu)-Total (mg/L)	<0.0010				
	Iron (Fe)-Total (mg/L)	0.031				
	Lead (Pb)-Total (mg/L)	<0.00050				
	Lithium (Li)-Total (mg/L)	<0.0050				
	Magnesium (Mg)-Total (mg/L)	0.57				
	Manganese (Mn)-Total (mg/L)	0.00109				
	Mercury (Hg)-Total (mg/L)	<0.000020				

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L826904-1	L826904-2	L826904-3	L826904-4	L826904-5
	Description					
	Sampled Date	27-SEP-09	27-SEP-09	27-SEP-09	27-SEP-09	27-SEP-09
	Sampled Time					
	Client ID	EAS-TPS-1	EAS-TPS-2	EAS-TPS-3	EAS-TPS-4	EAS-TPS-5
Grouping	**Analyte**					
WATER						
Total Metals	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)	<0.0050				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.00050				
	Barium (Ba)-Dissolved (mg/L)	<0.020				
	Beryllium (Be)-Dissolved (mg/L)	<0.0010				
	Boron (B)-Dissolved (mg/L)	<0.10				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017				
	Calcium (Ca)-Dissolved (mg/L)	1.19				
	Chromium (Cr)-Dissolved (mg/L)	<0.0010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00030				
	Copper (Cu)-Dissolved (mg/L)	<0.0010				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	<0.00050				
	Lithium (Li)-Dissolved (mg/L)	<0.0050				
	Magnesium (Mg)-Dissolved (mg/L)	0.56				
	Manganese (Mn)-Dissolved (mg/L)	0.00031				
	Mercury (Hg)-Dissolved (mg/L)	<0.000020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0010				
	Potassium (K)-Dissolved (mg/L)	<2.0				
	Selenium (Se)-Dissolved (mg/L)	<0.0010				
	Silver (Ag)-Dissolved (mg/L)	<0.000020				
	Sodium (Na)-Dissolved (mg/L)	<2.0				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.00050				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050				

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L826904-1	L826904-2	L826904-3	L826904-4	L826904-5
	Description					
	Sampled Date	27-SEP-09	27-SEP-09	27-SEP-09	27-SEP-09	27-SEP-09
	Sampled Time					
	Client ID	EAS-TPS-1	EAS-TPS-2	EAS-TPS-3	EAS-TPS-4	EAS-TPS-5
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug/L)	0.728	0.750	0.780	0.778	0.734

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

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Qualifiers for Individual Parameters Listed:

Qualifier	Description
RRV	Reported Result Verified By Repeat Analysis

Samples with Qualifiers for Individual Parameters as listed above:

Sample Number	Client Sample ID	Parameters	Qualifier
L826904-1	EAS-TPS-1	Total Organic Carbon	RRV

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
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	Analytical Method Reference(Based On)
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	Analytical Method Reference(Based On)
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	Analytical Method Reference(Based On)
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	Analytical Method Reference(Based On)
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	Analytical Method Reference(Based On)
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	Analytical Method Reference(Based On)
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	Analytical Method Reference(Based On)
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310 "TOTAL ORGANIC CARBON (TOC)"

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

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)

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

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 "TOTAL ORGANIC CARBON (TOC)"

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

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

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

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.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness is calculated from Calcium and Magnesium concentrations, and is expressed as calcium carbonate equivalents.

HG-DIS-CCME-CVAFS-VA	Water	Diss. Mercury in Water by CVAFS (CCME)	EPA 3005A/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-CCME-CVAFS-VA	Water	Total Mercury in Water by CVAFS (CCME)	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).

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).

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
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).

NH3-SIE-VA	Water	Ammonia by SIE	APHA 4500 D. - NH3 NITROGEN (AMMONIA)

This analysis is carried out, on sulphuric acid preserved samples, using procedures adapted from APHA Method 4500-NH3 "Nitrogen (Ammonia)". Ammonia is determined using an ammonia selective electrode.

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.

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.

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.

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.

TKN-SIE-VA	Water	Total Kjeldahl Nitrogen by SIE	APHA 4500-Norg (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg "Nitrogen (Organic)". Total kjeldahl nitrogen is determined by

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

sample digestion at 367 celcius with analysis using an ammonia selective electrode.

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.

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA		

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

Short Holding Time

Rush Processing

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

Chain of Custc
Canada Toll Free: [illegible]
www.alsglobal.com

COC # ______

Page 1 of 1

Report to: Randy Baker	
Company:	Azimuth Consulting Group Inc.
Contact:	Randy Baker
Address:	Vancouver
Phone:	604-730-1220 Fax:
Invoice To:	☑ Same as Report
Company:	
Contact:	
Address:	
Sample	
Phone:	Fax:
Lab Work Order # (lab use only)	L826904

Report Format / Distribution	
☑ Standard ☐ Other	
☑ PDF ☑ Excel ☐ Fax	
Email 1:	rbaker@azimuthgroup.ca
Email 2:	gmann@azimuthgroup.ca , mmcconnell@azimuthgroup.ca
Client / Project Information:	
Job #:	Meadowbank Mine BG-EAS
PO/AFE:	
Legal Site Description:	
Quote #:	ALSEQ09-077
ALS Contact:	Natasha MM
Sampler (Initials):	SH/NW/RT

Service Requested:

- ☑ Regular Service (Default)
- ☐ Rush Service (2-3 Days)
- ☐ Priority Service (1 Day or ASAP)
- ☐ Emergency Service (<1 Day / Wkend) - Contact ALS

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 (CCME)	D-Metals (CCME)	TOC, DOC	TKN, Ammonia	TDS, TSS-low	Alk (SPECIATED)	Anion Scan, Si, pH, EC	T-PO4, ortho-PO4	Chlorophyll-a (filters)	Turbididty	Hazardous?	Highly Contaminated?	Number of Containers
	EAS-TPS-1 (1000 ml filtered for chlor-a)	27-Sep-09		Water	x	x	x	x	x	x	x	x	x	x			
	EAS-TPS-2 (1000 ml filtered for chlor-a)	27-Sep-09		Water									x				
	EAS-TPS-3 (1000 ml filtered for chlor-a)	27-Sep-09		Water									x				
	EAS-TPS-4 (1000 ml filtered for chlor-a)	27-Sep-09		Water									x				
	EAS-TPS-5 (1000 ml filtered for chlor-a)	27-Sep-09		Water									x				

Guidelines / Regulations	Special Instructions / Hazardous Details
	Note: Travel blank only contains 1 x 1L plastic bottle; do what you can, but TSS would be lowest priority for analysis.

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)	
Relinquished By:	Gary Mann	Date & Time:	28-Sep-09	Received By:	[signature]	Date & Time:	10/06/09 9:15am	Temperature 12°C	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By:		Date & Time:		Received By:		Date & Time:			

Certificate of Analysis

AZIMUTH CONSULTING GROUP INC.
ATTN: RANDY BAKER
218 - 2902 WEST BROADWAY
VANCOUVER BC V6K 2G8

Report Date: 20-OCT-09 15:16 (MT)
Version: FINAL

Lab Work Order #: **L826912**
Date Received: **06-OCT-09**

Project P.O. #:
Job Reference: MEADOWBANK MINE BG-EAS
Legal Site Desc:
CofC Numbers:

Other Information:

Comments:

Lindsay Jones
Account Manager

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN AUTHORITY OF THE LABORATORY.
ALL SAMPLES WILL BE DISPOSED OF AFTER 30 DAYS FOLLOWING ANALYSIS. PLEASE CONTACT THE LAB IF YOU REQUIRE ADDITIONAL SAMPLE STORAGE TIME.

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L826912-1	L826912-2	L826912-3	L826912-4	L826912-5
	Description					
	Sampled Date	24-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09
	Sampled Time					
	Client ID	EAS-DT-1	EAS-DT-2	EAS-DT-3	EAS-DT-4	EAS-DT-5
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	27.0				
	Hardness (as CaCO3) (mg/L)	11.3				
	pH (pH)	7.67				
	Total Suspended Solids (mg/L)	<1.0				
	Total Dissolved Solids (mg/L)	12				
	Turbidity (NTU)	0.49				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	8.5				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	8.5				
	Ammonia as N (mg/L)	<0.020				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	0.73				
	Fluoride (F) (mg/L)	0.038				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	0.118				
	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)	2.40				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.73				
	Total Organic Carbon (mg/L)	1.80				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0166				
	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)	2.96				
	Chromium (Cr)-Total (mg/L)	<0.0010				
	Cobalt (Co)-Total (mg/L)	<0.00030				
	Copper (Cu)-Total (mg/L)	<0.0010				
	Iron (Fe)-Total (mg/L)	<0.030				
	Lead (Pb)-Total (mg/L)	<0.00050				
	Lithium (Li)-Total (mg/L)	<0.0050				
	Magnesium (Mg)-Total (mg/L)	0.94				
	Manganese (Mn)-Total (mg/L)	0.00092				
	Mercury (Hg)-Total (mg/L)	<0.000020				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L826912-6	L826912-7	L826912-8	L826912-9	L826912-10
	Description					
	Sampled Date	24-SEP-09	24-SEP-09	24-SEP-09	24-SEP-09	24-SEP-09
	Sampled Time					
	Client ID	EAS-BGW-1	EAS-BGW-2	EAS-BGW-3	EAS-BGW-4	EAS-BGW-5
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	17.0				
	Hardness (as CaCO3) (mg/L)	6.4				
	pH (pH)	6.97				
	Total Suspended Solids (mg/L)	9.1				
	Total Dissolved Solids (mg/L)	10				
	Turbidity (NTU)	11.2				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	4.5				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	4.5				
	Ammonia as N (mg/L)	<0.020				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	<0.50				
	Fluoride (F) (mg/L)	0.047				
	Nitrate (as N) (mg/L)	0.0095				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	0.095				
	Ortho Phosphate as P (mg/L)	<0.0010				
	Total Phosphate as P (mg/L)	0.0064				
	Silicate (as SIO2) (mg/L)	<1.0				
	Sulfate (SO4) (mg/L)	1.27				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.30				
	Total Organic Carbon (mg/L)	1.08				
Total Metals	Aluminum (Al)-Total (mg/L)	0.269				
	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)	1.56				
	Chromium (Cr)-Total (mg/L)	0.0013				
	Cobalt (Co)-Total (mg/L)	<0.00030				
	Copper (Cu)-Total (mg/L)	<0.0010				
	Iron (Fe)-Total (mg/L)	0.461				
	Lead (Pb)-Total (mg/L)	<0.00050				
	Lithium (Li)-Total (mg/L)	<0.0050				
	Magnesium (Mg)-Total (mg/L)	0.77				
	Manganese (Mn)-Total (mg/L)	0.00741				
	Mercury (Hg)-Total (mg/L)	<0.000020				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L826912-11	L826912-12	L826912-13	L826912-14	L826912-15
	Description					
	Sampled Date	26-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09
	Sampled Time					
	Client ID	EAS-SPC-1	EAS-SPC-2	EAS-SPC-3	EAS-SPC-4	EAS-SPC-5
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	23.0				
	Hardness (as CaCO3) (mg/L)	9.4				
	pH (pH)	7.41				
	Total Suspended Solids (mg/L)	1.3				
	Total Dissolved Solids (mg/L)	<10				
	Turbidity (NTU)	2.70				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	7.6				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	7.6				
	Ammonia as N (mg/L)	<0.020				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	<0.50				
	Fluoride (F) (mg/L)	0.042				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	0.126				
	Ortho Phosphate as P (mg/L)	<0.0010				
	Total Phosphate as P (mg/L)	0.0030				
	Silicate (as SIO2) (mg/L)	<1.0				
	Sulfate (SO4) (mg/L)	1.91				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.60				
	Total Organic Carbon (mg/L)	1.47				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0976				
	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)	2.42				
	Chromium (Cr)-Total (mg/L)	<0.0010				
	Cobalt (Co)-Total (mg/L)	<0.00030				
	Copper (Cu)-Total (mg/L)	<0.0010				
	Iron (Fe)-Total (mg/L)	0.119				
	Lead (Pb)-Total (mg/L)	<0.00050				
	Lithium (Li)-Total (mg/L)	<0.0050				
	Magnesium (Mg)-Total (mg/L)	0.86				
	Manganese (Mn)-Total (mg/L)	0.00280				
	Mercury (Hg)-Total (mg/L)	<0.000020				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L826912-16	L826912-17	L826912-18	L826912-19	L826912-20
	Description					
	Sampled Date	26-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09
	Sampled Time					
	Client ID	EAS-BGE-1	EAS-BGE-2	EAS-BGE-3	EAS-BGE-4	EAS-BGE-5
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	16.7				
	Hardness (as CaCO3) (mg/L)	6.3				
	pH (pH)	6.92				
	Total Suspended Solids (mg/L)	7.9				
	Total Dissolved Solids (mg/L)	<10				
	Turbidity (NTU)	16.3				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	5.1				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	5.1				
	Ammonia as N (mg/L)	<0.020				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	<0.50				
	Fluoride (F) (mg/L)	0.046				
	Nitrate (as N) (mg/L)	0.0128				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	0.100				
	Ortho Phosphate as P (mg/L)	<0.0010				
	Total Phosphate as P (mg/L)	0.0071				
	Silicate (as SIO2) (mg/L)	<1.0				
	Sulfate (SO4) (mg/L)	1.22				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.12				
	Total Organic Carbon (mg/L)	1.17				
Total Metals	Aluminum (Al)-Total (mg/L)	0.630				
	Antimony (Sb)-Total (mg/L)	<0.00050				
	Arsenic (As)-Total (mg/L)	0.00066				
	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)	1.49				
	Chromium (Cr)-Total (mg/L)	0.0028				
	Cobalt (Co)-Total (mg/L)	0.00035				
	Copper (Cu)-Total (mg/L)	0.0013				
	Iron (Fe)-Total (mg/L)	0.783				
	Lead (Pb)-Total (mg/L)	<0.00050				
	Lithium (Li)-Total (mg/L)	<0.0050				
	Magnesium (Mg)-Total (mg/L)	0.87				
	Manganese (Mn)-Total (mg/L)	0.0129				
	Mercury (Hg)-Total (mg/L)	<0.000020				

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	L826912-21	L826912-22	L826912-23	L826912-24	L826912-25
	Sample ID	L826912-21	L826912-22	L826912-23	L826912-24	L826912-25
	Description					
	Sampled Date	24-SEP-09	26-SEP-09	26-SEP-09	24-SEP-09	26-SEP-09
	Sampled Time					
	Client ID	EAS-DUP1	TRAVEL BLANK	EAS-EQ-1	EAS-DUP2	BLANK
WATER						
Physical Tests	Conductivity (uS/cm)	26.8	<2.0	<2.0		
	Hardness (as CaCO3) (mg/L)	11.3	<1.1	<1.1		
	pH (pH)	7.20	5.63	5.70		
	Total Suspended Solids (mg/L)	<1.0	<1.0	<1.0		
	Total Dissolved Solids (mg/L)	14	<10	<10		
	Turbidity (NTU)	0.52	<0.10	<0.10		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	8.6	<2.0	<2.0		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0		
	Alkalinity, Total (as CaCO3) (mg/L)	8.6	<2.0	<2.0		
	Ammonia as N (mg/L)	<0.020	<0.020	<0.020		
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050		
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50		
	Fluoride (F) (mg/L)	0.037	<0.020	<0.020		
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050		
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010		
	Total Kjeldahl Nitrogen (mg/L)	0.124	<0.050	<0.050		
	Ortho Phosphate as P (mg/L)	<0.0010	<0.0010	<0.0010		
	Total Phosphate as P (mg/L)	0.0024	<0.0020	<0.0020		
	Silicate (as SIO2) (mg/L)	<1.0	<1.0	<1.0		
	Sulfate (SO4) (mg/L)	2.40	<0.50	<0.50		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.75	<0.50	<0.50		
	Total Organic Carbon (mg/L)	1.78	<0.50	<0.50		
Total Metals	Aluminum (Al)-Total (mg/L)	0.0219	<0.0050	<0.0050		
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Arsenic (As)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Barium (Ba)-Total (mg/L)	<0.020	<0.020	<0.020		
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10		
	Cadmium (Cd)-Total (mg/L)	<0.000017	<0.000017	<0.000017		
	Calcium (Ca)-Total (mg/L)	2.95	<0.10	<0.10		
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Cobalt (Co)-Total (mg/L)	<0.00030	<0.00030	<0.00030		
	Copper (Cu)-Total (mg/L)	0.0011	<0.0010	<0.0010		
	Iron (Fe)-Total (mg/L)	<0.030	<0.030	<0.030		
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Lithium (Li)-Total (mg/L)	<0.0050	<0.0050	<0.0050		
	Magnesium (Mg)-Total (mg/L)	0.95	<0.10	<0.10		
	Manganese (Mn)-Total (mg/L)	0.00115	<0.00030	<0.00030		
	Mercury (Hg)-Total (mg/L)	<0.000020	<0.000020	<0.000020		

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L826912-1	L826912-2	L826912-3	L826912-4	L826912-5
	Description					
	Sampled Date	24-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09
	Sampled Time					
	Client ID	EAS-DT-1	EAS-DT-2	EAS-DT-3	EAS-DT-4	EAS-DT-5
Grouping	**Analyte**					
WATER						
Total Metals	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)	<0.0050				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.00050				
	Barium (Ba)-Dissolved (mg/L)	<0.020				
	Beryllium (Be)-Dissolved (mg/L)	<0.0010				
	Boron (B)-Dissolved (mg/L)	<0.10				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017				
	Calcium (Ca)-Dissolved (mg/L)	2.96				
	Chromium (Cr)-Dissolved (mg/L)	<0.0010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00030				
	Copper (Cu)-Dissolved (mg/L)	<0.0010				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	<0.00050				
	Lithium (Li)-Dissolved (mg/L)	<0.0050				
	Magnesium (Mg)-Dissolved (mg/L)	0.96				
	Manganese (Mn)-Dissolved (mg/L)	0.00037				
	Mercury (Hg)-Dissolved (mg/L)	<0.000020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0010				
	Potassium (K)-Dissolved (mg/L)	<2.0				
	Selenium (Se)-Dissolved (mg/L)	<0.0010				
	Silver (Ag)-Dissolved (mg/L)	<0.000020				
	Sodium (Na)-Dissolved (mg/L)	<2.0				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.00050				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L826912-6	L826912-7	L826912-8	L826912-9	L826912-10
	Description					
	Sampled Date	24-SEP-09	24-SEP-09	24-SEP-09	24-SEP-09	24-SEP-09
	Sampled Time					
	Client ID	EAS-BGW-1	EAS-BGW-2	EAS-BGW-3	EAS-BGW-4	EAS-BGW-5
Grouping	**Analyte**					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)	<0.0010				
	Nickel (Ni)-Total (mg/L)	0.0011				
	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)	0.016				
	Uranium (U)-Total (mg/L)	0.00021				
	Vanadium (V)-Total (mg/L)	<0.0010				
	Zinc (Zn)-Total (mg/L)	<0.0050				
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.0091				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.00050				
	Barium (Ba)-Dissolved (mg/L)	<0.020				
	Beryllium (Be)-Dissolved (mg/L)	<0.0010				
	Boron (B)-Dissolved (mg/L)	<0.10				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017				
	Calcium (Ca)-Dissolved (mg/L)	1.50				
	Chromium (Cr)-Dissolved (mg/L)	<0.0010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00030				
	Copper (Cu)-Dissolved (mg/L)	<0.0010				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	<0.00050				
	Lithium (Li)-Dissolved (mg/L)	<0.0050				
	Magnesium (Mg)-Dissolved (mg/L)	0.65				
	Manganese (Mn)-Dissolved (mg/L)	0.00099				
	Mercury (Hg)-Dissolved (mg/L)	<0.000020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0010				
	Potassium (K)-Dissolved (mg/L)	<2.0				
	Selenium (Se)-Dissolved (mg/L)	<0.0010				
	Silver (Ag)-Dissolved (mg/L)	<0.000020				
	Sodium (Na)-Dissolved (mg/L)	<2.0				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.00050				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050				

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	L826912-11	L826912-12	L826912-13	L826912-14	L826912-15
	Description					
	Sampled Date	26-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09
	Sampled Time					
	Client ID	EAS-SPC-1	EAS-SPC-2	EAS-SPC-3	EAS-SPC-4	EAS-SPC-5
WATER						
Total Metals	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)	0.0053				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.00050				
	Barium (Ba)-Dissolved (mg/L)	<0.020				
	Beryllium (Be)-Dissolved (mg/L)	<0.0010				
	Boron (B)-Dissolved (mg/L)	<0.10				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017				
	Calcium (Ca)-Dissolved (mg/L)	2.44				
	Chromium (Cr)-Dissolved (mg/L)	<0.0010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00030				
	Copper (Cu)-Dissolved (mg/L)	<0.0010				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	<0.00050				
	Lithium (Li)-Dissolved (mg/L)	<0.0050				
	Magnesium (Mg)-Dissolved (mg/L)	0.82				
	Manganese (Mn)-Dissolved (mg/L)	0.00032				
	Mercury (Hg)-Dissolved (mg/L)	<0.000020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0010				
	Potassium (K)-Dissolved (mg/L)	<2.0				
	Selenium (Se)-Dissolved (mg/L)	<0.0010				
	Silver (Ag)-Dissolved (mg/L)	<0.000020				
	Sodium (Na)-Dissolved (mg/L)	<2.0				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.00050				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L826912-16	L826912-17	L826912-18	L826912-19	L826912-20
	Description					
	Sampled Date	26-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09
	Sampled Time					
	Client ID	EAS-BGE-1	EAS-BGE-2	EAS-BGE-3	EAS-BGE-4	EAS-BGE-5
Grouping	**Analyte**					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)	<0.0010				
	Nickel (Ni)-Total (mg/L)	0.0019				
	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)	0.025				
	Uranium (U)-Total (mg/L)	0.00029				
	Vanadium (V)-Total (mg/L)	0.0010				
	Zinc (Zn)-Total (mg/L)	<0.0050				
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.0057				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.00050				
	Barium (Ba)-Dissolved (mg/L)	<0.020				
	Beryllium (Be)-Dissolved (mg/L)	<0.0010				
	Boron (B)-Dissolved (mg/L)	<0.10				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017				
	Calcium (Ca)-Dissolved (mg/L)	1.47				
	Chromium (Cr)-Dissolved (mg/L)	<0.0010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00030				
	Copper (Cu)-Dissolved (mg/L)	<0.0010				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	<0.00050				
	Lithium (Li)-Dissolved (mg/L)	<0.0050				
	Magnesium (Mg)-Dissolved (mg/L)	0.64				
	Manganese (Mn)-Dissolved (mg/L)	0.00117				
	Mercury (Hg)-Dissolved (mg/L)	<0.000020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0010				
	Potassium (K)-Dissolved (mg/L)	<2.0				
	Selenium (Se)-Dissolved (mg/L)	<0.0010				
	Silver (Ag)-Dissolved (mg/L)	<0.000020				
	Sodium (Na)-Dissolved (mg/L)	<2.0				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.00050				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L826912-21	L826912-22	L826912-23	L826912-24	L826912-25
	Description					
	Sampled Date	24-SEP-09	26-SEP-09	26-SEP-09	24-SEP-09	26-SEP-09
	Sampled Time					
	Client ID	EAS-DUP1	TRAVEL BLANK	EAS-EQ-1	EAS-DUP2	BLANK
Grouping	**Analyte**					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Nickel (Ni)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0		
	Selenium (Se)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Silver (Ag)-Total (mg/L)	<0.000020	<0.000020	<0.000020		
	Sodium (Na)-Total (mg/L)	<2.0	<2.0	<2.0		
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.00020	<0.00020		
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010		
	Uranium (U)-Total (mg/L)	<0.00020	<0.00020	<0.00020		
	Vanadium (V)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Zinc (Zn)-Total (mg/L)	<0.0050	<0.0050	<0.0050		
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	<0.0050		<0.0050		
	Antimony (Sb)-Dissolved (mg/L)	<0.00050		<0.00050		
	Arsenic (As)-Dissolved (mg/L)	<0.00050		<0.00050		
	Barium (Ba)-Dissolved (mg/L)	<0.020		<0.020		
	Beryllium (Be)-Dissolved (mg/L)	<0.0010		<0.0010		
	Boron (B)-Dissolved (mg/L)	<0.10		<0.10		
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017		<0.000017		
	Calcium (Ca)-Dissolved (mg/L)	2.97		<0.10		
	Chromium (Cr)-Dissolved (mg/L)	<0.0010		<0.0010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00030		<0.00030		
	Copper (Cu)-Dissolved (mg/L)	<0.0010		<0.0010		
	Iron (Fe)-Dissolved (mg/L)	<0.030		<0.030		
	Lead (Pb)-Dissolved (mg/L)	<0.00050		<0.00050		
	Lithium (Li)-Dissolved (mg/L)	<0.0050		<0.0050		
	Magnesium (Mg)-Dissolved (mg/L)	0.95		<0.10		
	Manganese (Mn)-Dissolved (mg/L)	0.00040		<0.00030		
	Mercury (Hg)-Dissolved (mg/L)	<0.000020		<0.000020		
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010		<0.0010		
	Nickel (Ni)-Dissolved (mg/L)	<0.0010		<0.0010		
	Potassium (K)-Dissolved (mg/L)	<2.0		<2.0		
	Selenium (Se)-Dissolved (mg/L)	<0.0010		<0.0010		
	Silver (Ag)-Dissolved (mg/L)	<0.000020		<0.000020		
	Sodium (Na)-Dissolved (mg/L)	<2.0		<2.0		
	Thallium (Tl)-Dissolved (mg/L)	<0.00020		<0.00020		
	Tin (Sn)-Dissolved (mg/L)	<0.00050		<0.00050		
	Titanium (Ti)-Dissolved (mg/L)	<0.010		<0.010		
	Uranium (U)-Dissolved (mg/L)	<0.00020		<0.00020		
	Vanadium (V)-Dissolved (mg/L)	<0.0010		<0.0010		
	Zinc (Zn)-Dissolved (mg/L)	<0.0050		<0.0050		

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	Sample ID	L826912-1	L826912-2	L826912-3	L826912-4	L826912-5
	Description					
	Sampled Date	24-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09
	Sampled Time					
	Client ID	EAS-DT-1	EAS-DT-2	EAS-DT-3	EAS-DT-4	EAS-DT-5
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug/L)	0.666	0.718	0.804	0.856	0.632

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L826912-6	L826912-7	L826912-8	L826912-9	L826912-10
	Description					
	Sampled Date	24-SEP-09	24-SEP-09	24-SEP-09	24-SEP-09	24-SEP-09
	Sampled Time					
	Client ID	EAS-BGW-1	EAS-BGW-2	EAS-BGW-3	EAS-BGW-4	EAS-BGW-5
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug/L)	0.715	0.377	0.244	0.522	0.523

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L826912-11	L826912-12	L826912-13	L826912-14	L826912-15
	Description					
	Sampled Date	26-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09	26-SEP-09
	Sampled Time					
	Client ID	EAS-SPC-1	EAS-SPC-2	EAS-SPC-3	EAS-SPC-4	EAS-SPC-5
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug/L)	0.996	0.715	0.681	0.746	0.473

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L826912-16 26-SEP-09 EAS-BGE-1	L826912-17 26-SEP-09 EAS-BGE-2	L826912-18 26-SEP-09 EAS-BGE-3	L826912-19 26-SEP-09 EAS-BGE-4	L826912-20 26-SEP-09 EAS-BGE-5
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug/L)	0.697	0.366	0.305	0.280	0.327

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L826912-21	L826912-22	L826912-23	L826912-24	L826912-25
	Description					
	Sampled Date	24-SEP-09	26-SEP-09	26-SEP-09	24-SEP-09	26-SEP-09
	Sampled Time					
	Client ID	EAS-DUP1	TRAVEL BLANK	EAS-EQ-1	EAS-DUP2	BLANK
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug/L)	0.639			0.929	<0.010

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
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.

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".

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".

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".

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.

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.

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".

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

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

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

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

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

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

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

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

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
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.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness is calculated from Calcium and Magnesium concentrations, and is expressed as calcium carbonate equivalents.

HG-DIS-CCME-CVAFS-VA	Water	Diss. Mercury in Water by CVAFS (CCME)	EPA 3005A/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-CCME-CVAFS-VA	Water	Total Mercury in Water by CVAFS (CCME)	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).

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).

NH3-SIE-VA	Water	Ammonia by SIE	APHA 4500 D. - NH3 NITROGEN (AMMONIA)

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

This analysis is carried out, on sulphuric acid preserved samples, using procedures adapted from APHA Method 4500-NH3 "Nitrogen (Ammonia)". Ammonia is determined using an ammonia selective electrode.

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.

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.

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

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

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.

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.

TKN-SIE-VA	Water	Total Kjeldahl Nitrogen by SIE	APHA 4500-Norg (TKN)

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg "Nitrogen (Organic)". Total kjeldahl nitrogen is determined by sample digestion at 367 celcius with analysis using an ammonia selective electrode.

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.

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA		

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

Short Holding Time

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

Chain of Custc
Canada 1
W

Rush Processing

COC # ____________

Page 1 of 3

Report to: Randy Baker		**Report Format / Distribution**	**Service Requested:**
Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other	☑ Regular Service (Default)
Contact:	Randy Baker	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address:	Vancouver	Email 1: rbaker@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2: gmann@azimuthgroup.ca , mmcconnell@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 BG-EAS	
Address:		PO/AFE:	
Sample		Legal Site Description:	
Phone:	Fax:	Quote #: ALSEQ09-077	
Lab Work Order # (lab use only)	L826912	**ALS Contact:** Natasha MM	**Sampler** (Initials): SH/NW/RT

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 (CCME)	D-Metals (CCME)	TOC, DOC	TKN, Ammonia	TDS, TSS-low	Alk (SPECIATED)	Anion Scan, Si, pH, EC	T-PO4, ortho-PO4	Chlorophyll-a (filters)	Turbididty	Hazardous?	Highly Contaminated?	Number of Containers
	EAS-DT-1 (1000 ml filtered for chlor-a)	24-Sep-09		Water	x	x	x	x	x	x	x	x	x	x			
	EAS-DT-2 (1000 ml filtered for chlor-a)	26-Sep-09		Water									x				
	EAS-DT-3 (1000 ml filtered for chlor-a)	26-Sep-09		Water									x				
	EAS-DT-4 (1000 ml filtered for chlor-a)	26-Sep-09		Water									x				
	EAS-DT-5 (1000 ml filtered for chlor-a)	26-Sep-09		Water									x				

Guidelines / Regulations	**Special Instructions / Hazardous Details**
Shipment contains two coolers; full COC provided in each cooler.	1L filtered for all chlor-a samples.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.

Relinquished By:	Gary Mann	Date & Time:	26-Sep-09	Received By:		Date & Time:	10/06/09 9:17 am	**Sample Condition (lab use only)** Temperature: 11°C	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By:		Date & Time:		Received By:		Date & Time:			

COOLER 1 of 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: Randy Baker	**Report Format / Distribution**
Company: Azimuth Consulting Group Inc.	☑ Standard ☐ Other
Contact: Randy Baker	☑ PDF ☑ Excel ☐ Fax
Address: Vancouver	Email 1: rbaker@azimuthgroup.ca
	Email 2: gmann@azimuthgroup.ca , mmcconnell@azimuthgroup.ca
Phone: 604-730-1220 Fax:	
Invoice To: ☑ Same as Report	Indicate Bottles: Filtered / Preserved (F/P) →
Company:	**Client / Project Information:**
Contact:	Job #: Meadowbank Mine BG-EAS
Address:	PO/AFE:
Sample	Legal Site Description:
Phone: Fax:	Quote #: ALSEQ09-077
Lab Work Order # (lab use only): L826912	ALS Contact: Natasha MM; Sampler (Initials): SH/NW/RT

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)	T-Metals (CCME)	D-Metals (CCME)	TOC, DOC	TKN, Ammonia	TDS, TSS-low	Alk (SPECIATED)	Anion Scan, Si, pH, EC	T-PO4, ortho-PO4	Chlorophyll-a (filters)	Turbididty	Hazardous?	Highly Contaminated?	Number of Containers
	EAS-BGW-1 (1000 ml filtered for chlor-a)	24-Sep-09		Water	x	x	x	x	x	x	x	x	x	x			
	EAS-BGW-2 (1000 ml filtered for chlor-a)	24-Sep-09		Water									x				
	EAS-BGW-3 (1000 ml filtered for chlor-a)	24-Sep-09		Water									x				
	EAS-BGW-4 (1000 ml filtered for chlor-a)	24-Sep-09		Water									x				
	EAS-BGW-5 (1000 ml filtered for chlor-a)	24-Sep-09		Water									x				
	EAS-SPC-1 (1000 ml filtered for chlor-a)	26-Sep-09		Water	x	x	x	x	x	x	x	x	x	x			
	EAS-SPC-2 1000 (~~500~~ ml filtered for chlor-a) GSM	26-Sep-09		Water									x				
	EAS-SPC-3 (1000 ml filtered for chlor-a)	26-Sep-09		Water									x				
	EAS-SPC-4 (1000 ml filtered for chlor-a)	26-Sep-09		Water									x				
	EAS-SPC-5 (1000 ml filtered for chlor-a)	26-Sep-09		Water									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:	Gary Mann	Date & Time:	26-Sep-09	Received By:	[signature]	Date & Time:	10/06/09 9:30	Sample Condition (lab use only) Temperature: 11°C	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By:		Date & Time:		Received By:		Date & Time:			

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

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Canada Toll Free: 1 800 668 9878
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COC # ____________

Report to: Randy Baker	**Report Format / Distribution**	**Service Requested:**
Company: Azimuth Consulting Group Inc.	☑ Standard ☐ Other	☑ Regular Service (Default)
Contact: Randy Baker	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address: Vancouver	Email 1: rbaker@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
	Email 2: gmann@azimuthgroup.ca , mmcconnell@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 BG-EAS	
Address:	PO/AFE:	
Sample	Legal Site Description:	
Phone: Fax:	Quote #: ALSEQ09-077	
Lab Work Order # (lab use only) L826912	**ALS Contact:** Natasha MM **Sampler** (Initials): SH/NW/RT	

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 (CCME)	D-Metals (CCME)	TOC, DOC	TKN, Ammonia	TDS, TSS-low	Alk (SPECIATED)	Anion Scan, Si, pH, EC	T-PO4, ortho-PO4	Chlorophyll-a (filters)	Turbididty	Hazardous?	Highly Contaminated?	Number of Containers
	EAS-BGE-1 (1000 ml filtered for chlor-a)	26-Sep-09		Water	x	x	x	x	x	x	x	x	x	x			
	EAS-BGE-2 (1000 ml filtered for chlor-a)	26-Sep-09		Water									x				
	EAS-BGE-3 (1000 ml filtered for chlor-a)	26-Sep-09		Water									x				
	EAS-BGE-4 (1000 ml filtered for chlor-a)	26-Sep-09		Water									x				
	EAS-BGE-5 (1000 ml filtered for chlor-a)	26-Sep-09		Water									x				
	EAS-DUP1 (1000 ml filtered for chlor-a)	24-Sep-09		Water	x	x	x	x	x	x	x	x	x	x			
	EAS-DUP2 (1000 ml filtered for chlor-a)	24-Sep-09		Water									x				
	TRAVEL BLANK	26-Sep-09		Water	x		x	x	x	x	x	x		x			
	EAS-EQ-1	26-Sep-09		Water	x	x	x	x	x	x	x	x		x			

Guidelines / Regulations	**Special Instructions / Hazardous Details**
	Note: Travel blank only contains 1 x 1L plastic bottle; do what you can, but TSS would be lowest priority for analysis.

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:	Gary Mann	Date & Time:	26-Sep-09	Received By:	[signature]	Date & Time:	10/06/09 9:17 AM	Sample Condition (lab use only): Temperature 11°C
Relinquished By:		Date & Time:		Received By:		Date & Time:		Samples Received in Good Condition? Y / N (if no provided details)

APPENDIX J

NAUTILUS ENVIRONMENTAL TOXICITY TESTING REPORT FOR SEPTEMBER 2009 SAMPLE, DECEMBER 2009

Toxicity testing for the Meadowbank Project: September 2009 sample

Final Report

Report date:

December 9, 2009

Submitted to:

Azimuth Consulting Group

Vancouver, BC

8664 Commerce Court

Burnaby, BC

V5A 4N7

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1.0 INTRODUCTION

Toxicity testing was conducted on water collected by Azimuth Consulting Group from the Meadowbank Site. The testing program was designed to evaluate whether total suspended solids (TSS) present in the water might result in adverse effects on aquatic organisms. Toxicity tests included acute tests using rainbow trout and *Daphnia magna*, as well as chronic toxicity tests using *Ceriodaphnia dubia* (survival and reproduction) and rainbow trout (embryo development and larval survival and growth tests). The results presented here relate only to the samples tested.

2.0 METHODS

2.1 Sample Collection and Transport

The sample was collected in plastic buckets by Azimuth on September 19, 2009, and transported to Nautilus Environmental by commercial courier. As a result of extended transport time, the sample was not received until September 29, 2009.

Upon arrival at the laboratory, the samples inspected and the contents verified against information provided on the chain of custody form. Receipt temperature was measured in the samples and recorded on the chain-of-custody form and in a bound logbook. A subset of the containers were delivered by commercial courier to the Nautilus Environmental laboratory in Tacoma, WA, where the chronic toxicity tests with rainbow trout were conducted. These tests could not be conducted in the Burnaby laboratory at this time because of a lack of availability of organisms of the appropriate age. The sample was stored at 4°C in the dark until used for testing.

2.2 Acute toxicity tests using rainbow trout and *Daphnia magna*

Acute toxicity tests using rainbow trout and *Daphnia magna* were conducted following Environment Canada (2000a and b) procedures, as summarized in Table 1.

Table 1. Summary of test conditions: acute tests using rainbow trout and *Daphnia magna*.

Test species	Rainbow trout	*Daphnia magna*
Test type	96 hr static	48 hr static
Endpoints	Survival	Survival
Organism source	Fraser Valley Trout Hatchery	In-house culture
Organism age	Fry – 0.3 – 0.6 g	< 24 hr old
Feeding	None	None
Test chamber	15-L glass aquaria	300 mL glass
Test volume	10 L	200 mL
Test temperature	15 ± 1°C	20 ± 2°C
Control water	Dechlorinated municipal tapwater	Moderately hard synthetic water,
Organisms/replicate	10	10
Number of replicates	1	1
Photoperiod	16 hours light/8 hours dark	16 hours light/8 hours dark
Aeration	Continuous	None
Acceptability criterion for controls	≥90% survival	≥90% survival

2.3 Chronic toxicity tests using *Ceriodaphnia dubia*

The sample was tested for chronic toxicity using *C. dubia* according to procedures summarized in Table 2, which are based on procedures from Environment Canada (2007).

Table 2. Summary of test conditions: 7-d *Ceriodaphnia dubia* test.

Test type	Static renewal (daily)
Endpoints	Survival and reproduction
Organism source	In-house culture
Organism age	<24 hr old neonates produced within 12 hr
Feeding	*Selenastrum capricornutum* and dYCT
Test chamber	Glass test tube
Test volume	15 mL
Test temperature	25 ± 1°C
Control water	Moderately hard synthetic water, diluted to the hardness of the sample
Number of organisms/replicate	1
Number of replicates	10
Photoperiod	16 hours light/8 hours dark
Aeration	None
Test acceptability criterion for controls	≥80% survival; ≥15 young per surviving control

2.4 Chronic toxicity tests using rainbow trout

2.4.1 Embryo development

Rainbow trout embryo toxicity tests were conducted using rainbow trout gametes according to procedures presented by Environment Canada (1998) with modifications from Canaria et al. (1999), as summarized in Table 3. This test involved a seven-day exposure of recently fertilized eggs to the test solutions. Embryonic development was the endpoint evaluated for this test. One test was performed with daily renewal and a second test was performed concurrently without renewals. The purpose of the test conducted without renewals was to provide a "worst-case" for settling of suspended particulate during the exposure period, since renewing the solutions would tend to rinse suspended solids from the eggs on the bottom of the container. As discussed with the Azimuth Consultants project manager, the tests were conducted in 500 mL volumes, which is smaller than the minimum volume of approximately 2-L specified in the Environment Canada test method. This modification was considered appropriate since the purpose of the investigation was to evaluate effects associated with suspended particulate, rather than toxicants in the sample.

2.4.2 Larval survival and growth

A toxicity test evaluating survival and growth was also conducted using larval rainbow trout. This test is based on a Draft USEPA procedure, and was conducted in order to test whether feeding might be impaired by the presence of TSS. Test methods for this test are summarized in Table 4.

Table 3. Summary of test conditions: rainbow trout embryo development test.

Test type	Static renewal (daily), or static
Test endpoints	Normal embryonic development
Test organism source	Trout Lodge; Sumner, WA
Test organism age	Within 30 minutes of fertilization
Test duration	7 days
Feeding	None
Test chamber	1-L plastic beaker
Test solution volume	500 mL
Test temperature	14 ± 1°C
Dilution water	Moderately hard synthetic water
Test concentrations (% sample)	100, 50, 25, 12.5, 6.25, laboratory control
Number of organisms/chamber	30
Number of replicates	4
Photoperiod	24-hr dark; low intensity light used during solution renewals
Aeration	Continuous gentle aeration
Test protocol	Environment Canada (1998); modifications from Canaria et al. (1999)
Test acceptability criterion for controls	≥ 70% normally developed (viable) embryos

Table 4. Summary of test conditions: rainbow trout larval survival and growth test.

Test type	Static renewal (daily)
Test endpoints	Survival and growth
Test organism source	Trout Lodge, Sumner, WA
Test organism age	15 days post hatch, 2 days post swim up
Test duration	7 days
Feeding	*Artemia nauplii* twice daily
Test chamber	1-L plastic beaker
Test solution volume	500 mL
Test temperature	15 ± 1°C
Dilution water	Moderately hard synthetic water
Test concentrations (% sample)	100, 50, 25, 12.5, 6.25, laboratory control
Number of organisms/chamber	5
Number of replicates	4
Photoperiod	16 hours light/8 hours dark
Aeration	None
Test protocol	USEPA draft SOP
Test acceptability criterion for controls	≥ 90% survival

3.0 RESULTS

No adverse effects were observed in acute toxicity tests with either rainbow trout or *Daphnia magna* (Table 5). Similarly, no adverse effects were observed in the chronic toxicity test using *Ceriodaphnia dubia* (Table 6).

Results of rainbow trout embryo development tests conducted under static renewal and static conditions are provided in Table 7. No adverse effects were observed in either of these exposures. Results of the larval survival and growth test conducted using rainbow trout are provided in Table 8. No adverse effects were observed in this test, indicating that the amount of TSS present in the sample did not affect the ability of the fry to locate and capture prey.

Table 5. Results of acute toxicity tests, presented as percent survival.

Percent sample	Rainbow trout	*Daphnia magna*
Control	100	100
6.25	100	100
12.5	100	100
25	100	100
50	100	100
100	100	100
LC50	>100%	>100%

Table 6. Results of chronic toxicity tests using *Ceriodaphnia dubia*.

Percent sample	Survival (%)	Reproduction (mean ± SD)
Control	100	16.6 ± 3.2
5	100	13.8 ± 5.5
10	100	14.4 ± 3.2
20	100	14.3 ± 2.2
40	100	13.9 ± 3.8
60	100	13.2 ± 4.1
80	100	13.7 ± 3.3
100	100	12.3 ± 3.0
LC50	>100%	--
IC25	--	>100%

Table 7. Results of rainbow trout embryo development tests presented as percent normally developed embryos.

Percent sample	Static renewal (daily) (mean ± SD)	Static (mean ± SD)
Control	86.7 ± 9.0	90.8 ± 7.9
6.25	92.5 ± 5.7	96.7 ± 4.7
12.5	98.3 ± 1.9	95.0 ± 3.3
25	83.3 ± 22.6	94.2 ± 9.6
50	94.2 ± 3.2	95.8 ± 4.2
100	90.0 ± 11.9	89.2 ± 14.2
EC25	>100%	>100%

Table 8. Results of rainbow trout larval survival and growth tests.

Percent sample	Survival (%)	Dry weight (mg)
Control	100.0 ± 0.0	27.3 ± 2.5
6.25	100.0 ± 0.0	26.6 ± 1.1
12.5	100.0 ± 0.0	29.1 ± 0.6
25	100.0 ± 0.0	28.2 ± 1.7
50	100.0 ± 0.0	30.9 ± 1.0
100	90.0 ± 20.0	26.3 ± 4.1
EC25	>100%	>100

Shading indicates significant difference relative to the control.

4.0 QA/QC

The toxicity tests were conducted outside of the holding times of three days for chronic tests and five days for acute tests, as specified in the test methods. Acute toxicity tests and sublethal tests using *Ceriodaphnia* were initiated 11 days following collection. Chronic toxicity tests using rainbow trout embryos and swim-up fry were initiated 11 and 12 days following collection, respectively. These exceedences were caused by the extended transportation time; the tests were conducted, regardless, as discussed with the Azimuth Consultants Project Manager, since the purpose of the tests was to evaluate the effect of suspended particulate, rather than toxicants. This deviation is not expected to have affected the outcome of the tests, because TSS would not be expected to degrade, volatilize or otherwise dissipate in the sample. The samples were thoroughly mixed prior to preparation of the test solutions to re-suspend any suspended particulate that might have settled during transport.

The rainbow trout embryo tests conducted in this program deviated from methods specified in Environment Canada (1998) in terms of sample volume. Volume was reduced to 500 mL because of the significant volume required for this test and the long distance required for transportation. In addition, use of this smaller volume has been shown to be an effective and sensitive alternative (Canaria et al. 1999).

The tests each met control acceptability criteria and water quality parameters remained within the acceptable ranges throughout the tests with the exception of a minor temperature exceedence in the rainbow trout embryo test on the final day of exposure. This minor exceedence is not expected to have had any effect on the outcome of the test.

Reference toxicant tests conducted in conjunction with this testing program fell within the acceptable range in all cases, indicating that the health and sensitivity of the test organisms was appropriate. Results for these tests are provided in Table 9.

Table 9. Results of reference toxicant tests.

Test	Date initiated	Result	Acceptable Range	CV (%)
Rainbow trout acute	Sept 22/09	4.6 mg/L SDS	4.0 – 6.2	11.0
Daphnia magna acute	Oct 8/09	3.9 mg/L NaCl	3.4 – 4.8	9.0
Ceriodaphnia dubia survival and reproduction	Oct 14/09	1.2 mg/L NaCl	0.9 – 1.5	14.0
Trout embryo survival & development	Sept 30/09	1.1 mg/L SDS	0.4 – 2.2	33.4
Larval trout survival & growth	Oct 1/09	44.7 µg/L Cu	35.4 - 83.4	20.2

5.0 REFERENCES

Canaria, E.C., Elphick, J.R. and Bailey, H.C. 1999. A simplified procedure for conducting small scale short-term embryo toxicity tests with salmonids. Environ. Toxicol. 14:301-307.

Environment Canada. 2007. Biological test method: test of reproduction and survival using the cladoceran *Ceriodaphnia dubia*. Environmental Protection Series. Report EPS 1/RM/21, Second Edition. Environment Canada, Science and Technology Branch, Ottawa, ON.

Environment Canada. 2000a. Biological test method: reference method for determining acute lethality of effluents to rainbow trout. Report EPS 1/RM/13, Second Edition. Environment Canada, Science and Technology Branch, Ottawa, ON.

Environment Canada. 2000b. Biological test method: reference method for determining acute lethality of effluents to *Daphnia magna*. Report EPS 1/RM/14, Second Edition. Environment Canada, Science and Technology Branch, Ottawa, ON.

Environment Canada. 1998. Biological Test Method: Toxicity Tests Using Early Life Stages of Salmonid Fish (Rainbow Trout). Second Edition. EPS/1/RM/28, July 1998.

APPENDIX A – Acute Toxicity Test Results

Rainbow Trout Summary Sheet

Client: Azimuth

Start Date/Time: Sep 30/09 @ 0945

Work Order No.: 09350

Test Species: *Oncorhynchus mykiss*

Sample Information:

Sample ID: EAS-BGE-1

Sample Date: Sept 19/09

Date Received: Sept 29/09

Sample Volume: 6 x 20L

Other: —

Dilution Water:

Type: Dechlorinated Municipal Tap Water

Hardness (mg/L $CaCO_3$): 12

Alkalinity (mg/L $CaCO_3$): 10

Test Organism Information:

Batch No.: 081409

Source: Sun Valley

Test Volume/No. Fish: 10 / 10L

Loading Density: 0.42

Mean Length ± SD (mm): 35 ± 3 mm — Range: 30 – 40

Mean Weight ± SD (g): 0.42 ± 0.13 g — Range: 0.29 – 0.65

SDS Reference Toxicant Results:

Reference Toxicant ID: RT 50

Stock Solution ID: 09503

Date Initiated: Sept 22/09

96-h LC50 (95% CL): 4.6 (3.8 – 5.5)

Reference Toxicant Mean ± 2 SD: 5.1 ± 1.1

Reference Toxicant CV (%): 11.0

Test Results: The 96-h LC50 > 100 % (v/v)

Reviewed by: [signature]

Date reviewed: 2 Dec 2009

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: Azimuth
Sample I.D.: EAS-BGE-1
W.O. #: ~~09349~~ 09350
RBT Batch #: 081409
Date Collected/Time: Sept 19/09 AM
Date Setup/Time: Sept 30/09 @ 0945
Sample Setup By: JLG

D.O. meter: DO-1
pH meter: pH-1
Cond. Meter: C-1

Number Fish/Volume: 10/10L
7-d % Mortality: 0 %
Total Pre-aeration Time (mins): 30 min
Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	15.8		15.8
pH	7.5		7.5
D.O. (mg/L)	10.0		10.0
Cond. (µS/cm)	17		17

Concentration %(v/v)	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
control				10	10	10	10	15.0	15.5	15.5	15.0	15.0	10.1	10.0	10.1	9.9	9.9	7.1	6.6	7.1	7.2	7.1	64	71
6.25				10	10	10	10	15.1	15.5	15.5	15.0	15.0	10.1	9.9	10.0	10.0	9.9	7.1	6.7	7.3	7.4	7.2	61	68
12.5				10	10	10	10	15.2	15.5	15.5	15.0	15.0	10.0	9.9	9.9	10.0	9.9	7.2	6.8	7.3	7.5	7.2	59	63
25				10	10	10	10	15.4	15.5	15.5	15.0	15.0	10.0	9.9	9.9	9.9	9.8	7.3	6.8	7.4	7.4	7.3	53	58
50				10	10	10	10	15.6	15.5	15.5	15.0	15.0	10.0	10.0	9.9	9.8	9.9	7.5	6.7	7.5	7.5	7.4	38	43
100				10	10	10	10	15.8	15.5	15.5	15.0	15.0	10.0	9.8	10.0	9.9	9.8	7.5	6.8	7.5	7.5	7.4	17	25
Initials				JLG	JLG	~	~	JLG	JLG	JLG	~	~	JLG	JLG	JLG	~	~	JLG	JLG	JLG	~	~	JLG	~

Sample Description/Comments: Pale grey, cloudy

Fish Description at 96? all fish ok

Other Observations:

Reviewed by: [signature] **Date Reviewed:** 2 Dec 2009

Daphnia magna Summary Sheet

Client: Azimuth
Work Order No.: 09 351

Start Date/Time: ~~Oct~~ Sept 30/09 @ 1330h
Test Species: D. magna
Set up by: DT

Sample Information:

Sample ID: EAB - BGE - 1
Sample Date: Sept 19/09
Date Received: Sept 29 ~~Oct~~ /09
Sample Volume: 6x20L

Test Organism Information:

Broodstock No.: 09 ~~2509~~ 09 A
Age of young (Day 0): <24-h
Avg No. young per brood in previous 7 d: ~~16~~ 33
Mortality (%) in previous 7 d: 0
Days to first brood: ~~8~~ 11

NaCl Reference Toxicant Results:

Reference Toxicant ID: DM 51
Stock Solution ID: 08 Na 04
Date Initiated: Oct 8/09
48-h LC50 (95% CL): 3.9 (3.2 - 4.9)

Reference Toxicant Mean ± 2 SD: 4.1 ± 0.7
Reference Toxicant CV (%): 9.0

Test Results: The 48-h LC50 > 100 % (v/v)

Reviewed by: [signature]

Date reviewed: 2 Dec 2009

Freshwater Acute
48 Hour Toxicity Test Data Sheet

Client: Arimetco
Sample ID: EAS-BGE-1
Work Order No.: 09351

Start Date/Time: Sept 30/09 @ 1330
No. Organisms/volume: 10/200mL
Test Organism: D.magna
Set up by: JJT

DO meter: DO-1 pH meter: pH-1 Conductivity meter: C-1

Concentration % (v/v)	Rep	Number of Live Organisms 24	Number of Live Organisms 48	No. Immobilized 48	Temperature (°C) 0	Temperature (°C) 24	Temperature (°C) 48	Dissolved oxygen (mg/L) 0	Dissolved oxygen (mg/L) 24	Dissolved oxygen (mg/L) 48	pH 0	pH 24	pH 48	Conductivity (μS/cm) 0	Conductivity (μS/cm) 48
Control	A	10	10	0	21.0	19.5	20.0	9.0		9.2	8.0		7.7	362	370
	B														
	C														
	D														
6.25	A	10	10	0	20.5	19.5	20.0	9.0		9.2	8.0		7.7	347	358
	B														
	C														
	D														
12.5	A	10	10	0	20.5	19.5	20.0	9.0		9.2	8.0		7.7	332	344
	B														
	C														
	D														
25	A	10	10	0	20.5	19.5	20.0	9.1		9.2	8.0		7.7	302	313
	B														
	C														
	D														
50	A	10	10	0	20.5	19.5	20.0	9.1		9.2	8.0		7.7	243	252
	B														
	C														
	D														
100	A	10	10	0	20.0	19.5	20.0	9.1		9.2	7.9		7.7	110	121
	B														
	C														
	D														
Technician Initials		JJT	JJT	JJT	JJT	JJT	JJT	JJT		JJT	JJT		JJT	JJT	JJT

Conc.	Hardness*		Alkalinity*	
	*(mg/L as CaCo3)			
Control (MHW)	100		~~55~~ 70	
Highest conc.	20	30[①]	4	140[①]

① After adjustment

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	20.5	hardness	20.0
DO (mg/L)	9.3	adjusted to	9.1
pH	6.0	25-30mg/L	7.9
Cond (μS/cm)	18	CaCO3	110

Sample Description: light yellow - slightly opaque

Comments: Batch#: 090909A 7-d previous # young/brood: 33 Day of 1st Brood: 11 Previous 7-d % Mortality: 0

Reviewed by: [signature] Date reviewed: 2 Dec 2009

Client: Azimuth

W.O.#: 09349

Hardness and Alkalinity Datasheet

		Alkalinity				Hardness			
Sample ID	Sample Date	Sample Volume (mL)	(mL) 0.02N HCL/H_2SO_4 used to pH 4.5	(mL) of 0.02N HCL/H_2SO_4 used to pH 4.2	Total Alkalinity (mg/L$CaCO_3$)	Sample Volume (mL)	Volume of 0.01M EDTA Used (mL)	Total Hardness (mg/L $CaCO_3$)	Technician
EAS-BGE-1	Sept30/09	50	0.3	0.4	4	50	1.0	20	AWD/SST

Notes:

Reviewed by:

Date Reviewed:

APPENDIX B – *Ceriodaphnia dubia* test results

Ceriodaphnia dubia Summary Sheet

Client:	Azimuth	Start Date/Time:	Sept 30/09 @1600h
Work Order No.:	09 349	Set up by:	JJT

Sample Information:

Sample ID:	EAS- BGE-1
Sample Date:	Sept 19/09
Date Received:	Sept 29/09
Sample Volume:	6×20L

Test Organism Information:

Broodstock No.:	092209
Age of young (Day 0):	<24-h (w/in 12-h)
Avg No. young in first 3 broods of previous 7 d:	21
Mortality (%) in previous 7 d:	2.5
Individual female # used ≥8 young on test day	22,23,33,35,31,39,40

NaCl Reference Toxicant Results:

Reference Toxicant ID:	Cd 47
Stock Solution ID:	08Na04
Date Initiated:	Oct 14/09
7-d LC50 (95% CL):	1.6 (1.3 - 2.0)
7-d IC50 (95% CL):	1.2 (1.1 - 1.4)

7-d LC50 Reference Toxicant Mean ± 2 SD:	1.7 ± 0.7	CV (%):	20
7-d IC50 Reference Toxicant Mean ± 2 SD:	1.2 ± 0.3	CV (%):	14

Test Results:

	Survival	Reproduction
LC50 %(v/v) (95% CL)	>100	
IC25 %(v/v) (95% CL)		>100
IC50 %(v/v) (95% CL)		>100

Reviewed by: [signature]

Date reviewed: 2 Dec 2009

Chronic Freshwater Toxicity Test
Initial and Final Water Quality Measurements

Client: Azimuth
Sample ID: EAS-BGE-1
Work Order #: 09349.

Start Date & Time: Sept 30/09 @ 1600h
Stop Date: ~~Sept~~ Oct 6/09 @ 1630h
Test Species: *Ceriodaphnia dubia*

Control Concentration (% V/V)	Days 0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	24.5	26.0	24.5	26.0	24.5	25.0	24.0	25.0	24.0	26.0	24.0	26.0		
DO (mg/L)	8.3	8.3	8.3	8.1	8.3	7.2	8.3	6.9	8.4	7.6	8.45	7.4		
pH	8.1	7.9	8.0	7.8	8.0	7.6	8.1	7.6	7.9	8.0	8.1	7.7		
Cond. (µS/cm)	206	207		216		212		208		201		208		
Initials	JJT	JJT		JJT		~		~		JJT		JJT		

5 Concentration	Days 0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	24.5	26.0	25.0	26.0	24.5	25.0	24.0	25.0	24.0	25.5	24.5	26.0		
DO (mg/L)	8.2	8.1	8.2	7.9	8.2	7.0	8.3	7.0	8.4	7.6	8.4	7.2		
pH	8.1	7.9	8.1	7.9	8.0	7.7	8.1	7.7	7.9	7.9	8.0	7.8		
Cond. (µS/cm)	196	197		208		209		195		193		205		
Initials	JJT	JJT		JJT		~		~		JJT		JJT		

40 Concentration	Days 0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	24.5	26.0	25.0	26.0	25.0	25.0	24.5	25.0	24.5	26.0	24.5	26.0		
DO (mg/L)	8.3	8.0	8.3	7.8	8.2	7.1	8.3	6.9	8.3	7.5	8.4	7.2		
pH	8.0	7.8	8.2	7.8	8.0	7.9	8.2	7.8	8.0	7.9	8.0	7.8		
Cond. (µS/cm)	136	136		142		136		135		131		136		
Initials	JJT	JJT		JJT		~		~		JJT		JJT		

100 Concentration	Days 0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	25.0	26.0	25.5	26.0	25.5	25.0	25.0	25.0	25.0	26.0	25.0	26.0		
DO (mg/L)	8.4	8.1	8.3	7.8	8.2	7.2	8.3	7.0	8.3	7.5	8.2	7.4		
pH	8.73	7.4	8.4	7.5	8.0	8.2	8.4	8.1	8.3	7.7	7.6	7.5		
Cond. (µS/cm)	22	18		19		18		19		20		26		
Initials	JJT	JJT		JJT		AS		~		JJT		JJT		

	Control	100		
Hardness*	100	20		
Alkalinity*	77	4		

* mg/L as CaCO3

Analysts: JJT, AS

Reviewed by: [illegible]

Date reviewed: 2/Dec/09

Sample Description: (1) light yellow - slightly opaque

Comments: Broodboard Used: 092209

Chronic Freshwater Toxicity Test
C. dubia Reproduction Data

Client: Azimuth
Sample ID: EAS-BGE-1
Work Order: 09349

Start Date & Time: JJT Sept 30/09 @ 1600
Stop Date & Time: ~~Sept~~ /09 @ 1630
Set up by: JJT

(% v/v)

Days	Concentration: Control										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	3	3	3	4	3	4	3	3	4	3	^
5	8	7	9	7	8	7	6	7	7	7	JJT
6	5	4	10	✓	9	3	7	6	8	8	JJT
7											
8											
Total	16	14	22	11	20	14	16	16	19	18	JJT

Days	Concentration: 5										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	^
4	✓	✓	3	3	5	2	3	4	4	3	^
5	8	~~3~~	10	8	8	7	9	7	✓	7	JJT
6	3	✓	5	4	7	4	6	3	10	5	JJT
7											
8											
Total	11	0	18	15	20	13	18	14	14	15	JJT

Days	Concentration: 10										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	^
4	✓	3	2	3	4	3	4	3	3	3	^
5	8	6	8	7	8	7	7	7	6	9	^
6	2	2	2	6	9	5	4	4	5	6	JJT
7											
8											
Total	10	12	12	13	21	15	15	14	14	18	JJT

Days	Concentration: 20										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	^
4	3	✓	4	3	3	4	3	4	4	2	^
5	6	7	6	9	7	7	8	7	8	10	JJT
6	2	4	3	5	6	2	3	5	4	4	JJT
7											
8											
Total	11	11	13	17	16	13	14	16	16	16	JJT

Days	Concentration: 40										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	^
4	3	3	3	4	✓	3	3	3	4	3	^
5	7	✓	7	11	4	8	7	7	8	10	JJT
6	6	3	2	✓	8	4	2	4	5	7	JJT
7											
8											
Total	16	6	12	15	12	15	12	14	17	20	JJT

Days	Concentration: 60										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	^
4	✓	3	3	3	3	1	2	2	3	3	^
5	8	8	10	8	8	9	4	7	4	9	JJT
6	✓	✓	6	5	2	[illegible]	3	2	7	8	JJT
7											
8											
Total	8	11	19	16	13	11	9	11	14	20	JJT

Days	Concentration: 80										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	✓	3	✓	3	2	✓	3	3	2	3	^
5	7	9	6	9	9	6	8	7	8	5	JJT
6	5	2	7	8	6	2	5	3	3	3	JJT
7											
8											
Total	12	14	13	20	17	8	16	13	13	11	JJT

Days	Concentration: 100										
	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	JJT
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	^
4	✓	✓	✓	3	✓	✓	✓	✓	✓	✓	^
5	✓	5	6	✓	✓	8	6	4	5	7	JJT
6	8	8	7	7	9	8	9	5	10	8	JJT
7											
8											
Total	8	13	13	10	9	16	15	9	15	15	JJT

Days	Concentration:										
	A	B	C	D	E	F	G	H	I	J	Init
1											
2											
3											
4											
5											
6											
7											
8											
Total											

Notes: X = mortality.

Sample Description: (1)

Comments: Total # Young only based on the first 3 Broods. Fourth and subsequent broods not included in total count.

Reviewed by: [signature]

Date reviewed: 2 Dec 2009

Version 2.1 Issued July 29, 2009

Nautilus Environmental

CETIS Analytical Report

Report Date: 16 Oct-09 17:03 (p 1 of 2)
Test Code: 19-0309-8699/09349cerio

Ceriodaphnia 7-d Survival and Reproduction Test — Nautilus Environmental

Analysis ID:	05-7955-4971	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.7.0
Analyzed:	16 Oct-09 17:00	**Analysis:**	Nonlinear Regression	**Official Results:**	Yes

Batch ID:	12-2077-8986	**Test Type:**	Reproduction-Survival (7d)	**Analyst:**	
Start Date:	30 Sep-09 16:00	**Protocol:**	EC/EPS 1/RM/21	**Diluent:**	
Ending Date:	06 Oct-09 16:30	**Species:**	Ceriodaphnia dubia	**Brine:**	
Duration:	6d 1h	**Source:**		**Age:**	

Sample ID:	07-7050-2434	**Code:**	2DECEF22	**Client:**	Azimuth
Sample Date:	19 Sep-09	**Material:**	Mining Discharge/Runoff	**Project:**	
Receive Date:	29 Sep-09	**Source:**	Azimuth		
Sample Age:	11d 16h	**Station:**	EAS-BGE-1		

Non-Linear Regression Options

Model Function	X Transform	Y Transform	Weighting Function	PTBS Function
3P Log-Gompertz EV [Y=A*exp(log(0.5)(X/D)^C)]	None	None	Normal [W=1]	Off [Y*=Y]

Regression Summary

Iters	Log LL	AICc	Adj R2	Optimize	F Stat	Critical	P-Value	Decision(1%)
10	-140.1	286.6	0.0610	Yes	0.2436	3.283	0.9417	Non-Significant Lack of Fit

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC10	1.179	N/A	120	84.85	0.8335	N/A
IC15	12.49	0.3304	125.9	8.008	0.7942	302.7
IC20	70.19	6.187	423.9	1.425	0.2359	16.16
IC25	280	0.6351	7649	0.3571	0.01307	157.4
IC40	6386	N/A	88660000	0.01566	0.0000011	N/A
IC50	33660	N/A	N/A	0.002971	N/A	N/A

The 6-d IC25 + IC50 > 100 %(v/v)

Regression Parameters

Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(5%)
A	16.57	1.126	14.33	18.81	14.71	<0.0001	Significant Parameter
C	0.1836	0.1845	-0.1837	0.5509	0.9954	0.3227	Non-Significant Parameter
D	33660	215200	-394800	462100	0.1564	0.8761	Non-Significant Parameter

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(1%)
Model	90.49018	45.24509	2	3.564	0.0331	Non-Significant
Lack of Fit	16.25982	3.251964	5	0.2436	0.9417	Non-Significant
Pure Error	961.2	13.35	72			
Residual	977.4598	12.69428	77			

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(1%)
Variances	Mod Levene Equality of Variance	0.4052	2.898	0.8961	Equal Variances
Distribution	Shapiro-Wilk Normality	0.9574		0.0094	Non-normal Distribution

Reproduction Summary

			Calculated Variate						
Conc-%	**Control Type**	**Count**	**Mean**	**Min**	**Max**	**Std Err**	**Std Dev**	**CV%**	**Diff%**
0	Negative Control	10	16.6	11	22	0.5913	3.239	19.51%	0.0%
5		10	13.8	0	20	1.01	5.534	40.1%	16.87%
10		10	14.4	10	21	0.5786	3.169	22.01%	13.25%
20		10	14.3	11	17	0.4041	2.214	15.48%	13.86%
40		10	13.9	6	20	0.6856	3.755	27.01%	16.27%
60		10	13.2	8	20	0.7394	4.05	30.68%	20.48%
80		10	13.7	8	20	0.6089	3.335	24.34%	17.47%
100		10	12.3	8	16	0.5514	3.02	24.56%	25.9%

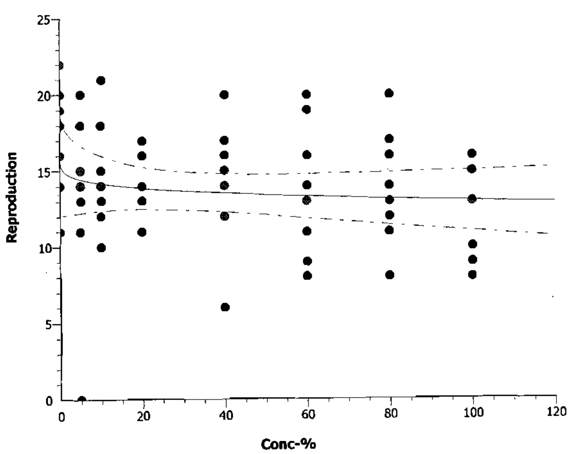
Ceriodaphnia 7-d Survival and Reproduction Test | **Nautilus Environmental**

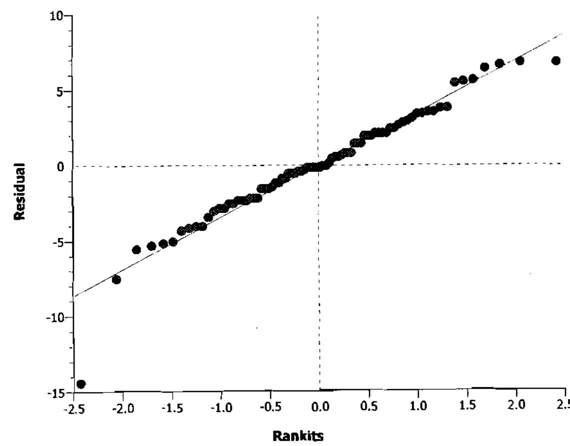
Analysis ID:	05-7955-4971	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.7.0
Analyzed:	16 Oct-09 17:00	**Analysis:**	Nonlinear Regression	**Official Results:**	Yes

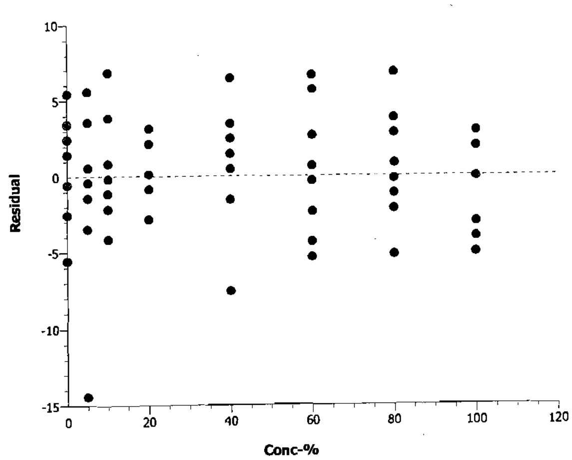
Reproduction Detail

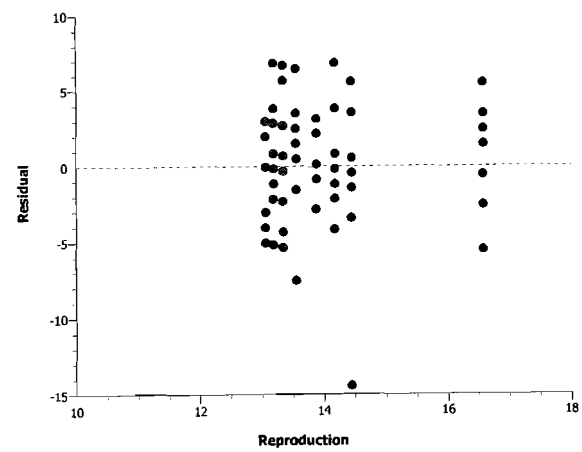
Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	16	14	22	11	20	14	16	16	19	18
5		11	0	18	15	20	13	18	14	14	15
10		10	12	12	13	21	15	15	14	14	18
20		11	11	13	17	16	13	14	16	16	16
40		16	6	12	15	12	15	12	14	17	20
60		8	11	19	16	13	11	9	11	14	20
80		12	14	13	20	17	8	16	13	13	11
100		8	13	13	10	9	16	15	9	15	15

Graphics









APPENDIX C – Rainbow trout embryo development test results

Nautilus Environmental
Washington Laboratory

Client: Azimuth
Sample ID. EAS-BGE
Test No: 0909-T207
Log-In#: 09-289 —

Initial and Final Chemistries
Seven Day Chronic Freshwater Bioassay

Start Date & Time: 9/30/09 1530
Stop Date & Time: 10/7/09 1500
Test Species: Oncorhynchus mykiss embryo
—

Conc. or % CON	Day 0 init.	Day 0 final	Day 1 init.	Day 1 final	Day 2 init.	Day 2 final	Day 3 init.	Day 3 final	Day 4 init.	Day 4 final	Day 5 init.	Day 5 final	* Day 6 init.	Day 6 final
pH	7.56	7.66	7.24	7.60	8.08	7.51	7.55	7.48	7.51	7.25	7.58	7.81	7.95	7.88
DO (mg/l)	9.1	9.5	9.6	9.8	9.8	9.9	10.1	9.8	10.1	9.7	9.8	9.5	9.9	9.6
Cond. (µmhos-cm)	225	235	224	228	229	224	223	223	223	238	226	225	234	226
Temperature (°C)	14.5	14.6	14.5	14.8	14.6	14.9	14.6	14.7	14.7	14.8	14.9	14.9	15.1	15.0

6.25	Day 0 init.	Day 0 final	Day 1 init.	Day 1 final	Day 2 init.	Day 2 final	Day 3 init.	Day 3 final	Day 4 init.	Day 4 final	Day 5 init.	Day 5 final	Day 6 init.	Day 6 final
pH	7.51	7.65	7.20	7.58	8.08	7.50	7.47	7.47	7.45	7.46	7.58	7.80	7.94	7.79
DO (mg/l)	9.3	9.8	9.4	9.9	10.0	9.9	10.1	9.9	10.2	9.4	9.7	9.5	9.8	9.8
Cond. (µmhos-cm)	211	225	211	214	217	211	212	211	211	213	221	213	221	213
Temperature (°C)	14.5	14.7	14.4	14.8	14.6	14.4	14.5	14.6	14.4	14.9	14.9	14.9	15.1	14.4

12.5	Day 0 init.	Day 0 final	Day 1 init.	Day 1 final	Day 2 init.	Day 2 final	Day 3 init.	Day 3 final	Day 4 init.	Day 4 final	Day 5 init.	Day 5 final	Day 6 init.	Day 6 final
pH	7.49	7.65	7.17	7.56	8.04	7.53	7.51	7.42	7.43	7.37	7.55	7.76	7.90	7.74
DO (mg/l)	9.3	9.8	9.7	9.9	10.0	9.8	9.9	9.8	10.1	9.3	9.9	9.5	9.8	9.8
Cond. (µmhos-cm)	199	212	200	202	204	198	199	197	203	203	204	201	209	200
Temperature (°C)	14.5	14.6	14.4	14.8	14.6	14.5	14.7	14.4	14.5	14.9	14.9	15.0	15.3	14.4

25	Day 0 init.	Day 0 final	Day 1 init.	Day 1 final	Day 2 init.	Day 2 final	Day 3 init.	Day 3 final	Day 4 init.	Day 4 final	Day 5 init.	Day 5 final	Day 6 init.	Day 6 final
pH	7.46	7.64	7.11	7.42	7.97	7.47	7.46	7.41	7.43	7.39	7.51	7.70	7.84	7.73
DO (mg/l)	9.3	9.6	9.6	9.8	10.0	9.9	10.0	9.9	10.2	9.5	9.7	9.2	9.9	9.8
Cond. (µmhos-cm)	173	187	176	179	179	173	176	174	177	176	179	177	185	176
Temperature (°C)	14.4	14.7	14.4	14.8	14.6	14.5	14.8	14.4	14.6	14.8	15.0	15.0	15.4	14.4

50	Day 0 init.	Day 0 final	Day 1 init.	Day 1 final	Day 2 init.	Day 2 final	Day 3 init.	Day 3 final	Day 4 init.	Day 4 final	Day 5 init.	Day 5 final	Day 6 init.	Day 6 final
pH	7.26	7.647	7.08	7.33	7.86	7.27	7.36	7.36	7.34	7.19	7.39	7.56	7.69	7.72
DO (mg/l)	9.3	9.7	9.7	9.6	10.3	9.9	10.0	9.9	10.2	9.4	9.9	9.4	9.9	9.8
Cond. (µmhos-cm)	121	133	123	126	126	123	126	124	126	125	126	126	136	138
Temperature (°C)	14.3	14.6	14.4	14.8	14.5	14.5	14.8	14.3	14.8	14.9	15.0	14.9	15.2	14.5

100	Day 0 init.	Day 0 final	Day 1 init.	Day 1 final	Day 2 init.	Day 2 final	Day 3 init.	Day 3 final	Day 4 init.	Day 4 final	Day 5 init.	Day 5 final	Day 6 init.	Day 6 final
pH	6.51	6.91	6.40	6.59	7.23	6.48	6.51	6.47	6.54	6.33	6.55	6.77	6.98	7.55
DO (mg/l)	9.3	9.9	10.3	10.1	10.5	9.9	10.3	10.0	10.4	9.4	10.4	9.5	10.4	10.0
Cond. (µmhos-cm)	14	25	15	18	16	15	15	15	15	16	17	18	22	16
Temperature (°C)	14.2	14.7	14.3	14.9	14.3	14.7	14.9	14.5	14.8	14.9	14.9	15.20	15.5	14.6
Tech. Initials	BP	NF	NF	BP	BP	ST	ST	ST	ST	M	BP	BP	BP	M

Dilution Water Batch #: MHSW063
Test Chamber: Room B

QA Check: CC

Sample Description: *Initial chemistries sat out too long and got warm
Animal Source: Troutlodge
Date Received: 9/30/09
Date of Hatch: —
Comments:

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Rainbow Trout
(*Oncorhynchus mykiss*)
Trout Embryo Test

Client Name: Azimuth

Test No.: 0909-T207

Sample ID: EAS-BGE

Conc.	Cont.	Rep.	# Embryos/Container Days 0	1	2	3	4	5	6	7	# Normal	# Abnormal	Mean % Viable
CON	201	1	30	30	30	~~30~~ 30	30	30	30	30	27	3	
	202	2	30	30	30	30	30	30	30	30	22	8	
	203	3	30	30	30	30	30	30	30	30	28	2	
	204	4	30	30	30	30	30	30	30	30	27	3	
6.25	205	1	30	30	30	30	30	30	30	30	28	2	
	206	2	30	30	30	30	30	30	29	29	26	3	
	207	3	30	30	30	30	30	30	30	30	30	0	
	208	4	30	30	30	30	30	30	30	30	27	3	
12.5	209	1	30	30	30	30	30	30	30	30	30	0	
	210	2	30	30	30	30	30	30	30	30	29	1	
	211	3	30	30	30	30	30	30	30	30	30	0	
	212	4	30	30	30	30	30	30	30	30	29	1	
25	213	1	30	29	29	29	29	28	28	28	28	0	
	214	2	30	30	30	30	30	30	30	30	15	15	
	215	3	30	30	30	30	30	30	30	30	30	0	
	216	4	30	30	30	30	30	30	30	30	27	3	
50	217	1	30	30	30	30	30	M ~~30~~ 29	M ~~28~~ 29	29	29	0	
	218	2	30	29	29	29	29	M ~~30~~ 29	29	29	27	2	
	219	3	30	30	30	30	30	30	30	30	29	1	
	220	4	30	30	30	30	30	30	30	30	28	2	
100	221	1	30	30	30	30	30	30	30	30	30	0	
	222	2	30	30	30	30	30	30	30	30	23	7	
	223	3	30	30	30	30	30	30	30	30	30	0	
	224	4	30	30	30	30	30	30	30	30	25	5	
		1											
		2											
		3											
		4											
		1											
		2											
		3											
		4											
Tech Initials			BP	MF	BP	[illegible]	[illegible]	M	BP	M	KS	KS	

QA Check: [illegible]

Comments:

CETIS Summary Report

Report Date:	12 Oct-09 15:26 (p 1 of 1)
Link/Link Code:	00-5028-4456/0909-T207

Salmonid Embryo Survival and Development Test — **Nautilus Environmental WA**

Test Run No:	16-2200-3594	**Test Type:**	Survival-Development	**Analyst:**	Meghan Feuk
Start Date:	30 Sep-09 15:30	**Protocol:**	EC/EPS 1/RM/28	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	07 Oct-09 15:00	**Species:**	Oncorhynchus mykiss	**Brine:**	
Duration:	6d 23h	**Source:**	Trout Lodge Fish Farm	**Age:**	

Sample No:	02-1826-3899	**Code:**	09-289	**Client:**	Vancouver BC Lab
Sample Date:	19 Sep-09	**Material:**	Receiving Water	**Project:**	
Receive Date:	30 Sep-09 12:35	**Source:**	Vancouver BC Lab		
Sample Age:	11d 16h (13.5 °C)	**Station:**			

Comments: Test was renewed once per day.

Comparison Summary

Analysis No	Endpoint	NOEL	LOEL	TOEL	PMSD	Method
17-0996-9069	Combined Development	100	> 100	N/A	27.0%	Dunnett's Multiple Comparison Test

Combined Development Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	0.867	0.833	0.9	0.733	0.933	0.0165	0.0903	10.4%	0.0%
6.25		4	0.925	0.904	0.946	0.867	1	0.0104	0.0569	6.15%	-6.73%
12.5		4	0.983	0.976	0.991	0.967	1	0.00351	0.0192	1.96%	-13.5%
25		4	0.833	0.749	0.918	0.5	1	0.0413	0.226	27.1%	3.85%
50		4	0.942	0.93	0.954	0.9	0.967	0.00583	0.0319	3.39%	-8.65%
100		4	0.9	0.856	0.944	0.767	1	0.0217	0.119	13.2%	-3.85%

Combined Development Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	0.9	0.733	0.933	0.9
6.25		0.933	0.867	1	0.9
12.5		1	0.967	1	0.967
25		0.933	0.5	1	0.9
50		0.967	0.9	0.967	0.933
100		1	0.767	1	0.833

Salmonid Embryo Survival and Development Test **Nautilus Environmental WA**

Analysis No:	17-0996-9069	**Endpoint:**	Combined Development	**CETIS Version:**	CETISv1.6.3
Analyzed:	12 Oct-09 15:26	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)		C > T	Not Run	100	>100	N/A	1	27.0%

Dunnett's Multiple Comparison Test

Control	vs	Conc-%	Test Stat	Critical	MSD	P-Value	Decision(5%)
Dilution Water		6.25	-0.832	2.41	0.289	0.9730	Non-Significant Effect
		12.5	-1.87	2.41	0.289	0.9990	Non-Significant Effect
		25	0.0259	2.41	0.289	0.8260	Non-Significant Effect
		50	-1.04	2.41	0.289	0.9840	Non-Significant Effect
		100	-0.708	2.41	0.289	0.9630	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	0.144364	0.028873	5	1	0.4440	Non-Significant Effect
Error	0.518485	0.028805	18			
Total	0.66285	0.057678	23			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	10.2	15.1	0.0692	Equal Variances
Distribution	Shapiro-Wilk Normality	0.955		0.3460	Normal Distribution

Combined Development Summary

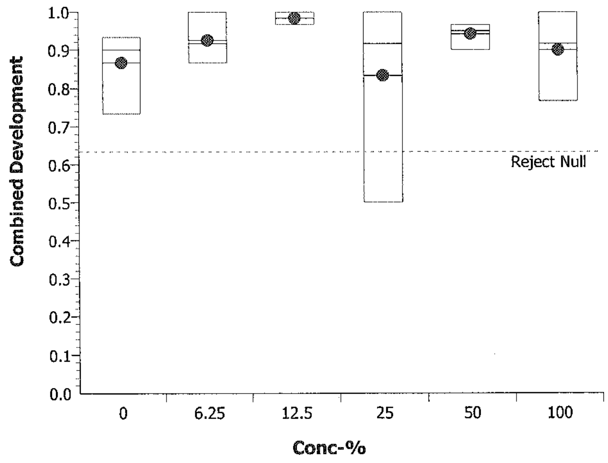
Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	0.867	0.832	0.901	0.733	0.933	0.0168	0.0903	10.4%	0.0%
6.25		4	0.925	0.903	0.947	0.867	1	0.0106	0.0569	6.15%	-6.73%
12.5		4	0.983	0.976	0.991	0.967	1	0.00357	0.0192	1.96%	-13.5%
25		4	0.833	0.747	0.919	0.5	1	0.042	0.226	27.1%	3.85%
50		4	0.942	0.93	0.954	0.9	0.967	0.00593	0.0319	3.39%	-8.65%
100		4	0.9	0.855	0.945	0.767	1	0.022	0.119	13.2%	-3.85%

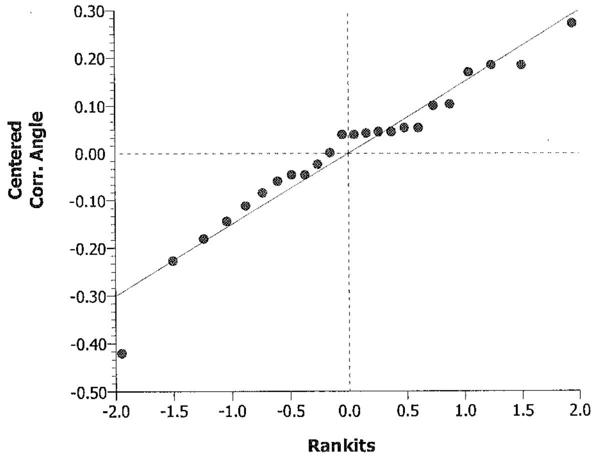
Angular (Corrected) Transformed Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	1.21	1.16	1.26	1.03	1.31	0.023	0.124	10.2%	0.0%
6.25		4	1.31	1.26	1.36	1.2	1.48	0.0228	0.123	9.38%	-8.25%
12.5		4	1.43	1.41	1.45	1.39	1.48	0.00988	0.0532	3.71%	-18.6%
25		4	1.21	1.09	1.32	0.785	1.48	0.0551	0.297	24.6%	0.26%
50		4	1.33	1.31	1.36	1.25	1.39	0.0124	0.067	5.03%	-10.3%
100		4	1.29	1.21	1.38	1.07	1.48	0.0403	0.217	16.8%	-7.03%

Salmonid Embryo Survival and Development Test					**Nautilus Environmental WA**
Analysis No:	17-0996-9069	**Endpoint:**	Combined Development	**CETIS Version:**	CETISv1.6.3
Analyzed:	12 Oct-09 15:26	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Graphics





Nautilus Environmental
Washington Laboratory

Daily Chemistries
Seven Day Freshwater Bioassay

Client: Azimuth
Sample ID. EAS-BGE
Test No: 0909-T208
Log-In#: 09-289 — —

Start Date & Time: 9/30/09 1530
Stop Date & Time: 10/7/09 1530
Test Species: *Oncorhynchus mykiss*

Conc. or % CON	Days 0	1	2	3	4	5	6	7
pH	7.56	7.57	7.87	7.52	7.61	7.56	8.13	7.76
DO (mg/l)	9.1	9.7	9.8	9.9	9.7	9.8	10.0	9.6
Cond. (µmhos-cm)	225	242	245	235	236	241	282	253
Temperature (°C)	14.5	14.9	14.3	14.7	14.8	15.0	14.8	15.0

6.25	Days 0	1	2	3	4	5	6	7
pH	7.51	7.58	7.91	7.51	7.60	7.64	8.14	7.78
DO (mg/l)	9.3	9.8	9.8	9.8	10.0	9.8	9.9	9.8
Cond. (µmhos-cm)	211	225	235	225	226	232	242	239
Temperature (°C)	14.5	14.5	14.1	14.3	14.3	14.9	14.9	14.5

12.5	Days 0	1	2	3	4	5	6	7
pH	7.49	7.58	7.87	7.53	7.60	7.62	8.09	7.76
DO (mg/l)	9.3	9.8	9.9	9.9	9.9	9.8	9.8	9.9
Cond. (µmhos-cm)	199	211	217	209	209	214	224	218
Temperature (°C)	14.5	14.5	14.3	14.4	14.4	15.0	15.0	14.6

25	Days 0	1	2	3	4	5	6	7
pH	7.46	7.54	7.83	7.51	7.55	7.57	8.05	7.71
DO (mg/l)	9.3	9.7	9.9	9.9	9.9	9.8	10.0	10.0
Cond. (µmhos-cm)	173	187	191	184	185	188	201	193
Temperature (°C)	14.4	14.6	14.4	14.5	14.5	15.0	15.0	14.6

50	Days 0	1	2	3	4	5	6	7
pH	7.26	7.36	7.62	7.25	7.34	7.30	7.96	7.58
DO (mg/l)	9.3	9.6	9.7	9.8	9.7	9.2	10.0	9.8
Cond. (µmhos-cm)	121	137	141	135	136	139	148	143
Temperature (°C)	14.3	14.5	14.4	14.6	14.5	15.0	15.0	14.7

100	Days 0	1	2	3	4	5	6	7
pH	6.51	6.84	7.16	6.73	6.75	6.96	7.42	7.09
DO (mg/l)	9.3	9.8	9.8	9.9	9.9	9.8	9.9	9.7
Cond. (µmhos-cm)	14	29	30	28	29	31	44	36
Temperature (°C)	14.2	14.6	14.5	14.6	14.6	15.1	15.1	14.8
Tech. Initials	BP	AF	BP	Ut	Ut	BP	BP	M

Dilution Water Batch #: MHSW063

QA Check: Cl

Sample Description:
Animal Source: Troutlodge
Date Received: 9/30
Date of Hatch: ——
Comments:

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Rainbow Trout
(*Oncorhynchus mykiss*)
Trout Embryo Test

Client Name: Azimuth

Test No.: 0909-T208

Sample ID: EAS-BGE

 # Embryos/Container

Conc.	Cont.	Rep.	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	# Normal	# Abnormal	Mean % Viable
CON	301	1	30	30	30	30	30	30	30	30	29	1	
	302	2	30	30	30	30	30	30	30	30	24	6	
	303	3	30	30	30	30	30	30	30	28	27	1	
	304	4	30	30	30	30	30	30	30	30	29	1	
6.25	305	1	30	30	30	30	30	30	30	30	30	0	
	306	2	30	30	30	30	30	30	30	30	27	3	
	307	3	30	30	30	30	30	30	30	30	30	0	
	308	4	30	30	30	30	30	30	29	29	29	0	
12.5	309	1	30	30	30	30	30	30	30	30	30	0	
	310	2	30	30	30	30	30	30	30	30	28	2	
	311	3	30	30	30	30	30	30	29	29	28	1	
	312	4	30	30	30	30	30	30	30	30	28	2	
25	313	1	30	30	30	30	30	30	30	30	30	0	
	314	2	30	30	30	30	30	30	30	30	29	1	
	315	3	30	30	30	30	30	30	30	30	30	0	
	316	4	30	30	30	30	30	30	30	30	24	6	
50	317	1	30	30	30	30	30	30	30	30	29	1	
	318	2	30	30	30	30	30	30	30	30	27	3	
	319	3	30	30	30	30	30	30	30	30	30	0	
	320	4	30	30	30	30	30	30	30	30	29	~~0~~ 1 ies	
100	321	1	30	30	30	30	30	30	30	30	30	0	
	322	2	30	30	30	30	30	30	30	30	21	9	
	323	3	30	30	30	30	30	30	30	30	30	0	
	324	4	30	30	30	30	30	30	30	30	26	~~2~~ 4 ies	
		1											
		2											
		3											
		4											
		1											
		2											
		3											
		4											
Tech Initials			BP	MF	BP	Ut	Ut	BP	BP	M	ies	ies	

QA Check: CC

Comments:

CETIS Summary Report

Report Date: 12 Oct-09 15:32 (p 1 of 1)
Link/Link Code: 06-6968-4020/0909-T208

Salmonid Embryo Survival and Development Test — **Nautilus Environmental WA**

Test Run No:	20-7572-2322	**Test Type:**	Survival-Development	**Analyst:**	Meghan Feuk
Start Date:	30 Sep-09 15:30	**Protocol:**	EC/EPS 1/RM/28	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	07 Oct-09 15:30	**Species:**	Oncorhynchus mykiss	**Brine:**	
Duration:	7d 0h	**Source:**	Trout Lodge Fish Farm	**Age:**	

Sample No:	02-1826-3899	**Code:**	09-289	**Client:**	Vancouver BC Lab
Sample Date:	19 Sep-09	**Material:**	Receiving Water	**Project:**	
Receive Date:	30 Sep-09 12:35	**Source:**	Vancouver BC Lab		
Sample Age:	11d 16h (13.5 °C)	**Station:**			

Comments: Test was not renewed.

Comparison Summary

Analysis No	Endpoint	NOEL	LOEL	TOEL	PMSD	Method
19-2786-3690	Combined Development	100	> 100	N/A	19.2%	Dunnett's Multiple Comparison Test

Combined Development Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	0.908	0.879	0.938	0.8	0.967	0.0144	0.0788	8.67%	0.0%
6.25		4	0.967	0.949	0.984	0.9	1	0.00861	0.0471	4.88%	-6.42%
12.5		4	0.95	0.938	0.962	0.933	1	0.00609	0.0333	3.51%	-4.59%
25		4	0.942	0.906	0.977	0.8	1	0.0175	0.0957	10.2%	-3.67%
50		4	0.958	0.943	0.974	0.9	1	0.00766	0.0419	4.38%	-5.5%
100		4	0.892	0.838	0.945	0.7	1	0.026	0.142	16.0%	1.83%

Combined Development Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	0.967	0.8	0.9	0.967
6.25		1	0.9	1	0.967
12.5		1	0.933	0.933	0.933
25		1	0.967	1	0.8
50		0.967	0.9	1	0.967
100		1	0.7	1	0.867

CETIS Analytical Report

Report Date: 12 Oct-09 15:32 (p 1 of 2)
Link/Link Code: 06-6968-4020/0909-T208

Salmonid Embryo Survival and Development Test — Nautilus Environmental WA

Analysis No:	19-2786-3690	**Endpoint:**	Combined Development	**CETIS Version:**	CETISv1.6.3
Analyzed:	12 Oct-09 15:31	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)		C > T	Not Run	100	>100	N/A	1	19.2%

Dunnett's Multiple Comparison Test

Control	vs	Conc-%	Test Stat	Critical	MSD	P-Value	Decision(5%)
Dilution Water		6.25	-1.1	2.41	0.254	0.9870	Non-Significant Effect
		12.5	-0.658	2.41	0.254	0.9580	Non-Significant Effect
		25	-0.764	2.41	0.254	0.9680	Non-Significant Effect
		50	-0.882	2.41	0.254	0.9760	Non-Significant Effect
		100	-0.0387	2.41	0.254	0.8440	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	0.045919	0.009184	5	0.412	0.8340	Non-Significant Effect
Error	0.400779	0.022266	18			
Total	0.446699	0.031449	23			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	4.29	15.1	0.5090	Equal Variances
Distribution	Shapiro-Wilk Normality	0.947		0.2280	Normal Distribution

Combined Development Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	0.908	0.878	0.938	0.8	0.967	0.0146	0.0788	8.67%	0.0%
6.25		4	0.967	0.949	0.985	0.9	1	0.00875	0.0471	4.88%	-6.42%
12.5		4	0.95	0.937	0.963	0.933	1	0.00619	0.0333	3.51%	-4.59%
25		4	0.942	0.905	0.978	0.8	1	0.0178	0.0957	10.2%	-3.67%
50		4	0.958	0.942	0.974	0.9	1	0.00779	0.0419	4.38%	-5.5%
100		4	0.892	0.838	0.946	0.7	1	0.0264	0.142	16.0%	1.83%

Angular (Corrected) Transformed Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	1.28	1.23	1.33	1.11	1.39	0.0249	0.134	10.4%	0.0%
6.25		4	1.4	1.36	1.44	1.25	1.48	0.0202	0.109	7.78%	-9.05%
12.5		4	1.35	1.32	1.38	1.31	1.48	0.0158	0.0849	6.28%	-5.41%
25		4	1.36	1.3	1.43	1.11	1.48	0.0327	0.176	12.9%	-6.29%
50		4	1.38	1.34	1.41	1.25	1.48	0.0176	0.095	6.9%	-7.26%
100		4	1.29	1.2	1.38	0.991	1.48	0.0442	0.238	18.5%	-0.32%

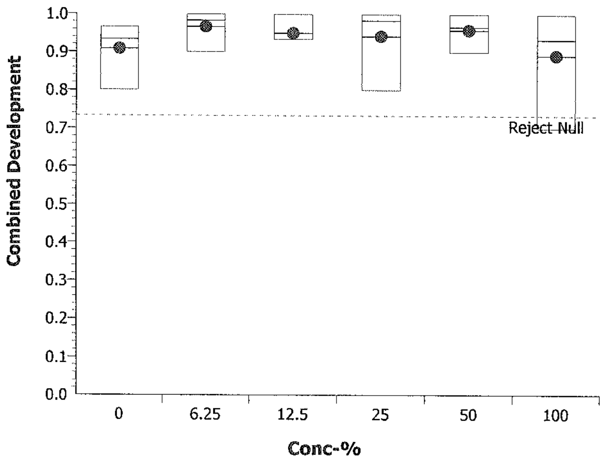
CETIS Analytical Report

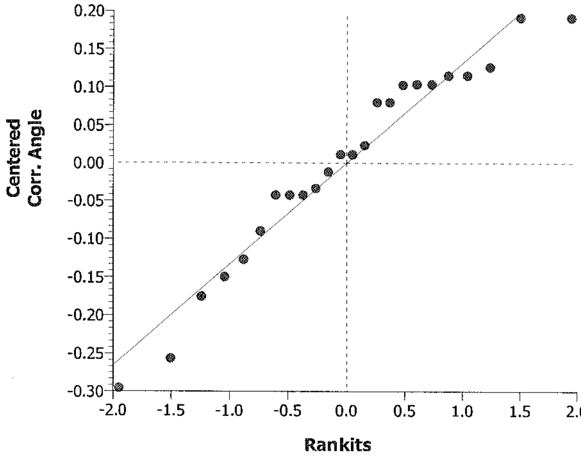
		Report Date:	12 Oct-09 15:32 (p 2 of 2)
		Link/Link Code:	06-6968-4020/0909-T208

Salmonid Embryo Survival and Development Test — **Nautilus Environmental WA**

Analysis No:	19-2786-3690	**Endpoint:**	Combined Development	**CETIS Version:**	CETISv1.6.3
Analyzed:	12 Oct-09 15:31	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Graphics





APPENDIX D – Rainbow trout larval survival and growth test results

Nautilus Environmental
Washington Laboratory

Client: Azimuth
Sample ID. EAS-BGE
Test No: 0910-T001
Log-In#: 09-289 —

Initial and Final Chemistries
Seven Day Chronic Freshwater Bioassay

Start Date & Time: 10/1/09 1300
Stop Date & Time: 10/8/09 1400
Test Species: Oncorhynchus mykiss
—

Conc. or % CON	Day 0 init.	Day 0 final	Day 1 init.	Day 1 final	Day 2 init.	Day 2 final	Day 3 init.	Day 3 final	Day 4 init.	Day 4 final	Day 5 init.	Day 5 final	Day 6 init.	Day 6 final
pH	7.72	7.60	7.99	7.71	7.37	7.59	7.54	7.61	7.46	7.12	8.14	7.29	7.59	7.23
DO (mg/l)	9.3	6.3	9.9	6.4	9.5	6.4	9.5	6.7	9.4	6.2	9.4	6.2	9.9	5.8
Cond. (µmhos-cm)	255	268	253	279	251	269	254	292	255	282	258	288	255	286
Temperature (°C)	15.6	15.1	15.3	15.2	14.5	15.5	15.0	14.7	15.0	15.2	15.3	15.2	15.3	15.3

6.25	Day 0 init.	Day 0 final	Day 1 init.	Day 1 final	Day 2 init.	Day 2 final	Day 3 init.	Day 3 final	Day 4 init.	Day 4 final	Day 5 init.	Day 5 final	Day 6 init.	Day 6 final
pH	7.67	7.60	7.99	7.65	7.38	7.57	7.59	7.57	7.44	7.12	8.13	7.23	7.62	7.18
DO (mg/l)	9.4	6.6	9.9	6.4	9.9	6.1	9.7	6.3	9.5	6.1	9.8	6.2	9.8	5.7
Cond. (µmhos-cm)	240	252	240	264	238	254	240	257	243	265	245	262	242	271
Temperature (°C)	15.6	15.1	15.2	15.2	14.5	15.6	14.9	14.6	15.0	15.2	15.3	15.2	15.0	15.3

12.5	Day 0 init.	Day 0 final	Day 1 init.	Day 1 final	Day 2 init.	Day 2 final	Day 3 init.	Day 3 final	Day 4 init.	Day 4 final	Day 5 init.	Day 5 final	Day 6 init.	Day 6 final
pH	7.62	7.59	7.98	7.65	7.35	7.59	7.61	7.54	7.42	7.11	8.10	7.26	7.63	7.21
DO (mg/l)	9.4	6.5	9.9	6.3	9.7	6.4	9.5	6.3	9.7	6.0	9.7	6.3	9.9	5.8
Cond. (µmhos-cm)	227	237	224	251	225	271	255	243	229	251	231	253	228	257
Temperature (°C)	15.9	15.1	15.2	15.2	14.8	15.5	15.0	14.6	15.0	15.1	15.3	15.2	15.0	15.3

25	Day 0 init.	Day 0 final	Day 1 init.	Day 1 final	Day 2 init.	Day 2 final	Day 3 init.	Day 3 final	Day 4 init.	Day 4 final	Day 5 init.	Day 5 final	Day 6 init.	Day 6 final
pH	7.58	7.49	7.94	7.62	7.29	7.60	7.60	7.47	7.36	7.06	8.09	7.20	7.60	7.11
DO (mg/l)	9.4	6.3	9.8	6.4	9.9	6.7	9.7	6.2	9.7	6.3	9.8	6.3	10.0	5.6
Cond. (µmhos-cm)	197	207	196	218	197	211	198	221	199	220	202	221	199	224
Temperature (°C)	15.6	15.1	15.0	15.1	14.6	15.6	15.1	14.6	15.0	15.1	15.4	15.2	15.0	15.2

50	Day 0 init.	Day 0 final	Day 1 init.	Day 1 final	Day 2 init.	Day 2 final	Day 3 init.	Day 3 final	Day 4 init.	Day 4 final	Day 5 init.	Day 5 final	Day 6 init.	Day 6 final
pH	7.40	7.35	7.88	7.52	7.14	7.45	7.47	7.31	7.19	6.92	8.04	7.15	7.56	7.00
DO (mg/l)	9.6	5.8	10.0	6.2	9.6	6.3	9.6	6.1	9.8	6.1	9.8	6.2	10.0	5.8
Cond. (µmhos-cm)	140	152	140	160	140	155	142	166	140	161	145	163	142	166
Temperature (°C)	15.6	15.1	14.8	~~89~~ 15.1	14.7	15.6	15.2	14.7	14.9	15.1	~~14~~ 15.4 MF	15.2	15.1	15.2

100	Day 0 init.	Day 0 final	Day 1 init.	Day 1 final	Day 2 init.	Day 2 final	Day 3 init.	Day 3 final	Day 4 init.	Day 4 final	Day 5 init.	Day 5 final	Day 6 init.	Day 6 final
pH	6.42	6.91	7.11	7.08	6.11	7.01	6.37	6.88	6.35	6.33	7.43	6.58	6.52	6.47
DO (mg/l)	9.8	7.2	10.2	7.3	10.5	7.0	10.2	6.7	10.3	6.5	10.2	6.3	10.2	6.7
Cond. (µmhos-cm)	14	28	15	32	16	31	17	39	16	33	17	32	16	33
Temperature (°C)	15.3	15.1	14.3	15.1	15.5	15.6	15.4	14.8	14.9	15.1	15.2	15.2	15.0	15.2
Tech. Initials	Et	Et	Et	Et	Et	Et	Et	BP	BP	Et	MF	Et	Et	Et

Dilution Water Batch #: MHSW 064
Test Chamber: Environmental Room C

QA Check: CC

Sample Description:
Animal Source: Trout Lodge
Date Received: 9/30/09
Date of Hatch:
Comments: Swim up 9/24/09

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Rainbow Trout
(*Oncorhynchus mykiss*)
Larval Survival

Client Name: Azimuth

Sample ID: EAS-BGE

Test No.: 0910-T001

Conc.	Cont.	Rep.	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Mean % Survival
CON	3	1	5	5	5	5	5	5	5	5	
	24	2	5	5	5	5	5	5	5	5	
	1	3	5	5	5	5	5	5	5	5	
	17	4	5	5	5	5	5	5	5	5	
6.25	6	1	5	5	5	5	5	5	5	5	
	4	2	5	5	5	5	5	5	5	5	
	2	3	5	5	5	5	5	5	5	5	
	20	4	5	5	5	5	5	5	5	5	
12.5	23	1	5	5	5	5	5	5	5	5	
	19	2	5	5	5	5	5	5	5	5	
	22	3	5	5	5	5	5	5	5	5	
	12	4	5	5	5	5	5	5	5	5	
25	7	1	5	5	5	5	5	5	5	5	
	16	2	5	5	5	5	5	5	5	5	
	11	3	5	5	5	5	5	5	5	5	
	15	4	5	5	5	5	5	5	5	5	
50	5	1	5	5	5	5	5	5	5	5	
	8	2	5	5	5	5	5	5	5	5	
	9	3	5	5	5	5	5	5	5	5	
	18	4	5	5	5	5	5	5	5	5	
100	10	1	5	5	5	5	5	5	5	5	
	21	2	5	5	5	5	5	5	5	5	
	14	3	5	5	4	3	3	3	3	3	
	13	4	5	5	5	5	5	5	5	5	
		1									
		2									
		3									
		4									
		1									
		2									
		3									
		4									
Tech Initials			Qt	Qt	Qt	Qt	BP	Qt	Qt	Qt	

Feeding Tech: 0 ___ 1600 1 915 1445 2 815 1445 3 815 1400 4 1045 1600 5 915 1445 6 900 1430

Comments: ______

QA Check: CC

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Fish Weights
Seven Day Chronic Bioassay

Client: Azimuth

Test No: 0910-T001

Sample ID: EAS-BGE

Species: *O. mykiss*

Conc.	cont #	rep #	pan wt. (gm)	pan + fish (gm)	fish wt. (mg)	# fish	avg. per fish (mg)	avg. per conc. (mg)
CON	3	1	0.62030	0.76999		5		
	24	2	0.56005	0.68212		5		
	1	3	0.60497	0.73604		5		
	17	4	0.59265	0.73560		5		
6.25	6	1	0.60885	0.74674		5		
	4	2	0.59478	0.72203		5		
	2	3	0.61207	0.74144		5		
	20	4	0.57329	0.71117		5		
12.5	23	1	0.54085	0.68552		5		
	19	2	0.59221	0.73539		5		
	22	3	0.60999	0.75376		5		
	12	4	0.61271	0.76231		5		
25	7	1	0.59672	0.72632		5		
	16	2	0.55675	0.70416		5		
	11	3	0.62729	0.76786		5		
	15	4	0.55397	0.70115		5		
50	5	1	0.59706	0.75246		5		
	8	2	0.57903	0.73084		5		
	9	3	0.60773	0.75689		5		
	18	4	0.57372	0.73467		5		
100	10	1	0.62093	0.74127		5		
	21	2	0.57546	0.69550		5		
	14	3	0.53994	0.63699		3		
	13	4	0.60445	0.72747		5		
Initial	1	1	0.58720	0.70460		5		
	2	2	0.60008	0.70912		5		
	3	3	0.58902	0.69628		5		
	4	4	0.58858	0.70008		5		
		Technician Initials:	CC	ET				

Date/Time in: 10/8/09 1400 Oven temp. (°C): 67.0

Date/Time out: 10/12/09 945 Oven temp. (°C): 65.0

QA Check: CC

CETIS Summary Report

Chronic Larval Fish Survival and Growth Test — **Nautilus Environmental WA**

Test Run No: 18-8367-6994	**Test Type:** Growth-Survival (7d)	**Analyst:** Meghan Feuk
Start Date: 01 Oct-09 13:00	**Protocol:** EPA/821/R-02-013 (2002)	**Diluent:** Mod-Hard Synthetic Water
Ending Date: 08 Oct-09 14:00	**Species:** Oncorhynchus mykiss	**Brine:**
Duration: 7d 1h	**Source:** Trout Lodge Fish Farm	**Age:** 7d

Sample No: 02-1826-3899	**Code:** 09-289	**Client:** Vancouver BC Lab
Sample Date: 19 Sep-09	**Material:** Receiving Water	**Project:**
Receive Date: 30 Sep-09 12:35	**Source:** Vancouver BC Lab	
Sample Age: 12d 13h (13.5 °C)	**Station:**	

Comparison Summary

Analysis No	Endpoint	NOEL	LOEL	TOEL	PMSD	Method
09-5203-1559	7d Survival Rate	100	> 100	N/A	14.1%	Steel Many-One Rank Test
13-6431-8899	Mean Dry Biomass-mg	50	100	70.7	10.6%	Dunnett's Multiple Comparison Test
09-6211-0583	Mean Dry Weight-mg	100	> 100	N/A	13.5%	Dunnett's Multiple Comparison Test

Point Estimate Summary

Analysis No	Endpoint	Effect-%	Conc-%	95% LCL	95% UCL	Method
20-7459-6617	Mean Dry Biomass-mg	25	> 100	N/A	N/A	Linear Interpolation (ICPIN)
		50	> 100	N/A	N/A	
03-3560-7381	Mean Dry Weight-mg	25	> 100	N/A	N/A	Linear Interpolation (ICPIN)
		50	> 100	N/A	N/A	

7d Survival Rate Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	1	1	1	1	1	0	0	0.0%	0.0%
6.25		4	1	1	1	1	1	0	0	0.0%	0.0%
12.5		4	1	1	1	1	1	0	0	0.0%	0.0%
25		4	1	1	1	1	1	0	0	0.0%	0.0%
50		4	1	1	1	1	1	0	0	0.0%	0.0%
100		4	0.9	0.825	0.975	0.6	1	0.0365	0.2	22.2%	10.0%

Mean Dry Biomass-mg Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	27.3	26.4	28.2	24.4	29.9	0.449	2.46	9.01%	0.0%
6.25		4	26.6	26.2	27	25.5	27.6	0.204	1.12	4.2%	2.45%
12.5		4	29.1	28.8	29.3	28.6	29.9	0.107	0.586	2.02%	-6.49%
25		4	28.2	27.6	28.9	25.9	29.5	0.305	1.67	5.92%	-3.48%
50		4	30.9	30.5	31.2	29.8	32.2	0.186	1.02	3.3%	-13.1%
100		4	23	22.1	23.9	19.4	24.6	0.442	2.42	10.5%	15.6%

Mean Dry Weight-mg Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	27.3	26.4	28.2	24.4	29.9	0.449	2.46	9.01%	0.0%
6.25		4	26.6	26.2	27	25.5	27.6	0.204	1.12	4.2%	2.45%
12.5		4	29.1	28.8	29.3	28.6	29.9	0.107	0.586	2.02%	-6.49%
25		4	28.2	27.6	28.9	25.9	29.5	0.305	1.67	5.92%	-3.48%
50		4	30.9	30.5	31.2	29.8	32.2	0.186	1.02	3.3%	-13.1%
100		4	26.3	24.7	27.8	24	32.3	0.743	4.07	15.5%	3.78%

Chronic Larval Fish Survival and Growth Test | **Nautilus Environmental WA**

7d Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1	1	1	1
6.25		1	1	1	1
12.5		1	1	1	1
25		1	1	1	1
50		1	1	1	1
100		1	1	0.6	1

Mean Dry Biomass-mg Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	29.9	24.4	26.2	28.6
6.25		27.6	25.5	25.9	27.6
12.5		28.9	28.6	28.8	29.9
25		25.9	29.5	28.1	29.4
50		31.1	30.4	29.8	32.2
100		24.1	24	19.4	24.6

Mean Dry Weight-mg Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	29.9	24.4	26.2	28.6
6.25		27.6	25.5	25.9	27.6
12.5		28.9	28.6	28.8	29.9
25		25.9	29.5	28.1	29.4
50		31.1	30.4	29.8	32.2
100		24.1	24	32.3	24.6

CETIS Analytical Report

Report Date: 12 Oct-09 16:06 (p 1 of 4)
Link/Link Code: 12-3976-2052/0910-T001

Chronic Larval Fish Survival and Growth Test — **Nautilus Environmental WA**

Analysis No:	09-6211-0583	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.6.3
Analyzed:	12 Oct-09 16:05	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	100	>100	N/A	1	13.5%

Dunnett's Multiple Comparison Test

Control	vs	Conc-%	Test Stat	Critical	MSD	P-Value	Decision(5%)
Dilution Water		6.25	0.438	2.41	3.68	0.6740	Non-Significant Effect
		12.5	-1.16	2.41	3.68	0.9890	Non-Significant Effect
		25	-0.621	2.41	3.68	0.9540	Non-Significant Effect
		50	-2.34	2.41	3.68	1.0000	Non-Significant Effect
		100	0.675	2.41	3.68	0.5690	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	59.30282	11.86056	5	2.54	0.0660	Non-Significant Effect
Error	84.11691	4.673161	18			
Total	143.4197	16.53372	23			

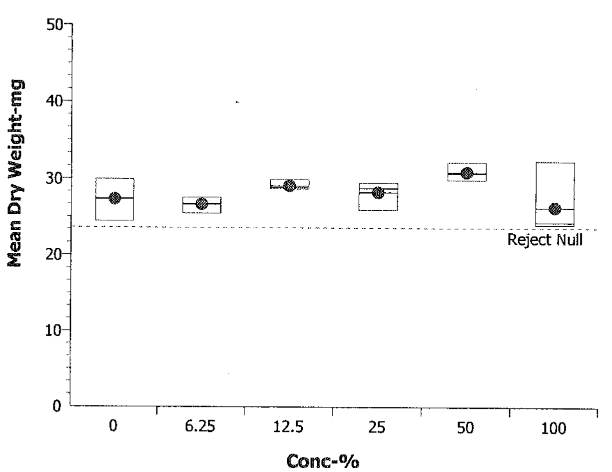
ANOVA Assumptions

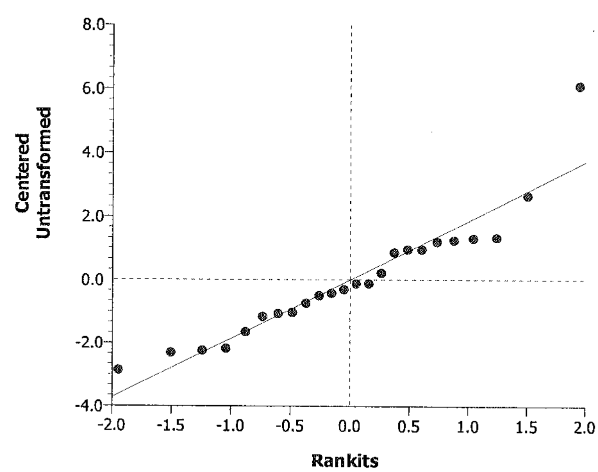
Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	11.7	15.1	0.0384	Equal Variances
Distribution	Shapiro-Wilk Normality	0.907		0.0298	Normal Distribution

Mean Dry Weight-mg Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	27.3	26.4	28.2	24.4	29.9	0.457	2.46	9.01%	0.0%
6.25		4	26.6	26.2	27	25.5	27.6	0.208	1.12	4.2%	2.45%
12.5		4	29.1	28.8	29.3	28.6	29.9	0.109	0.586	2.02%	-6.49%
25		4	28.2	27.6	28.9	25.9	29.5	0.31	1.67	5.92%	-3.48%
50		4	30.9	30.5	31.3	29.8	32.2	0.189	1.02	3.31%	-13.1%
100		4	26.3	24.7	27.8	24	32.3	0.756	4.07	15.5%	3.78%

Graphics





CETIS Analytical Report

Report Date: 12 Oct-09 16:06 (p 2 of 4)
Link/Link Code: 12-3976-2052/0910-T001

Chronic Larval Fish Survival and Growth Test | **Nautilus Environmental WA**

Analysis No:	13-6431-8899	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.6.3
Analyzed:	12 Oct-09 16:05	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	50	100	70.7	2	10.6%

Dunnett's Multiple Comparison Test

Control	vs	Conc-%	Test Stat	Critical	MSD	P-Value	Decision(5%)
Dilution Water		6.25	0.557	2.41	2.89	0.6230	Non-Significant Effect
		12.5	-1.47	2.41	2.89	0.9960	Non-Significant Effect
		25	-0.789	2.41	2.89	0.9700	Non-Significant Effect
		50	-2.98	2.41	2.89	1.0000	Non-Significant Effect
		100*	3.55	2.41	2.89	0.0048	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	140.7106	28.14212	5	9.74	0.0001	Significant Effect
Error	52.02573	2.890319	18			
Total	192.7363	31.03243	23			

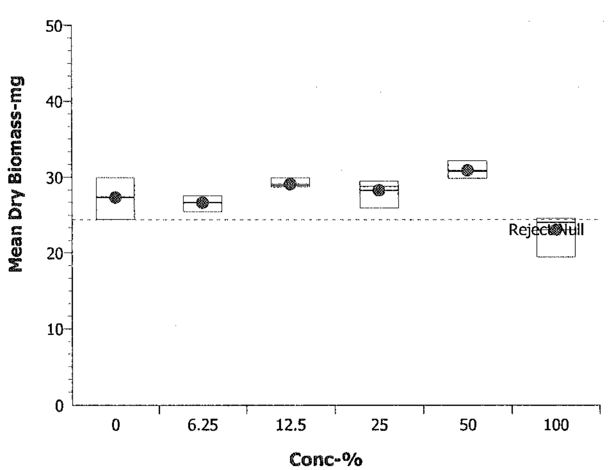
ANOVA Assumptions

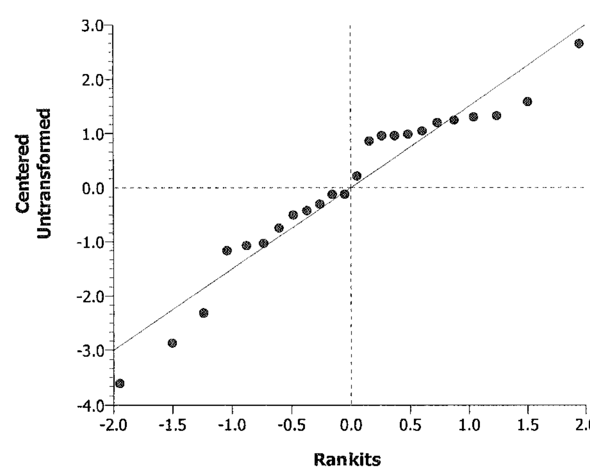
Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	6.85	15.1	0.2320	Equal Variances
Distribution	Shapiro-Wilk Normality	0.94		0.1610	Normal Distribution

Mean Dry Biomass-mg Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	27.3	26.4	28.2	24.4	29.9	0.457	2.46	9.01%	0.0%
6.25		4	26.6	26.2	27	25.5	27.6	0.208	1.12	4.2%	2.45%
12.5		4	29.1	28.8	29.3	28.6	29.9	0.109	0.586	2.02%	-6.49%
25		4	28.2	27.6	28.9	25.9	29.5	0.31	1.67	5.92%	-3.48%
50		4	30.9	30.5	31.3	29.8	32.2	0.189	1.02	3.31%	-13.1%
100		4	23	22.1	23.9	19.4	24.6	0.45	2.42	10.5%	15.6%

Graphics





Chronic Larval Fish Survival and Growth Test — **Nautilus Environmental WA**

Analysis No:	09-5203-1559	**Endpoint:**	7d Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	12 Oct-09 16:05	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Rank		C > T	Not Run	100	>100	N/A	1	14.1%

Steel Many-One Rank Test

Control	vs	Conc-%	Test Stat	Critical	Ties	P-Value	Decision(5%)
Dilution Water		6.25	18	10	1	0.8330	Non-Significant Effect
		12.5	18	10	1	0.8330	Non-Significant Effect
		25	18	10	1	0.8330	Non-Significant Effect
		50	18	10	1	0.8330	Non-Significant Effect
		100	16	10	1	0.6100	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	0.043931	0.008786	5	1	0.4460	Non-Significant Effect
Error	0.158153	0.008786	18			
Total	0.202084	0.017573	23			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Mod Levene Equality of Varianc	1	4.25	0.4460	Equal Variances
Distribution	Shapiro-Wilk Normality	0.463		0.0000	Non-normal Distribution

7d Survival Rate Summary

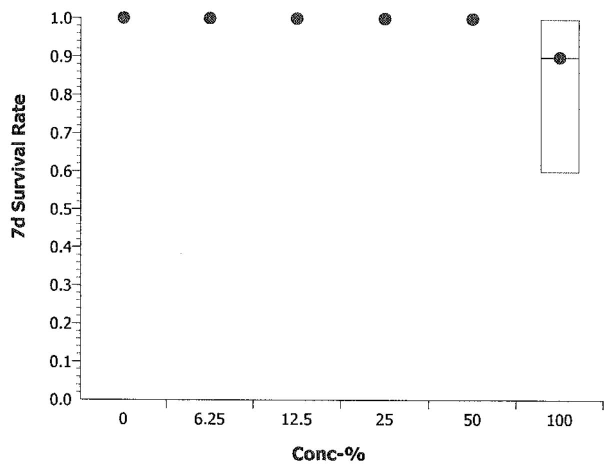
Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	1	1	1	1	1	0	0	0.0%	0.0%
6.25		4	1	1	1	1	1	0	0	0.0%	0.0%
12.5		4	1	1	1	1	1	0	0	0.0%	0.0%
25		4	1	1	1	1	1	0	0	0.0%	0.0%
50		4	1	1	1	1	1	0	0	0.0%	0.0%
100		4	0.9	0.824	0.976	0.6	1	0.0371	0.2	22.2%	10.0%

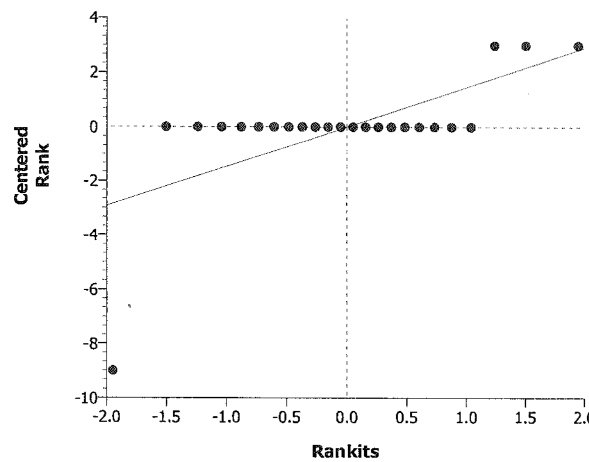
Rank Transformed Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	13	13	13	13	13	0	0	0.0%	0.0%
6.25		4	13	13	13	13	13	0	0	0.0%	0.0%
12.5		4	13	13	13	13	13	0	0	0.0%	0.0%
25		4	13	13	13	13	13	0	0	0.0%	0.0%
50		4	13	13	13	13	13	0	0	0.0%	0.0%
100		4	10	7.72	12.3	1	13	1.11	6	60.0%	23.1%

Chronic Larval Fish Survival and Growth Test					Nautilus Environmental WA
Analysis No:	09-5203-1559	**Endpoint:**	7d Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	12 Oct-09 16:05	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Graphics





CETIS Analytical Report

Report Date:	12 Oct-09 16:06 (p 1 of 2)
Link/Link Code:	12-3976-2052/0910-T001

Chronic Larval Fish Survival and Growth Test — **Nautilus Environmental WA**

Analysis No:	03-3560-7381	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.6.3
Analyzed:	12 Oct-09 16:05	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Linear	Linear	3019480	280	Yes	Two-Point Interpolation

Point Estimates

Effect-%	Conc-%	95% LCL	95% UCL
25	> 100	N/A	N/A
50	> 100	N/A	N/A

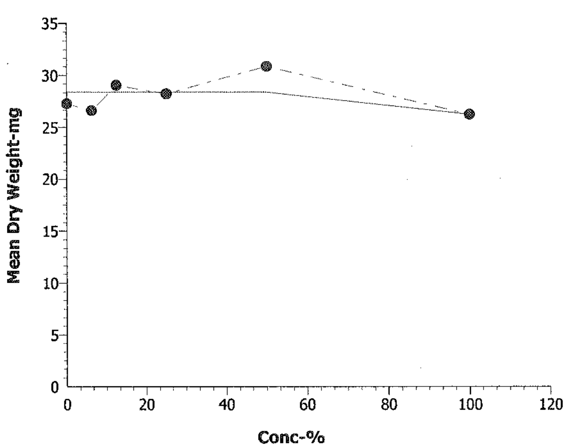
Mean Dry Weight-mg Summary

			Calculated Variate						
Conc-%	**Control Type**	**Count**	**Mean**	**Min**	**Max**	**Std Err**	**Std Dev**	**CV%**	**Diff%**
0	Dilution Water	4	27.3	24.4	29.9	0.449	2.46	9.01%	0.0%
6.25		4	26.6	25.5	27.6	0.204	1.12	4.2%	2.45%
12.5		4	29.1	28.6	29.9	0.107	0.586	2.02%	-6.49%
25		4	28.2	25.9	29.5	0.305	1.67	5.92%	-3.48%
50		4	30.9	29.8	32.2	0.186	1.02	3.31%	-13.1%
100		4	26.3	24	32.3	0.743	4.07	15.5%	3.78%

Mean Dry Weight-mg Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	29.9	24.4	26.2	28.6
6.25		27.6	25.5	25.9	27.6
12.5		28.9	28.6	28.8	29.9
25		25.9	29.5	28.1	29.4
50		31.1	30.4	29.8	32.2
100		24.1	24	32.3	24.6

Graphics



Chronic Larval Fish Survival and Growth Test — **Nautilus Environmental WA**

Analysis No:	20-7459-6617	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.6.3
Analyzed:	12 Oct-09 16:05	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Linear	Linear	2895625	280	Yes	Two-Point Interpolation

Point Estimates

Effect-%	Conc-%	95% LCL	95% UCL
25	> 100	N/A	N/A
50	> 100	N/A	N/A

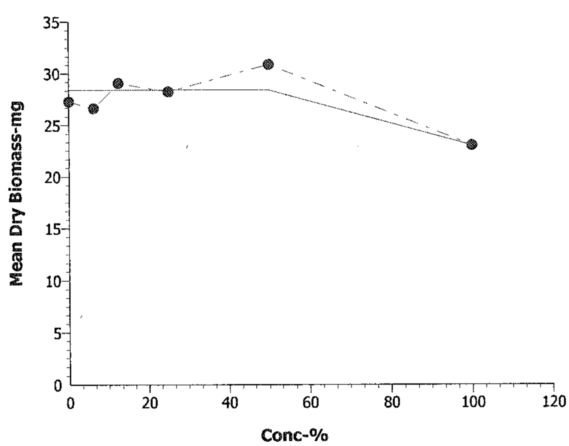
Mean Dry Biomass-mg Summary

			Calculated Variate						
Conc-%	**Control Type**	**Count**	**Mean**	**Min**	**Max**	**Std Err**	**Std Dev**	**CV%**	**Diff%**
0	Dilution Water	4	27.3	24.4	29.9	0.449	2.46	9.01%	0.0%
6.25		4	26.6	25.5	27.6	0.204	1.12	4.2%	2.45%
12.5		4	29.1	28.6	29.9	0.107	0.586	2.02%	-6.49%
25		4	28.2	25.9	29.5	0.305	1.67	5.92%	-3.48%
50		4	30.9	29.8	32.2	0.186	1.02	3.31%	-13.1%
100		4	23	19.4	24.6	0.442	2.42	10.5%	15.6%

Mean Dry Biomass-mg Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	29.9	24.4	26.2	28.6
6.25		27.6	25.5	25.9	27.6
12.5		28.9	28.6	28.8	29.9
25		25.9	29.5	28.1	29.4
50		31.1	30.4	29.8	32.2
100		24.1	24	19.4	24.6

Graphics



Nautilus Environmental

BRITISH COLUMBIA
8664 Commerce Court
Burnaby British Columbia Canada V5A 4N7
Phone 604.420.8773
Fax 604.357.1361

Chain of Custody

0027

Date ______ Page ______ of ______

Sample Collection by: GM.

Report to:
Company: Azimuth west
Address: 218 2902 Broadway
City: Vancouver Prov. BC PC V6K 2G8
Contact: Gary Mann
Phone No. 604-730-1220

Invoice to:
Company: Azimuth
Address:
City: Prov. PC
Contact:
Phone No.

ANALYSIS REQUIRED

SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	NUMBER OF CONTAINERS	COMMENTS	7-d Ceriodaphnia	96-h RBT LC50	48-h Daphnia LC50	7-d RBT embryo	7-d RBT embryo w/o renewal	7-d RBT swim-up						RECEIPT TEMPERATURE (°C)
EAS-BGE-1	Sept 19 2009		w	P	6×20L	~~sh~~ mix contents well before using for testing.	✓	✓	✓	✓	✓	✓						
							WO#09349	WO#09350	WO#09351	WO#09352	WO#09353	WO#09354						

PROJECT INFORMATION	
CLIENT	Azimuth
P.O. NO.	
SHIPPED VIA:	Purolator

SAMPLE RECEIPT	
TOTAL NO. OF CONTAINERS	6
REC'D GOOD CONDITION	✓

RELINQUISHED BY (CLIENT)
(Signature) (Time)
(Printed Name) G. Mann (1) (Date)
(Company) Azimuth

RELINQUISHED BY (COURIER)
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY (COURIER)
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY (LABORATORY)
(Signature) (Time) 1430
(Printed Name) John T. (Date) Sep/29/09

SPECIAL INSTRUCTIONS/COMMENTS:
(1) Sample exceeded holding time - sample was tested as per client request.

Additional costs may be required for sample disposal or storage. Net 30 unless otherwise contracted.

DISTRIBUTION: WHITE - Nautilus Environmental, COLOR - Originator

APPENDIX K

PRESENCE (+) / ABSENCE (-) MATRIX OF PHYTOPLANKTON SPECIES, BAY-GOOSE DIKE TSS EAS, SEPTEMBER 2009

Appendix K. Presence (+) / Absence (-) Matrix of Phytoplankton Species, Bay-Goose Dike TSS EAS, Round 1, September 2009.

	EAS-BGE					EAS-BGW					EAS-SPC					EAS-DT					EAS-TPS				
	19-Sep-09					18-Sep-09					19-Sep-09					18-Sep-09					17-Sep-09				
Species and Code	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***
Cyanophyte																									
1008 *Aphanocapsa sp.*	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1012 *Aphanothece sp.*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1014 *Chroococcus limneticus Lemmermann*	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1024 *Woronichinia naegelianum (Unger) Elenk.*	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1026 *Merismopedia tenuissima Lemmermann*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
1033 *Rhabdogloea lineare Schmidle and Lauterborn*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
1054 *Planktolyngbya limnetica*	+	+	+	+	+	+	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-
1073 *Snowella sp*	-	-	-	+	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1077 *Pseudoanabaena sp.*	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1089 *Cyanodictyon sp.*	-	-	-	-	-	+	+	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	+	+
1097 *Snowella lacustris (Chodat) Komarek and Hindak*	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Chlorophyte																									
2100 *Pyramidomonas tetrarhynchus Schmarda*	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	+	-	+	+	+	+	-	+	+	-
2105 *Chlamydomonas spp.*	-	-	+	-	+	-	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	-
2112 *Sphaerocystis schroeteri Chodat*	-	-	+	+	-	-	-	-	-	-	+	-	+	-	-	-	+	+	+	+	+	+	-	+	-
2121 *Oocystis lacustris Chodat*	+	-	-	+	-	+	+	+	-	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+
2126 *Chodatella sp.*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
2137 *Dictyosphaerium simplex Sukja*	-	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	+	-	+
2145 *Crucigenia quadrata Morr.*	-	+	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	+	+	+	-	-	+	+	-
2154 *Coelastrum microporum Naegeli*	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-
2167 *Elakatothrix gelatinosa Willen*	-	-	+	+	+	+	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2178 *Cosmarium sp.*	-	-	-	-	-	-	-	-	-	-	+	-	+	+	+	+	-	-	+	-	-	-	-	+	-
2182 *Euastrum spp.*	-	-	-	-	-	+	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
2185 *Micrasterias sp.*	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2186 *Xanthidium sp.*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
2187 *Staurodesmus extensus (Andersson) Teiling*	-	-	+	+	+	+	-	-	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+
2193 *Staurodesmus paradoxum Meyen*	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	+	-	-	-
2195 *Staurodesmus bullardii G.M. Smith*	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2199 *Spondylosium planum (Wolle) W. and G.S. West*	-	-	+	-	-	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-	-	+	-	-	-
2205 *Mougeotia sp.*	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-
2206 *Botryococcus braunii Kutzing*	+	+	+	+	+	+	+	-	+	-	+	-	+	-	+	+	-	-	+	-	+	+	-	+	+
2215 *Tetraedron caudatum (Corda) Hansgrig*	+	-	-	-	-	+	-	-	-	-	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
2235 *Ankistrodesmus spiralis Lemmermann*	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+
2247 *Oocystis gigas Archer*	-	-	-	-	+	+	-	-	+	-	+	+	-	-	+	-	+	+	+	-	+	-	-	-	+

Appendix K. Presence (+) / Absence (-) Matrix of Phytoplankton Species, Bay-Goose Dike TSS EAS, Round 1, September 2009.

	EAS-BGE					EAS-BGW					EAS-SPC					EAS-DT					EAS-TPS				
	19-Sep-09					18-Sep-09					19-Sep-09					18-Sep-09					17-Sep-09				
Species and Code	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***
Chrysophyte																									
4351 *Small chrysophyceae*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4352 *Large chrysophyceae*	-	+	+	+	+	-	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+
4354 *Chromulina spp.*	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4355 *Chrysochromulina parva Lackey*	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	-	-	-	+	+
4357 *Chrysococcus sp.*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4358 *Chrysostephanospaera globulifera Scherffel*	-	-	-	-	-	-	-	-	-	+	+	-	+	+	+	-	-	+	-	+	-	-	-	-	-
4361 *Kephyrion boreale Skuja*	-	-	+	-	-	-	+	-	-	+	-	+	+	+	-	-	+	+	-	+	-	-	-	+	-
4362 *Kephyrion sp.*	-	+	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4363 *Spinifiromonas sirratus*	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+
4367 *Mallomonas duerrschmidtiae Siver, Hamer and Kling*	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4368 *Mallomonas crassisquama (Asmund) Fott*	-	-	-	-	+	-	-	-	-	-	-	-	+	-	+	+	+	+	+	+	+	-	-	-	-
4378 *Dinobryon borgei Lemmermann*	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-
4381 *Dinobryon mucronutom Nygaard*	-	-	-	+	-	-	-	-	-	+	+	+	-	+	+	+	+	+	+	+	-	+	+	-	+
4383 *Dinobryon bavaricum Imhof*	-	-	-	-	-	-	-	+	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
4388 *Dinobryon sertularia Ehrenberg*	-	-	+	-	+	-	-	+	-	+	-	-	-	+	-	-	-	-	-	-	-	+	-	-	+
4390 *Dinobryon sociale Ehrenberg*	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4394 *Epiphyxis sp.*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	+
4396 *Chrysolkos skuja (Nauwerck) Willen*	-	-	-	-	-	+	-	-	+	+	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+
4403 *Chrysosphaerella longispina Lauterborn*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
4411 *Bitrichia chodatii (Reverdin) Chodat*	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	+
4413 *Chrysochromulina laurentiana Kling*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4414 *Stichogloea spp.*	-	-	-	-	+	+	-	+	+	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+
4415 *Bicoeca lacustris Clark*	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-
4416 *Bicoeca ainikkiae Jarnefelt*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4418 *Salpingoeca frequentissima (Zach.) Lemmermann*	+	-	+	-	+	-	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-
4436 *Dinobryon attenatum Hill*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	+	-	-
4437 *Pteridomonas sp.*	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	-	-	-	-	+	+	-	-	-
Diatom																									
5306 *Navicula minima Grunow*	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5446 *Gomphonema constrictum v capitata (Ehrenberg) Cl*	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	+	-	+	+	-	-	-	-	-
5507 *Cyclotella stelligera Cleve and Grunow*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5511 *Rhizosolenia eriense H.L. Smith*	+	-	+	-	+	+	-	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5513 *Tabellaria fenestrata (Lyngbye) Kutzing*	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+	+	-	-	-	-	-
5514 *Tabellaria flocculsa (Roth) Kutzing*	-	+	-	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	-	-	-	+	-	-
5518 *Synedra acus Kutzing*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+
5546 *Gyrosigma sp*	-	+	+	-	-	+	-	-	+	+	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-
5551 *Cyclotella michiganiana Skvortzow*	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+
5702 *Achnanthes minutissima Kutzing*	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-
5720 *Cyclotella bodanica Eulenst.*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+	+	+	-	-
5733 *Eunotia pectinalis (Kutzing) Rabenhorst*	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
5820 *Eunotia arcus Ehrenberg*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
5865 *Cymbella prostata (Berkeley) Cleve*	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5881 *Diatoma elongatum Agardh*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-
Cryptophyte																									
6554 *Rhodomonas minuta Skuja*	+	+	+	+	-	-	+	+	-	+	-	+	-	+	-	+	+	+	+	+	+	-	+	-	-
6558 *Cryptomonas erosa Ehrenberg*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6562 *Cryptomonas reflexa (Marsson) Skuja*	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6565 *Cryptomonas rostratiformis Skuja*	-	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	-	+
6568 *Katablepharis ovalis Skuja*	-	+	+	-	+	-	-	-	-	+	-	+	+	+	+	+	+	-	+	+	-	-	-	-	+
Dinoflagellate																									
7628 *Gymnodinium mirabile Penard*	+	-	+	-	-	-	-	+	+	+	-	-	-	-	-	+	+	+	+	+	+	+	+	-	+
7631 *Gymnodinium helveticum Penard*	-	-	+	-	-	-	-	-	-	-	-	+	-	-	+	-	+	+	+	-	+	-	+	-	+
7632 *Gymnodinium sp.*	-	+	-	+	-	+	-	-	+	-	-	-	+	+	-	+	+	+	+	+	+	-	-	+	-
7635 *Peridinium willei Huitfeldt-Kaas*	-	-	-	-	-	-	-	-	-	-	+	+	-	-	+	-	-	+	+	-	+	-	-	-	-
7639 *Peridinium pusillum (Penard) Lemmermann*	-	-	+	+	-	-	-	-	-	-	+	-	+	+	-	+	+	-	+	+	-	-	-	-	-
7641 *Peridinium aciculiferum Lemmermann*	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix K. Presence (+) / Absence (-) Matrix of Phytoplankton Species, Bay-Goose Dike TSS EAS, Round 2, September 2009.

	EAS-BGE					EAS-BGW					EAS-SPC					EAS-DT					EAS-TPS				
	26-Sep-09					24-Sep-09					26-Sep-09					26-Sep-09					27-Sep-09				
Species and Code	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***
Cyanophyte																									
1012 *Aphanothece sp.*	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1014 *Chroococcus limneticus Lemmermann*	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1024 *Woronichinia naegelianum (Unger) Elenk.*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
1026 *Merismopedia tenuissima Lemmermann*	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1054 *Planktolyngbya limnetica*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
1070 *Anabaenopsis sp.*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
1073 *Snowella sp*	-	-	-	-	-	-	-	-	+	-	+	+	+	+	-	-	-	-	-	-	-	+	-	-	+
1089 *Cyanodictyon sp.*	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-
1097 *Snowella lacustris (Chodat) Komarek and Hindak*	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorophyte																									
2100 *Pyramidomonas tetrarhynchus Schmarda*	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	+	+	-
2105 *Chlamydomonas spp.*	-	-	+	+	-	-	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	+	+
2112 *Sphaerocystis schroeteri Chodat*	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	+	+	-	-	+	-	-	+	+
2121 *Oocystis lacustris Chodat*	+	+	+	-	-	+	-	-	-	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+
2132 *Scenedesmus denticulatus Lagerhiem*	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2137 *Dictyosphaerium simplex Sukja*	+	+	+	-	-	+	+	-	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	+
2143 *Monoraphidium minutum (Nag.) Komarkova-Legnerov*	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-
2145 *Crucigenia quadrata Morr.*	-	-	+	-	-	+	+	-	-	+	-	+	-	-	-	-	-	+	-	-	+	-	+	-	-
2154 *Coelastrum microporum Naegeli*	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2167 *Elakatothrix gelatinosa Willen*	+	-	-	+	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+
2178 *Cosmarium sp.*	+	-	+	-	-	+	-	-	+	-	-	+	+	+	-	+	+	-	-	-	-	-	+	-	+
2182 *Euastrum spp.*	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-
2185 *Micrasterias sp.*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
2187 *Staurodesmus extensus (Andersson) Teiling*	+	-	-	-	-	+	+	+	+	+	+	-	+	+	+	+	-	+	+	+	+	+	+	+	+
2191 *Staurodesmus cuspidatus (Brebisson and Ralfs) Teilin*	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
2193 *Staurodesmus paradoxum Meyen*	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-
2195 *Staurodesmus bullardii G.M. Smith*	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-
2199 *Spondylosium planum (Wolle) W. and G.S. West*	-	-	+	-	-	-	-	-	-	-	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
2205 *Mougeotia sp.*	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	+
2206 *Botryococcus braunii Kutzing*	-	+	+	+	+	-	+	+	-	+	+	-	+	-	+	-	+	+	-	+	+	-	+	+	+
2215 *Tetraedron caudatum (Corda) Hansgrig*	+	-	-	-	-	-	-	-	-	+	+	+	-	+	+	+	-	+	+	+	-	+	-	+	-
2235 *Ankistrodesmus spiralis Lemmermann*	+	-	+	-	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	-	+	+	-	-	-
2247 *Oocystis gigas Archer*	-	-	-	-	-	+	-	-	+	+	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-
Euglenophyte																									
3301 *Euglena acus Ehrenberg*	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3305 *Trachelomonas volvocina Ehrenberg*	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix K. Presence (+) / Absence (-) Matrix of Phytoplankton Species, Bay-Goose Dike TSS EAS, Round 2, September 2009.

	EAS-BGE					EAS-BGW					EAS-SPC					EAS-DT					EAS-TPS				
	26-Sep-09					24-Sep-09					26-Sep-09					26-Sep-09					27-Sep-09				
Species and Code	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***	***rep-1***	***rep-2***	***rep-3***	***rep-4***	***rep-5***
Chrysophyte																									
4351 *Small chrysophyceae*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4352 *Large chrysophyceae*	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	+	+
4355 *Chrysochromulina parva Lackey*	-	-	-	-	-	-	-	-	-	-	+	+	-	+	+	+	-	+	+	-	-	-	-	+	+
4357 *Chrysococcus sp.*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4358 *Chrysostephanospaera globulifera Scherffel*	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-
4361 *Kephyrion boreale Skuja*	+	-	+	-	-	+	-	-	-	-	+	+	+	+	+	+	+	+	+	+	-	+	+	+	-
4362 *Kephyrion sp.*	+	+	-	+	+	+	+	-	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+
4363 *Spinifiromonas sirratus*	-	-	+	-	-	-	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-
4367 *Mallomonas duerrschmidtiae Siver, Hamer and Kling*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4368 *Mallomonas crassisquama (Asmund) Fott*	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+	-	-	-	-	-	-	-	-	-
4378 *Dinobryon borgei Lemmermann*	+	+	-	-	-	+	-	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-
4381 *Dinobryon mucronutom Nygaard*	+	-	-	+	-	+	-	-	-	+	-	+	+	+	+	-	-	+	+	+	+	+	+	+	-
4383 *Dinobryon bavaricum Imhof*	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4388 *Dinobryon sertularia Ehrenberg*	-	-	+	-	-	-	-	-	+	-	-	+	-	-	-	+	-	-	-	-	-	-	+	-	+
4390 *Dinobryon sociale Ehrenberg*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4394 *Epiphyxis sp.*	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
4396 *Chrysolkos skuja (Nauwerck) Willen*	+	-	+	-	+	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	-
4403 *Chrysosphaerella longispina Lauterborn*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
4411 *Bitrichia chodatii (Reverdin) Chodat*	-	-	-	-	-	+	-	-	+	-	-	-	+	-	-	-	+	+	-	-	+	-	+	-	-
4413 *Chrysochromulina laurentiana Kling*	+	+	+	+	+	+	+	+	+	-	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+
4414 *Stichogloea spp.*	-	-	-	+	-	-	-	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+
4415 *Bicoeca lacustris Clark*	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4418 *Salpingoeca frequentissima (Zach.) Lemmermann*	+	+	+	-	-	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	-	-	+	+
4425 *Mallomonas hamata Asmund*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	+	+	-	+	-	-	-
4436 *Dinobryon attenatum Hill*	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4437 *Pteridomonas sp.*	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-	+	-	-	-	-	-	-	+
Diatom																									
5446 *Gomphonema constrictum v capitata (Ehrenberg) Clev*	-	-	-	-	-	-	+	-	-	-	+	+	-	-	-	+	+	+	+	+	-	-	-	+	-
5507 *Cyclotella stelligera Cleve and Grunow*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5511 *Rhizosolenia eriense H.L. Smith*	+	+	+	-	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	-	-	-	-	-
5513 *Tabellaria fenestrata (Lyngbye) Kutzing*	-	-	-	-	+	+	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-
5514 *Tabellaria flocculsa (Roth) Kutzing*	+	-	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-
5518 *Synedra acus Kutzing*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+
5551 *Cyclotella michiganiana Skvortzow*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+
5702 *Achnanthes minutissima Kutzing*	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-	-	-	-	-	-	-	-
5720 *Cyclotella bodanica Eulenst.*	-	-	-	+	-	-	-	-	-	+	-	-	-	-	+	+	+	+	+	+	+	+	-	+	+
5860 *Diatoma vulgare Bory*	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5865 *Cymbella prostata (Berkeley) Cleve*	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5881 *Diatoma elongatum Agardh*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-
Cryptophyte																									
6554 *Rhodomonas minuta Skuja*	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6558 *Cryptomonas erosa Ehrenberg*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+
6562 *Cryptomonas reflexa (Marsson) Skuja*	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+
6565 *Cryptomonas rostratiformis Skuja*	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	+	+
6568 *Katablepharis ovalis Skuja*	+	-	+	-	-	+	-	-	-	-	+	+	-	+	+	+	+	+	+	+	-	+	-	-	-
Dinoflagellate																									
7628 *Gymnodinium mirabile Penard*	+	-	+	+	-	+	-	-	-	+	-	+	+	-	-	+	-	-	+	+	+	-	-	-	-
7631 *Gymnodinium helveticum Penard*	+	-	-	-	-	-	-	+	-	-	-	+	-	+	+	+	-	-	-	+	-	-	-	+	-
7632 *Gymnodinium sp.*	+	+	-	+	-	-	-	+	-	-	+	+	+	+	+	-	+	+	+	+	-	+	+	+	+
7635 *Peridinium willei Huitfeldt-Kaas*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
7639 *Peridinium pusillum (Penard) Lemmermann*	-	-	-	-	-	+	-	-	-	-	-	-	-	+	+	-	-	+	-	+	-	-	+	+	+
7641 *Peridinium aciculiferum Lemmermann*	-	-	-	-	-	-	-	-	-	-	+	-	+	-	+	-	-	-	-	+	-	-	-	+	-

APPENDIX L

ZOOPLANKTON SPECIES IDENTIFICATION AND BIOMASS ANALYSES, BAY-GOOSE DIKE TSS EAS, SEPTEMBER 2009

Appendix L. Zooplankton Species Identification, Bay-Goose Dike TSS EAS, September 2009.

Type of Analysis: Zoopl TAXONOMIC
Project Number: AE-09-01/2-EAS
Sampling Dates: Sept 18-27, 2009
Water Body: Meadowbank Project Lakes
No. of Samples: 12
Note: washed through a 63 micron mesh test sieve

Taxonomist: External
Data Entry: External
QA/QC: Ginger Gill

Location/Sample ID	EAS-BGW-1 TAX	EAS-DT-1 TAX	EAS-TPS-1 TAX	EAS-SPC-1 TAX	EAS-BGE-1 TAX	EAS-DUP-1 TAX
Date	18-Sep-09	18-Sep-09	19-Sep-09	19-Sep-09	19-Sep-09	18-Sep-09
BG EAS Event	1	1	1	1	1	1
Acanthocyclops vernalis Fisher	16	1				2
Cyclops scutifer Sars	728	15	1312	640	928	32
Diaptomus ashlandi Marsh	16	2	12	8	8	
Diaptomus minutus Lilljeborg	16	2	64	48	16	8
Diaptomus sicilis S.A. Forbes	582	9	768	800	992	10
Diaptomus spp. (unid. Females)	720	49	2368	1664	1404	148
Heterocope septentrionalis Juday and Muttkowski		1	24	7		
Bosmina longirostris (O.F. Muller)	64	54	24	32	64	58
Alona guttata Sars						
Chydorus sp.		1		1		2
Holopedium gibberum Zaddach	5		88	10	32	4
Daphnia longiremis Sars	32	61	16			92
Daphnia middendorffiana Fischer	64	1	480	32	16	8
Calanoida copepodite			128		168	6
Cyclopoid copepodite	96	5	416	64	96	44
Zooplankton Site Totals	2339	201	5700	3306	3724	414
Oligochaeta		1				
Harpacticoida (unid)		1				2
Chironomidae larva (unid)	8	5				10

Appendix L. Zooplankton Species Identification, Bay-Goose Dike TSS EAS, September 2009.

Type of Analysis: Zoopl TAXONOMIC
Project Number: AE-09-01/2-EAS
Sampling Dates: Sept 18-27, 2009
Water Body: Meadowbank Project Lakes
No. of Samples: 12
Note: washed through a 63 micron mesh test sieve

Taxonomist: External
Data Entry: External
QA/QC: Ginger Gill

Location/Sample ID	EAS-TPS-1 TAX	EAS-SPC-1 TAX	EAS-BGE-1 TAX	EAS-DUP-1 TAX	EAS-BGW-1 TAX	EAS-DT-1 TAX
Date	27-Sep-09	26-Sep-09	26-Sep-09	24-Sep-09	24-Sep-09	24-Sep-09
BG EAS Event	2	2	2	2	2	2
Acanthocyclops vernalis Fisher		16	64	4	96	2
Cyclops scutifer Sars	448	512	736	16	896	32
Diaptomus ashlandi Marsh		32		6	32	2
Diaptomus minutus Lilljeborg	96	62	96		96	4
Diaptomus sicilis S.A. Forbes	352	448	928	22	512	20
Diaptomus spp. (unid. Females)	406	896	1632	36	1024	44
Heterocope septentrionalis Juday and Muttkowski	24	12	15	1	1	4
Bosmina longirostris (O.F. Muller)		76	20	40	160	84
Alona guttata Sars			4	2		
Chydorus sp.		4				6
Holopedium gibberum Zaddach	40	8	8		1	
Daphnia longiremis Sars	8	32	5	84	1	59
Daphnia middendorffiana Fischer	88	8	5		13	3
Calanoida copepodite		4	64		320	
Cyclopoid copepodite	96	84	96	22	32	18
Zooplankton Site Totals	1558	2194	3673	233	3184	278
Oligochaeta						
Harpacticoida (unid)						
Chironomidae larva (unid)		4	6	9		14

APPENDIX M

ALS SEDIMENT TRAP CHEMISTRY LABORATORY REPORT, 2009

Certificate of Analysis

AZIMUTH CONSULTING GROUP INC.
ATTN: RANDY BAKER
218 - 2902 WEST BROADWAY
VANCOUVER BC V6K 2G8

Report Date: 26-JAN-10 12:48 (MT)
Version: FINAL

Lab Work Order #: **L827196** **Date Received:** **06-OCT-09**

Project P.O. #: NOT SUBMITTED
Job Reference: MEADOWBANK EAS SEDIMENT TRAPS
Legal Site Desc:
CofC Numbers:

Other Information:

Comments: ADDITIONAL 22-DEC-09 16:45

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 for twelve samples and Ash Free Dry Weight analysis for the rest of the samples.

In order to determine dry weight of the algae and sediment, samples were filtered through pre-weighed glass fiber filters. Algae and sediment found on the filter and the filter itself were then dried at 105 degrees Celsius. 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 dry sample at 550 degrees Celsius and subtracting Ash Weight from the Dry Weight of the sample.
Total Metals were analyzed by digesting dry sample (including the filter) using regular CSR digestion procedure and subsequently analyzing digests using ICPOES, ICPMS and CVAF instruments (please refer to the Methodology Section at the back of the report).

Please note that filter blanks, treated in the same manner as samples, were digested and analyzed for Total Metals. Levels of some of the Metals found in the filter blank samples (ALS samples L827196-64 and L827196-65) are quite high and this should be considered when reviewing metals data in the samples.

Natasha Markovic-Mirovic
Account Manager

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L827196-5	L827196-8	L827196-15	L827196-20	L827196-24
	Description					
	Sampled Date	12-SEP-09	12-SEP-09	15-SEP-09	12-SEP-09	15-SEP-09
	Sampled Time					
	Client ID	SP-ST3-120909-R3	SP-ST4-120909-R2	SP-ST6-150909-R1	SP-ST7-120909-R2	SP-ST8-150909-R2
Grouping	**Analyte**					
SOIL						
Metals	Aluminum (Al) (mg/kg)	27900	29000	28900	21800	32100
	Antimony (Sb) (mg/kg)	<20	<10	<10	<20	<10
	Arsenic (As) (mg/kg)	49	28.5	39.2	37	27.8
	Barium (Ba) (mg/kg)	175	171	159	102	157
	Beryllium (Be) (mg/kg)	1.5	1.86	2.34	1.3	2.10
	Bismuth (Bi) (mg/kg)	<40	<20	<20	<40	<20
	Cadmium (Cd) (mg/kg)	<1.0	0.60	0.70	<1.0	<0.50
	Calcium (Ca) (mg/kg)	4810	3910	2560	4190	2910
	Chromium (Cr) (mg/kg)	135	105	101	72.5	159
	Cobalt (Co) (mg/kg)	19.6	12.7	17.6	11.7	16.3
	Copper (Cu) (mg/kg)	71.4	96.9	126	398	97.2
	Iron (Fe) (mg/kg)	52800	32400	75800	32300	49800
	Lead (Pb) (mg/kg)	<60	<30	<30	<60	<30
	Lithium (Li) (mg/kg)	52.7	52.0	51.0	43.5	57.7
	Magnesium (Mg) (mg/kg)	14800	12100	10800	10400	14400
	Manganese (Mn) (mg/kg)	2890	595	1770	631	864
	Mercury (Hg) (mg/kg)	0.053	0.0463	0.0602	0.210	0.0274
	Molybdenum (Mo) (mg/kg)	<8.0	4.5	12.1	<8.0	5.9
	Nickel (Ni) (mg/kg)	93	75.2	98.8	50	94.6
	Phosphorus (P) (mg/kg)	1130	874	1450	780	742
	Potassium (K) (mg/kg)	5330	5100	4660	3800	5320
	Selenium (Se) (mg/kg)	<4.0	<2.0	<2.0	<4.0	<2.0
	Silver (Ag) (mg/kg)	<4.0	<2.0	<2.0	<4.0	<2.0
	Sodium (Na) (mg/kg)	<400	240	<200	<400	220
	Strontium (Sr) (mg/kg)	42.6	30.7	21.5	30.6	25.9
	Thallium (Tl) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Tin (Sn) (mg/kg)	<10	<5.0	<5.0	<10	<5.0
	Titanium (Ti) (mg/kg)	1150	850	643	980	1050
	Vanadium (V) (mg/kg)	49.2	40.9	43.5	33.6	51.9
	Zinc (Zn) (mg/kg)	133	153	163	161	139

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L827196-30	L827196-33	L827196-38	L827196-42	L827196-43
	Description					
	Sampled Date	13-SEP-09	13-SEP-09	13-SEP-09	13-SEP-09	13-SEP-09
	Sampled Time					
	Client ID	BG-ST1-130909-R4	BG-ST2-130909-R3	BG-ST3-130909-R4	BG-ST4-130909-R4	BG-ST5-130909-R1
Grouping	**Analyte**					
SOIL						
Metals	Aluminum (Al) (mg/kg)	28600	32900	31300	30900	31700
	Antimony (Sb) (mg/kg)	<10	<10	<10	<10	<10
	Arsenic (As) (mg/kg)	20.6	24.6	19.9	20.8	25.6
	Barium (Ba) (mg/kg)	121	122	122	116	164
	Beryllium (Be) (mg/kg)	1.73	1.33	1.24	1.18	1.56
	Bismuth (Bi) (mg/kg)	<20	<20	<20	<20	<20
	Cadmium (Cd) (mg/kg)	<0.50	<0.50	<0.50	0.66	<0.50
	Calcium (Ca) (mg/kg)	3120	2420	2400	2840	2900
	Chromium (Cr) (mg/kg)	173	339	289	353	241
	Cobalt (Co) (mg/kg)	14.7	21.8	20.4	20.4	22.3
	Copper (Cu) (mg/kg)	67.5	56.7	50.1	54.8	63.4
	Iron (Fe) (mg/kg)	41800	54700	50700	50500	57500
	Lead (Pb) (mg/kg)	<30	<30	<30	<30	<30
	Lithium (Li) (mg/kg)	52.8	56.2	54.6	49.9	57.7
	Magnesium (Mg) (mg/kg)	14300	20800	19800	20500	17800
	Manganese (Mn) (mg/kg)	490	699	626	882	4900
	Mercury (Hg) (mg/kg)	0.0173	0.0294	0.0204	0.0289	0.0322
	Molybdenum (Mo) (mg/kg)	<4.0	<4.0	<4.0	<4.0	4.6
	Nickel (Ni) (mg/kg)	82.6	118	106	127	126
	Phosphorus (P) (mg/kg)	530	721	622	1200	596
	Potassium (K) (mg/kg)	4810	5290	5210	4660	5480
	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
	Sodium (Na) (mg/kg)	220	220	210	<200	230
	Strontium (Sr) (mg/kg)	24.2	21.7	21.5	22.1	26.0
	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
	Titanium (Ti) (mg/kg)	1030	1010	1030	836	1040
	Vanadium (V) (mg/kg)	48.6	60.9	58.2	57.5	55.9
	Zinc (Zn) (mg/kg)	130	107	99.1	135	120

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	L827196-47	L827196-53	L827196-64	L827196-65
	Description				
	Sampled Date	16-SEP-09	26-JUL-09		
	Sampled Time				
	Client ID	BG-ST6-160909-R1	SP-ST1-260709-R1	GF FILTER BLANK 1	GF FILTER BLANK 2
SOIL					
Metals	Aluminum (Al) (mg/kg)	20300	30500	1820	3100
	Antimony (Sb) (mg/kg)	<10	<20	<10	<10
	Arsenic (As) (mg/kg)	31.3	34	74.1	123
	Barium (Ba) (mg/kg)	89.7	146	54.3	90.5
	Beryllium (Be) (mg/kg)	1.38	1.2	<0.50	<0.50
	Bismuth (Bi) (mg/kg)	<20	<40	<20	<20
	Cadmium (Cd) (mg/kg)	<0.50	<1.0	<0.50	<0.50
	Calcium (Ca) (mg/kg)	2160	3080	2970	5300
	Chromium (Cr) (mg/kg)	119	259	<2.0	<2.0
	Cobalt (Co) (mg/kg)	12.5	22.0	<2.0	<2.0
	Copper (Cu) (mg/kg)	66.6	111	<1.0	<1.0
	Iron (Fe) (mg/kg)	106000	88000	119	173
	Lead (Pb) (mg/kg)	<30	<60	<30	<30
	Lithium (Li) (mg/kg)	38.1	46.4	4.7	7.6
	Magnesium (Mg) (mg/kg)	10300	19700	689	1150
	Manganese (Mn) (mg/kg)	407	689	3.1	4.9
	Mercury (Hg) (mg/kg)	0.0344	0.036	<0.0050	<0.0050
	Molybdenum (Mo) (mg/kg)	5.6	14.6	<4.0	<4.0
	Nickel (Ni) (mg/kg)	76.9	128	<5.0	<5.0
	Phosphorus (P) (mg/kg)	1540	1110	<50	<50
	Potassium (K) (mg/kg)	3160	4900	<200	<200
	Selenium (Se) (mg/kg)	4.3	<4.0	<2.0	<2.0
	Silver (Ag) (mg/kg)	<2.0	<4.0	<2.0	<2.0
	Sodium (Na) (mg/kg)	<200	<400	<200	<200
	Strontium (Sr) (mg/kg)	14.0	28.5	28.3	47.4
	Thallium (Tl) (mg/kg)	<1.0	<1.0	<1.0	<1.0
	Tin (Sn) (mg/kg)	<5.0	10	<5.0	<5.0
	Titanium (Ti) (mg/kg)	503	1050	10.1	14.1
	Vanadium (V) (mg/kg)	34.2	58.8	<2.0	<2.0
	Zinc (Zn) (mg/kg)	119	504	1.8	2.0

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L827196-1	L827196-2	L827196-3	L827196-4	L827196-5
	Description					
	Sampled Date	21-SEP-09	21-SEP-09	12-SEP-09	12-SEP-09	12-SEP-09
	Sampled Time					
	Client ID	SP-ST2-210909-R1	SP-ST2-210909-R2	SP-ST3-120909-R1	SP-ST3-120909-R2	SP-ST3-120909-R3
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.316	0.418	0.339	0.415	0.498
	Ash Weight (g)	0.0440	0.0583	0.0582	0.0648	
	Ash Free Dry Weight (g)	0.272	0.359	0.281	0.350	

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L827196-6	L827196-7	L827196-8	L827196-9	L827196-10
	Description					
	Sampled Date	12-SEP-09	12-SEP-09	12-SEP-09	12-SEP-09	12-SEP-09
	Sampled Time					
	Client ID	SP-ST3-120909-R4	SP-ST4-120909-R1	SP-ST4-120909-R2	SP-ST4-120909-R3	SP-ST4-120909-R4
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.301	2.78	2.54	2.19	1.96
	Ash Weight (g)	0.0510	0.637		0.500	0.834
	Ash Free Dry Weight (g)	0.250	2.14		1.69	1.12

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L827196-11	L827196-12	L827196-13	L827196-14	L827196-15
	Description					
	Sampled Date	12-SEP-09	12-SEP-09	12-SEP-09	12-SEP-09	15-SEP-09
	Sampled Time					
	Client ID	SP-ST5-120909-R1	SP-ST5-120909-R2	SP-ST5-120909-R3	SP-ST5-120909-R4	SP-ST6-150909-R1
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.204	0.250	0.219	0.232	2.68
	Ash Weight (g)	0.0299	0.0310	0.0351	0.0340	
	Ash Free Dry Weight (g)	0.174	0.219	0.184	0.198	

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample ID		L827196-16	L827196-17	L827196-18	L827196-19	L827196-20
Description						
Sampled Date		15-SEP-09	15-SEP-09	15-SEP-09	12-SEP-09	12-SEP-09
Sampled Time						
Client ID		SP-ST6-150909-R2	SP-ST6-150909-R3	SP-ST6-150909-R4	SP-ST7-120909-R1	SP-ST7-120909-R2
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	2.32	2.11	2.71	0.239	0.575
	Ash Weight (g)	0.412	0.416	0.511	0.0472	
	Ash Free Dry Weight (g)	1.91	1.69	2.20	0.191	

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L827196-21	L827196-22	L827196-23	L827196-24	L827196-25
	Description					
	Sampled Date	12-SEP-09	12-SEP-09	15-SEP-09	15-SEP-09	15-SEP-09
	Sampled Time					
	Client ID	SP-ST7-120909-R3	SP-ST7-120909-R4	SP-ST8-150909-R1	SP-ST8-150909-R2	SP-ST8-150909-R3
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.319	0.246	0.746	1.29	0.794
	Ash Weight (g)	0.0598	0.0544	0.105		0.0945
	Ash Free Dry Weight (g)	0.259	0.192	0.641		0.700

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L827196-26	L827196-27	L827196-28	L827196-29	L827196-30
	Description					
	Sampled Date	15-SEP-09	13-SEP-09	13-SEP-09	13-SEP-09	13-SEP-09
	Sampled Time					
	Client ID	SP-ST8-150909-R4	BG-ST1-130909-R1	BG-ST1-130909-R2	BG-ST1-130909-R3	BG-ST1-130909-R4
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	2.55	1.70	2.16	1.40	1.75
	Ash Weight (g)	0.310	0.191	0.257	0.165	
	Ash Free Dry Weight (g)	2.24	1.51	1.90	1.24	

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L827196-31	L827196-32	L827196-33	L827196-34	L827196-35
	Description					
	Sampled Date	13-SEP-09	13-SEP-09	13-SEP-09	13-SEP-09	13-SEP-09
	Sampled Time					
	Client ID	BG-ST2-130909-R1	BG-ST2-130909-R2	BG-ST2-130909-R3	BG-ST2-130909-R4	BG-ST3-130909-R1
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.953	0.856	1.03	1.20	1.38
	Ash Weight (g)	0.0656	0.0722		0.0928	0.0747
	Ash Free Dry Weight (g)	0.888	0.783		1.11	1.30

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L827196-36	L827196-37	L827196-38	L827196-39	L827196-40
	Description					
	Sampled Date	13-SEP-09	13-SEP-09	13-SEP-09	13-SEP-09	13-SEP-09
	Sampled Time					
	Client ID	BG-ST3-130909-R2	BG-ST3-130909-R3	BG-ST3-130909-R4	BG-ST4-130909-R1	BG-ST4-130909-R2
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	1.71	1.72	1.52	1.13	1.07
	Ash Weight (g)	0.0999	0.0925		0.0877	0.0755
	Ash Free Dry Weight (g)	1.61	1.63		1.04	0.998

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L827196-41	L827196-42	L827196-43	L827196-44	L827196-45
	Description					
	Sampled Date	13-SEP-09	13-SEP-09	13-SEP-09	13-SEP-09	13-SEP-09
	Sampled Time					
	Client ID	BG-ST4-130909-R3	BG-ST4-130909-R4	BG-ST5-130909-R1	BG-ST5-130909-R2	BG-ST5-130909-R3
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	1.29	1.20	1.29	1.26	2.79
	Ash Weight (g)	0.0810			0.125	0.107
	Ash Free Dry Weight (g)	1.21			1.14	2.68

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L827196-46	L827196-47	L827196-48	L827196-49	L827196-50
	Description					
	Sampled Date	13-SEP-09	16-SEP-09	16-SEP-09	16-SEP-09	16-SEP-09
	Sampled Time					
	Client ID	BG-ST5-130909-R4	BG-ST6-160909-R1	BG-ST6-160909-R2	BG-ST6-160909-R3	BG-ST6-160909-R4
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	1.21	7.17	15.0	2.53	2.06
	Ash Weight (g)	0.118		3.02	0.446	0.393
	Ash Free Dry Weight (g)	1.09		12.0	2.09	1.67

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L827196-51	L827196-52	L827196-53	L827196-54	L827196-55
	Description					
	Sampled Date	17-SEP-09	17-SEP-09	26-JUL-09	26-JUL-09	26-JUL-09
	Sampled Time					
	Client ID	TE-ST1-170909-R1	TE-ST1-170909-R2	SP-ST1-260709-R1	SP-ST1-260709-R2	SP-ST1-260709-R3
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.295	0.609	0.512	0.527	0.468
	Ash Weight (g)	0.0625	0.112		0.0365	0.0365
	Ash Free Dry Weight (g)	0.232	0.497		0.491	0.432

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample ID		L827196-56	L827196-57	L827196-58	L827196-59	L827196-60
Description						
Sampled Date		26-JUL-09	26-JUL-09	26-JUL-09	26-JUL-09	26-JUL-09
Sampled Time						
Client ID		SP-ST1-260709-R4	SP-ST5-260709-R1	SP-ST5-260709-R2	SP-ST5-260709-R3	SP-ST5-260709-R4
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.433	0.0817	0.115	0.0685	0.122
	Ash Weight (g)	0.0312	0.0105	0.0142	0.0142	0.0136
	Ash Free Dry Weight (g)	0.402	0.0712	0.101	0.0543	0.109

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L827196-61	L827196-62	L827196-63		
	Description					
	Sampled Date	26-JUL-09	26-JUL-09	26-JUL-09		
	Sampled Time					
	Client ID	SP-ST6-260709-R1	SP-ST6-260709-R2	SP-ST6-260709-R3		
Grouping	**Analyte**					
TISSUE						
Physical Tests	Dry Weight (g)	0.122	0.408	0.339		
	Ash Weight (g)	0.0196	0.0638	0.0444		
	Ash Free Dry Weight (g)	0.102	0.344	0.295		

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
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-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.

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.

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 (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.

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA		

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

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COC # ____

Report to:	Report Format / Distribution	Service Requested:
Company: Azimuth Consulting Group Inc.	☑ Standard ☐ Other	☑ Regular Service (Default)
Contact: Randy Baker	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address: Vancouver	Email 1: rbaker@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
	Email 2: gmann@azimuthgroup.ca , mmcconnell@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 EAS Sediment Traps	
Address:	PO/AFE:	
Sample	Legal Site Description:	
Phone: Fax:	Quote #: ALSEQ09-077	
Lab Work Order # (lab use only) L827196	ALS Contact: Natasha MM; Sampler (Initials): GSM; RAH	

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-ST2-210909-R1	21-Sep-09		Other	X												
	SP-ST2-210909-R2	21-Sep-09		Other	X												
	SP-ST3-120909-R1	12-Sep-09		Other	X												
	SP-ST3-120909-R2	12-Sep-09		Other	X												
	SP-ST3-120909-R3	12-Sep-09		Other	X												
	SP-ST3-120909-R4	12-Sep-09		Other	X												
	SP-ST4-120909-R1	12-Sep-09		Other	X												
	SP-ST4-120909-R2	12-Sep-09		Other	X												
	SP-ST4-120909-R3	12-Sep-09		Other	X												
	SP-ST4-120909-R4	12-Sep-09		Other	X												

Guidelines / Regulations	Special Instructions / Hazardous Details
(Shipped in two batches; full COCs placed in both; see attached list)	Trap sampes mix of water and sediments; please contact us regarding other analyses (e.g., LOI, metal, PSA).

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)	
Relinquished By	G Mann	Date & Time:	26-Sep-09	Received By	[illegible signature]	Date & Time	10/06/09 9:10 AM	Temperature	Samples Received in Good Condition? Y / N (if no provided details)
~~Relinquished~~ By		Date & Time:		Received By		Date & Time		12°C	

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Environmental Division

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COC # ____

Report to:		Report Format / Distribution		Service Requested:
Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other		☑ Regular Service (Default)
Contact:	Randy Baker	☑ PDF ☑ Excel ☐ Fax		☐ Rush Service (2-3 Days)
Address:	Vancouver	Email 1:	rbaker@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2:	gmann@azimuthgroup.ca , mmcconnell@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 EAS Sediment Traps	
Address:		PO/AFE:		
Sample		Legal Site Description:		
Phone:	Fax:	Quote #:	ALSEQ09-077	
Lab Work Order # (lab use only)		ALS Contact:	Natasha MM	Sampler (Initials) RAH; GSM

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-ST5-120909-R1	12-Sep-09		Other	X												
	SP-ST5-120909-R2	12-Sep-09		Other	X												
	SP-ST5-120909-R3	12-Sep-09		Other	X												
	SP-ST5-120909-R4	12-Sep-09		Other	X												
	SP-ST6-150909-R1	15-Sep-09		Other	X												
	SP-ST6-150909-R2	15-Sep-09		Other	X												
	SP-ST6-150909-R3	15-Sep-09		Other	X												
	SP-ST6-150909-R4	15-Sep-09		Other	X												
	SP-ST7-120909-R1	12-Sep-09		Other	X												
	SP-ST7-120909-R2	12-Sep-09		Other	X												

Guidelines / Regulations	Special Instructions / Hazardous Details
	Trap sampes mix of water and sediments; please contact us regarding other analyses (e.g., LOI, metal, PSA).

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

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Relinquished By	G. Mann	Date & Time	26-Sep-09	Received By	[signature]	Date & Time	10/06/09 9'AM	Sample Condition (lab use only) Temperature: 12°C	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By		Date & Time		Received By		Date & Time			

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COC #

Report to:		Report Format / Distribution		Service Requested:
Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other		☑ Regular Service (Default)
Contact:	Randy Baker	☑ PDF ☑ Excel ☐ Fax		☐ Rush Service (2-3 Days)
Address:	Vancouver	Email 1:	rbaker@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2:	gmann@azimuthgroup.ca , mmcconnell@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 EAS Sediment Traps	
Address:		PO/AFE:		
Sample		Legal Site Description:		
Phone:	Fax:	Quote #:	ALSEQ09-077	
Lab Work Order # (lab use only)		ALS Contact:	Natasha MM	Sampler (Initials): GSM; RAH

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-ST7-120909-R3	12-Sep-09		Other	X												
	SP-ST7-120909-R4	12-Sep-09		Other	X												
	SP-ST8-150909-R1	15-Sep-09		Other	X												
	SP-ST8-150909-R2	15-Sep-09		Other	X												
	SP-ST8-150909-R3	15-Sep-09		Other	X												
	SP-ST8-150909-R4	15-Sep-09		Other	X												
	BG-ST1-130909-R1	13-Sep-09		Other	X												
	BG-ST1-130909-R2	13-Sep-09		Other	X												
	BG-ST1-130909-R3	13-Sep-09		Other	X												
	BG-ST1-130909-R4	13-Sep-09		Other	X												

Guidelines / Regulations	Special Instructions / Hazardous Details
	Trap sampes mix of water and sediments; please contact us regarding other analyses (e.g., LOI, metal, PSA).

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

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Relinquished By	G Mann	Date & Time:	26-Sep-09	Received By:	[signature]	Date & Time:	10/06/09 9:AM	Sample Condition (lab use only) Temperature: 12°C	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By		Date & Time:		Received By:		Date & Time:			

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COC # ____________

Report to:	
Company:	Azimuth Consulting Group Inc.
Contact:	Randy Baker
Address:	Vancouver
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:	rbaker@azimuthgroup.ca
Email 2:	gmann@azimuthgroup.ca , mmcconnell@azimuthgroup.ca
Indicate Bottles: Filtered / Preserved (F/P) →→	
Client / Project Information:	
Job #:	Meadowbank EAS Sediment Traps
PO/AFE:	
Legal Site Description:	
Quote #:	ALSEQ09-077
ALS Contact:	Natasha MM
Sampler (Initials):	RAH

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
	BG-ST2-130909-R1	13-Sep-09		Other	X												
	BG-ST2-130909-R2	13-Sep-09		Other	X												
	BG-ST2-130909-R3	13-Sep-09		Other	X												
	BG-ST2-130909-R4	13-Sep-09		Other	X												
	BG-ST3-130909-R1	13-Sep-09		Other	X												
	BG-ST3-130909-R2	13-Sep-09		Other	X												
	BG-ST3-130909-R3	13-Sep-09		Other	X												
	BG-ST3-130909-R4	13-Sep-09		Other	X												
	BG-ST4-130909-R1	13-Sep-09		Other	X												
	BG-ST4-130909-R2	13-Sep-09		Other	X												

Guidelines / Regulations	Special Instructions / Hazardous Details
	Trap sampes mix of water and sediments; please contact us regarding other analyses (e.g., LOI, metal, PSA).

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)	
Relinquished By:	G. Mann	Date & Time	26-Sep-09	Received By.	[signature]	Date & Time	10/06/09 9:10 AM	Temperature	Samples Received in Good Condition? Y / N (if no provided details)
~~Relinquished~~ By		~~Date & Time~~		Received By.		Date & Time		12°C	

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COC # ____________

Report to:		Report Format / Distribution		Service Requested:
Company:	Azimuth Consulting Group Inc.	☑ Standard ☐ Other		☑ Regular Service (Default)
Contact:	Randy Baker	☑ PDF ☑ Excel ☐ Fax		☐ Rush Service (2-3 Days)
Address:	Vancouver	Email 1:	rbaker@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2:	gmann@azimuthgroup.ca , mmcconnell@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 EAS Sediment Traps	
Address:		PO/AFE:		
Sample		Legal Site Description:		
Phone:	Fax:	Quote #:	ALSEQ09-077	
Lab Work Order # (lab use only)		ALS Contact:	Natasha MM	Sampler (Initials): GSM; RAH

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-ST4-130909-R3	13-Sep-09		Other	X												
	BG-ST4-130909-R4	13-Sep-09		Other	X												
	BG-ST5-130909-R1	13-Sep-09		Other	X												
	BG-ST5-130909-R2	13-Sep-09		Other	X												
	BG-ST5-130909-R3	13-Sep-09		Other	X												
	BG-ST5-130909-R4	13-Sep-09		Other	X												
	BG-ST6-160909-R1	16-Sep-09		Other	X												
	BG-ST6-160909-R2	16-Sep-09		Other	X												
	BG-ST6-160909-R3	16-Sep-09		Other	X												
	BG-ST6-160909-R4	16-Sep-09		Other	X												

Guidelines / Regulations	Special Instructions / Hazardous Details
	Trap sampes mix of water and sediments; please contact us regarding other analyses (e.g., LOI, metal, PSA).

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:	G Mann	Date & Time:	26-Sep-09	Received By:	[signature]	Date & Time:	10/06/09 9:10 AM	Temperature	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By:		Date & Time:		Received By:		Date & Time:		12°C	

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 688 9878
www.alsglobal.com

COC # ____________

Report to:	**Report Format / Distribution**	**Service Requested:**
Company: Azimuth Consulting Group Inc.	☑ Standard ☐ Other	☑ Regular Service (Default)
Contact: Randy Baker	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address: Vancouver	Email 1: rbaker@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
	Email 2: gmann@azimuthgroup.ca , mmcconnell@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 EAS Sediment Traps	
Address:	PO/AFE:	
Sample	Legal Site Description:	
Phone: Fax:	Quote #: ALSEQ09-077	
Lab Work Order # (lab use only)	ALS Contact: Natasha MM; Sampler (Initials): GSM; RAH	

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-ST1-170909-R1	17-Sep-09		Other	X												
	TE-ST1-170909-R2	17-Sep-09		Other	X												
	SP-ST1-260709-R1	26-Jul-09		Other	X												
	SP-ST1-260709-R2	26-Jul-09		Other	X												
	SP-ST1-260709-R3	26-Jul-09		Other	X												
	SP-ST1-260709-R4	26-Jul-09		Other	X												
	SP-ST5-260709-R1	26-Jul-09		Other	X												
	SP-ST5-260709-R2	26-Jul-09		Other	X												
	SP-ST5-260709-R3	26-Jul-09		Other	X												
	SP-ST5-260709-R4	26-Jul-09		Other	X												

Guidelines / Regulations	**Special Instructions / Hazardous Details**
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Relinquished By	G Mann	Date & Time	26-Sep-09	Received By	[signature]	Date & Time	10/06/09 910AM	Sample Condition (lab use only): Temperature 12°C	Samples Received in Good Condition? Y / N (if no provided details)
~~Relinquished~~ By		Date & Time		Received By		Date & Time			

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:	Randy Baker	☑ PDF ☑ Excel ☐ Fax	☐ Rush Service (2-3 Days)
Address:	Vancouver	Email 1: rbaker@azimuthgroup.ca	☐ Priority Service (1 Day or ASAP)
		Email 2: gmann@azimuthgroup.ca , mmcconnell@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 EAS Sediment Traps	
Address:		PO/AFE:	
Sample		Legal Site Description:	
Phone:	Fax:	Quote #: ALSEQ09-077	
Lab Work Order # (lab use only)		ALS Contact: Natasha MM / Sampler (Initials): RAH	

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-ST6-260709-R1	26-Jul-09		Other	X												
	SP-ST6-260709-R2	26-Jul-09		Other	X												
	SP-ST6-260709-R3	26-Jul-09		Other	X												

Guidelines / Regulations	Special Instructions / Hazardous Details
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Relinquished By		Date & Time		Received By		Date & Time		Sample Condition (lab use only)	
Relinquished By	G Mann	Date & Time	26-Sep-09	Received By	Deddy	Date & Time	10/06/09 9[10] AM	Temperature 12°C	Samples Received in Good Condition? Y / N (if no provided details)
Relinquished By		Date & Time		Received By		Date & Time			