# Appendix X-10

# North Inlet Sediment Investigation

REPORT

**April 1, 2011**

# NORTH INLET SEDIMENT INVESTIGATION

# Diavik Diamond Mine

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# Executive Summary

Prior to development of the Diavik Diamond Mine, North Inlet was a natural feature of the east island of Lac de Gras. During mine development, a dike was constructed across the mouth of North Inlet to isolate it from Lac de Gras. North Inlet currently operates as: (i) a final settling basin for mine water, prior to treatment by the North Inlet Water Treatment Plan (NIWTP) and release to Lac de Gras; and, (ii) a repository for sludge from the NIWTP, which is currently discharged near the head of North Inlet.

Diavik Diamond Mines Inc. (DDMI) is considering the ongoing closure of North Inlet (*i.e.,* continued physical separation from Lac de Gras), and actions that might be taken at mine closure. In June 2010, Golder Associates Ltd. (Golder) was requested by DDMI to conduct an investigation of sediment quality in North Inlet. The objective of this investigation was to answer the following two questions:

1) At mine closure, could North Inlet be opened up and allowed to naturally return to fish habitat?
2) If not, what management/remediation activities would be required to make this possible?

The study design involved sampling five stations within North Inlet and three reference stations in Lac de Gras. Surface sediments from each station were assessed for sediment chemistry, toxicity and benthic invertebrate community structure; sub-surface sediments from the North Inlet stations were assessed for sediment chemistry. NIWTP sludge was also assessed for sediment chemistry and toxicity. Sediment toxicity tests were performed on whole-sediment and sludge samples using a shrimp-like species (the amphipod *Hyalella azteca*) that lives on the sediment surface, and midge larvae (the chironomid *Chironomus tentans*) that live in the sediment during larval development before emerging as adult insects. The benthic invertebrate community was assessed by examining the number and type of invertebrates in sediment grab samples from North Inlet and Lac de Gras.

Assessment and measurement endpoints were developed as shown below. Assessment endpoints are defined as the environmental values that are to be protected. Measurement endpoints are the measureable ecological characteristics related to the assessment endpoint.

- Assessment Endpoint - Maintenance of the health and ecological integrity of the benthic invertebrate community, productivity in Lac de Gras, and fish populations.
- Measurement Endpoints - Lethal and sublethal effects of sediments and sludge on representative benthic invertebrates in laboratory toxicity tests, measuring *in situ* changes in benthic community structure, and comparing sludge, sediment and water chemistry data to applicable CCME (or other jurisdiction) guidelines for protection of aquatic life.

Results of this assessment indicate that the NIWTP sludge, four of the five North Inlet samples, and all three reference sediment samples contained elevated concentrations of some parameters that were identified as being potentially toxic to aquatic biota based on screening of data against representative, conservative environmental quality guidelines for sediment and water. However, elevated concentrations present in reference sediments were not associated with adverse biological effects, and therefore corresponding elevated concentrations could not always be clearly associated with the adverse biological effects that were observed for the sludge and North Inlet sediments.

Results of the sediment toxicity tests and benthic taxonomy analyses showed that NIWTP sludge was toxic in standard sediment toxicity tests, and that sediments from four of the North Inlet stations (NI-1 to NI-4) were also classified as toxic and had impoverished benthic invertebrate communities. In contrast, the North Inlet station located closest to the mouth of the inlet (NI-5) was generally not classified as toxic relative to the reference stations (it was only classified as potentially toxic with respect to chironomid dry weight when compared to the pooled mean reference station response), and had a benthic invertebrate community composition that was more similar to the reference stations in terms of total density and biomass (but not taxa richness) than to the other North Inlet stations. The physical characteristics of the NI-1 to NI-4 sediments were also different from NI-5, the former having varying amounts of a viscous unconsolidated algal material on the sediment surface.

Toxicity of the NIWTP sludge sample was likely (at least in part) due to the elevated total sulphide concentration in interstitial water, which was higher than the acute LC50s reported for several freshwater invertebrate species. However the sludge sample used for this study was collected from the NIWTP clarifier tank, and it is therefore possible that the elevated sulphide concentration is an artefact of sludge storage conditions and not representative of sulphide concentrations in the sludge slurry that is discharged to North Inlet. In addition, elevated TOC and total phosphorus concentrations may also have contributed to the sludge toxicity.

The NI-5 sediments had concentrations of several parameters that were above the lower-bound sediment quality guidelines (SQGs), but none that were above the upper-bound SQGs used in this assessment. In contrast, the other four North Inlet sediments had concentrations of at least one parameter that were above the upper-bound SQGs. This indicates that metals cannot be definitively excluded from consideration as stressors of potential concern.

Nutrient enrichment (elevated total phosphorus) may have contributed to the observed adverse biological effects at NI-1. However, given the low percentage of available phosphorus, and the fact that the thickest observed layer of unconsolidated material was found at this station, the substrate condition (and associated micro-habitat) appears to be a strong candidate for explaining the observed responses. Concentrations of arsenic, chromium, and nickel were elevated at this station. However, the strong responses observed for both toxicity and benthic community structure suggest a causal factor that is pronounced in influence, in contrast to the weak to moderate evidence for metal-mediated responses.

Organic or nutrient enrichment (total organic carbon [TOC] or total phosphorus) were less likely to be contributing to the observed biological effects at NI-2, NI-3 and NI-4. Nickel concentrations were above an upper-bound SQG at all three stations, and chromium concentrations were above upper-bound SQGs at two stations and could have contributed to the observed biological effects.

Although the three reference stations generally had better performance in the sediment toxicity tests and healthier benthic invertebrate communities than at least four of the North Inlet stations, concentrations of arsenic, beryllium, iron and manganese were above their respective upper-bound SQGs and were higher than concentrations reported for most North Inlet sediment samples. These comparisons indicated that arsenic, beryllium, iron, and manganese were unlikely to explain the observed pattern of responses, reducing the number of candidate contaminants of potential concern (COPCs). Accordingly, the list of primary COPCs was refined to

TOC, chromium, nickel, and total phosphorus (*i.e.,* by removing background contaminants from the preliminary list identified through screening to SQGs). Sulphide was not included as a COPC as its association with sludge toxicity may have been an artefact of sludge storage conditions.

In conclusion, the adverse biological effects (sediment toxicity and/or benthic invertebrate impoverishment) observed for the NIWTP sludge and sediments from four North Inlet stations were not attributable to a single stressor. In addition to the sulphide toxicity associated with the sludge sample, it appears that a combination of organic or nutrient enrichment contributed to adverse biological effects at some stations whereas metals may have been a contributing factor at other stations. The lack of suitable benthic habitat in areas where the layer of unconsolidated material on the sediment surface was relatively thick was also a factor. Near the mouth of North Inlet, sediment quality was similar to that observed at reference stations in Lac de Gras. Despite the adverse biological effects associated with some North Inlet sediments, there was evidence of a resident zooplankton community in the water column within North Inlet.

Although effects were observed within North Inlet, it is unlikely that opening North Inlet to Lac de Gras would adversely affect the water quality of Lac de Gras. However, with respect to whether North Inlet could be opened up at mine closure and allowed to return naturally to fish habitat, the results obtained from the 2010 study were insufficient to adequately address that question, and follow-up studies and testing will be necessary to reduce uncertainty about the suitability of North Inlet as fish habitat. It would be premature to begin to consider what management or remediation activities might be required until that question has been answered.

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# 1.0 INTRODUCTION

Prior to development of the Diavik Diamond Mine, North Inlet was a natural feature of the east island of Lac de Gras. During mine development, a dike was constructed across the mouth of North Inlet to isolate it from Lac de Gras. North Inlet currently operates as: (i) a final settling basin for mine water, prior to treatment by the North Inlet Water Treatment Plan (NIWTP) and release to Lac de Gras; and, (ii) a repository for sludge from the NIWTP, which is currently discharged near the head of North Inlet.

Diavik Diamond Mines Inc. (DDMI) is considering the ongoing closure of North Inlet (*i.e.,* continued physical separation from Lac de Gras), and actions that might be taken at mine closure. In June 2010, Golder Associates Ltd. (Golder) was requested by DDMI to conduct an investigation of sediment quality in North Inlet. The objective of this investigation was to answer the following two questions:

1) At mine closure, could North Inlet be opened up and allowed to naturally return to fish habitat?

2) If not, what management/remediation activities would be required to make this possible?

Available information regarding North Inlet sediment quality and exposure pathways was reviewed and compiled, and a conceptual site model, and a sampling and analysis plan were developed to address the above questions (Golder 2010). The study design involved sampling a series of five stations located within North Inlet, as well as three reference stations in Lac de Gras. Surficial sediments from each station were assessed for sediment chemistry, toxicity and benthic invertebrate community structure; sub-surface sediments from North Inlet were also assessed for sediment chemistry. NIWTP sludge was also assessed for sediment chemistry and toxicity. Sediment toxicity tests were performed on whole-sediment and sludge samples using a shrimp-like species (the amphipod *Hyalella azteca*) that lives on the sediment surface, and midge larvae (the chironomid *Chironomus tentans*) that live in the sediment during larval development before emerging as adult insects. The benthic invertebrate community was assessed by examining the number and type of invertebrates present in grab samples of surficial sediments from North Inlet and Lac de Gras.

Assessment and measurement endpoints were developed as shown below. Assessment endpoints are defined as the environmental values that are to be protected. Measurement endpoints are the measureable ecological characteristics related to the assessment endpoint.

- Assessment Endpoint - Maintenance of the health and ecological integrity of the benthic invertebrate community, productivity in Lac de Gras, and fish populations.
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# 2.0 METHODS

## 2.1 Sample Collection

Field sampling was conducted in early September 2010, and station locations are shown in Figure 1. Sediment grab samples (*i.e.,* surface sediments) were collected from five exposure stations in North Inlet (NI-1, NI-2, NI-3, NI-4 and NI-5) and three reference stations (REF-1, REF-2, REF-3) in Lac de Gras, northwest of the Mine Site. Water depths at these locations ranged from 8 to 13 m. Sediment core samples (*i.e.,* subsurface sediments) were collected from the five North Inlet stations, and a sample of whole sludge was collected from the NIWTP. Field datasheets are provided in Appendix A.

The North Inlet stations were spaced more closely together near the point of sludge discharge to North Inlet, to facilitate delineation of sludge-impacted sediments and to attempt to characterize gradient(s) in chemical conditions and biological responses related to the sludge. Further away from the sludge discharge, station spacing was greater because it was expected that sediment conditions would be less variable outside the sludge-impacted zone and that less intensive sampling would therefore be required. Prior to conducting the actual sediment collections, a preliminary reconnaissance survey was performed in North Inlet to determine the extent of sludge deposition and confirm the suitability of the proposed station locations. Individual grab samples were collected at eight locations along the length of the inlet. These reconnaissance grabs were photographed (Appendix A) and assessed in the field for water depth and sediment characteristics, and then discarded.

Lac de Gras reference stations were selected to match water depth, proximity to shoreline, and sediment particle size relative to the stations in North Inlet. Matching of water depth (and sediment characteristics) was essential for making meaningful comparisons of benthic invertebrate community structure, and was the reason that the existing reference stations used for DDMI’s annual aquatic environmental monitoring program AEMP; Rio Tinto 2010) were not suitable for this North Inlet sediment assessment. The reference stations for this study were located in the general area of the FF-1 reference stations used for the AEMP; however, for the purposes of this study, samples were collected closer to shore in order to match conditions expected within North Inlet.

After suitable station locations were identified through the reconnaissance survey, samples were collected by DDMI personnel with a Golder representative initially present to provide assistance and guidance as needed. The boat and sampling equipment used for sediment collection were supplied by DDMI.

NIWTP sludge discharge occurs as a slurry near the head of North Inlet, and the sludge was primarily sand. During 2010 field sampling, this discharge had a distinctive green colour and DDMI personnel advised that it typically contained a large amount of algae. Sludge deposition within North Inlet was indicated by the presence on the sediment surface of dark black-green viscous unconsolidated material that contained large amounts of algae. During sediment core sampling, the thickness of this unconsolidated layer varied with increasing distance from the discharge: 23 cm at NI-1 near the head of North Inlet, 5 to 7 cm at NI-2, 3 to 4 cm at NI-3 and NI-4, and 1 cm at NI-5 closest to the dike at the mouth of North Inlet. In contrast, sediments collected at NI-5 and at the three Lac de Gras reference stations were much more consolidated.

Following completion of the field program, sediment and sludge samples intended for chemistry analyses and toxicity testing were shipped to Maxxam Analytics (Burnaby, BC) and HydroQual Laboratories (Calgary, AB), respectively. Preserved benthic invertebrate samples were shipped to Dr. Jack Zloty (Summerland, BC).

### 2.1.1 Surface Sediment Collection

Grab samples of surface sediment for chemistry, toxicity, and benthic community analyses were collected from each exposure and reference station (total of eight stations) using an Ekman grab sampler (15 x 15 cm; 0.023-$m^2$ surface area). A minimum of 10 grabs were collected at each station: five for chemistry/toxicity, and five for benthic invertebrate analyses. At each station, these grabs were collected at random positions within a few metres of each other.

Collection procedures were the same for the chemistry/toxicity and benthic grabs, but sample processing was different (see below). Once the boat was confirmed to be on station and the GPS coordinates had been recorded, the grab sampler was deployed. Only those grab samples that met the following acceptability criteria were retained:

- The sampler was fully closed and did not contain large rocks or other debris;
- There was adequate penetration depth (*i.e.,* at least 10 cm);
- The sample was not overfilled or disturbed, and the sampler was not deployed on an angle (sediment surface did not touch the top of the sampler, and was relatively flat); and,
- The sampler was not leaking (there was overlying water present and no visible leaks).

If the grab was classified as acceptable, then sample processing proceeded as described below. Upon acceptance, the overlying water in the grab was removed using a siphon and a description of the sediment with respect to colour, particle size, odour, and presence of non-sediment materials (*e.g.,* shells, debris, biota) was recorded.

***Chemistry and Toxicity*** — At each station, five grab samples were collected to generate one composite sediment sample for chemistry analyses and five field replicate samples for sediment toxicity testing. Pre-cleaned bowls and utensils were used for subsampling and compositing these sediments. The top 5 cm of surface sediment from the first grab was removed and placed in the “replicate” bowl. This material was mixed until the sediment was homogeneous in colour and texture; one 500-mL glass jar was filled with a subsample of this homogenized sediment (Toxicity Tests Rep 1) and the remainder was transferred to the “composite” bowl. The empty “replicate” bowl was rinsed with site water, and then the process was repeated with the remaining four grabs, resulting in five 500-mL jars of sediment (Toxicity Tests Reps 1 to 5) and the “composite” bowl containing the remaining top 5 cm of sediment from the five grabs. The contents of the “composite” bowl were mixed until homogeneous in colour and texture, and then distributed to the sample containers (two 250-mL glass jars, one 500-mL glass jar[1], and one 1-L Ziploc plastic bag) for chemistry analyses. Each sample container was filled completely, sealed immediately, and placed in a cooler with ice packs.

A field duplicate sample was collected at Station NI-1 for chemistry analyses only, using a separate set of freshly collected grab samples. Once the main sampling was completed at that station, five additional grab samples were collected, the top 5 cm of surface sediment was subsampled from each grab and homogenized to generate one composite sample for chemistry analyses, and the sediment was transferred to sample containers (two 250-mL glass jars, and one 1-L Ziploc plastic bag).

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[1] The 500-mL glass jar of sediment from the composite sample was submitted to HydroQual for measurement of total ammonia in interstitial water as part of the sediment toxicity tests (this needed to be measured at each station but not on each field replicate). This jar was labelled “Toxicity Tests Ammonia Composite”.

***Benthic Community Structure*** — At each station, five grab samples were collected for benthic invertebrate community analyses. Each grab was processed separately to generate five replicate samples per station. The contents of each acceptable grab were gently rinsed through a 500-µm mesh sieve with filtered site water. The material remaining on the sieve was transferred into a 1-L plastic container using a minimal volume of filtered site water. Containers were not filled more than two-thirds full with organisms and debris. A 10% solution of buffered formalin was added to the sample to preserve all tissues; the container was sealed and then inverted repeatedly to allow proper mixing of the contents with the formalin solution.

### 2.1.2 Subsurface Sediment Collection

Sediment core samples were collected at the five North Inlet stations, using a KB gravity feed corer lined with polyacrylic core tubes (7.5-cm diameter; 0.9-m length).

The sediment quality triad (*i.e.,* chemistry, toxicity and benthos) focussed on surface sediment only. Toxicity testing was not conducted on sediment core samples because they were likely to have physical/chemical properties (*i.e.,* anoxia, elevated sulphides) that could confound toxicological results. Therefore, only chemical analyses were conducted, to assess the vertical gradient in chemical contamination at each North Inlet location. Inferences concerning the potential toxic effects of sediments at depth were based on extrapolation from the observed relationship between surface sediment chemistry and toxicity.

Three core samples were collected at each station, to generate the required sample volume for chemical analyses. Each sediment core was inspected before being accepted based on the following acceptability criteria:

- The sediment retention was at least 50% of the penetration depth;
- The sample core appeared to be undisturbed; and,
- The sample was not exposed to any contamination during handling.

Once the core was accepted, sediments from the following discrete depth intervals were subsampled:

- Top (0 – 5 cm);
- Middle (5-cm section from middle of core); and,
- Bottom (5-cm section from bottom of core).

Three sets of pre-cleaned bowls and utensils were used for subsampling and compositing these sediments, one set for each depth interval. At each station, each core sample was extruded from the core tube, measured and photographed. The applicable 5-cm depth intervals were sectioned from each core and transferred to the applicable bowl for compositing. For each depth interval, sediments from the multiple core sections were mixed until sediments were homogeneous in colour and texture, and then distributed to sample containers for chemistry analyses. Sample containers were filled completely, sealed immediately, and placed in a cooler with ice packs.

### 2.1.3 NIWTP Sludge Collection

DDMI requested that whole sludge from the NIWTP be included for chemistry analyses and sediment toxicity testing in conjunction with this North Inlet sediment investigation, to characterize the sludge and provide a comparison with the findings from the de Rosemond and Liber (2005) study. A 20-L plastic bucket of sludge was collected from the clarifier tank and shipped to HydroQual. This sludge sample was allowed to settle undisturbed for four days (at 4°C in the dark), and then the overlying water (approximately 3 L) was siphoned off and discarded. The remaining 12 L of sludge was homogenized, subsamples were collected and submitted to Maxxam for chemistry analyses, and the remainder was retained by HydroQual for toxicity testing.

### 2.1.4 Quality Assurance/Quality Control (QA/QC) - Field Program

The generation of quality data begins with sample collection; therefore, the integrity of the sample collection process is of utmost importance to the success of the investigation. To confirm sample integrity, the following were undertaken:

- Samples were collected and processed by qualified experienced personnel;
- Samples were collected in such a way that no foreign material was introduced to the sample and no material of interest escaped from the sample prior to analyses;
- Sample handling or contact with contaminating materials/surfaces was minimized;
- Samples were placed in appropriate clean containers and preserved (where appropriate) so that no material of interest was lost due to adsorption, degradation, or volatilization;
- Sufficient sample volumes were collected so that required detection limits could be met and quality control samples analyzed (including a field duplicate sample for chemistry analyses); and,
- Samples were packaged and shipped to the laboratories by appropriate means, so that holding times and storage conditions for the analyses were met.

## 2.2 Chemical Analyses

Chemical analyses were performed on samples of sediment and NIWTP sludge, and on water samples generated from the laboratory toxicity tests, as described below. Quality control (QC) measures included with these sample analyses were: a method blank, a laboratory duplicate, a spiked blank, a matrix spike, and/or a QC standard. Details of the analytical methods are available from the laboratory (Maxxam) upon request.

### 2.2.1 Sediment and Sludge Samples

Surface and subsurface sediment samples (composites prepared from grabs and cores), and the NIWTP sludge sample, were submitted to Maxxam and analysed for the following suite of parameters:

- Moisture content, sediment pH (performed on a 2:1 deionized water extract), particle size, total organic carbon (TOC);

- Acid volatile sulphides (AVS) and simultaneously extractable metals (SEM);
- Total metals[2], and total and available phosphorus; and,
- Reagents (alum and lime).

### 2.2.2 Water Samples Generated From Sediment Toxicity Tests

HydroQual measured routine water quality parameters (temperature, pH, conductivity, dissolved oxygen, alkalinity and hardness) during the sediment toxicity tests with both test species. Total ammonia and total sulphide were measured in interstitial water at the start of the *H. azteca* toxicity tests, and in overlying water at the start of both toxicity tests. Total ammonia was also measured in overlying water at the end of both toxicity tests.

In addition, HydroQual collected composite samples of overlying water from test containers at the start and end of each sediment toxicity test and submitted these to Maxxam for analyses of dissolved metals (including calcium and magnesium), and dissolved phosphorus.

## 2.3 Laboratory Toxicity Tests

Sediment toxicity tests were conducted on eight surface sediment samples (five North Inlet stations and three Lac de Gras reference stations) and one NIWTP sludge sample using the freshwater amphipod *H. azteca* and the freshwater midge *C. tentans*.

Quality control (QC) procedures incorporated into the toxicity test methods were: concurrent testing of negative (clean) controls, reference toxicant testing, maintenance of water quality conditions, use of test organisms from known sources, instrument calibration, and use of standard operating procedures.

### 2.3.1 Sediment Toxicity Tests with *Hyalella azteca*

The 14-d *H. azteca* survival and growth tests were conducted as described in Environment Canada (1997a) using the following experimental design:

- The negative control sediment was clean sand, and the control/dilution water was the standard laboratory water used by HydroQual for *H. azteca* sediment toxicity tests. Laboratory dilution water was used rather than one prepared to mimic Lac de Gras characteristics in order to avoid potential problems with test organism health associated with acclimation to Lac de Gras water.
- Test containers were 375-mL glass jars, each containing 100 mL of sediment (or sludge) and 175 mL of overlying dilution/control water.
- Five replicates were prepared per treatment, and each replicate contained 10 amphipods (2 to 9 days old at test initiation).

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[2] In this document, “metals” refers to metals as well as metalloids (such as arsenic and selenium) and other elements included in the Maxxam ICPMS scan.

- The tests were conducted for 14 days at 23 ± 1°C under a 16:8 h light:dark photoperiod.
- Overlying water was not renewed during the test; gentle aeration (2 to 3 bubbles/sec) was provided throughout the exposure period, and each test container received 3.5 mL of a mixture of fermented trout chow, yeast and alfalfa powder three times per week.
- Temperature and dissolved oxygen (DO) were measured in overlying water daily in the 5th replicate (Replicate E) of each treatment; pH, conductivity, hardness, alkalinity, and total ammonia were measured in overlying water at the start and end of the tests; total sulphide was measured in overlying water at the start of the tests.
- Final counts of survival were made on Day 14, and average individual dry weight was determined for surviving organisms from each replicate. The *H. azteca* test was considered valid if mean control survival was ≥80% and mean control individual dry weight was ≥0.1 mg/amphipod.
- A 96-h water-only reference toxicant test with copper was tested concurrently.
- Composite samples of overlying water were collected at the start and end of the tests for analyses of dissolved metals and dissolved phosphorus.

### 2.3.2 Sediment Toxicity Tests with *Chironomus tentans*

The 10-d *C. tentans* survival and growth tests were conducted as described in Environment Canada (1997b) using the following experimental design:

- The negative control sediment was clean sand, and the control/dilution water was the standard laboratory water used by HydroQual for *C. tentans* sediment toxicity tests. Laboratory dilution water was used rather than one prepared to mimic Lac de Gras characteristics in order to avoid potential problems with test organism health associated with acclimation to Lac de Gras water.
- Test containers were 375-mL glass jars, each containing 100 mL of sediment (or sludge) and 175 mL of overlying dilution/control water.
- Five replicates were prepared per treatment, and each replicate contained 10 chironomid larvae (third instar at test initiation).
- The tests were conducted for 10 days at 23 ± 1°C under a 16:8 h light:dark photoperiod.
- Overlying water was not renewed during the test; gentle aeration (2 to 3 bubbles/sec) was provided throughout the exposure period, and each test container received 3.75 mL of a ground Nutrafin$^{(TM)}$ fish flake slurry three times per week.
- Temperature and dissolved oxygen (DO) were measured in overlying water daily in the 5th replicate (Replicate E) of each treatment; pH, conductivity, hardness, alkalinity, and total ammonia were measured in overlying water at the start and end of the tests; total sulphide was measured in overlying water at the start of the tests.

- Final counts of survival were made on Day 10, and average individual dry weight was determined for surviving organisms from each replicate. The *C. tentans* test was considered valid if mean control survival was ≥70% and mean control individual dry weight was ≥0.6 mg/chironomid.
- A 96-h water-only reference toxicant test with potassium chloride (KCl) was tested concurrently.
- Composite samples of overlying water were collected at the start and end of the tests for analyses of dissolved metals and dissolved phosphorus.

## 2.4 Benthic Invertebrate Community

Five replicate grab samples were collected from each sampling station, screened (500-µm mesh) and preserved in the field for benthic community analysis, and then shipped to Dr. Jack Zloty for taxonomic processing and analysis according to standard procedures based on recommendations in Environment Canada (2002) and Gibbons *et al.* (1993). All samples were enumerated in their entirety, and no subsampling was required. Four samples were re-sorted as a QC check; no organisms were recovered during re-sorting, indicating 100% sorting efficiency.

Invertebrates were counted and identified to the lower practical taxonomic level (typically genus or species) using recognized taxonomic keys. The biomass of each replicate sample was estimated as total wet weight of the preserved organisms (including any non-benthic taxa present in the sample) in each grab sample. Invertebrate abundance data (individuals per 0.023/m$^2$ grab sample) were converted to density data (individuals per m$^2$) to facilitate comparisons with benthic data from DDMI's AEMP.

# 3.0 RESULTS

## 3.1 Chemical Analyses

### 3.1.1 Surface Sediments and NIWTP Sludge

Results of chemical analyses performed on the sludge and surface sediment grab samples are provided in Table 1. All results are presented on a dry weight basis. Detailed results are provided in the Maxxam laboratory reports in Appendix B.

Consistent with the approach used for DDMI's AEMP, sediment chemistry data were compared to sediment quality guidelines (SQGs) published by the Canadian Council of Ministers of the Environment (CCME 2002) and Ontario Ministry of Environment and Energy (OMOEE 1993). In addition, freshwater sediment quality values developed for Washington State (Avocet Consulting 2003) were used in this comparison. Sediment concentrations exceeding these SQGs are highlighted in Table 1. The OMOEE and Washington State SQGs were included because they encompass more inorganic parameters than the CCME SQGs. These Washington State values represent lowest Apparent Effect Thresholds (LAETs) derived from amphipod, chironomid or Microtox® sediment toxicity data; for this application, only the LAETs derived from amphipod or chironomid test data were used. The CCME Interim Sediment Quality Guideline (ISQG) and OMOEE Lowest Effect Level (LEL) represent lower-bound SQGs, concentrations at which adverse biological effects are rare or not expected to occur in the majority of sediment-dwelling organisms. Conversely, the CCME Probable Effect Level (PEL) and OMOEE Severe Effect Level (SEL) represent concentrations at or above which adverse biological effects often occurred in the toxicity database. The Washington State LAETs represent the highest concentration at which the biological response in the sediment toxicity test was not statistically different from the negative control.

The approach of using SQGs from multiple jurisdictions was intended to provide an indication of the uncertainty associated with these guidelines, and also to evaluate where North Inlet sediments fall along the continuum of available guidelines. As guidelines were developed for the purpose of screening, and not for quantitative evaluation of ecological risk, exceedances of one or more guidelines should not be interpreted as a direct indication of probability or magnitude of harm.

The sludge sample consisted mostly of sand-sized particles and only 24% fines (silt and clay). The North Inlet sediments consisted of 56 to 99% fines, and the reference sediments were 69 to 93% fines. Total organic carbon content (TOC) was highest in the sludge (9.94%), and ranged from 0.44 to 1.67% in the North Inlet sediments (TOC was lowest at NI-5), and from 1.6 to 2.43% in the reference sediments. Such TOC concentrations are typical of freshwater sediments and are considered appropriate for the application of laboratory toxicity tests. Sediment pH values (measured on a 2:1 deionised water extract) were: 7.14 in sludge, 7.50 to 8.34 in the North Inlet sediments, and 5.68 to 6.16 in the reference sediments.

Concentrations of most total metals and other substances were lower in the sludge sample than in the North Inlet and/or reference sediments, with the exception of: aluminum, arsenic, molybdenum, total phosphorus, sodium, strontium, and zirconium. Concentrations of most total metals were lower in reference sediments than in all or most North Inlet sediments, with the exception of: arsenic, beryllium, cobalt, copper, iron, manganese, and vanadium. Among the North Inlet sediments, NI-5 either had the lowest concentrations of most total metals or had concentrations within the range bracketed by the other four stations; bismuth was the only measured parameter that was highest at NI-5.

Samples with an excess of AVS relative to ∑SEM were assumed to have no bioavailability for divalent metal cations (*e.g.*, cadmium, copper, lead, nickel and zinc), which are typically sequestered as insoluble metal-sulphide complexes thus lowering their bioavailability to aquatic biota. The sludge and NI-1 samples had elevated AVS concentrations relative to other stations; these two samples also exhibited an excess of AVS relative to ∑SEM, and therefore divalent metals were not expected to be bioavailable. The other North Inlet and reference station samples exhibited an excess of ∑SEM (primarily due to nickel, zinc and copper); these results do not necessarily indicate toxicity of sediments, but indicate that the extractable metals have potential to cause toxicity based on potential bioavailability.

Although the total phosphorus concentration was higher in the sludge sample than in the North Inlet and reference sediments, available phosphate (orthophosphate) concentrations were orders of magnitude lower than total phosphorus in all samples and were lower in the sludge sample than in the sediment samples. The latter finding is indicative of a reduced potential for the phosphorus to exert nutrient enrichment responses on the resident biota. For the reagents, the sludge sample had the lowest lime concentration, and the calculated alum concentrations were higher in three North Inlet samples than in the sludge sample.

As shown in Table 1, concentrations of 10 parameters were above the lower-bound CCME ISQG and/or OMOEE LEL values in one or more of the sludge or surface sediment samples: TOC, arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel, and total phosphorus. Other contaminants can be confidently excluded from consideration as potential toxicants based on the inherent conservatism in the development of these lower-bound sediment quality values. Concentrations that were above the upper-bound CCME PEL and/or OMOEE SEL values, or the Washington State LAETs derived from amphipod or chironomid toxicity data, are noted below:

- TOC concentration above the LAET and very close to the SEL in the sludge;
- arsenic concentrations above the PEL, SEL and LAET in the sludge, NI-1 and all three reference station samples, with the highest concentration occurring at REF-3;
- beryllium concentrations slightly above the LAET in the three reference station samples;
- chromium concentrations above the PEL, SEL and/or LAET in the NI-1, NI-2 and NI-4 samples;
- iron concentrations above the SEL in the three reference station samples;
- manganese concentrations above the SEL in the three reference station samples;
- nickel concentrations above the SEL and LAET in the NI-1, NI-2, NI-3 and NI-4 samples; and,
- total phosphorus concentrations above the SEL in the sludge and NI-1 samples.

The above analytes were considered as potential toxicants, and the distributions of these substances (over space, and in relation to biological and toxicological endpoints) were evaluated. The magnitude by which these eight analytes exceeded their respective upper-bound SQGs ranged from a factor of less than two to a factor of six.

### 3.1.2 Subsurface Sediments

Results of chemical analyses performed on the subsurface sediment core samples are provided in Table 2; core samples were only collected from the five North Inlet stations. All results are presented on a dry weight basis. Detailed results are provided in the Maxxam laboratory reports in Appendix B.

Core penetration depths ranged from 33 to 57 cm. Results for the top 5-cm depth intervals from the core samples were generally similar to the results obtained for the surficial sediment grabs, which were composites of the top 5 cm of sediment from multiple grabs, although there were some differences. As with the sludge and surface sediment data summarized above and in Table 1, data from these sediment core samples were also compared to applicable SQGs.

Moisture content in the core sections ranged from 30 to 96%. Percent fines (silt plus clay) ranged from 12 to 98%. TOC concentrations ranged from 0.6 to 4.2%. Sediment pH values (measured on a 2:1 deionised water extract) ranged from 5.38 to 8.21.

Concentrations of most total metals appeared to be increasing over time (*i.e.,* concentrations in the top or middle 5-cm depth intervals were higher than in the bottom 5-cm depth interval) at the majority of North Inlet stations. Exceptions to this profile were observed for beryllium, cadmium, copper and manganese, which had concentrations that appeared to be decreasing over time (*i.e.,* concentrations in the top 5-cm depth interval were lower than in the middle or bottom 5-cm depth intervals) at the majority of North Inlet stations.

The top 5-cm depth interval from NI-2 had an elevated AVS concentration compared to all other samples; this was the only core sample with an excess of AVS relative to ∑SEM and therefore divalent metals were not expected to be bioavailable in this sample. All other core samples exhibited an excess of ∑SEM (primarily due to copper, nickel, and zinc). For the latter samples, these results do not necessarily indicate toxicity of sediments, but indicate that the extractable metals have potential to cause responses based on likely bioavailability.

Total phosphorus concentrations were either similar among depth intervals or decreased with increasing sediment depth. Available phosphate (orthophosphate) concentrations were orders of magnitude lower than total phosphorus in all samples; concentrations generally increased with depth at NI-1 and NI-5, and decreased with depth at the other three North Inlet stations. For the reagents, the lime and calculated alum concentrations generally decreased with increasing sediment depth.

As shown in Table 2, concentrations of 10 parameters were above the lower-bound CCME ISQG and/or OMOEE LEL values in one or more of the depth interval samples from North Inlet stations: TOC, arsenic, chromium, copper, iron, lead, manganese, nickel, total phosphorus, and zinc. Concentrations that were above the upper-bound CCME PEL and/or OMOEE SEL values, or the Washington State LAETs derived from amphipod or chironomid toxicity data, are noted below:

- Arsenic concentrations above the PEL, SEL and/or LAET at one or more depth intervals in the NI-1, NI-2, NI-3 and NI-4 samples;
- Beryllium concentrations above the LAET at one or more depth intervals in the NI-1, NI-3, NI-4 and NI-5 samples;
- Chromium concentrations above the PEL, SEL and/or LAET at one or more depth intervals in the NI-1, NI-2, NI-3 and NI-4 samples;

- Iron concentrations above the SEL at one depth interval in the NI-4 sample;
- Manganese concentrations above the SEL at one depth interval in the NI-1 and NI-2 samples;
- Nickel concentrations above the SEL and LAET at one or more depth intervals in the NI-1, NI-2, NI-3 and NI-4 samples; and,
- Total phosphorus concentrations above the SEL at one or more depth intervals in the NI-1 and NI-2 samples.

The magnitude by which these seven analytes exceeded their respective upper-bound SQGs ranged from a factor of less than two to a factor of eight.

### 3.1.3 Water Samples Generated From Sediment Toxicity Tests

Results of chemical analyses performed on water samples collected from the sediment toxicity tests are provided in Table 3 (hardness, dissolved metals, dissolved phosphorus) and Table 4 (total ammonia, total sulphide, routine water quality parameters). Detailed results are provided in the Maxxam and HydroQual laboratory reports in Appendix C and D, respectively.

Table 3 provides the water chemistry data for each of the two sediment toxicity test methods, for samples of overlying water collected at the start and end of the toxicity tests. Concentration ranges are also included for each group of water chemistry samples. There were some differences between the water chemistry results obtained for the two toxicity test methods. Overall, water hardness increased during testing; concentrations of some parameters increased during testing, whereas others decreased or remained similar.

Dissolved metals concentrations were conservatively compared to CCME water quality guidelines (WQGs) for the protection of aquatic life (CCME 2007), even though the CCME WQGs apply to total metals concentrations. Emphasis on dissolved metal exposures helped to focus the analysis on the bioavailable fractions, which are relevant to assessing potential causes of observed responses. Dissolved metals concentrations that were above CCME WQGs in overlying water samples are noted below:

- Aluminum concentrations in the sludge, all North Inlet samples, and some reference station samples;
- Arsenic concentrations in the sludge, most North Inlet samples, and some reference station samples;
- Cadmium concentrations in all North Inlet and reference station samples;
- Chromium in some North Inlet station samples;
- Copper concentrations in some or all North Inlet and reference station samples, depending on sampling event;
- Iron concentrations in some or all North Inlet and reference station samples, depending on sampling event;
- Lead concentrations in some North Inlet samples; and,

- Aluminum, cadmium, copper, iron, and mercury concentrations in one or more negative control samples.

The magnitude by which these analytes exceeded their respective upper-bound SQGs ranged from a factor of less than 2 to a factor of close to 50 (for aluminum). Also WQGs and SQGs are derived using different methods and different test species, the occurrence of exceedances of these guidelines was compared. Concentrations of arsenic, cadmium, chromium, copper, iron and lead exceeded their respective WQGs and SQGs at one or more of the North Inlet or reference stations, although not necessarily at the same stations. For example, dissolved cadmium concentrations in water samples were above the WQG in overlying water samples collected at the start and end of both toxicity tests for all North Inlet and reference stations, but sediment cadmium concentrations were only above the SQG in the NI-1 surface sediment sample. Aluminum concentrations exceeded the WQG but there was no corresponding aluminum SQG. Nickel and zinc concentrations were above their respective SQGs in surface and/or subsurface sediment samples, but dissolved water concentrations were not above the WQGs.

### 3.1.4 Quality Assurance/Quality Control (QA/QC) – Chemistry Analyses

Results of the QA/QC review of the sludge and sediment chemistry analyses showed that target analytes were not detected in the method blanks, except that barium, titanium and sulphide were measured at their respective detection limits in one method blank. The relative percent difference (RPD) values for the laboratory duplicates were within the acceptable limits of 20 to 35% RPD (depending on the parameter), and ranged from 0.1 to 13.1% RPD. Percent recovery for the spiked blanks ranged from 87 to 111%, which was within the acceptable range of 75 to 125%. Percent recovery for the matrix spikes ranged from 95 to 113% (acceptable range of 75 to 125%), except that percent recoveries for two sulphide matrix spikes were 3.9 and 38%. These low recoveries were attributed to matrix interference, and re-analyses yielded similar results. Percent recovery for the QC standard ranged from 75 to 120% (acceptable range of 70 to 130%), except that percent recovery for silver was 66 to 67%.

Results of the QA/QC review of the water chemistry analyses showed that target analytes were not detected in the method blanks, except that total aluminum, total copper and total iron were detected at concentrations slightly above their detection limits in one method blank. RPDs for laboratory duplicates were within the acceptable limit of 20% RPD. Percent recoveries for the spiked blanks (85 to 122%) and matrix spikes (85 to 115%) were within the acceptable ranges of 80 to 120%, except that percent recovery for one spiked blank for lithium was 122%.

## 3.2 Laboratory Toxicity Tests

Results of the sediment toxicity tests, and associated water quality data, are summarized in Table 4. Detailed results are provided in the HydroQual laboratory reports in Appendix D.

Test acceptability criteria for control performance were met for both sediment toxicity test methods. The sludge and North Inlet sediment samples were considered to be toxic if there was a ≥20% reduction in mean response (survival or dry weight) in the sample relative to the reference sediments. Since three reference sediments were used in this study, and the results for each were variable, these comparisons were made using the pooled mean for all three reference sediments.

### 3.2.1 Sediment Toxicity Tests With *Hyalella azteca*

Mean control survival was 94%. Mean survival for the test samples was: 12% for the sludge sample, 18 to 80% for the North Inlet sediments, and 64 to 74% for the reference sediments. Among the North Inlet sediments, mean survival was highest (80%) for NI-5 and ranged from 18 to 36% for the other four samples.

Mean control dry weight was 0.21 mg/amphipod. Mean dry weight for the test samples was: 0.13 mg/amphipod for the sludge sample, 0.06 to 0.12 mg/amphipod for the North Inlet sediments, and 0.09 to 0.20 mg/amphipod for the reference sediments. Among the North Inlet sediments, mean dry weight was greatest (0.12 mg/amphipod) for NI-5 and ranged from 0.06 to 0.10 mg/amphipod for the other four samples.

Mean results for the sludge and North Inlet sediment samples were compared to the pooled mean results for the three reference sediments, to identify the samples that were considered toxic based on a ≥20% reduction in mean response. For the survival endpoint, the sludge sample and the NI-1 to NI-4 sediment samples were classified as toxic. For the dry weight endpoint, the NI-1 to NI-4 sediment samples were classified as toxic.

The 96-h LC50 for the water-only copper reference toxicant test was 2.27 log µg/L Cu, which was within the warming limits (mean ± 2SD) reported by HydroQual for historical test performance.

Water quality parameters measured in overlying water during the 14-d *H. azteca* tests were within the following ranges: temperature (23 to 24°C), DO (0.7 to 8.0 mg/L), pH (6.5 to 8.2), conductivity (343 to 1,089 µS/cm), alkalinity (40 to >240 mg/L $CaCO_3$), and hardness (120 to 425 mg/L as $CaCO_3$). DO concentrations in the replicates used for water quality monitoring were ≥2.1 mg/L except for isolated measurements that ranged from 0.7 to 1.7 mg/L in the sludge, NI-1, NI-2, NI-4, REF-1 and REF-3 treatments. Aeration was provided at the prescribed rate of 2 to 3 bubbles/sec during the test; Environment Canada (1997a) does not specify a lower limit for DO that would invalidate the test. Survival in these replicates ranged from 10 to 90%, and was similar to the other replicates for each treatment. *Hyalella azteca* are able to tolerate conditions of low DO concentrations (Environment Canada 1997a); Nebeker *et al.* (1992) reported 96-h and 30-d LC50s of <0.3 mg/L DO for adult *H. azteca,* but Irving *et al.* (2004) reported that 80% mortality occurred when juveniles were exposed to 1.2 mg/L DO for five days. The short periods of time during which DO concentrations were low were not likely long enough that this could account for the observed mortality.

Total ammonia concentrations measured in interstitial water samples collected at the start of the *H. azteca* sediment toxicity tests ranged from 0.35 to 3.51 mg/L N, and were 0.1 mg/L N in the negative control. Concentrations were higher among the North Inlet sediments, than for the sludge or reference sediment samples. Concentrations of total ammonia measured in overlying water samples collected at the start and end of these tests ranged from <0.05 to 3.79 mg/L N. Ankley *et al.* (1995) reported 96-h LC50s for total ammonia of 105 and 64 mg/L N in tests with *H. azteca* at the range of pH and water hardness used for this study; therefore, it is unlikely that ammonia contributed to the observed sediment toxicity. This differed from the findings of de Rosemond and Liber (2005), who identified ammonia as a COPC with respect to NIWTP sludge toxicity.

Total sulphide concentrations measured in interstitial water samples collected at the start of the *H. azteca* sediment toxicity tests ranged from <0.005 to 0.047 mg/L S in the North Inlet and reference sediment samples, and were 27.3 mg/L S in the sludge sample. Total sulphide concentrations measured in overlying water at the start of both toxicity tests ranged from <0.005 to 0.032 mg/L S. Wang and Chapman (1999) reported 96-h LC50s for total sulphide ranging from 0.02 to 1.07 mg/L S for several freshwater invertebrates other than *H. azteca* and

*C. tentans*. Based on that information, it is likely that sulphide contributed to the observed toxicity of the sludge sample, but probably not in the North Inlet sediments.

### 3.2.2 Sediment Toxicity Tests With *Chironomus tentans*

Mean control survival was 82%. Mean survival for the test samples was: 10% for the sludge sample, 42 to 70% for the North Inlet sediments, and 46 to 60% for the reference sediments. Among the North Inlet sediments, mean survival was higher for NI-5 (70%) than for the other four samples (42 to 54%).

Mean control dry weight was 2.71 mg/chironomid. Mean dry weights for the test samples were: 0.65 mg/chironomid for the sludge sample, 0.30 to 1.42 mg/chironomid for the North Inlet sediments, and 1.66 to 2.22 mg/chironomid for the reference sediments. Among the North Inlet sediments, mean dry weights were 1.42 mg/chironomid for NI-5 and ranged from 0.30 to 0.48 mg/chironomid for the other four samples.

Mean results for the sludge and North Inlet sediment samples were compared to the pooled mean results for the three reference sediments, to identify the samples that were considered toxic based on a ≥20% reduction in mean response. For the survival endpoint, the sludge and NI-4 samples were classified as toxic. For the dry weight endpoint, the sludge sample and all five North Inlet sediment samples were classified as toxic.

The 96-h LC50 for the water-only KCl reference toxicant test was 0.68 log mg/L KCl, which was within the warming limits (mean ± 2SD) reported by HydroQual for historical test performance.

Water quality parameters measured in overlying water during the 10-d *C. tentans* tests were within the following ranges: temperature (23 to 24°C), DO (1.2 to 7.8 mg/L), pH (7.4 to 8.4), conductivity (253 to 690 µS/cm), alkalinity (40 to >240 mg/L $CaCO_3$), and hardness (120 to >425 mg/L as $CaCO_3$). DO concentrations in the replicates used for water quality monitoring were ≥2.2 mg/L except for isolated measurements that ranged from 1.2 to 1.7 mg/L in the sludge, NI-1, NI-2, NI-4 and REF-1 treatments. Aeration was provided at the prescribed rate of 2 to 3 bubbles/sec during the test; Environment Canada (1997b) does not specify a lower limit for DO that would invalidate the test. Survival in these replicates ranged from 0 to 80%, and was similar to the other replicates for each treatment. *Chironomus tentans* are able to tolerate conditions of low DO concentrations (Environment Canada 1997b); for example, Irving *et al.* (2004) reported that *C. tentans* survival and growth were not adversely affected in 10-d exposures to 1.2 mg/L DO. It is unlikely that low DO was the cause of the observed mortality.

At previously reported, total ammonia concentrations in interstitial water at the start of the *H. azteca* toxicity tests ranged from 0.35 to 3.51 mg/L N. Concentrations of total ammonia in overlying water at the start and end of the *C. tentans* tests ranged from <0.05 to 3.72 mg/L N. Schubauer-Berigan *et al.* (1995) reported a 10-d LC50 for total ammonia of 186 mg/L for *C. tentans* at the pH and hardness used for this study; therefore, it is unlikely that ammonia contributed to the observed sediment toxicity.

Total sulphide concentrations in interstitial water at the start of the *H. azteca* toxicity tests ranged from <0.005 to 0.047 mg/L S in the North Inlet and reference sediment samples, and were 27.3 mg/L S in the sludge sample. Total sulphide concentrations measured in overlying water at the start of the *C. tentans* tests ranged from <0.005 to 0.029 mg/L S. Based on the 96-h LC50s for total sulphide reported by Wang and Chapman (1999) that ranged from 0.02 to 1.07 mg/L S for several freshwater invertebrates other than *H. azteca* and *C. tentans,* it is likely that sulphide contributed to the observed toxicity of the sludge sample but not the North Inlet sediments.

### 3.2.3 Quality Assurance/Quality Control (QA/QC) – Toxicity Tests

A QA/QC review was performed on the data for the two sediment toxicity test methods. Sediment and sludge samples were tested within holding time limits, test acceptability criteria were met for all negative (clean) controls, reference toxicant test results were within warning limits (mean ± 2SD) reported for historical laboratory performance, and water quality parameters measured during testing were within acceptable limits with the exception of some isolated low DO measurements in both tests.

## 3.3 Benthic Invertebrate Community Structure

Results of the benthic invertebrate taxonomy analyses are summarized in Table 5 (A-D). Raw data for abundance and biomass are provided in Appendix E.

Two replicates from NI-5 contained unusually high numbers of Tubificidae (a family of oligochaete worms) relative to the other stations (this was also the only benthic taxon present in those two samples), so data for NI-5 were presented with and without data from those two replicates.

Table 5 (A) shows the total density (converted from abundance data) of all taxa for each replicate sample, as well as the mean total density for each station. These data include all the taxa that were recovered, including benthic taxa, meiofauna, and non-benthic taxa. Among the North Inlet samples, mean total density ranged from 198 to 784 individuals/m$^2$ for the NI-1 to NI-4 stations and was 27,966 individuals/m$^2$ for NI-5 (1,112 individuals/m$^2$ with the two anomalous tubificid replicates excluded). Mean total density ranged from 1,129 to 4,810 individuals/m$^2$ for the three reference stations.

When benthic invertebrate data have been enumerated and tabulated, one of the first steps in data processing is normally to remove the data for meiofauna (in this case nematodes) and any non-benthic taxa. Meiofauna are typically excluded because their small size means that they may not have been representatively sampled during field collection, and non-benthic taxa are excluded because they are not representative of the ecological compartment under investigation (*i.e.,* sediment-dwelling organisms). Meiofauna abundance may vary, but non-benthic taxa do not typically account for a large portion of the total taxa numbers in benthic samples. However, as shown in Table 5 (B), this was not the case for the 2010 North Inlet study. Non-benthic taxa (and meiofauna to a lesser extent) accounted for the majority of taxa recovered from the NI-1 to NI-4 samples. Only 8 to 17% of the organisms recovered from the NI-1 to NI-4 samples were benthic taxa, whereas >90% of the organisms recovered from NI-5 and the reference sediments were benthic taxa. Most of the non-benthic taxa were calanoid and cyclopoid copepods, and the presence of these non-benthic taxa within North Inlet indicated the existence of a resident plankton community in the water column of North Inlet. In addition, the relative lack of benthic-dwelling species is indicative of an environment that is relatively inhospitable to burrowing or epibenthic organisms.

Mean taxa richness was low (≤2 benthic taxa/grab) for all five North Inlet stations, and ranged from 9 to 13 benthic taxa/grab for the three reference stations (Table 5C). Station totals (number of benthic taxa/station) were also calculated for taxa richness, as is done for DDMI's annual AEMP (*e.g.,* Rio Tinto 2010), by adding all the different taxa present among replicates at a particular station; these station totals ranged from one to six benthic taxa/station for all five North Inlet stations, and from 16 to 23 benthic taxa/station for the three reference stations.

Mean total biomass was low (0.5 to 3.0 mg/grab) for the NI-1 to NI-4 stations, and much higher for NI-5 (818 mg/grab with all taxa included, or 26 mg/grab with the two anomalous tubificid replicates excluded). Mean total biomass ranged from 32 to 57 mg/grab for the three reference stations (Table 5; Panel D). Station totals were also calculated for total biomass.

Overall, the benthic invertebrate analyses showed that the NI-1 to NI-4 stations were impoverished with respect to total density, taxa richness, and biomass. The benthic community at NI-5 was more similar to the reference stations in terms of total density and biomass, but had low taxa richness similar to the other North Inlet stations. The three reference stations had higher mean total densities, but similar taxa richness and biomass, when compared to the FF-1 reference stations used for the 2009 AEMP (Rio Tinto 2010). Chironomids accounted for approximately half the total abundance among all stations, when the two NI-5 samples with high tubificid counts were excluded.

# 4.0 CONCLUSIONS

Results of this assessment indicate that the NIWTP sludge, four of the five North Inlet samples, and all three reference sediment samples contained elevated concentrations of some parameters that were identified as being potentially toxic to aquatic biota based on screening of data against representative, conservative environmental quality guidelines for sediment and water. However, elevated concentrations were not associated with adverse biological effects in reference station sediments, and therefore could not always be clearly associated with the adverse biological effects that were for the sludge and North Inlet sediments.

Results of the sediment toxicity tests and benthic taxonomy analyses showed that NIWTP sludge was toxic in standard sediment toxicity tests, and that sediments from four of the North Inlet stations (NI-1 to NI-4) were also classified as toxic and had impoverished benthic invertebrate communities. In contrast, the North Inlet station located closest to the mouth of the inlet (NI-5) was generally not classified as toxic relative to the reference stations (it was only classified as potentially toxic with respect to chironomid dry weight when compared to the pooled mean reference station response), and had a benthic invertebrate community composition that was more similar to the reference stations in terms of total density and biomass (but not taxa richness) than to the other North Inlet stations. The physical characteristics of the NI-1 to NI-4 sediments were also different from NI-5, the former having varying amounts of the previously described viscous unconsolidated algal material on the sediment surface.

Toxicity of the NIWTP sludge sample was likely (at least in part) due to the elevated total sulphide concentration in interstitial water, which was higher than the acute LC50s reported for several freshwater invertebrate species. However the sludge sample used for this study was collected from the NIWTP clarifier tank and it is therefore possible that the elevated sulphide concentration is an artefact of sludge storage conditions and not representative of sulphide concentrations in the sludge slurry that is discharged to North Inlet. Elevated TOC and total phosphorus concentrations may also have contributed to the sludge toxicity. Although the arsenic concentration was high in the sludge sample, it was not as high as REF-3 (which had better performance in the sediment toxicity tests). The sludge sample also had an excess of AVS relative to ∑SEM, indicating that divalent metals would not be bioavailable.

The NI-5 sediments had concentrations of five metals (arsenic, chromium, copper, iron and nickel) and total phosphorus that were above the lower-bound SQGs (ISQG and LEL), but none that were above the upper-bound SQGs (PEL, SEL and/or LAET) used in this assessment. In contrast, the other four North Inlet sediments had concentrations of up to three metals (arsenic, chromium and nickel), and total phosphorus at NI-1, that were above the upper-bound SQGs. This indicates that metals and total phosphorus cannot be definitively excluded from consideration as COPCs.

At NI-1, nutrient enrichment (elevated total phosphorus) may have contributed to the observed biological effects. However, given the low percentage of available phosphorus, and the fact that the thickest observed layer of unconsolidated material was found at this station, the substrate condition (and associated micro-habitat) appears to be a strong candidate for explaining the observed responses. Although concentrations of arsenic, chromium, and nickel were elevated at this station, the NI-1 sample also had an excess of AVS relative to ∑SEM, indicating that divalent metals were not bioavailable; bioavailability of arsenic would also have been reduced. The strong responses observed for both toxicity and benthic community structure suggest a causal factor that is pronounced in influence, in contrast to the weak to moderate evidence for metal-mediated responses.

At NI-2 to NI-4, organic or nutrient enrichment (TOC or total phosphorus) were less likely to be contributing to the observed biological effects. Nickel concentrations were above LAET values at all three stations, and chromium concentrations were above upper-bound SQGs or LAETs at two stations. The molar difference for AVS - ∑SEM was negative for sediments from the NI-2 to NI-4 stations, so metals could have been bioavailable.

Although the three reference stations generally had better performance in the sediment toxicity tests and healthier benthic invertebrate communities than at least four of the North Inlet stations, concentrations of four metals were above their respective upper-bound SQGs and/or LAETs (arsenic, beryllium, iron, and manganese) and higher than concentrations reported for most North Inlet sediment samples. These comparisons indicate that arsenic, beryllium, iron, and manganese are unlikely to explain the observed pattern of responses, reducing the number of candidate chemical stressors. Accordingly, the list of primary COPCs can be refined to include only TOC, chromium, nickel, and total phosphorus (*i.e.,* by removing background contaminants from the preliminary list identified through screening to SQGs).

In conclusion, the adverse biological effects (sediment toxicity and/or benthic invertebrate impoverishment) observed for the NIWTP sludge and sediments from four North Inlet stations could not be attributed to a single stressor. In addition to the sulphide toxicity observed for the sludge sample, it appears that a combination of organic or nutrient enrichment contributed to adverse biological effects at some stations whereas metals may have been a contributing factor at other stations. The lack of suitable benthic habitat in areas where the layer of unconsolidated material on the sediment surface was relatively thick was also a factor. Near the mouth of North Inlet, sediment quality was similar to that observed at reference stations in Lac de Gras. Despite the adverse biological effects associated with some North Inlet sediments, there was evidence of a resident zooplankton community in the water column within North Inlet, indicating that water quality conditions in North Inlet were far from inimical to aquatic life.

Although adverse effects were observed associated with North Inlet sediments to organisms living in or placed in those sediments, it is unlikely that opening North Inlet to Lac de Gras would adversely affect water quality conditions in Lac de Gras. However, with respect to whether North Inlet could be opened up at mine closure and allowed to return naturally to fish habitat, the results obtained from the 2010 study were insufficient to adequately address that question, and follow-up studies and testing will be necessary to reduce uncertainty about the suitability of North Inlet as fish habitat. It would be premature to begin to consider what management or remediation activities might be required until that question has been answered.

# 5.0 CLOSURE

We trust that the information contained in this report is sufficient for your present needs. Should you have any additional questions regarding this study, please do not hesitate to contact the undersigned.

**GOLDER ASSOCIATES LTD.**

**Reviewed by:**

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## Table 1. Chemistry Results For Sludge and Surficial Sediment Grab Samples

| Sediment Parameter | Units (dry wt) | CCME SQGs (ISQG / PEL) | OMOEE SQGs (LEL / SEL) | WDOE LAET | NIWTP Sludge | NI-1 | NI-2 | NI-3 | NI-4 | NI-5 | REF-1 | REF-2 | REF-3 | Field Duplicate (NI-1) | Min | Max | NI Mean | REF Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Moisture Content** | % | | | | 97 | 78 | 78 | 71 | 70 | 40 | 74 | 68 | 78 | 94 | 40 | 97 | 67 | 73 |
| **Particle Size** | | | | | | | | | | | | | | | | | | |
| % sand by hydrometer | % | | | | 76 | 44 | 2 | 3 | <2 | 28 | 7 | 21 | 31 | 50 | <2 | 76 | 19 | 20 |
| % silt by hydrometer | % | | | | 10 | 49 | 78 | 77 | 79 | 59 | 75 | 67 | 61 | 43 | <2 | 79 | 68 | 68 |
| Clay Content | % | | | | 14 | 7 | 20 | 20 | 20 | 13 | 18 | 11 | 8 | 8 | 7 | 20 | 16 | 12 |
| Gravel | % | | | | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | | |
| % Silt+Clay | % | | | | 24 | 56 | 98 | 97 | 99 | 72 | 93 | 78 | 69 | 51 | 24 | 99 | 84 | 80 |
| **Total Organic Carbon (TOC)** | % | | 1 / 10 | 9.82 | 9.94 | 1.67 | 1.63 | 1.3 | 1.55 | 0.44 | 1.84 | 1.6 | 2.43 | 1.78 | 0.44 | 9.94 | 1.32 | 1.96 |
| **pH (2:1 DI Water Extract)** | pH Units | | | | 7.14 | 7.62 | 8.24 | 8.34 | 7.56 | 7.50 | 6.16 | 6.02 | 5.68 | 8.00 | 5.68 | 8.34 | 7.9 | 6.0 |
| **Total Metals (by ICPMS)** | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | mg/kg | | | | 150,000 | 32,400 | 26,100 | 19,900 | 22,100 | 14,100 | 18,600 | 15,900 | 15,000 | 31,500 | 14,100 | 150,000 | 22,920 | 16,500 |
| Antimony (Sb) | mg/kg | | | 0.6 | 1.0 | 0.4 | 0.3 | 0.3 | 0.3 | 0.1 | <0.1 | <0.1 | <0.1 | 0.3 | <0.1 | 1.0 | 0.28 | 0.05 |
| Arsenic (As) | mg/kg | 5.9 / 17 | 6 / 33 | 31.4 | **136** | **37.2** | 10.0 | 2.9 | 7.1 | 10.9 | **85.0** | **71.7** | **195** | 20.1 | 2.9 | 195 | 14 | 117 |
| Barium (Ba) | mg/kg | | | | 98.2 | 322 | 386 | 264 | 381 | 102 | 149 | 127 | 123 | 309 | 98.2 | 386 | 291 | 133 |
| Beryllium (Be) | mg/kg | | | 0.46 | <0.1 | 0.4 | 0.3 | 0.3 | 0.4 | 0.3 | 0.5 | 0.6 | 0.5 | 0.3 | 0.05 | 0.6 | 0.3 | 0.5 |
| Bismuth (Bi) | mg/kg | | | | 0.3 | 0.7 | 0.8 | 1.0 | 1.2 | 1.7 | 0.3 | 0.3 | 0.2 | 0.8 | 0.2 | 1.7 | 1.1 | 0.3 |
| Cadmium (Cd) | mg/kg | 0.6 / 3.5 | 0.6 / 10 | 2.39 | 0.14 | 0.71 | 0.27 | 0.17 | 0.21 | 0.15 | 0.22 | 0.26 | 0.27 | 0.20 | 0.14 | 0.71 | 0.30 | 0.25 |
| Calcium (Ca) | mg/kg | | | | 3,110 | 8,910 | 11,000 | 8,160 | 7,660 | 3,990 | 1,430 | 1,320 | 1,090 | 8,580 | 1,090 | 11,000 | 7,944 | 1,280 |
| Chromium (Cr) | mg/kg | 37.3 / 90 | 26 / 110 | 133 | 14 | **129** | **171** | 87 | **113** | 47 | 66 | 58 | 50 | **127** | 14 | 171 | 109 | 58 |
| Cobalt (Co) | mg/kg | | | | 4.8 | 26.3 | 30.7 | 18.5 | 23.6 | 11.2 | 35.9 | 20.6 | 32.6 | 22.9 | 4.8 | 35.9 | 22 | 30 |
| Copper (Cu) | mg/kg | 35.7 / 197 | 16 / 110 | 619 | 12.7 | 36.7 | 32.9 | 31.1 | 35.6 | 33.9 | 34.9 | 33.1 | 42.8 | 29.1 | 12.7 | 42.8 | 34 | 37 |
| Iron (Fe) | mg/kg | | 20,000 / 40,000 | | 3,150 | 31,600 | 31,900 | 26,700 | 28,700 | 22,000 | **63,800** | **46,800** | **72,400** | 28,800 | 3,150 | 72,400 | 28,180 | 61,000 |
| Lead (Pb) | mg/kg | 35 / 91.3 | 31 / 250 | 335 | 4.7 | 23.9 | 23.4 | 32.6 | 32.0 | 25.4 | 5.7 | 5.9 | 4.6 | 21.4 | 4.6 | 32.6 | 27 | 5.4 |
| Magnesium (Mg) | mg/kg | | | | 4,940 | 35,900 | 48,000 | 21,600 | 31,800 | 8,190 | 9,590 | 8,410 | 6,910 | 33,900 | 4,940 | 48,000 | 29,098 | 8,303 |
| Manganese (Mn) | mg/kg | | 460 / 1,100 | | 637 | 576 | 667 | 454 | 678 | 286 | **3,500** | **1,220** | **1,930** | 567 | 286 | 3,500 | 532 | 2,217 |
| Mercury (Hg) | mg/kg | 0.17 / 0.49 | 0.2 / 2 | 0.8 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Molybdenum (Mo) | mg/kg | | | | 68.8 | 6.2 | 8.7 | 8.2 | 10.5 | 2.8 | 2.9 | 1.8 | 3.0 | 6.6 | 1.8 | 68.8 | 7.3 | 2.6 |
| Nickel (Ni) | mg/kg | | 16 / 75 | 113 | 56.9 | **286** | **419** | **169** | **260** | 51.4 | 62.5 | 57.0 | 72.1 | **277** | 51.4 | 419 | 237 | 64 |
| Phosphorus (P) | mg/kg | | 600 / 2,000 | | **6,150** | **3,360** | 1,940 | 1,520 | 1,700 | 1,590 | 1,220 | 1,230 | 1,810 | **3,090** | 1,220 | 6,150 | 2,022 | 1,420 |
| Potassium (K) | mg/kg | | | | 1,500 | 9,730 | 8,610 | 9,990 | 9,200 | 6,960 | 4,960 | 4,750 | 3,740 | 9,340 | 1,500 | 9,990 | 8,898 | 4,483 |
| Selenium (Se) | mg/kg | | | | <2 | <0.5 | 0.6 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 0.6 | 0.6 | <0.5 |
| Silver (Ag) | mg/kg | | | 3.5 | <0.05 | 0.24 | 0.22 | 0.25 | 0.25 | 0.14 | 0.06 | 0.06 | 0.06 | 0.24 | <0.05 | 0.25 | 0.22 | 0.06 |
| Sodium (Na) | mg/kg | | | | 993 | 661 | 626 | 615 | 738 | 268 | 212 | 202 | 162 | 598 | 162 | 993 | 582 | 192 |
| Strontium (Sr) | mg/kg | | | | 96.5 | 113 | 143 | 66.1 | 82.1 | 21.1 | 11.0 | 10.0 | 9.2 | 115 | 9.2 | 143 | 85 | 10 |
| Thallium (Tl) | mg/kg | | | | <0.05 | 0.53 | 0.50 | 0.57 | 0.51 | 0.43 | 0.34 | 0.27 | 0.30 | 0.52 | <0.05 | 0.57 | 0.51 | 0.30 |
| Tin (Sn) | mg/kg | | | | 0.7 | 2.0 | 1.1 | 1.3 | 1.7 | 1.3 | 0.8 | 1.2 | 0.7 | 1.3 | 0.7 | 2 | 1.5 | 0.9 |
| Titanium (Ti) | mg/kg | | | | 100 | 1,150 | 973 | 1,430 | 1,220 | 1,010 | 872 | 876 | 528 | 1,260 | 100 | 1,430 | 1,157 | 759 |
| Vanadium (V) | mg/kg | | | | 15 | 46 | 53 | 40 | 42 | 31 | 54 | 46 | 43 | 45 | 15 | 54 | 42 | 48 |
| Zinc (Zn) | mg/kg | 123 / 315 | 120 / 820 | 683 | 16 | 110 | 102 | 113 | 116 | 81 | 91 | 79 | 83 | 102 | 16 | 116 | 104 | 84 |
| Zirconium (Zr) | mg/kg | | | | 3.1 | 5.8 | 4.4 | 10.5 | 9.7 | 4.6 | 1.1 | 1.0 | 0.5 | 7.0 | 0.5 | 10.5 | 7.0 | 0.9 |
| **Acid Volatile Sulphide (AVS)** | umole/g | | | | 9.1 | 14.4 | 0.35 | 0.79 | 0.37 | 0.043 | <0.02 | 0.01 | 0.05 | 0.56 | 0.01 | 14.4 | 3.19 | 0.02 |
| **Simultaneously Extractable Metals (SEM)** | | | | | | | | | | | | | | | | | | |
| Cadmium (Cd) | umole/g | | | | <0.0002 | 0.0006 | 0.0008 | 0.0014 | 0.0005 | 0.0007 | 0.0014 | 0.0006 | 0.0021 | 0.0016 | 0.0005 | 0.0021 | 0.0008 | 0.0014 |
| Copper (Cu) | umole/g | | | | 0.006 | 0.117 | 0.113 | 0.317 | 0.120 | 0.232 | 0.322 | 0.185 | 0.565 | 0.283 | 0.006 | 0.565 | 0.180 | 0.357 |
| Lead (Pb) | umole/g | | | | 0.0021 | 0.0371 | 0.0346 | 0.137 | 0.0493 | 0.0792 | 0.0165 | 0.0080 | 0.0177 | 0.0692 | 0.0021 | 0.137 | 0.067 | 0.014 |
| Mercury (Hg) | umole/g | | | | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 |
| Nickel (Ni) | umole/g | | | | 0.077 | 1.19 | 1.51 | 2.00 | 0.923 | 0.504 | 0.578 | 0.335 | 1.01 | 3.12 | 0.077 | 2 | 1.225 | 0.641 |
| Zinc (Zn) | umole/g | | | | 0.021 | 0.525 | 0.464 | 1.47 | 0.564 | 0.802 | 0.632 | 0.438 | 0.996 | 0.979 | 0.021 | 1.47 | 0.765 | 0.689 |
| ∑SEM (umoles/g) | umole/g | | | | 0.1 | 1.9 | 2.1 | 3.9 | 1.7 | 1.6 | 1.5 | 1.0 | 2.6 | 4.5 | 0.1 | 3.9 | 2.2 | 1.7 |
| AVS - ∑SEM (umoles/g) | umole/g | | | | 9.0 | 12.5 | -1.8 | -3.1 | -1.3 | -1.6 | -1.5 | -1.0 | -2.5 | -3.9 | -3.1 | 12.5 | 1.0 | -1.7 |
| **Available Phosphate** | | | | | | | | | | | | | | | | | | |
| Orthophosphate (P) | mg/kg | | | | 28.2 | 67.0 | 70.8 | 60.9 | 71.0 | 67.9 | 68.3 | 68.0 | 67.4 | 60.9 | 28.2 | 71 | 68 | 68 |
| **Reagents** | | | | | | | | | | | | | | | | | | |
| Lime (CaO) | % | | | | 0.46 | 1.6 | 2.01 | 1.66 | 1.51 | 1.12 | 1.19 | 1.31 | 1.13 | 1.6 | 0.46 | 2.01 | 1.58 | 1.21 |
| Alum (calculated) | mg/kg | | | | 0.84 | 1.32 | 1.41 | 0.51 | 1.78 | 0.47 | 0.16 | 0.16 | 0.26 | 0.86 | 0.16 | 1.78 | 1.10 | 0.19 |

**Legend:**

| | |
|---|---|
| Concentration above CCME ISQG | 🟨 |
| Concentration above CCME PEL | 🟧 |
| Concentration above OMOEE LEL | ☐ |
| Concentration above OMOEE SEL | **xx** |
| Concentration above WDOE LAET | ☐ |

### Table 2. Chemistry Results for Subsurface Sediment Core Samples From North Inlet Stations

| Sediment Parameter | Units (dry wt) | CCME SQGs (ISQG / PEL) | OMOEE SQGs (LEL / SEL) | WDOE LAET | NI-1 Surface | NI-1 Middle | NI-1 Bottom | NI-2 Surface | NI-2 Middle | NI-2 Bottom | NI-3 Surface | NI-3 Middle | NI-3 Bottom | NI-4 Surface | NI-4 Middle | NI-4 Bottom | NI-5 Surface | NI-5 Middle | NI-5 Bottom | Min | Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Moisture** | % | | | | 96 | 44 | 30 | 88 | 39 | 43 | 77 | 68 | 68 | 69 | 78 | 66 | 59 | 73 | 74 | 30 | 96 |
| **Particle Size** | | | | | | | | | | | | | | | | | | | | | |
| % sand by hydrometer | % | | | | 87 | 5 | 22 | 42 | 26 | 27 | - | <2 | <2 | 32 | 68 | 58 | 28 | 69 | 76 | <2 | 87 |
| % silt by hydrometer | % | | | | 11 | 72 | 68 | 46 | 59 | 64 | - | 68 | 77 | 49 | 28 | 36 | 52 | 28 | 19 | <2 | 77 |
| Clay Content | % | | | | <2 | 24 | 11 | 12 | 15 | 9 | - | 30 | 21 | 19 | 4 | 6 | 21 | 2 | 4 | 2 | 30 |
| Gravel | % | | | | <2 | <2 | <2 | <2 | <2 | <2 | - | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 |
| % Silt+Clay | % | | | | 12 | 96 | 79 | 58 | 74 | 73 | - | 98 | 98 | 68 | 32 | 42 | 73 | 30 | 23 | 12 | 98 |
| **Total Organic Carbon (TOC)** | % | | 1 / 10 | 9.82 | 4.15 | | 0.77 | 2.95 | 0.76 | 0.65 | 1.44 | 1.57 | 3.14 | 1.57 | 3.79 | 2.73 | 0.73 | 3.77 | 3.57 | 0.65 | 4.15 |
| **pH (2:1 DI Water Extract)** | pH Units | | | | 8.20 | 8.12 | 7.17 | 8.21 | 7.22 | 5.74 | 8.20 | 8.13 | 6.38 | 7.99 | 6.47 | 5.38 | 7.97 | 6.54 | 6.10 | 5.38 | 8.21 |
| **Total Metals (by ICPMS)** | | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | mg/kg | | | | 57,000 | 32,000 | 12,700 | 37,600 | 12,700 | 12,700 | 20,100 | 25,100 | 15,100 | 23,400 | 19,400 | 18,800 | 16,900 | 15,300 | 17,200 | 12,700 | 57,000 |
| Antimony (Sb) | mg/kg | | | 0.6 | 0.4 | 0.3 | <0.1 | 0.4 | <0.1 | <0.1 | 0.3 | 0.2 | <0.1 | 0.3 | <0.1 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | 0.4 |
| Arsenic (As) | mg/kg | 5.9 / 17 | 6 / 33 | 31.4 | 29.7 | 14.5 | 25.1 | 15.7 | **101** | 13.4 | 3.5 | 13.0 | 31.9 | 6.4 | **72.0** | **46.8** | 11.6 | 13.1 | 11.2 | 3.5 | 101 |
| Barium (Ba) | mg/kg | | | | 485 | 414 | 90.8 | 443 | 143 | 119 | 259 | 451 | 129 | 395 | 170 | 155 | 179 | 125 | 136 | 90.8 | 485 |
| Beryllium (Be) | mg/kg | | | 0.46 | 0.3 | 0.5 | 0.5 | 0.4 | 0.4 | 0.4 | 0.3 | 0.7 | 0.6 | 0.5 | 0.8 | 0.7 | 0.5 | 0.7 | 0.7 | 0.3 | 0.8 |
| Bismuth (Bi) | mg/kg | | | | 0.6 | 1.0 | 0.3 | 0.9 | 0.9 | 0.3 | 1.0 | 1.7 | 0.4 | 0.9 | 0.5 | 0.5 | 2.1 | 1.5 | 0.6 | 0.3 | 2.1 |
| Cadmium (Cd) | mg/kg | 0.6 / 3.5 | 0.6 / 10 | 2.39 | 0.18 | 0.25 | 0.09 | 0.27 | 0.11 | 0.19 | 0.20 | 0.35 | 0.27 | 0.19 | 0.57 | 0.45 | 0.18 | 0.29 | 0.40 | 0.09 | 0.57 |
| Calcium (Ca) | mg/kg | | | | 14,000 | 9,730 | 1,290 | 11,500 | 1,750 | 916 | 8,110 | 8,670 | 1,680 | 8,030 | 1,590 | 1,260 | 4,440 | 1,770 | 1,520 | 916 | 14,000 |
| Chromium (Cr) | mg/kg | 37.3 / 90 | 26 / 110 | 133 | **137** | **143** | 43 | **152** | 46 | 47 | 87 | **203** | 50 | **120** | 65 | 64 | 65 | 55 | 60 | 43 | 203 |
| Cobalt (Co) | mg/kg | | | | 23.9 | 27.5 | 23.0 | 26.9 | 20.5 | 15.3 | 18.2 | 39.8 | 13.5 | 24.1 | 38.2 | 40.8 | 14.6 | 13.4 | 13.6 | 13.4 | 40.8 |
| Copper (Cu) | mg/kg | 35.7 / 197 | 16 / 110 | 619 | 28.7 | 37.0 | 25.5 | 35.6 | 29.2 | 29.2 | 31.9 | 79.5 | 48.5 | 36.9 | 80.3 | 74.0 | 35.9 | 51.0 | 64.4 | 25.5 | 80.3 |
| Iron (Fe) | mg/kg | | 20,000 / 40,000 | | 26,100 | 30,200 | 24,600 | 32,200 | 32,200 | 21,600 | 26,500 | 35,000 | 25,300 | 29,300 | **48,900** | 38,700 | 25,900 | 20,500 | 21,100 | 20,500 | 48,900 |
| Lead (Pb) | mg/kg | 35 / 91.3 | 31 / 250 | 335 | 18.1 | 26.2 | 4.2 | 23.2 | 6.3 | 4.6 | 34.2 | 27.9 | 5.3 | 32.0 | 7.4 | 6.0 | 28.8 | 7.6 | 6.3 | 4.2 | 34.2 |
| Magnesium (Mg) | mg/kg | | | | 46,900 | 41,100 | 5,770 | 45,500 | 6,830 | 6,190 | 22,300 | 53,800 | 6,810 | 33,400 | 8,610 | 8,240 | 13,600 | 7,060 | 7,650 | 5,770 | 53,800 |
| Manganese (Mn) | mg/kg | | 460 / 1,100 | | 898 | 803 | **1,370** | 855 | **4,110** | 526 | 499 | 775 | 281 | 770 | 641 | 429 | 410 | 283 | 264 | 264 | 4,110 |
| Mercury (Hg) | mg/kg | 0.17 / 0.49 | 0.2 / 2 | 0.8 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Molybdenum (Mo) | mg/kg | | | | 8.0 | 7.0 | 1.6 | 10.4 | 2.2 | 1.1 | 11.5 | 10.7 | 2.6 | 11.9 | 4.1 | 3.4 | 4.9 | 1.9 | 2.2 | 1.1 | 11.9 |
| Nickel (Ni) | mg/kg | | 16 / 75 | 113 | **337** | **345** | 30.2 | **345** | 39.8 | 39.8 | **165** | **559** | 44.1 | **276** | **117** | **122** | 91.1 | 47.8 | 56.8 | 30.2 | 559 |
| Phosphorus (P) | mg/kg | | 600 / 2,000 | | **4,150** | **2,320** | 704 | **2,780** | 784 | 758 | 1,670 | 1,880 | 982 | 1,540 | 1,690 | 1,420 | 1,740 | 804 | 824 | 704 | 4,150 |
| Potassium (K) | mg/kg | | | | 7,590 | 8,480 | 3,420 | 9,610 | 3,860 | 3,860 | 9,860 | 6,800 | 3,900 | 9,150 | 4,510 | 4,530 | 7,170 | 4,440 | 4,680 | 3,420 | 9,860 |
| Selenium (Se) | mg/kg | | | | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 0.7 | 0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 0.7 |
| Silver (Ag) | mg/kg | | | 3.5 | 0.12 | 0.20 | <0.05 | 0.21 | 0.07 | <0.05 | 0.23 | 0.24 | 0.09 | 0.21 | 0.10 | 0.11 | 0.14 | 0.08 | 0.08 | <0.05 | 0.24 |
| Sodium (Na) | mg/kg | | | | 1,140 | 715 | 199 | 771 | 221 | 179 | 674 | 562 | 254 | 778 | 467 | 274 | 396 | 319 | 295 | 179 | 1,140 |
| Strontium (Sr) | mg/kg | | | | 224 | 132 | 11.3 | 161 | 15.4 | 6.1 | 69.5 | 111 | 11.1 | 90.3 | 17.6 | 10.8 | 36.2 | 16.6 | 11.3 | 6.1 | 224 |
| Thallium (Tl) | mg/kg | | | | 0.44 | 0.49 | 0.20 | 0.57 | 0.20 | 0.22 | 0.54 | 0.40 | 0.26 | 0.49 | 0.42 | 0.38 | 0.46 | 0.24 | 0.30 | <0.4 | 0.57 |
| Tin (Sn) | mg/kg | | | | 1.4 | 1.1 | 0.4 | 1.4 | 0.4 | 0.5 | 1.4 | 0.9 | 0.5 | 1.2 | 0.6 | 0.6 | 1.1 | 1.0 | 0.5 | 0.4 | 1.4 |
| Titanium (Ti) | mg/kg | | | | 773 | 939 | 638 | 769 | 635 | 732 | 1,340 | 983 | 668 | 910 | 704 | 833 | 969 | 667 | 692 | 635 | 1,340 |
| Vanadium (V) | mg/kg | | | | 42 | 49 | 36 | 55 | 37 | 38 | 40 | 54 | 42 | 43 | 56 | 56 | 36 | 46 | 54 | 36 | 56 |
| Zinc (Zn) | mg/kg | 123 / 315 | 120 / 820 | 683 | 83 | 104 | 49 | 109 | 51 | 63 | 111 | 101 | 86 | 115 | 146 | 133 | 95 | 80 | 109 | 49 | 146 |
| Zirconium (Zr) | mg/kg | | | | 4.1 | 4.1 | 0.8 | 2.6 | 1.8 | 1.6 | 8.4 | 9.7 | 1.2 | 4.1 | 1.5 | 2.0 | 4.1 | 0.8 | 1.2 | 0.8 | 9.7 |
| **Acid Volatile Sulphide (AVS)** | umole/g | | | | 0.4 | 1.49 | 0.008 | 26.3 | 0.012 | 0.031 | 0.33 | 0.05 | <0.01 | 0.14 | 0.05 | <0.02 | 0.07 | 0.12 | 0.05 | <0.01 | 26.3 |
| **Simultaneously Extractable Metals (SEM)** | | | | | | | | | | | | | | | | | | | | | |
| Cadmium (Cd) | umole/g | | | | 0.0012 | 0.0007 | 0.0004 | 0.0005 | 0.0010 | 0.0010 | 0.0128 | 0.0031 | 0.0010 | 0.0007 | 0.0062 | 0.0033 | 0.0015 | 0.0007 | 0.0008 | 0.0004 | 0.0128 |
| Copper (Cu) | umole/g | | | | 0.172 | 0.132 | 0.196 | 0.066 | 0.418 | 0.263 | 0.693 | 0.915 | 0.267 | 0.161 | 1.21 | 0.845 | 0.416 | 0.206 | 0.257 | 0.066 | 1.21 |
| Lead (Pb) | umole/g | | | | 0.0564 | 0.0409 | 0.0085 | 0.0206 | 0.0263 | 0.0107 | 0.672 | 0.0912 | 0.0094 | 0.0556 | 0.0299 | 0.0203 | 0.134 | 0.0078 | 0.0078 | 0.0078 | 0.672 |
| Mercury (Hg) | umole/g | | | | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 |
| Nickel (Ni) | umole/g | | | | 3.71 | 1.31 | 0.229 | 0.781 | 0.579 | 0.362 | 2.08 | 6.12 | 0.271 | 1.15 | 1.93 | 1.53 | 1.19 | 0.192 | 0.241 | 0.192 | 6.12 |
| Zinc (Zn) | umole/g | | | | 0.488 | 0.492 | 0.332 | 0.320 | 0.687 | 0.524 | 2.39 | 0.982 | 0.502 | 0.633 | 2.18 | 1.55 | 1.30 | 0.311 | 0.403 | 0.311 | 2.39 |
| ∑SEM (umoles/g) | umole/g | | | | 4.4 | 2.0 | 0.8 | 1.2 | 1.7 | 1.2 | 5.8 | 8.1 | 1.1 | 2.0 | 5.4 | 3.9 | 3.0 | 0.7 | 0.9 | 0.7 | 8.1 |
| AVS - ∑SEM (umoles/g) | umole/g | | | | -4.0 | -0.5 | -0.8 | 25.1 | -1.7 | -1.1 | -5.5 | -8.1 | -1.0 | -1.9 | -5.3 | -3.9 | -3.0 | -0.6 | -0.9 | -8.1 | 25.1 |
| **Available Phosphate** | | | | | | | | | | | | | | | | | | | | | |
| Orthophosphate (P) | mg/kg | | | | 70.4 | 77.4 | 72.9 | 94.5 | 69.0 | 61.2 | 75.8 | 91.3 | 68.2 | 79.5 | 77.7 | 72.7 | 69.8 | 75.8 | 80.9 | 61.2 | 94.5 |
| **Reagents** | | | | | | | | | | | | | | | | | | | | | |
| Lime (CaO) | % | | | | 2.2 | NM | 1.49 | 1.87 | 1.54 | 1.51 | 1.65 | 1.58 | 1.36 | 1.48 | 1.19 | 1.26 | 1.12 | 1.26 | 1.22 | 1.12 | 2.2 |
| Alum (calculated) | mg/kg | | | | NM | NM | 0.4198 | 3.1852 | 0.3704 | 0.4444 | 0.9259 | 1.4445 | 0.6173 | 2.0000 | 0.6049 | 0.5309 | 0.8272 | 0.3580 | 0.2346 | 0.23 | 3.19 |

**Legend:**

| | |
|---|---|
| Concentration above CCME ISQG | 🟨 |
| Concentration above CCME PEL | 🟧 |
| Concentration above OMOEE LEL | ☐ |
| Concentration above OMOEE SEL | **xx** |
| Concentration above WDOE LAET | ☐ |

NM = not measured

## Table 3. Chemistry Results For Water Samples Collected From Sediment Toxicity Tests

### A. Results For Water Samples Collected From *Hyalella azteca* Sediment Toxicity Tests

| Parameter | Units | CCME WQG | Day 0 Results | | | | | | | | | | | | Day 14 Results | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Negative Control | NIWTP Sludge | NI-1 | NI-2 | NI-3 | NI-4 | NI-5 | REF-1 | REF-2 | REF-3 | Min | Max | Negative Control | NIWTP Sludge | NI-1 | NI-2 | NI-3 | NI-4 | NI-5 | REF-1 | REF-2 | REF-3 | Min | Max |
| **Hardness (calculated as CaCO3)** | mg/L | | 331 | 194 | 301 | 278 | 268 | 223 | 197 | 113 | 105 | 98.5 | 98.5 | 331 | 357 | 228 | 380 | 386 | 344 | 324 | 264 | 188 | 150 | 149 | 149 | 386 |
| **Dissolved Metals (by ICPMS)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | µg/L | 100 | 1230 | 2510 | 766 | 562 | 327 | 417 | 202 | 167 | 291 | 1530 | 167 | 2510 | 228 | 429 | 896 | 206 | 137 | 139 | 456 | 294 | 51 | 108 | 51 | 896 |
| Antimony (Sb) | µg/L | | <0.5 | <0.5 | 0.5 | 0.6 | 0.7 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 0.7 | <0.5 | 0.7 | 0.9 | 0.5 | 0.7 | 0.6 | 0.6 | <0.5 | <0.5 | <0.5 | <0.5 | 0.9 |
| Arsenic (As) | µg/L | 5 | 1 | 18.3 | 25 | 14.1 | 10.3 | 8.9 | 9.9 | 0.9 | 1.7 | 6.8 | 0.9 | 25 | 1.6 | 12.2 | 8.5 | 11.4 | 4.7 | 2.3 | 7.5 | 1.6 | 1.8 | 5.7 | 1.6 | 12.2 |
| Barium (Ba) | µg/L | | 179 | 106 | 195 | 280 | 186 | 341 | 100 | 54 | 70 | 116 | 54 | 341 | 163 | 99 | 216 | 332 | 198 | 369 | 116 | 110 | 104 | 142 | 99 | 369 |
| Beryllium (Be) | µg/L | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Bismuth (Bi) | µg/L | | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Boron (B) | µg/L | | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | 50 | 50 | <50 | <50 | <50 | <50 | <50 | <50 | 50 |
| Cadmium (Cd) | µg/L | 0.017 | 0.12 | <0.01 | 0.03 | 0.04 | 0.04 | 0.03 | 0.03 | 0.15 | 0.22 | 0.3 | <0.01 | 0.3 | 0.04 | 0.01 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.22 | 0.36 | 0.4 | 0.01 | 0.4 |
| Calcium (Ca) | µg/L | | 90,900 | 56,700 | 59,700 | 61,100 | 63,900 | 53,500 | 54,200 | 35,400 | 33,500 | 30,800 | 30800 | 90900 | 98,600 | 70,200 | 91,800 | 95,000 | 88,400 | 87,600 | 75,300 | 57,900 | 47,000 | 47,100 | 47000 | 98600 |
| Chromium (Cr) | µg/L | 8.9 | 3 | <1 | 2 | 3 | 1 | 2 | <1 | <1 | 1 | 5 | <1 | 5 | 1 | <1 | 2 | <1 | <1 | <1 | 1 | <1 | <1 | <1 | <1 | 2 |
| Cobalt (Co) | µg/L | | 1.4 | <0.5 | 0.6 | 1 | 0.5 | 1 | 0.6 | 2.4 | 5.7 | 23.1 | <0.5 | 23.1 | 0.6 | <0.5 | 0.8 | 0.8 | 0.6 | 1.2 | 1 | 1.3 | 2.7 | 7.5 | <0.5 | 7.5 |
| Copper (Cu) | µg/L | 4 | 3.1 | 0.5 | 1.1 | 5.4 | 4 | 1.4 | 1.7 | 2 | 2.1 | 7.7 | 0.5 | 7.7 | 3.4 | 0.3 | 1.5 | 1.4 | 1.3 | 1 | 4.7 | 4.8 | 5.6 | 7.2 | 0.3 | 7.2 |
| Iron (Fe) | µg/L | 300 | 2050 | 101 | 409 | 569 | 331 | 546 | 305 | 385 | 832 | 4280 | 101 | 4280 | 248 | 15 | 426 | 146 | 77 | 76 | 575 | 545 | 184 | 306 | 15 | 575 |
| Lead (Pb) | µg/L | 7 | 1.9 | 0.2 | 0.8 | 0.9 | 2.5 | 1.1 | 1.4 | 0.3 | 0.3 | 0.7 | 0.2 | 2.5 | 0.4 | <0.2 | 0.7 | 0.3 | 0.4 | 0.3 | 2.5 | 0.3 | <0.2 | 0.2 | <0.2 | 2.5 |
| Lithium (Li) | µg/L | | 8 | 5 | 7 | 10 | 25 | 17 | 21 | <5 | <5 | 7 | <5 | 25 | 7 | <5 | <5 | 6 | 22 | 13 | 18 | 6 | 6 | 6 | <5 | 22 |
| Magnesium (Mg) | µg/L | | 25,300 | 12,600 | 37,000 | 30,500 | 26,400 | 21,700 | 15,100 | 6,070 | 5,150 | 5,270 | 5150 | 37000 | 27,000 | 12,700 | 36,600 | 36,200 | 29,900 | 25,700 | 18,400 | 10,600 | 8,000 | 7,590 | 7590 | 36600 |
| Manganese (Mn) | µg/L | | 154 | 3140 | 416 | 363 | 325 | 1620 | 566 | 4260 | 5940 | 8350 | 154 | 8350 | 19 | 2220 | 98 | 273 | 128 | 1080 | 61 | 2200 | 6130 | 9240 | 19 | 9240 |
| Mercury (Hg) | µg/L | 0.026 | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.04 | <0.02 | <0.02 | <0.02 | <0.02 | 0.04 | 0.03 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.03 |
| Molybdenum (Mo) | µg/L | | 6 | 5 | 23 | 29 | 41 | 34 | 11 | <1 | <1 | <1 | <1 | 41 | 6 | 19 | 31 | 28 | 30 | 39 | 15 | <1 | <1 | <1 | <1 | 39 |
| Nickel (Ni) | µg/L | 150 | 4 | 3 | 14 | 27 | 14 | 28 | 8 | 19 | 32 | 55 | 3 | 55 | 2 | 5 | 27 | 39 | 31 | 53 | 17 | 29 | 65 | 63 | 2 | 65 |
| Potassium (K) | µg/L | | 4,750 | 13,200 | 21,000 | 22,000 | 19,900 | 16,600 | 13,700 | 3,020 | 2,940 | 3,340 | 2940 | 22000 | 8,390 | 13,000 | 19,700 | 22,000 | 19,100 | 15,900 | 15,400 | 7,560 | 7,160 | 8,210 | 7160 | 22000 |
| Selenium (Se) | µg/L | 1 | 0.2 | 0.3 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.3 | 0.2 | 0.1 | <0.1 | 0.1 | 0.1 | 0.1 | 0.1 | <0.1 | 0.1 | 0.1 | <0.1 | 0.2 |
| Silicon (Si) | µg/L | | 5000 | 1100 | 3200 | 4500 | 6700 | 7900 | 7800 | 2800 | 4000 | 8100 | 1100 | 8100 | 4100 | 400 | 2600 | 4400 | 7300 | 6900 | 9000 | 5300 | 6500 | 11600 | 400 | 11600 |
| Silver (Ag) | µg/L | 0.1 | 0.03 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.03 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.03 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.03 |
| Sodium (Na) | µg/L | | 36,400 | 32,400 | 41,300 | 40,100 | 40,200 | 39,000 | 33,800 | 16,600 | 16,100 | 16,500 | 16100 | 41300 | 45,400 | 35,500 | 54,300 | 54,100 | 51,300 | 47,100 | 41,000 | 29,300 | 26,700 | 29,700 | 26700 | 54300 |
| Strontium (Sr) | µg/L | | 263 | 206 | 810 | 824 | 732 | 626 | 510 | 85 | 67 | 66 | 66 | 824 | 322 | 157 | 831 | 991 | 782 | 739 | 596 | 162 | 108 | 104 | 104 | 991 |
| Sulphur (S) | µg/L | | 19,000 | 35,000 | 5,000 | 9,000 | 10,000 | 12,000 | 6,000 | 7,000 | 8,000 | 6,000 | 5000 | 35000 | 21,000 | 48,000 | 19,000 | 17,000 | 19,000 | 29,000 | 13,000 | 12,000 | 12,000 | 13,000 | 12000 | 48000 |
| Thallium (Tl) | µg/L | 0.8 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.07 | 0.18 | <0.05 | 0.18 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.1 | 0.13 | 0.23 | <0.05 | 0.23 |
| Tin (Sn) | µg/L | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Titanium (Ti) | µg/L | | 14 | <5 | 13 | 23 | 19 | 25 | 12 | 12 | 23 | 111 | <5 | 111 | <5 | <5 | 24 | 5 | <5 | <5 | 22 | 17 | <5 | 6 | <5 | 24 |
| Uranium (U) | µg/L | | 0.7 | 5.8 | 62.3 | 51.4 | 29.6 | 28 | 13.2 | <0.1 | <0.1 | 0.5 | <0.1 | 62.3 | 0.7 | 3.3 | 78.9 | 46.8 | 23.9 | 36.7 | 24.1 | 0.3 | <0.1 | <0.1 | <0.1 | 78.9 |
| Vanadium (V) | µg/L | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Zinc (Zn) | µg/L | 30 | 10 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 16 | <5 | 16 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 9 | 9 | <5 | 9 |
| Zirconium (Zr) | µg/L | | 0.6 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 0.6 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 1.1 | <0.5 | <0.5 | <0.5 | <0.5 | 1.1 |
| **Phosphorus-P (Dissolved)** | µg/L | | 820 | 510 | 381 | 231 | 386 | 409 | 148 | 41 | 17 | 10 | 10 | 820 | 189 | 53 | 98 | 101 | 128 | 95 | 207 | 93 | 174 | 158 | 53 | 207 |

### B. Results For Water Samples Collected From *Chironomus tentans* Sediment Toxicity Tests

| Parameter | Units | CCME WQG | Day 0 Results | | | | | | | | | | | | Day 10 Results | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Negative Control | NIWTP Sludge | NI-1 | NI-2 | NI-3 | NI-4 | NI-5 | REF-1 | REF-2 | REF-3 | Min | Max | Negative Control | NIWTP Sludge | NI-1 | NI-2 | NI-3 | NI-4 | NI-5 | REF-1 | REF-2 | REF-3 | Min | Max |
| **Hardness (calculated as CaCO3)** | mg/L | | NA | 177 | 253 | 286 | 274 | 196 | 187 | 89.5 | 89.1 | 70.3 | 70.3 | 286 | 235 | 190 | 249 | 258 | 273 | 225 | 217 | 102 | 103 | 82.2 | 82.2 | 273 |
| **Dissolved Metals (by ICPMS)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | µg/L | 100 | NA | 3260 | 1370 | 4080 | 2890 | 1950 | 1180 | 1340 | 1580 | 1770 | 1180 | 4080 | 279 | 4660 | 565 | 1080 | 589 | 488 | 838 | 300 | 91 | 57 | 57 | 4660 |
| Antimony (Sb) | µg/L | | NA | <0.5 | 0.5 | 0.5 | 0.8 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 0.8 | <0.5 | 0.6 | <0.5 | 0.8 | <0.5 | 0.6 | 0.7 | <0.5 | <0.5 | <0.5 | <0.5 | 0.8 |
| Arsenic (As) | µg/L | 5 | NA | 21.3 | 28.3 | 25.6 | 16.2 | 15.3 | 20.4 | 2.9 | 4.6 | 11.6 | 2.9 | 28.3 | 1.8 | 27.1 | 15.7 | 10 | 6.5 | 4.8 | 15.3 | 2.2 | 3.4 | 10.6 | 1.8 | 27.1 |
| Barium (Ba) | µg/L | | NA | 91 | 154 | 318 | 223 | 331 | 104 | 38 | 45 | 55 | 38 | 331 | 84 | 79 | 119 | 215 | 143 | 255 | 90 | 30 | 34 | 42 | 30 | 255 |
| Beryllium (Be) | µg/L | | NA | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Bismuth (Bi) | µg/L | | NA | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Boron (B) | µg/L | | NA | <50 | <50 | <50 | <50 | <50 | 50 | <50 | <50 | <50 | <50 | 50 | <50 | <50 | <50 | <50 | 50 | <50 | <50 | <50 | <50 | <50 | <50 | 50 |
| Cadmium (Cd) | µg/L | 0.017 | NA | 0.01 | 0.03 | 0.09 | 0.08 | 0.05 | 0.04 | 0.08 | 0.07 | 0.08 | 0.01 | 0.09 | 0.05 | 0.01 | 0.02 | 0.04 | 0.02 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.01 | 0.05 |
| Calcium (Ca) | µg/L | | NA | 40,400 | 41,900 | 51,700 | 57,500 | 35,800 | 39,600 | 21,300 | 21,200 | 15,800 | 15800 | 57500 | 53,500 | 41,600 | 50,700 | 54,400 | 62,500 | 50,800 | 50,000 | 23,900 | 24,300 | 19,400 | 19400 | 62500 |
| Chromium (Cr) | µg/L | 8.9 | NA | <1 | 3 | 23 | 12 | 10 | 3 | 5 | 7 | 6 | <1 | 23 | <1 | <1 | <1 | 5 | 3 | 2 | 3 | 1 | <1 | <1 | <1 | 5 |
| Cobalt (Co) | µg/L | | NA | <0.5 | 0.9 | 5.1 | 2.8 | 2.5 | 1.6 | 3.1 | 4.6 | 8.5 | <0.5 | 8.5 | 0.8 | <0.5 | 0.7 | 1.7 | 1.1 | 1.3 | 1.7 | 1.8 | 1.9 | 2.7 | <0.5 | 2.7 |
| Copper (Cu) | µg/L | 4 | NA | 0.5 | 1.7 | 4.8 | 3.7 | 3.2 | 4.1 | 7.5 | 6.3 | 8.7 | 0.5 | 8.7 | 5.3 | 0.5 | 0.8 | 1.4 | 1.2 | 1.3 | 4.4 | 5.4 | 6.4 | 5 | 0.5 | 6.4 |
| Iron (Fe) | µg/L | 300 | NA | 136 | 823 | 4350 | 3560 | 2230 | 1630 | 2870 | 4560 | 5740 | 136 | 5740 | 423 | 90 | 120 | 1020 | 559 | 491 | 1090 | 456 | 346 | 593 | 90 | 1090 |
| Lead (Pb) | µg/L | 7 | NA | 0.2 | 1.6 | 5.6 | 11.9 | 3.8 | 7.4 | 0.7 | 0.7 | 0.9 | 0.2 | 11.9 | 0.5 | 0.3 | 0.3 | 1.1 | 1.2 | 0.9 | 3.6 | 0.6 | <0.2 | <0.2 | <0.2 | 3.6 |
| Lithium (Li) | µg/L | | NA | 6 | 8 | 17 | 33 | 22 | 32 | <5 | 6 | 7 | <5 | 33 | 8 | 6 | <5 | 8 | 18 | 12 | 17 | <5 | <5 | <5 | <5 | 18 |
| Magnesium (Mg) | µg/L | | NA | 18,500 | 36,100 | 38,100 | 31,700 | 25,800 | 21,400 | 8,820 | 8,810 | 7,510 | 7510 | 38100 | 24,600 | 21,000 | 29,700 | 29,800 | 28,500 | 23,900 | 22,300 | 10,300 | 10,300 | 8,180 | 8180 | 29800 |
| Manganese (Mn) | µg/L | | NA | 2460 | 279 | 464 | 456 | 1730 | 526 | 3060 | 3550 | 3280 | 279 | 3550 | 27 | 1750 | 159 | 170 | 116 | 835 | 148 | 2990 | 3150 | 2570 | 27 | 3150 |
| Mercury (Hg) | µg/L | 0.026 | NA | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.04 | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.04 |
| Molybdenum (Mo) | µg/L | | NA | 15 | 23 | 29 | 45 | 36 | 15 | <1 | <1 | <1 | 15 | 45 | 7 | 14 | 18 | 34 | 23 | 37 | 20 | 1 | 2 | 1 | 1 | 37 |
| Nickel (Ni) | µg/L | 150 | NA | 5 | 19 | 78 | 33 | 44 | 13 | 11 | 14 | 18 | 5 | 78 | 4 | 6 | 26 | 56 | 38 | 51 | 22 | 14 | 14 | 14 | 4 | 56 |
| Potassium (K) | µg/L | | NA | 11,400 | 17,800 | 20,800 | 19,400 | 16,200 | 15,200 | 2,260 | 2,570 | 2,370 | 2260 | 20800 | 4,530 | 10,800 | 12,700 | 14,400 | 13,700 | 11,200 | 11,500 | 3,400 | 3,150 | 3,350 | 3150 | 14400 |
| Selenium (Se) | µg/L | 1 | NA | 0.3 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.3 | 0.3 | 0.2 | 0.1 | 0.3 | 0.7 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.2 | 0.7 |
| Silicon (Si) | µg/L | | NA | 1200 | 3700 | 10000 | 11300 | 9100 | 10700 | 4800 | 6800 | 7800 | 1200 | 11300 | 4900 | 1100 | 2500 | 4500 | 6900 | 6800 | 8700 | 4700 | 5300 | 8600 | 1100 | 8700 |
| Silver (Ag) | µg/L | 0.1 | NA | <0.02 | <0.02 | 0.04 | 0.05 | 0.02 | 0.03 | 0.02 | <0.02 | <0.02 | <0.02 | 0.05 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0 |
| Sodium (Na) | µg/L | | NA | 18,700 | 24,600 | 26,600 | 26,800 | 27,000 | 26,400 | 4,690 | 4,780 | 4,540 | 4540 | 27000 | 18,900 | 20,900 | 21,500 | 23,600 | 24,600 | 23,100 | 22,400 | 9,680 | 9,620 | 10,000 | 9620 | 24600 |
| Strontium (Sr) | µg/L | | NA | 337 | 700 | 823 | 753 | 631 | 636 | 147 | 126 | 111 | 111 | 823 | 371 | 262 | 607 | 771 | 692 | 603 | 603 | 167 | 165 | 132 | 132 | 771 |
| Sulphur (S) | µg/L | | NA | 40,000 | 11,000 | 17,000 | 18,000 | 20,000 | 14,000 | 18,000 | 17,000 | 16,000 | 11000 | 40000 | 34,000 | 55,000 | 16,000 | 24,000 | 22,000 | 28,000 | 27,000 | 25,000 | 26,000 | 26,000 | 16000 | 55000 |
| Thallium (Tl) | µg/L | 0.8 | NA | <0.05 | <0.05 | 0.08 | 0.08 | 0.05 | <0.05 | <0.05 | 0.06 | 0.08 | <0.05 | 0.08 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.07 | <0.05 | 0.07 |
| Tin (Sn) | µg/L | | NA | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Titanium (Ti) | µg/L | | NA | <5 | 28 | 154 | 191 | 125 | 58 | 102 | 134 | 121 | 28 | 191 | <5 | <5 | <5 | 51 | 30 | 25 | 50 | 18 | <5 | <5 | <5 | 51 |
| Uranium (U) | µg/L | | NA | 9 | 62.9 | 58.7 | 35.7 | 40.7 | 24.7 | 0.5 | 0.4 | 0.5 | 0.4 | 62.9 | 1.4 | 10.8 | 69.4 | 60.9 | 24.6 | 46.1 | 52.2 | 0.6 | 0.3 | <0.1 | <0.1 | 69.4 |
| Vanadium (V) | µg/L | | NA | <5 | <5 | 7 | 7 | <5 | <5 | <5 | 5 | 5 | <5 | 7 | <5 | <5 | <5 | <5 | <5 | <5 | 5 | <5 | <5 | <5 | <5 | 5 |
| Zinc (Zn) | µg/L | 30 | NA | <5 | <5 | 16 | 18 | 11 | 7 | 9 | 11 | 13 | <5 | 18 | <5 | <5 | <5 | 5 | <5 | <5 | 6 | <5 | <5 | <5 | <5 | 6 |
| Zirconium (Zr) | µg/L | | NA | <0.5 | <0.5 | 1.1 | 0.8 | 1 | 0.8 | <0.5 | <0.5 | <0.5 | <0.5 | 1.1 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 0.6 | <0.5 | <0.5 | <0.5 | <0.5 | 0.6 |
| **Phosphorus-P (Dissolved)** | µg/L | | 34 | 960 | 241 | 182 | 370 | 184 | 192 | 64 | 39 | 35 | 34 | 960 | 104 | 430 | 255 | 255 | 372 | 137 | 325 | 115 | 138 | 160 | 104 | 430 |

**Legend**

NA = not applicable. Water sample from Chironomid test (Control - Initial) was not filtered and preserved at time of sampling; sample was analysed for total metals and hardness (see original lab report) but results not comparable to dissolved data.

Concentration above CCME WQG 🟨

# Table 4. Summary of Sediment Toxicity Test Results and Associated Water Quality Data

### A. Sediment Toxicity Test Results - *Hyalella azteca*

| Sample ID | Survival (%) | | Dry Weight (mg/ind) | | Total Ammonia (mg/L) | | | Sulphide (mg/L) | | Hardness (mg/L CaCO3) | | Alkalinity (mg/L CaCO3) | | pH | | Conductivity (µS/cm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Interstitial | Day 0 | Day 14 | Interstitial | Day 0 | Day 0 | Day 14 | Day 0 | Day 14 | Day 0 | Day 14 | Day 0 | Day 14 |
| Sludge | 12 | 4 | 0.13 | 0.05 | 0.62 | 3.76 | 3.79 | 27.3 | 0.032 | 120 | 425 | 80 | 40 | 6.6 | 6.7 | 667 | 836 |
| NI-1 | 36 | 18 | 0.10 | 0.02 | 1.35 | 3.37 | 2.83 | <0.005 | 0.009 | 250 | 425 | >240 | 240 | 7.9 | 6.9 | 787 | 1085 |
| NI-2 | 30 | 10 | 0.09 | 0.03 | 1.81 | 3.13 | <0.05 | <0.005 | 0.006 | 250 | 425 | >240 | 240 | 8 | 7.1 | 764 | 1089 |
| NI-3 | 18 | 8 | 0.10 | 0.03 | 1.8 | 3.48 | <0.05 | <0.005 | 0.009 | 425 | 425 | >240 | 240 | 8.2 | 7.1 | 710 | 942 |
| NI-4 | 22 | 18 | 0.06 | 0.04 | 3.21 | <0.05 | <0.05 | 0.047 | 0.005 | 250 | 425 | 180 | 120 | 8 | 7.1 | 649 | 900 |
| NI-5 | 80 | 10 | 0.12 | 0.03 | 3.51 | 2.07 | <0.05 | 0.007 | 0.006 | 250 | 425 | 240 | 120 | 7.9 | 7.1 | 619 | 816 |
| REF-1 | 74 | 18 | 0.20 | 0.03 | 0.49 | <0.05 | 0.47 | 0.01 | 0.006 | 120 | 425 | 66 | 66 | 7.9 | 7.1 | 354 | 662 |
| REF-2 | 66 | 36 | 0.15 | 0.02 | 0.4 | 0.18 | 2.48 | 0.006 | 0.005 | 120 | 425 | 66 | 66 | 7.7 | 6.7 | 371 | 637 |
| REF-3 | 64 | 17 | 0.09 | 0.02 | 0.35 | 0.23 | 1.93 | 0.007 | <0.005 | 250 | 425 | 66 | 66 | 7.5 | 6.5 | 354 | 662 |
| Control | 94 | 5 | 0.21 | 0.03 | 0.1 | <0.05 | 0.32 | NM | <0.005 | 250 | 425 | 80 | 120 | 7.6 | 6.9 | 343 | 958 |

### B. Sediment Toxicity Test Results - *Chironomus tentans*

| Sample ID | Survival (%) | | Dry Weight (mg/ind) | | Total Ammonia (mg/L) | | | Sulphide (mg/L) | | Hardness (mg/L CaCO3) | | Alkalinity (mg/L CaCO3) | | pH | | Conductivity (µS/cm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Interstitial | Day 0 | Day 10 | Interstitial | Day 0 | Day 0 | Day 10 | Day 0 | Day 10 | Day 0 | Day 10 | Day 0 | Day 10 |
| Sludge | 10 | 10 | 0.65 | 0.29 | 0.62 | 3.72 | 3.59 | 27.3 | 0.029 | 250 | 425 | 240 | >240 | 7.7 | 7 | 598 | 632 |
| NI-1 | 48 | 27 | 0.43 | 0.20 | 1.35 | 3.43 | 2.83 | <0.005 | 0.015 | 250 | 425 | 240 | >240 | 8.1 | 8.4 | 640 | 554 |
| NI-2 | 54 | 22 | 0.48 | 0.25 | 1.81 | 3.39 | 1.25 | <0.005 | 0.006 | 250 | 425 | >240 | >240 | 8.2 | 8.2 | 690 | 570 |
| NI-3 | 48 | 16 | 0.30 | 0.10 | 1.8 | 3.33 | 2.3 | <0.005 | 0.01 | 250 | 425 | >240 | >240 | 8.3 | 8.3 | 684 | 571 |
| NI-4 | 42 | 20 | 0.41 | 0.29 | 3.21 | 0.61 | 0.1 | 0.047 | <0.005 | 250 | 425 | >240 | >240 | 8.2 | 8.3 | 565 | 586 |
| NI-5 | 70 | 19 | 1.42 | 0.44 | 3.51 | 2.28 | 0.09 | 0.007 | <0.005 | 250 | 425 | >240 | >240 | 8.1 | 7.7 | 547 | 547 |
| REF-1 | 46 | 17 | 2.22 | 0.30 | 0.49 | 0.14 | 1.9 | 0.01 | <0.005 | 120 | 100 | 40 | 80 | 8.2 | 7.9 | 253 | 339 |
| REF-2 | 60 | 19 | 2.02 | 0.29 | 0.4 | 0.18 | 2.48 | 0.006 | <0.005 | 120 | 100 | 80 | 80 | 7.9 | 7.3 | 257 | 292 |
| REF-3 | 56 | 9 | 1.66 | 0.34 | 0.35 | 0.17 | 2.52 | 0.007 | <0.005 | 120 | 100 | 40 | 80 | 7.8 | 7.4 | 598 | 632 |
| Control | 82 | 8 | 2.71 | 0.47 | 0.1 | 0.16 | 1.52 | NM | <0.005 | >425 | 425 | >180 | >240 | 7.9 | 8.3 | 485 | 541 |

# Table 5. Summary of Benthic Invertebrate Taxonomy Results

## A. Total Density (no./m$^2$) - Benthic and Non-benthic Taxa

| Rep | NI-1 | NI-2 | NI-3 | NI-4 | NI-5 | NI-5 (excluding Tubificidae) | REF-1 | REF-2 | REF-3 |
|---|---|---|---|---|---|---|---|---|---|
| A | 1,164 | 259 | 517 | 345 | 71,595 | 0 | 3,147 | 2,716 | 1,336 |
| B | 0 | 259 | 86 | 991 | 3,190 | 3,190 | 1,121 | 733 | 2,974 |
| C | 345 | 43 | 43 | 431 | 948 | 948 | 4,612 | 991 | 3,793 |
| D | 43 | 216 | 43 | 1,078 | 1,422 | 1,422 | 3,017 | 948 | 3,922 |
| E | 474 | 216 | 388 | 1,078 | 62,672 | 0 | 12,155 | 259 | 2,802 |
| Mean | 405 | 198 | 216 | 784 | 27,966 | 1,112 | 4,810 | 1,129 | 2,966 |
| SD | 469 | 89 | 222 | 365 | 35,904 | 1,315 | 4,289 | 933 | 1,035 |

## B. Total Density (no./m$^2$) - Benthic Taxa Only

| Rep | NI-1 | NI-2 | NI-3 | NI-4 | NI-5 | NI-5 (excluding Tubificidae) | REF-1 | REF-2 | REF-3 |
|---|---|---|---|---|---|---|---|---|---|
| A | 86 | 43 | 43 | 86 | 71,466 | 0 | 3,103 | 2,586 | 1,293 |
| B | 0 | 43 | 43 | 43 | 2,457 | 2,457 | 1,034 | 690 | 2,759 |
| C | 172 | 0 | 0 | 0 | 733 | 733 | 4,483 | 991 | 3,319 |
| D | 43 | 0 | 0 | 172 | 1,422 | 1,422 | 2,845 | 733 | 3,405 |
| E | 43 | 0 | 0 | 86 | 62,543 | 0 | 11,897 | 259 | 2,716 |
| Mean | 69 | 17 | 17 | 78 | 27,724 | 922 | 4,672 | 1,052 | 2,698 |
| SD | 65 | 24 | 24 | 64 | 36,001 | 1,042 | 4,221 | 897 | 846 |

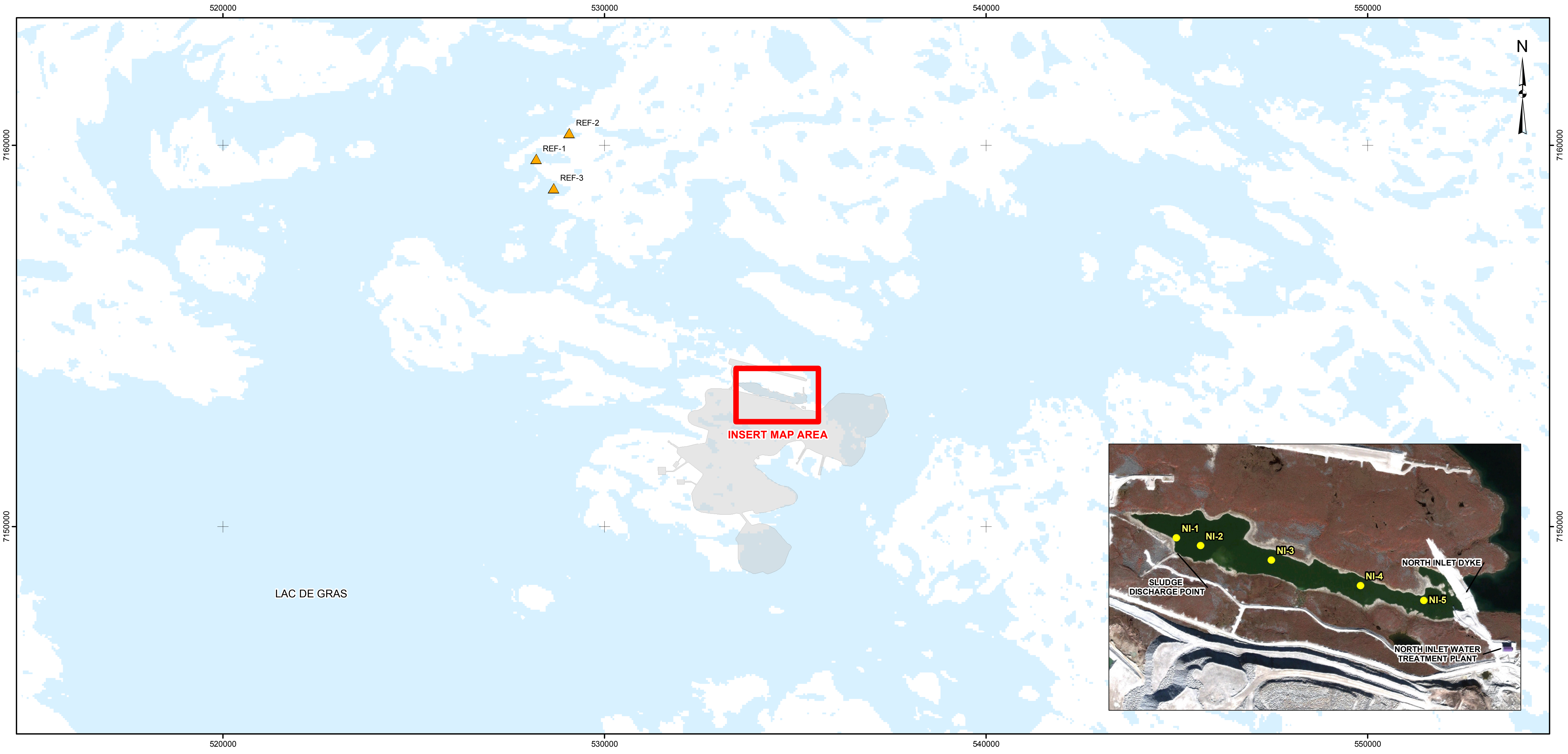
## C. Taxa Richness (taxa/0.023 m2 grab) - Benthic Taxa Only

| Rep | NI-1 | NI-2 | NI-3 | NI-4 | NI-5 | NI-5 (excluding Tubificidae) | REF-1 | REF-2 | REF-3 |
|---|---|---|---|---|---|---|---|---|---|
| A | 2 | 1 | 1 | 2 | 1 | 0 | 13 | 14 | 10 |
| B | 0 | 1 | 1 | 1 | 3 | 3 | 8 | 8 | 10 |
| C | 4 | 0 | 0 | 0 | 1 | 1 | 13 | 8 | 10 |
| D | 1 | 0 | 0 | 2 | 2 | 2 | 13 | 9 | 11 |
| E | 1 | 0 | 0 | 1 | 1 | 0 | 19 | 4 | 6 |
| Mean | 1.6 | 0.4 | 0.4 | 1.2 | 1.6 | 1.2 | 13.2 | 8.6 | 9.4 |
| SD | 1.5 | 0.5 | 0.5 | 0.8 | 0.9 | 1.3 | 3.9 | 3.6 | 1.9 |
| Station Total | 6 | 2 | 1 | 3 | 3 | 3 | 23 | 18 | 16 |

## D. Total Biomass (mg/0.023 m$^2$ grab) - All Taxa

| Rep | NI-1 | NI-2 | NI-3 | NI-4 | NI-5 | NI-5 (excluding Tubificidae) | REF-1 | REF-2 | REF-3 |
|---|---|---|---|---|---|---|---|---|---|
| A | 2.0 | 0.5 | 1.2 | 2.7 | 2128.1 | 0 | 128.1 | 38.8 | 85.0 |
| B | 0.0 | 1.1 | 2.6 | 4.2 | 61.4 | 61.4 | 17.2 | 32.6 | 47.9 |
| C | 5.2 | 0.1 | 0.1 | 0.6 | 12.8 | 12.8 | 33.7 | 10.2 | 102.4 |
| D | 2.6 | 0.8 | 0.1 | 4.6 | 56.0 | 56.0 | 29.4 | 25.7 | 26.7 |
| E | 0.9 | 0.2 | 2.8 | 2.7 | 1833.8 | 0 | 61.6 | 53.0 | 20.8 |
| Mean | 2.1 | 0.5 | 1.3 | 3.0 | 818.4 | 26.0 | 54.0 | 32.1 | 56.6 |
| SD | 2.0 | 0.4 | 1.3 | 1.6 | 1066.5 | 30.3 | 44.5 | 15.8 | 35.9 |
| Station Total | 10.7 | 2.7 | 6.7 | 14.8 | 4092 | 130 | 270 | 160 | 283 |

N:\Bur-Graphics\Projects\2010\1328\10-1328-0028\GIS\projects\figure-01_sample-locations-north-inlet.mxd



2.5 0 2.5
SCALE 1:100,000 KILOMETRES

**LEGEND**

- ▲ Reference Area
- ▨ Predicted Diavik Footprint
- 🟦 Waterbody

| Station | Easting | Northing |
|---|---|---|
| NI-1 | 533797 | 7153657 |
| NI-2 | 533923 | 7153618 |
| NI-3 | 534295 | 7153541 |
| NI-4 | 534761 | 7153408 |
| NI-5 | 535093 | 7153329 |
| REF-1 | 528209 | 7159644 |
| REF-2 | 529076 | 7160323 |
| REF-3 | 528669 | 7158872 |

*DRAFT*

**REFERENCE**

Orthophoto obtained from Google Earth, 2009.
Projection: UTM Zone 12 Datum: NAD 83

PROJECT
DIAVIK DIAMOND MINES INC.

TITLE
## SAMPLING LOCATIONS FOR NORTH INLET AND LAC DE GRAS REFERENCE STATIONS

Golder Associates
Greater Vancouver Office, B.C.

| | | | | |
|---|---|---|---|---|
| PROJECT NO. 10-1328-0028 | | | PHASE No. 7000/7300 | |
| DESIGN | CM | 10 Nov. 2010 | SCALE AS SHOWN | REV. 0 |
| GIS | CDB | 10 Nov. 2010 | FIGURE 1 | |
| CHECK | | | | |
| REVIEW | | | | |

# APPENDIX A

## Field Records

# DIAVIK NORTH INLET SEDIMENT QUALITY (10-1328-0028/7000/7200)

## Station Information

Station ID: ~~[illegible]~~ NI-1

Date: SEPT 1/2010

Start Time: 3:08 pm

Stop Time: 5:25

GPS (NAD83): 533797 ~~[illegible]~~ 7153657 UTM ZONE 12

Water Depth: 12m

Weather: SUN + MODERATE BREEZE

Sample Collection Gear: EKMAN + KB CORER

Sampled By: TWJ + DARCY (DDMI

## Sediment Characteristics

Colour: DARK GREY

Odour: MODERATE AMMONIA (?)

Grain Size: SILT/CLAY

Benthos: OBSERVED AMPHIPODS + SMALL WORMS

Debris: NONE

Vis Contam: NONE

Redox Depth: UNKNOWN

Other

Photos Taken PHOTO 1 ] GRAB CHARACTERISTICS
PHOTO 2 ]

## Sample Processing Record

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Surface Chemistry | YES | YES | Yes | 2010.09.06 |
| Toxicity | YES | YES | Yes | 2010.09.06 |
| Benthic Taxonomy | YES | ~~[illegible]~~ Yes | Yes | 2010.09.06 |
| Subsurface Chem-Top | Yes (Dark-Moist Loose.) | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Mid | Yes | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Bot | Yes Silt/Clay/Grey | Yes | Yes | 2010.09.06 |

Photos Taken Sediment have high water content.

## Quality Control Samples Collected (Chemistry Only)

Field Duplicate: [✓ yes] no

**Duplicate is composite from 5 new grabs**

(if yes, assign Sample ID) FIELD REPLICATE

Analyze for: Surface Chemistry parameters only

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Duplicate | YES | YES | Yes | 2010.09.06 |

## Notes

CORE 1: ~~3~~ 44cm PENETRATION : PHOTO 3

CORE 2: 46cm PENETRATION : PHOTO 4

CORE 3: 36cm PENETRATION : PHOTO 5 + 23cm DARK LOOSE LAYER AT SURFACE

## Sample Checklist

**Surface Chemistry** — **Composite of 5 grabs at each station**

**(composite remaining sediment after toxicity sample removed)**

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☑ backup = 1x250ml glass
☑ particle size = 1x1L whirlpack bag
☑ ammonia analysis = 1x500ml glass (during toxicity testing)

**Toxicity** — **5 replicate grabs from each station**

☑ toxicity = 5x500m glass

**Benthos** — **5 replicate grabs from each station**

☐ benthos = 5x1L plastic (500 micron sieve, preserve in 10% formalin)

**Subsurface Chemistry** — **Composites of at least 2 cores per station** USE 125ml GLASS

NI only

***Surface (0-5 cm)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☑ particle size = 1x1L whirlpack bag

***Middle (5 cm from middle)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☑ particle size = 1x1L whirlpack bag

***Bottom (5 cm from bottom)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☑ particle size = 1x1L whirlpack bag

**Reference Sediment** — **Collect Additional Sediment at One Reference Station**

☐ Additional Reference Sediment for Kimberlite Study = 5L

- MODERATE AMMONIA(?) ODOUR IN TOXICITY GRABS

- FIELD REPLICATE DONE AT THIS STATION
  = 5 NEW GRABS AND COMPOSITE FOR CHEMISTRY ANALYSES.

# DIAVIK NORTH INLET SEDIMENT QUALITY (10-1328-0028/7000/7200)

## Station Information

Station ID: [redacted] NI-2
Date: SEPT 1/2010
Start Time: 1230pm
Stop Time: 3pm
GPS (NAD83): 0533923 7153618 UTM ZONE 12
Water Depth: 13 m
Weather: SUN + MODERATE BREEZE
Sample Collection Gear: EKMAN + KB CORER
Sampled By: DWS + DARCY (DDMI)

## Sediment Characteristics

Colour: DARK+LIGHT GRAY
Odour: NO SULPHIDE ODOUR
Grain Size: SILT + CLAY
Benthos: NONE OBSERVED
Debris: NONE
Vis Contam: NONE
Redox Depth: UNABLE TO TELL
Other

Photos Taken
PHOTO 1 (FOLLOWING TRANSECT PHOTOS) = COMPOSITE
PHOTO 2 = INLET OF SLUDGE SLURRY TO NI

## Sample Processing Record

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Surface Chemistry | YES | YES | Yes | 2010.09.06 |
| Toxicity | YES | YES | Yes | 2010.09.06 |
| Benthic Taxonomy | YES (X5) | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Top | YES - DARK + MOIST/LOOSE | YES | Yes | 2010.09.06 |
| Subsurface Chem-Mid | YES | YES | Yes | 2010.09.06 |
| Subsurface Chem-Bot | SILT/GRAY/GRAY | YES | Yes | 2010.09.06 |

Photos Taken
SEDIMENTS HAVE HIGH WATER CONTENT ~~BUT~~ AND
FINE GRAIN SIZE

## Quality Control Samples Collected (Chemistry Only)

Field Duplicate: yes [✓ no]

**Duplicate is composite from 5 new grabs**

(if yes, assign Sample ID)

Analyze for: Surface Chemistry parameters only

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Duplicate | | | | |

## Notes

CORE 1 = 57cm PENETRATION : PHOTO 3
CORE 2 = 51cm PENETRATION : PHOTO 4 / ~5cm OF DARKER UNCONSOLIDATED MATERIAL AT SURFACE
CORE 3 = 56cm PENETRATION : PHOTO 5 / ~7cm OF DARKER LOOSE MATERIAL AT SURFACE
PHOTO 6 -

## Sample Checklist

**Surface Chemistry** **Composite of 5 grabs at each station**

**(composite remaining sediment after toxicity sample removed)**

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☑ backup = 1x250ml glass
☑ particle size = 1x1L whirlpack bag
☑ ammonia analysis = 1x500ml glass (during toxicity testing)

**Toxicity** **5 replicate grabs from each station**

☑ toxicity = 5x500m glass

**Benthos** **5 replicate grabs from each station**

☐ benthos = 5x1L plastic (500 micron sieve, preserve in 10% formalin)

**Subsurface Chemistry** **Composites of at least 2 cores per station** [illegible]

NI only

***Surface (0-5 cm)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☑ particle size = 1x1L whirlpack bag

***Middle (5 cm from middle)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☐ particle size = 1x1L whirlpack bag

***Bottom (5 cm from bottom)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☑ particle size = 1x1L whirlpack bag

**Reference Sediment** **Collect Additional Sediment at One Reference Station**

☐ Additional Reference Sediment for Kimberlite Study = 5L

- MODERATE AMMONIA(?) ODOUR IN SURFACE CORE COMPOSITE

# DIAVIK NORTH INLET SEDIMENT QUALITY (10-1328-0028/7000/7200)

## Station Information

Station ID: NI-3
Date: 2010.09.03
Start Time: 09:20
Stop Time: 11:20
GPS (NAD83): 0534295 7153541 UTM 12
Water Depth: 11m
Weather:
Sample Collection Gear: Ekman dredge + KB corer
Sampled By: Darcy B, James M

## Sediment Characteristics

Colour: Dark + Light grey
Odour: No Sulphide odor
Grain Size: Silt + Clay
Benthos: None Observed
Debris: None
Vis Contam: None
Redox Depth: unable to tell
Other

Photos Taken

## Sample Processing Record

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Surface Chemistry | Yes | Yes | Yes | 2010.09.06 |
| Toxicity | Yes | Yes | Yes | 2010.09.06 |
| Benthic Taxonomy | Yes (x5). | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Top | Yes - Moist - Dark | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Mid | Yes | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Bot | Silt/Gray/Gray | Yes | Yes | 2010.09.06 |

Photos Taken Sediment has high water content
Grain size is small.

## Quality Control Samples Collected (Chemistry Only)

Field Duplicate: yes [✓ no]

**Duplicate is composite from 5 new grabs**

(if yes, assign Sample ID)
Analyze for: Surface Chemistry parameters only

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Duplicate | | | | |

## Notes

Core 1: 47cm Penetration : Photo 1 - 3 cm of dark loose material @ surfa

Core 2: 50cm Penetration : Photo 2 - 4 cm of dark lose material @ surfa

Core 3: 51 cm Penetration : Photo 3 - 4cm of dark lose material @ surfa

## Sample Checklist

**Surface Chemistry** **Composite of 5 grabs at each station**

**(composite remaining sediment after toxicity sample removed)**

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☑ backup = 1x250ml glass
☑ particle size = 1x1L whirlpack bag
☑ ammonia analysis = 1x500ml glass (during toxicity testing)

**Toxicity** **5 replicate grabs from each station**

☑ toxicity = 5x500m glass

**Benthos** **5 replicate grabs from each station**

☑ benthos = 5x1L plastic (500 micron sieve, preserve in 10% formalin)

**Subsurface Chemistry** **Composites of at least 2 cores per station** USE 125 ml GLASS

NI only

***Surface (0-5 cm)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☑ particle size = 1x1L whirlpack bag

***Middle (5 cm from middle)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☑ particle size = 1x1L whirlpack bag

***Bottom (5 cm from bottom)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☑ particle size = 1x1L whirlpack bag

**Reference Sediment** **Collect Additional Sediment at One Reference Station**

☐ Additional Reference Sediment for Kimberlite Study = 5L

# DIAVIK NORTH INLET SEDIMENT QUALITY (10-1328-0028/7000/7200)

## Station Information

Station ID: NI-4
Date: 2010.09.03
Start Time: 12:01
Stop Time: 13:37
GPS (NAD83): 0534761 -7153408
Water Depth: 8.2 m
Weather:
Sample Collection Gear: Ekman + KB Corer
Sampled By: DB / JM

## Sediment Characteristics

Colour: Dark + light Gray
Odour: NO ODOUR
Grain Size: Silt + Clay
Benthos: NO OBS
Debris: None
Vis Contam: NONE
Redox Depth: Unknown
Other

Photos Taken

## Sample Processing Record

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Surface Chemistry | Yes | Yes | Yes | 2010.09.06 |
| Toxicity | Yes | Yes | Yes | 2010.09.06 |
| Benthic Taxonomy | Yes (x5) | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Top | Yes (moist-dark) | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Mid | Yes | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Bot | Silt/Gray/Gray | Yes | Yes | 2010.09.06 |

Photos Taken

## Quality Control Samples Collected (Chemistry Only)

Field Duplicate: yes [✓ no]

**Duplicate is composite from 5 new grabs**

(if yes, assign Sample ID)

Analyze for: Surface Chemistry parameters only

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Duplicate | | | | |

**Notes**

Core 1: 43cm Penetration - Photo 4 ~3 cm of dark loose material @ surface
Core 2 = 48cm Penetration - Photo 5 ~3 cm of dark loose material @ surface
Core 3 - 41cm Penetration Photo 6 ~4 cm of dark loose material @ surface
Site was moved (20 m east of Map coordinates. Depth was not good.

## Sample Checklist

### Surface Chemistry

### Composite of 5 grabs at each station

**(composite remaining sediment after toxicity sample removed)**

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☑ backup = 1x250ml glass
☑ particle size = 1x1L whirlpack bag
☑ ammonia analysis = 1x500ml glass (during toxicity testing)

### Toxicity

### 5 replicate grabs from each station

☑ toxicity = 5x500m glass

### Benthos

### 5 replicate grabs from each station

☑ benthos = 5x1L plastic (500 micron sieve, preserve in 10% formalin)

### Subsurface Chemistry

NI only

### Composites of at least 2 cores per station

use 125 ml GLASS

***Surface (0-5 cm)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☑ particle size = 1x1L whirlpack bag

***Middle (5 cm from middle)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☑ particle size = 1x1L whirlpack bag

***Bottom (5 cm from bottom)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☑ particle size = 1x1L whirlpack bag

### Reference Sediment

### Collect Additional Sediment at One Reference Station

☐ Additional Reference Sediment for Kimberlite Study = 5L

# DIAVIK NORTH INLET SEDIMENT QUALITY (10-1328-0028/7000/7200)

## Station Information

Station ID: NI-5
Date: 2010.09.03
Start Time: 13:56
Stop Time: 15:39
GPS (NAD83): 0535093 7153329
Water Depth: 10 m
Weather:
Sample Collection Gear: Ekman + KB corer
Sampled By: Doray + James

## Sediment Characteristics

Colour: Dark + light Gray
Odour: None Sulphide odor
Grain Size: Silt + clay + ~~[illegible]~~
Benthos: None observed
Debris: None
Vis Contam: None
Redox Depth: Unable to tell
Other

Photos Taken

## Sample Processing Record

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Surface Chemistry | Yes | Yes | Yes | 2010.09.06 |
| Toxicity | Yes | Yes | Yes | 2010.09.06 |
| Benthic Taxonomy | Yes (×5) | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Top | Yes - moist - dark | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Mid | Yes | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Bot | Silt - gray - sandy | Yes | Yes | 2010.09.06 |

Photos Taken

## Quality Control Samples Collected (Chemistry Only)

Field Duplicate: yes [✓ no]

**Duplicate is composite from 5 new grabs**

(if yes, assign Sample ID)

Analyze for: Surface Chemistry parameters only

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Duplicate | | | | |

**Notes**

Core #1 = 36 cm - 1cm of dar loose material @ top Photo 7
Core #2 = 33 cm - 1cm of dark loose material @ topsurface Photo 8
Core #3 = 35 cm - 1cm of dark loose matrial @ surface Photo 9

## Sample Checklist

**Surface Chemistry**

**Composite of 5 grabs at each station**

**(composite remaining sediment after toxicity sample removed)**

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☑ backup = 1x250ml glass
☑ particle size = 1x1L whirlpack bag
☑ ammonia analysis = 1x500ml glass (during toxicity testing)

**Toxicity**

**5 replicate grabs from each station**

☑ toxicity = 5x500m glass

**Benthos**

**5 replicate grabs from each station**

☑ benthos = 5x1L plastic (500 micron sieve, preserve in 10% formalin)

**Subsurface Chemistry**
NI only

**Composites of at least 2 cores per station** use 125 ml Glass

***Surface (0-5 cm)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☑ particle size = 1x1L whirlpack bag

***Middle (5 cm from middle)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☑ particle size = 1x1L whirlpack bag

***Bottom (5 cm from bottom)***

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ ~~backup = 1x250ml glass~~
☑ particle size = 1x1L whirlpack bag

**Reference Sediment**

**Collect Additional Sediment at One Reference Station**

☐ Additional Reference Sediment for Kimberlite Study = 5L

# DIAVIK NORTH INLET SEDIMENT QUALITY (10-1328-0028/7000/7200)

## Station Information

Station ID: REF-1
Date: SEPT 2/2010
Start Time: 1130 pm
Stop Time: 1230 pm
GPS (NAD83): 528209 7159644 (UTM ZONE 12)
Water Depth: 10 m
Weather: SUN/CLEAR + MODERATE BREEZE
Sample Collection Gear: EKMAN GRAB
Sampled By: TRWS / DARCY (DDMI)

## Sediment Characteristics

Colour: BROWN SURFACE + GREY
Odour: NONE
Grain Size: MOSTLY FINES + CLAY
Benthos: NONE OBSERVED
Debris: NONE
Vis Contam: NONE
Redox Depth: UNKNOWN
Other

Photos Taken PHOTO 1 = GRAB CONDITIONS

## Sample Processing Record

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Surface Chemistry | YES (BUT NO ARCHIVE FROM COMPOSITE) | YES | Yes | 2010.09.06 |
| Toxicity | YES | YES | Yes | 2010.09.06 |
| Benthic Taxonomy | YES | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Top | | | | |
| Subsurface Chem-Mid | | | | |
| Subsurface Chem-Bot | | | | |

Photos Taken

## Quality Control Samples Collected (Chemistry Only)

Field Duplicate: yes [✓ no]

**Duplicate is composite from 5 new grabs**

(if yes, assign Sample ID)

Analyze for: Surface Chemistry parameters only

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Duplicate | | | | |

## Notes

THIN SURFACE LAYER OF BROWN FINE SAND OVERLYING MEDIUM GREY SILT/CLAY

* Location was moved because of wx constraints + Logistical constraints. DB.

## Sample Checklist

**Surface Chemistry** **Composite of 5 grabs at each station**

**(composite remaining sediment after toxicity sample removed)**

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ backup = 1x250ml glass NO (NOT ENOUGH SEDIMENT)
☑ particle size = 1x1L whirlpack bag
☑ ammonia analysis = 1x500ml glass (during toxicity testing)

**Toxicity** **5 replicate grabs from each station**

☑ toxicity = 5x500m glass

**Benthos** **5 replicate grabs from each station**

☑ benthos = 5x1L plastic (500 micron sieve, preserve in 10% formalin) (NEED TO BE SIEVED)

~~**Subsurface Chemistry** **Composites of at least 2 cores per station**~~

~~NI only~~

~~***Surface (0-5 cm)***~~

☐ ~~AVS-SEM = 1x250ml glass~~
☐ ~~metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass~~
☐ ~~backup = 1x250ml glass~~
☐ ~~particle size = 1x1L whirlpack bag~~

~~***Middle (5 cm from middle)***~~

☐ ~~AVS-SEM = 1x250ml glass~~
☐ ~~metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass~~
☐ ~~backup = 1x250ml glass~~
☐ ~~particle size = 1x1L whirlpack bag~~

~~***Bottom (5 cm from bottom)***~~

☐ ~~AVS-SEM = 1x250ml glass~~
☐ ~~metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass~~
☐ ~~backup = 1x250ml glass~~
☐ ~~particle size = 1x1L whirlpack bag~~

**Reference Sediment** **Collect Additional Sediment at One Reference Station**

☐ Additional Reference Sediment for Kimberlite Study = 5L

# DIAVIK NORTH INLET SEDIMENT QUALITY (10-1328-0028/7000/7200)

## Station Information

Station ID: REF-2
Date: 2010.09.04
Start Time: 15:15
Stop Time: 16:45
GPS (NAD83): 0529076 7160323 UTM 12
Water Depth: 9.5
Weather:
Sample Collection Gear: Ekman 4x
Sampled By: James (DDMI), Darcy (AMI)

## Sediment Characteristics

Colour: Brown surface - gray
Odour: None
Grain Size: mostly fine; silts/clays
Benthos: None Observed
Debris: None
Vis Contam: None
Redox Depth: Unknown
Other

Photos Taken

## Sample Processing Record

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Surface Chemistry | Yes | Yes | Yes | 2010.09.06 |
| Toxicity | Yes | Yes | Yes | 2010.09.06 |
| Benthic Taxonomy | Yes | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Top | | | | |
| Subsurface Chem-Mid | | | | |
| Subsurface Chem-Bot | | | | |

Photos Taken

## Quality Control Samples Collected (Chemistry Only)

Field Duplicate: yes [✓ no]

**Duplicate is composite from 5 new grabs**

(if yes, assign Sample ID)

Analyze for: Surface Chemistry parameters only

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Duplicate | | | | |

## Notes

Extra Grabs for Kimberlite toxicity was completed @ this site

## Sample Checklist

**Surface Chemistry**

**Composite of 5 grabs at each station**

**(composite remaining sediment after toxicity sample removed)**

☑ AVS-SEM = 1x250ml glass
☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
☐ backup = 1x250ml glass (not enough sediment in composite)
☑ particle size = 1x1L whirlpack bag
☑ ammonia analysis = 1x500ml glass (during toxicity testing)

**Toxicity**

**5 replicate grabs from each station**

☑ toxicity = 5x500m glass

**Benthos**

**5 replicate grabs from each station**

☑ benthos = 5x1L plastic (500 micron sieve, preserve in 10% formalin)

**Subsurface Chemistry**
NI only

**Composites of at least 2 cores per station**

~~*Surface (0-5 cm)*~~

~~☐ AVS-SEM = 1x250ml glass~~
~~☐ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass~~
~~☐ backup = 1x250ml glass~~
~~☐ particle size = 1x1L whirlpack bag~~

~~*Middle (5 cm from middle)*~~

~~☐ AVS-SEM = 1x250ml glass~~
~~☐ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass~~
~~☐ backup = 1x250ml glass~~
~~☐ particle size = 1x1L whirlpack bag~~

~~*Bottom (5 cm from bottom)*~~

~~☐ AVS-SEM = 1x250ml glass~~
~~☐ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass~~
~~☐ backup = 1x250ml glass~~
~~☐ particle size = 1x1L whirlpack bag~~

**Reference Sediment**

**Collect Additional Sediment at One Reference Station**

☑ Additional Reference Sediment for Kimberlite Study = 5L

# DIAVIK NORTH INLET SEDIMENT QUALITY (10-1328-0028/7000/7200)

## Station Information

Station ID: Ref-3
Date: 2010.09.04
Start Time: 16:03
Stop Time: 16:42
GPS (NAD83): 0528669 7158872
Water Depth: 11m
Weather:
Sample Collection Gear: Ekman Dredge
Sampled By: James / Darcy

## Sediment Characteristics

Colour: brown surface + grey.
Odour: None
Grain Size: Mostly clay + silt sand sand
Benthos: None Observed
Debris: None
Vis Contam: None
Redox Depth: Unknown
Other

Photos Taken

## Sample Processing Record

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Surface Chemistry | Yes (no archive from composite) | Yes | Yes | 2010.09.06 |
| Toxicity | Yes | Yes | Yes | 2010.09.06 |
| Benthic Taxonomy | Yes | Yes | Yes | 2010.09.06 |
| Subsurface Chem-Top | | | | |
| Subsurface Chem-Mid | | | | |
| Subsurface Chem-Bot | | | | |

Photos Taken

## Quality Control Samples Collected (Chemistry Only)

Field Duplicate: yes [✓ no]

**Duplicate is composite from 5 new grabs**

(if yes, assign Sample ID)
Analyze for: Surface Chemistry parameters only

| Type | Collected | Processed | Checked on COC | Shipped |
|---|---|---|---|---|
| Duplicate | | | | |

## Notes

Not enough sample to fill archive from composite

*Reference

## Sample Checklist

**Surface Chemistry**

**Composite of 5 grabs at each station**

**(composite remaining sediment after toxicity sample removed)**

- ☑ AVS-SEM = 1x250ml glass
- ☑ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
- ☐ backup = 1x250ml glass
- ☑ particle size = 1x1L whirlpack bag
- ☑ ammonia analysis = 1x500ml glass (during toxicity testing)

**Toxicity**

**5 replicate grabs from each station**

- ☑ toxicity = 5x500m glass

**Benthos**

**5 replicate grabs from each station**

- ☑ benthos = 5x1L plastic (500 micron sieve, preserve in 10% formalin)

**Subsurface Chemistry**

NI only

**Composites of at least 2 cores per station**

***Surface (0-5 cm)***

- ☐ AVS-SEM = 1x250ml glass
- ☐ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
- ☐ backup = 1x250ml glass
- ☐ particle size = 1x1L whirlpack bag

***Middle (5 cm from middle)***

- ☐ AVS-SEM = 1x250ml glass
- ☐ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
- ☐ backup = 1x250ml glass
- ☐ particle size = 1x1L whirlpack bag

***Bottom (5 cm from bottom)***

- ☐ AVS-SEM = 1x250ml glass
- ☐ metals, TOC, total phosphorus, reagents, and moisture content = 1x250ml glass
- ☐ backup = 1x250ml glass
- ☐ particle size = 1x1L whirlpack bag

**Reference Sediment**

**Collect Additional Sediment at One Reference Station**

- ☐ Additional Reference Sediment for Kimberlite Study = 5L

*Figure 1: First discharge pipe to North Inlet from direction of NIWTP. Discharge water appears to contain light brown / grey suspended solids that settle out onto bottom sediment once discharge enters North Inlet. UTM coordinates (UTM Zone 12): 533749 easting, 7153478 northing.*

*Figure 2: Overland flow from first discharge pipe to North Inlet.*

*Figure 3: Suspended solids at point where first discharge enters North Inlet. Very fine sediment suspended in water and on bottom surface. UTM coordinates (UTM Zone 12): 533789 easting, 7153560 northing.*

*Figure 4: Second discharge pipe to North Inlet from direction of NIWTP. Discharge water contains green suspended material, presumed to be algae. UTM coordinates (UTM Zone 12): 533672 easting, 7153536 northing.*

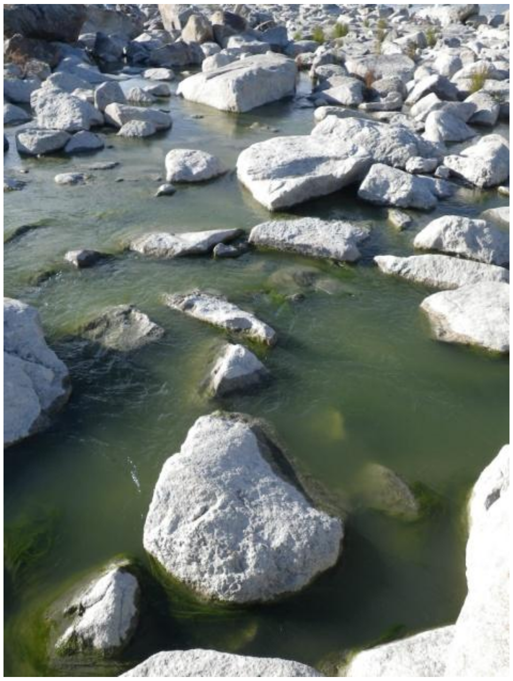


*Figure 5: Algae present in overland flow from second discharge pipe; green material settles out as discharge flows overland.*

*Figure 6: Fine material and algae setting out at point where second discharge enters North Inlet. UTM coordinates (UTM Zone 12): 533719 easting, 7153610 northing.*

*Figure 7: North Inlet reconnaissance: grab at transect location 1. Grab collected west of Station NI-1. Green/black algae and slime layer overlying very fine silt and clay. UTM coordinates (UTM Zone 12): 533617 easting, 7153717 northing.*

*Figure 8: North Inlet reconnaissance: grab at transect location 2. Grab collected west of Station NI-1. Black/green slime layer approximately 2 cm thick overlying grey and brown silt and clay. UTM coordinates (UTM Zone 12): 533717 easting, 7153704 northing.*

*Figure 9: North Inlet reconnaissance: grab at transect location 3. Grab collected near Station NI-1. Black/green layer (1 to 2 cm thick) overlying grey silt/clay; high water content in upper layer. UTM coordinates (UTM Zone 12): 533806 easting, 7153649 northing.*

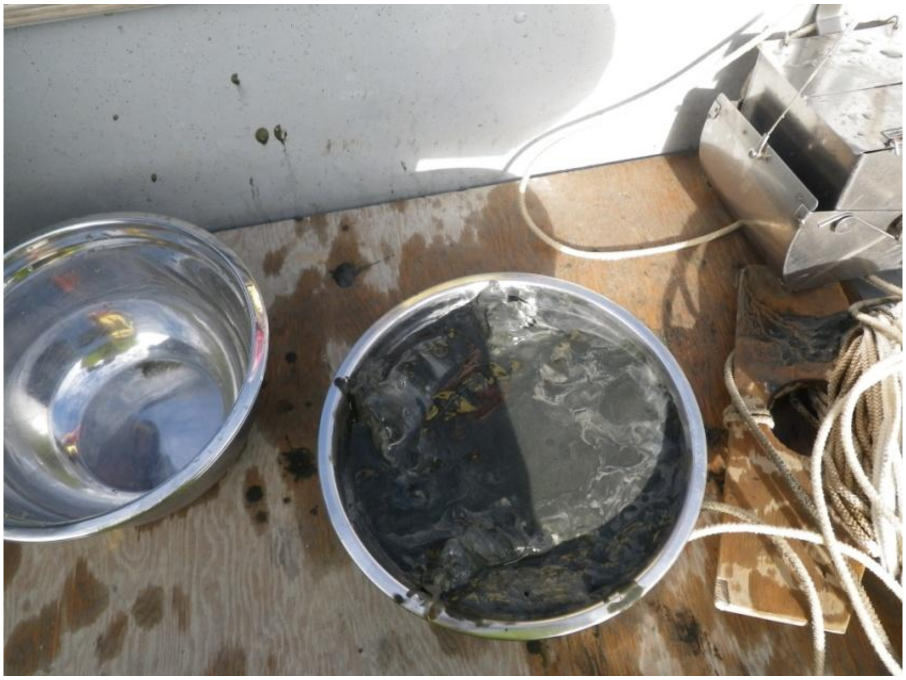


*Figure 10: North Inlet reconnaissance: grab at transect location 4. Grab collected between Stations NI-1 and NI-2. Black/green layer (1 to 2 cm thick) overlying grey silt/clay; high water content in upper layer. UTM coordinates (UTM Zone 12): 533876 easting, 7153586 northing.*

*Figure 11: North Inlet reconnaissance: grab at transect location 5. Grab collected at east end of North Inlet near Station NI-5. Grey sediments (silt and clay) with thin brown surface layer; sediments more consolidated than at transect locations 1 to 4, with less moisture. Lower grab penetration. UTM coordinates (UTM Zone 12): 535063 easting, 7153300 northing.*

*Figure 12: North Inlet reconnaissance: grab at transect location 6. Grab collected between Stations NI-2 and NI-5. UTM coordinates and grab description not available.*

*Figure 13: North Inlet reconnaissance: grab at transect location 7. Grab collected between Stations NI-2 and NI-5. UTM coordinates and grab description not available.*

*Figure 14: North Inlet reconnaissance: grab at transect location 8. Grab collected between Stations NI-2 and NI-5. UTM coordinates and grab description not available.*

*Figure 15: Station NI-1 sediment grab collected for toxicity testing. Dark unconsolidated sediment with greenish tinge (possibly algae) overlying grey sediment.*

*Figure 16: Station NI-1, first sediment core sample. Penetration depth: 44 cm.*

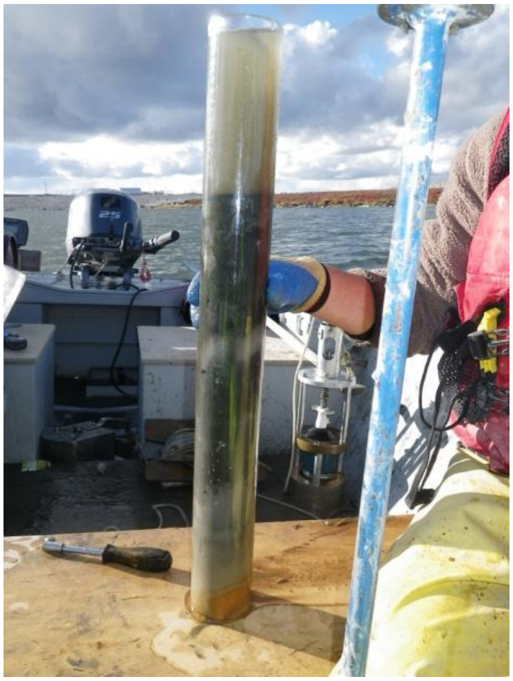


*Figure 17: Station NI-1, second sediment core sample. Penetration depth: 46 cm.*

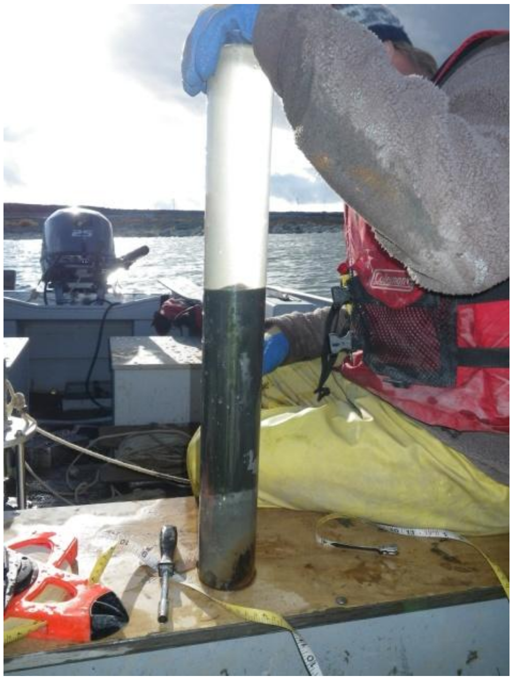


*Figure 18: Station NI-1, third sediment core sample. Penetration depth: 36 cm. Approximately 23 cm of darker loose layer at sediment surface.*

*Figure 19: Station NI-2. Homogenized composite from sediment grab samples. Sediments have high water content; fine grain size; mixture of silt and clay, with dark layer overlying medium grey sediments.*

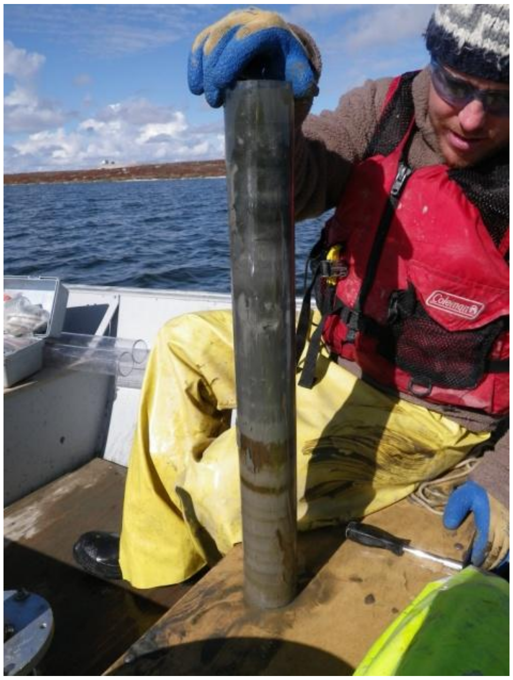


*Figure 20: Station NI-2, first sediment core sample. Penetration depth: 57 cm.*

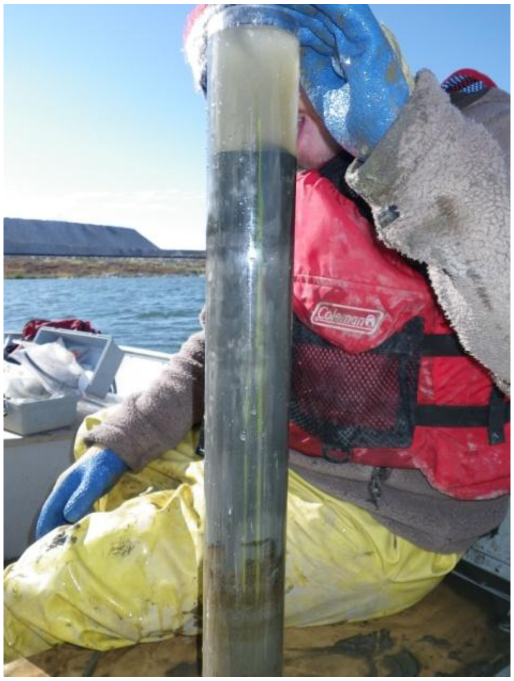


*Figure 21: Station NI-2, second sediment core sample. Penetration depth: 51 cm. Approximately 5 cm of darker unconsolidated material at surface.*

*Figure 22: Station NI-2, third sediment core sample. Penetration depth: 56 cm. Approximately 7 cm of darker loose material at surface.*

*Figure 23: Station REF-1. Thin layer of brown sand overlying light grey silt/clay. Multiple exploratory grabs were collected near this station, and all had similar characteristics.*

o:\active_2010\1328\10-1328-0028\phase 7000 - north inlet sediments\07-reporting\appendices\appendix a - field photos.docx

# APPENDIX B

## Laboratory Report - Sediment and Sludge Chemistry (Maxxam Analytics)

Your P.O. #: 10-1328-0028/700
Your Project #: DIAVIK NORTH INLET
Your C.O.C. #: 5455, 5452, 5451

**Attention: Ryan Stevenson**
GOLDER ASSOCIATES LTD
4260 STILL CREEK DRIVE
Suite 500
BURNABY, BC
Canada V5C 6C6

**Report Date: 2010/11/03**
This report supersedes all previous reports with the same Maxxam job number

# CERTIFICATE OF ANALYSIS

**MAXXAM JOB #: B082579**
**Received: 2010/09/08, 09:30**

Sample Matrix: Soil
# Samples Received: 27

| Analyses | Quantity | Date Extracted | Date Analyzed | Laboratory Method | Analytical Method |
|---|---|---|---|---|---|
| Elements by ICPMS (total) | 11 | 2010/09/17 | 2010/09/17 | BRN SOP-00203 R5.0 | Based on EPA 200.8 |
| Elements by ICPMS (total) | 13 | 2010/09/18 | 2010/09/20 | BRN SOP-00203 R5.0 | Based on EPA 200.8 |
| Simultaneously Extractable Metals-ICPMS | 24 | 2010/09/20 | 2010/09/20 | BRN SOP-00203 5.0 | Based on EPA 200.8 |
| Moisture | 24 | N/A | 2010/09/22 | BRN SOP-00321 R5.0 | Ont MOE -E 3139 |
| pH (2:1 DI Water Extract) | 11 | 2010/09/17 | 2010/09/17 | BRN SOP-00266 R6.0 | Carter, SSMA 16.2 |
| pH (2:1 DI Water Extract) | 13 | 2010/09/18 | 2010/09/20 | BRN SOP-00266 R6.0 | Carter, SSMA 16.2 |
| Available Phosphate | 24 | 2010/09/20 | 2010/09/20 | BRN SOP-00235 R5.0 | SM SECTION 4500 PE |
| Sulfide (AVS) (soil) - Calc for umole/g | 13 | 2010/09/10 | 2010/09/22 | BRN SOP-00229 R2.0 | Based EPA821-R91-100 |
| Sulfide (AVS) (soil) - Calc for umole/g | 11 | 2010/09/16 | 2010/09/22 | BRN SOP-00229 R2.0 | Based EPA821-R91-100 |
| Sulfide (AVS) (soil) | 24 | 2010/09/20 | 2010/09/20 | BRN SOP-00229 R2.0 | Based EPA821-R91-100 |
| Texture by Hydrometer, incl Gravel (Wet) (1) | 23 | 2010/09/20 | 2010/09/21 | EENVSOP-00076 | MMFSPA Ch9 |
| Texture by Hydrometer, incl Gravel (Wet) (1) | 1 | 2010/10/13 | 2010/10/13 | EENVSOP-00076 | MMFSPA Ch9 |

* Results relate only to the items tested.

(1) This test was performed by Maxxam Edmonton Environmental

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

VJ OCO, Burnaby Customer Service
Email: VOco@maxxam.ca
Phone# (604) 639-8422

====================================================================
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

## RESULTS OF CHEMICAL ANALYSES OF SOIL

| Maxxam ID | | W82387 | | W82388 | | | W82389 | W82390 | | W82391 | | W82392 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/01 | | 2010/09/01 | | | 2010/09/03 | 2010/09/03 | | 2010/09/03 | | 2010/09/03 | | |
| | **Units** | **NI-2 BOTTOM** | **RDL** | **FIELD REPLICATE** | **RDL** | **QC Batch** | **NI-3** | **NI-3** | **RDL** | **NI-3 SURFACE** | **RDL** | **NI-3 MIDDLE** | **RDL** | **QC Batch** |
| **Calculated Parameters** | | | | | | | | | | | | | | |
| Sulphide | umole/g | 0.031 | 0.007 | 0.56 | 0.09 | 4256070 | 0.79 | | 0.02 | 0.33 | 0.02 | 0.05 | 0.02 | 4266646 |
| **MISCELLANEOUS** | | | | | | | | | | | | | | |
| Sulphide | ug/g | 1.0(1) | 0.2 | 18 | 3 | 4273873 | 25.3 | | 0.6 | 10.6 | 0.7 | 1.7(1) | 0.6 | 4273873 |
| **Nutrients** | | | | | | | | | | | | | | |
| Available (KCl) Orthophosphate (P) | ug/g | 61.2 | 0.5 | 60.9 | 0.5 | 4273892 | 60.9 | | 0.5 | 75.8 | 0.5 | 91.3 | 0.5 | 4273892 |
| **Physical Properties** | | | | | | | | | | | | | | |
| % sand by hydrometer | % | 27 | 2 | 50 | 2 | 4275367 | | 3 | 2 | | | <2 | 2 | 4275367 |
| % silt by hydrometer | % | 64 | 2 | 43 | 2 | 4275367 | | 77 | 2 | | | 68 | 2 | 4275367 |
| Clay Content | % | 9 | 2 | 8 | 2 | 4275367 | | 20 | 2 | | | 30 | 2 | 4275367 |
| Gravel | % | <2 | 2 | <2 | 2 | 4275367 | | <2 | 2 | | | <2 | 2 | 4275367 |

| Maxxam ID | | W82393 | | W82394 | | W82395 | | | W82396 | | W82419 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/03 | | 2010/09/03 | | 2010/09/03 | | | 2010/09/03 | | 2010/09/03 | | |
| | **Units** | **NI-3 BOTTOM** | **RDL** | **NI-4** | **RDL** | **NI-4 SURFACE** | **RDL** | **QC Batch** | **NI-4 MIDDLE** | **RDL** | **NI-4 BOTTOM** | **RDL** | **QC Batch** |
| **Calculated Parameters** | | | | | | | | | | | | | |
| Sulphide | umole/g | <0.01 | 0.01 | 0.37 | 0.02 | 0.14 | 0.01 | 4256070 | 0.05 | 0.02 | <0.02 | 0.02 | 4266646 |
| **MISCELLANEOUS** | | | | | | | | | | | | | |
| Sulphide | ug/g | <0.4(1) | 0.4 | 11.7 | 0.5 | 4.5 | 0.4 | 4273873 | 1.5(1) | 0.7 | 0.6(1) | 0.6 | 4273873 |
| **Nutrients** | | | | | | | | | | | | | |
| Available (KCl) Orthophosphate (P) | ug/g | 68.2 | 0.5 | 71.0 | 0.5 | 79.5 | 0.5 | 4273892 | 77.7 | 0.5 | 72.7 | 0.5 | 4273892 |
| **Physical Properties** | | | | | | | | | | | | | |
| % sand by hydrometer | % | <2 | 2 | <2 | 2 | 32 | 2 | 4275367 | 68 | 2 | 58 | 2 | 4275367 |
| % silt by hydrometer | % | 77 | 2 | 79 | 2 | 49 | 2 | 4275367 | 28 | 2 | 36 | 2 | 4275367 |
| Clay Content | % | 21 | 2 | 20 | 2 | 19 | 2 | 4275367 | 4 | 2 | 6 | 2 | 4275367 |
| Gravel | % | <2 | 2 | <2 | 2 | <2 | 2 | 4275367 | <2 | 2 | <2 | 2 | 4275367 |

---

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

## RESULTS OF CHEMICAL ANALYSES OF SOIL

| Maxxam ID | | W82420 | | | W82421 | | | W82422 | W82423 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/03 | | | 2010/09/03 | | | 2010/09/03 | 2010/09/03 | | |
| | **Units** | **NI-5** | **RDL** | **QC Batch** | **NI-5 SURFACE** | **RDL** | **QC Batch** | **NI-5 MIDDLE** | **NI-5 BOTTOM** | **RDL** | **QC Batch** |
| **Calculated Parameters** | | | | | | | | | | | |
| Sulphide | umole/g | 0.043 | 0.008 | 4256070 | 0.07 | 0.01 | 4266646 | 0.12 | 0.05 | 0.02 | 4256070 |
| **MISCELLANEOUS** | | | | | | | | | | | |
| Sulphide | ug/g | 1.4 | 0.3 | 4273873 | 2.1 | 0.4 | 4273873 | 4.0 | 1.7(1) | 0.6 | 4273873 |
| **Nutrients** | | | | | | | | | | | |
| Available (KCl) Orthophosphate (P) | ug/g | 67.9 | 0.5 | 4273892 | 69.8 | 0.5 | 4273892 | 75.8 | 80.9 | 0.5 | 4273892 |
| **Physical Properties** | | | | | | | | | | | |
| % sand by hydrometer | % | 28 | 2 | 4275367 | 28 | 2 | 4275367 | 69 | 76 | 2 | 4275367 |
| % silt by hydrometer | % | 59 | 2 | 4275367 | 52 | 2 | 4275367 | 28 | 19 | 2 | 4275367 |
| Clay Content | % | 13 | 2 | 4275367 | 21 | 2 | 4275367 | 2 | 4 | 2 | 4275367 |
| Gravel | % | <2 | 2 | 4275367 | <2 | 2 | 4275367 | <2 | <2 | 2 | 4275367 |

| Maxxam ID | | W82424 | | | W82425 | | | W82426 | | | W82440 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/02 | | | 2010/09/04 | | | 2010/09/04 | | | 2010/09/01 | | |
| | **Units** | **REF-1** | **RDL** | **QC Batch** | **REF-2** | **RDL** | **QC Batch** | **REF-3** | **RDL** | **QC Batch** | **NI-1** | **RDL** | **QC Batch** |
| **Calculated Parameters** | | | | | | | | | | | | | |
| Sulphide | umole/g | <0.02 | 0.02 | 4266646 | 0.01 | 0.01 | 4256070 | 0.05 | 0.03 | 4266646 | 14.4 | 0.3 | 4256070 |
| **MISCELLANEOUS** | | | | | | | | | | | | | |
| Sulphide | ug/g | <0.7(1) | 0.7 | 4273873 | 0.5(1) | 0.4 | 4273873 | 1.6(2) | 0.8 | 4273873 | 461 | 10 | 4273873 |
| **Nutrients** | | | | | | | | | | | | | |
| Available (KCl) Orthophosphate (P) | ug/g | 68.3 | 0.5 | 4273892 | 68.0 | 0.5 | 4273892 | 67.4 | 0.5 | 4273892 | 67.0 | 0.5 | 4273892 |
| **Physical Properties** | | | | | | | | | | | | | |
| % sand by hydrometer | % | 7 | 2 | 4275367 | 21 | 2 | 4275367 | 31 | 2 | 4275367 | | | |
| % silt by hydrometer | % | 75 | 2 | 4275367 | 67 | 2 | 4275367 | 61 | 2 | 4275367 | | | |
| Clay Content | % | 18 | 2 | 4275367 | 11 | 2 | 4275367 | 8 | 2 | 4275367 | | | |
| Gravel | % | <2 | 2 | 4275367 | <2 | 2 | 4275367 | <2 | 2 | 4275367 | | | |

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RDL = Reportable Detection Limit
(1) - RDL raised due to sample dilution.
(2) - Matrix spike exceeds acceptance limits due to matrix interference. Re-analysis yields similar results.
RDL raised due to sample dilution.

Maxxam Job #: B082579
Report Date: 2010/11/03

GOLDER ASSOCIATES LTD
Client Project #: DIAVIK NORTH INLET

Your P.O. #: 10-1328-0028/700

## RESULTS OF CHEMICAL ANALYSES OF SOIL

| Maxxam ID |  | W82441 |  |  | W82442 |  | W82443 |  | W82444 |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date |  | 2010/09/01 |  |  | 2010/09/01 |  | 2010/09/01 |  | 2010/09/01 |  |  |
|  | **Units** | **NI-1 SURFACE** | **RDL** | **QC Batch** | **NI-1 MIDDLE** | **RDL** | **NI-1 BOTTOM** | **RDL** | **NI-2** | **RDL** | **QC Batch** |
| **Calculated Parameters** |  |  |  |  |  |  |  |  |  |  |  |
| Sulphide | umole/g | 0.4 | 0.1 | 4266646 | 1.49 | 0.07 | 0.008 | 0.007 | 0.35 | 0.02 | 4256070 |
| **MISCELLANEOUS** |  |  |  |  |  |  |  |  |  |  |  |
| Sulphide | ug/g | 14(1) | 5 | 4273873 | 48 | 2 | 0.3(1) | 0.2 | 11.2 | 0.7 | 4273873 |
| **Nutrients** |  |  |  |  |  |  |  |  |  |  |  |
| Available (KCl) Orthophosphate (P) | ug/g | 70.4 | 0.5 | 4273892 | 77.4 | 0.5 | 72.9 | 0.5 | 70.8 | 0.5 | 4273892 |
| **Physical Properties** |  |  |  |  |  |  |  |  |  |  |  |
| % sand by hydrometer | % | 87 | 2 | 4275367 | 5 | 2 | 22 | 2 | 2 | 2 | 4275727 |
| % silt by hydrometer | % | 11 | 2 | 4275367 | 72 | 2 | 68 | 2 | 78 | 2 | 4275727 |
| Clay Content | % | <2 | 2 | 4275367 | 24 | 2 | 11 | 2 | 20 | 2 | 4275727 |
| Gravel | % | <2 | 2 | 4275367 | <2 | 2 | <2 | 2 | <2 | 2 | 4275727 |

| Maxxam ID |  | W82446 |  | W82447 | W82448 |  | X10994 |  |  |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date |  | 2010/09/01 |  | 2010/09/01 | 2010/09/01 |  | 2010/09/03 |  |  |
|  | **Units** | **NI-2 SURFACE** | **RDL** | **NI-2 MIDDLE** | **NI-1** | **QC Batch** | **NI-3 BOTTOM (B)** | **RDL** | **QC Batch** |
| **Calculated Parameters** |  |  |  |  |  |  |  |  |  |
| Sulphide | umole/g | 26.3 | 0.7 | 0.012 |  | 4266646 |  | 0.009 |  |
| **MISCELLANEOUS** |  |  |  |  |  |  |  |  |  |
| Sulphide | ug/g | 844 | 20 | 0.4(2) |  | 4273873 |  | 0.3 |  |
| **Nutrients** |  |  |  |  |  |  |  |  |  |
| Available (KCl) Orthophosphate (P) | ug/g | 94.5 | 0.5 | 69.0 |  | 4273892 |  | 0.5 |  |
| **Physical Properties** |  |  |  |  |  |  |  |  |  |
| % sand by hydrometer | % | 42 | 2 | 26 | 44 | 4275727 | 22 | 2 | 4332191 |
| % silt by hydrometer | % | 46 | 2 | 59 | 49 | 4275727 | 69 | 2 | 4332191 |
| Clay Content | % | 12 | 2 | 15 | 7 | 4275727 | 9 | 2 | 4332191 |
| Gravel | % | <2 | 2 | <2 | <2 | 4275727 | <2 | 2 | 4332191 |

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RDL = Reportable Detection Limit
(1) - RDL raised due to sample dilution.
(2) - Matrix spike exceeds acceptance limits due to matrix interference. Re-analysis yields similar results.
RDL raised due to sample dilution.

## PHYSICAL TESTING (SOIL)

| Maxxam ID | | W82387 | W82388 | W82389 | W82391 | W82392 | W82393 | W82394 | W82395 | W82396 | W82419 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/01 | 2010/09/01 | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/03 | | |
| | **Units** | **NI-2 BOTTOM** | **FIELD REPLICATE** | **NI-3** | **NI-3 SURFACE** | **NI-3 MIDDLE** | **NI-3 BOTTOM** | **NI-4** | **NI-4 SURFACE** | **NI-4 MIDDLE** | **NI-4 BOTTOM** | **RDL** | **QC Batch** |
| **Physical Properties** | | | | | | | | | | | | | |
| Moisture | % | 43 | 94 | 71 | 77 | 68 | 68 | 70 | 69 | 78 | 66 | 0.3 | 4282662 |

| Maxxam ID | | W82420 | W82421 | W82422 | W82423 | | W82424 | W82425 | W82426 | W82440 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/03 | | 2010/09/02 | 2010/09/04 | 2010/09/04 | 2010/09/01 | | |
| | **Units** | **NI-5** | **NI-5 SURFACE** | **NI-5 MIDDLE** | **NI-5 BOTTOM** | **QC Batch** | **REF-1** | **REF-2** | **REF-3** | **NI-1** | **RDL** | **QC Batch** |
| **Physical Properties** | | | | | | | | | | | | |
| Moisture | % | 40 | 59 | 73 | 74 | 4282662 | 74 | 68 | 78 | 78 | 0.3 | 4282769 |

| Maxxam ID | | W82441 | W82442 | W82443 | W82444 | W82446 | W82447 | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/01 | 2010/09/01 | 2010/09/01 | 2010/09/01 | 2010/09/01 | 2010/09/01 | | |
| | **Units** | **NI-1 SURFACE** | **NI-1 MIDDLE** | **NI-1 BOTTOM** | **NI-2** | **NI-2 SURFACE** | **NI-2 MIDDLE** | **RDL** | **QC Batch** |
| **Physical Properties** | | | | | | | | | |
| Moisture | % | 96 | 44 | 30 | 78 | 88 | 39 | 0.3 | 4282769 |

## ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

| Maxxam ID | | W82387 | W82388 | W82389 | W82391 | W82392 | W82393 | W82394 | W82395 | W82396 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/01 | 2010/09/01 | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/03 | | |
| | **Units** | **NI-2 BOTTOM** | **FIELD REPLICATE** | **NI-3** | **NI-3 SURFACE** | **NI-3 MIDDLE** | **NI-3 BOTTOM** | **NI-4** | **NI-4 SURFACE** | **NI-4 MIDDLE** | **RDL** | **QC Batch** |
| **SEM Metals by ICPMS** | | | | | | | | | | | | |
| SEM Cadmium (Cd) | umole/g | 0.0010 | 0.0016 | 0.0014 | 0.0128 | 0.0031 | 0.0010 | 0.0005 | 0.0007 | 0.0062 | 0.0002 | 4275750 |
| SEM Copper (Cu) | umole/g | 0.263 | 0.283 | 0.317 | 0.693 | 0.915 | 0.267 | 0.120 | 0.161 | 1.21 | 0.004 | 4275750 |
| SEM Lead (Pb) | umole/g | 0.0107 | 0.0692 | 0.137 | 0.672 | 0.0912 | 0.0094 | 0.0493 | 0.0556 | 0.0299 | 0.0002 | 4275750 |
| SEM Mercury (Hg) | umole/g | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | 0.0003 | 4275750 |
| SEM Nickel (Ni) | umole/g | 0.362 | 3.12 | 2.00 | 2.08 | 6.12 | 0.271 | 0.923 | 1.15 | 1.93 | 0.004 | 4275750 |
| SEM Zinc (Zn) | umole/g | 0.524 | 0.979 | 1.47 | 2.39 | 0.982 | 0.502 | 0.564 | 0.633 | 2.18 | 0.008 | 4275750 |

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RDL = Reportable Detection Limit

## ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

| Maxxam ID | | W82419 | W82420 | W82421 | W82422 | W82423 | W82424 | W82425 | W82426 | W82440 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/02 | 2010/09/04 | 2010/09/04 | 2010/09/01 | | |
| | **Units** | **NI-4 BOTTOM** | **NI-5** | **NI-5 SURFACE** | **NI-5 MIDDLE** | **NI-5 BOTTOM** | **REF-1** | **REF-2** | **REF-3** | **NI-1** | **RDL** | **QC Batch** |
| **SEM Metals by ICPMS** | | | | | | | | | | | | |
| SEM Cadmium (Cd) | umole/g | 0.0033 | 0.0007 | 0.0015 | 0.0007 | 0.0008 | 0.0014 | 0.0006 | 0.0021 | 0.0006 | 0.0002 | 4275750 |
| SEM Copper (Cu) | umole/g | 0.845 | 0.232 | 0.416 | 0.206 | 0.257 | 0.322 | 0.185 | 0.565 | 0.117 | 0.004 | 4275750 |
| SEM Lead (Pb) | umole/g | 0.0203 | 0.0792 | 0.134 | 0.0078 | 0.0078 | 0.0165 | 0.0080 | 0.0177 | 0.0371 | 0.0002 | 4275750 |
| SEM Mercury (Hg) | umole/g | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | 0.0003 | 4275750 |
| SEM Nickel (Ni) | umole/g | 1.53 | 0.504 | 1.19 | 0.192 | 0.241 | 0.578 | 0.335 | 1.01 | 1.19 | 0.004 | 4275750 |
| SEM Zinc (Zn) | umole/g | 1.55 | 0.802 | 1.30 | 0.311 | 0.403 | 0.632 | 0.438 | 0.996 | 0.525 | 0.008 | 4275750 |

| Maxxam ID | | W82441 | W82442 | W82443 | W82444 | W82446 | W82447 | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/01 | 2010/09/01 | 2010/09/01 | 2010/09/01 | 2010/09/01 | 2010/09/01 | | |
| | **Units** | **NI-1 SURFACE** | **NI-1 MIDDLE** | **NI-1 BOTTOM** | **NI-2** | **NI-2 SURFACE** | **NI-2 MIDDLE** | **RDL** | **QC Batch** |
| **SEM Metals by ICPMS** | | | | | | | | | |
| SEM Cadmium (Cd) | umole/g | 0.0012 | 0.0007 | 0.0004 | 0.0008 | 0.0005 | 0.0010 | 0.0002 | 4275750 |
| SEM Copper (Cu) | umole/g | 0.172 | 0.132 | 0.196 | 0.113 | 0.066 | 0.418 | 0.004 | 4275750 |
| SEM Lead (Pb) | umole/g | 0.0564 | 0.0409 | 0.0085 | 0.0346 | 0.0206 | 0.0263 | 0.0002 | 4275750 |
| SEM Mercury (Hg) | umole/g | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | <0.0003 | 0.0003 | 4275750 |
| SEM Nickel (Ni) | umole/g | 3.71 | 1.31 | 0.229 | 1.51 | 0.781 | 0.579 | 0.004 | 4275750 |
| SEM Zinc (Zn) | umole/g | 0.488 | 0.492 | 0.332 | 0.464 | 0.320 | 0.687 | 0.008 | 4275750 |

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RDL = Reportable Detection Limit

## CSR/CCME METALS IN SOIL (SOIL)

| Maxxam ID | | W82387 | W82388 | W82389 | W82391 | W82392 | W82393 | W82394 | | W82395 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/01 | 2010/09/01 | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/03 | 2010/09/03 | | 2010/09/03 | | |
| | **Units** | **NI-2 BOTTOM** | **FIELD REPLICATE** | **NI-3** | **NI-3 SURFACE** | **NI-3 MIDDLE** | **NI-3 BOTTOM** | **NI-4** | **QC Batch** | **NI-4 SURFACE** | **RDL** | **QC Batch** |
| **Physical Properties** | | | | | | | | | | | | |
| Soluble (2:1) pH | pH Units | 5.74 | 8.00 | 8.34 | 8.20 | 8.13 | 6.38 | 7.56 | 4268744 | 7.99 | 0.01 | 4271680 |
| **Total Metals by ICPMS** | | | | | | | | | | | | |
| Total Aluminum (Al) | mg/kg | 12700 | 31500 | 19900 | 20100 | 25100 | 15100 | 22100 | 4268700 | 23400 | 100 | 4271670 |
| Total Antimony (Sb) | mg/kg | <0.1 | 0.3 | 0.3 | 0.3 | 0.2 | <0.1 | 0.3 | 4268700 | 0.3 | 0.1 | 4271670 |
| Total Arsenic (As) | mg/kg | 13.4 | 20.1 | 2.9 | 3.5 | 13.0 | 31.9 | 7.1 | 4268700 | 6.4 | 0.2 | 4271670 |
| Total Barium (Ba) | mg/kg | 119 | 309 | 264 | 259 | 451 | 129 | 381 | 4268700 | 395 | 0.1 | 4271670 |
| Total Beryllium (Be) | mg/kg | 0.4 | 0.3 | 0.3 | 0.3 | 0.7 | 0.6 | 0.4 | 4268700 | 0.5 | 0.1 | 4271670 |
| Total Bismuth (Bi) | mg/kg | 0.3 | 0.8 | 1.0 | 1.0 | 1.7 | 0.4 | 1.2 | 4268700 | 0.9 | 0.1 | 4271670 |
| Total Cadmium (Cd) | mg/kg | 0.19 | 0.20 | 0.17 | 0.20 | 0.35 | 0.27 | 0.21 | 4268700 | 0.19 | 0.05 | 4271670 |
| Total Calcium (Ca) | mg/kg | 916 | 8580 | 8160 | 8110 | 8670 | 1680 | 7660 | 4268700 | 8030 | 100 | 4271670 |
| Total Chromium (Cr) | mg/kg | 47 | 127 | 87 | 87 | 203 | 50 | 113 | 4268700 | 120 | 1 | 4271670 |
| Total Cobalt (Co) | mg/kg | 15.3 | 22.9 | 18.5 | 18.2 | 39.8 | 13.5 | 23.6 | 4268700 | 24.1 | 0.3 | 4271670 |
| Total Copper (Cu) | mg/kg | 29.2 | 29.1 | 31.1 | 31.9 | 79.5 | 48.5 | 35.6 | 4268700 | 36.9 | 0.5 | 4271670 |
| Total Iron (Fe) | mg/kg | 21600 | 28800 | 26700 | 26500 | 35000 | 25300 | 28700 | 4268700 | 29300 | 100 | 4271670 |
| Total Lead (Pb) | mg/kg | 4.6 | 21.4 | 32.6 | 34.2 | 27.9 | 5.3 | 32.0 | 4268700 | 32.0 | 0.1 | 4271670 |
| Total Magnesium (Mg) | mg/kg | 6190 | 33900 | 21600 | 22300 | 53800 | 6810 | 31800 | 4268700 | 33400 | 100 | 4271670 |
| Total Manganese (Mn) | mg/kg | 526 | 567 | 454 | 499 | 775 | 281 | 678 | 4268700 | 770 | 0.2 | 4271670 |
| Total Mercury (Hg) | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 4268700 | <0.05 | 0.05 | 4271670 |
| Total Molybdenum (Mo) | mg/kg | 1.1 | 6.6 | 8.2 | 11.5 | 10.7 | 2.6 | 10.5 | 4268700 | 11.9 | 0.1 | 4271670 |
| Total Nickel (Ni) | mg/kg | 39.8 | 277 | 169 | 165 | 559 | 44.1 | 260 | 4268700 | 276 | 0.8 | 4271670 |
| Total Phosphorus (P) | mg/kg | 758 | 3090 | 1520 | 1670 | 1880 | 982 | 1700 | 4268700 | 1540 | 10 | 4271670 |
| Total Potassium (K) | mg/kg | 3860 | 9340 | 9990 | 9860 | 6800 | 3900 | 9200 | 4268700 | 9150 | 100 | 4271670 |
| Total Selenium (Se) | mg/kg | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 4268700 | <0.5 | 0.5 | 4271670 |
| Total Silver (Ag) | mg/kg | <0.05 | 0.24 | 0.25 | 0.23 | 0.24 | 0.09 | 0.25 | 4268700 | 0.21 | 0.05 | 4271670 |
| Total Sodium (Na) | mg/kg | 179 | 598 | 615 | 674 | 562 | 254 | 738 | 4268700 | 778 | 100 | 4271670 |
| Total Strontium (Sr) | mg/kg | 6.1 | 115 | 66.1 | 69.5 | 111 | 11.1 | 82.1 | 4268700 | 90.3 | 0.1 | 4271670 |
| Total Thallium (Tl) | mg/kg | 0.22 | 0.52 | 0.57 | 0.54 | 0.40 | 0.26 | 0.51 | 4268700 | 0.49 | 0.05 | 4271670 |
| Total Tin (Sn) | mg/kg | 0.5 | 1.3 | 1.3 | 1.4 | 0.9 | 0.5 | 1.7 | 4268700 | 1.2 | 0.1 | 4271670 |
| Total Titanium (Ti) | mg/kg | 732 | 1260 | 1430 | 1340 | 983 | 668 | 1220 | 4268700 | 910 | 1 | 4271670 |
| Total Vanadium (V) | mg/kg | 38 | 45 | 40 | 40 | 54 | 42 | 42 | 4268700 | 43 | 2 | 4271670 |
| Total Zinc (Zn) | mg/kg | 63 | 102 | 113 | 111 | 101 | 86 | 116 | 4268700 | 115 | 1 | 4271670 |
| Total Zirconium (Zr) | mg/kg | 1.6 | 7.0 | 10.5 | 8.4 | 9.7 | 1.2 | 9.7 | 4268700 | 4.1 | 0.5 | 4271670 |

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RDL = Reportable Detection Limit

## CSR/CCME METALS IN SOIL (SOIL)

| Maxxam ID | | W82396 | W82419 | | W82420 | | W82421 | | W82422 | | W82423 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/03 | 2010/09/03 | | 2010/09/03 | | 2010/09/03 | | 2010/09/03 | | 2010/09/03 | | |
| | **Units** | **NI-4 MIDDLE** | **NI-4 BOTTOM** | **QC Batch** | **NI-5** | **QC Batch** | **NI-5 SURFACE** | **QC Batch** | **NI-5 MIDDLE** | **QC Batch** | **NI-5 BOTTOM** | **RDL** | **QC Batch** |
| **Physical Properties** | | | | | | | | | | | | | |
| Soluble (2:1) pH | pH Units | 6.47 | 5.38 | 4271543 | 7.50 | 4268744 | 7.97 | 4271543 | 6.54 | 4268744 | 6.10 | 0.01 | 4271543 |
| **Total Metals by ICPMS** | | | | | | | | | | | | | |
| Total Aluminum (Al) | mg/kg | 19400 | 18800 | 4271536 | 14100 | 4268700 | 16900 | 4271536 | 15300 | 4268700 | 17200 | 100 | 4271536 |
| Total Antimony (Sb) | mg/kg | <0.1 | <0.1 | 4271536 | 0.1 | 4268700 | 0.2 | 4271536 | <0.1 | 4268700 | <0.1 | 0.1 | 4271536 |
| Total Arsenic (As) | mg/kg | 72.0 | 46.8 | 4271536 | 10.9 | 4268700 | 11.6 | 4271536 | 13.1 | 4268700 | 11.2 | 0.2 | 4271536 |
| Total Barium (Ba) | mg/kg | 170 | 155 | 4271536 | 102 | 4268700 | 179 | 4271536 | 125 | 4268700 | 136 | 0.1 | 4271536 |
| Total Beryllium (Be) | mg/kg | 0.8 | 0.7 | 4271536 | 0.3 | 4268700 | 0.5 | 4271536 | 0.7 | 4268700 | 0.7 | 0.1 | 4271536 |
| Total Bismuth (Bi) | mg/kg | 0.5 | 0.5 | 4271536 | 1.7 | 4268700 | 2.1 | 4271536 | 1.5 | 4268700 | 0.6 | 0.1 | 4271536 |
| Total Cadmium (Cd) | mg/kg | 0.57 | 0.45 | 4271536 | 0.15 | 4268700 | 0.18 | 4271536 | 0.29 | 4268700 | 0.40 | 0.05 | 4271536 |
| Total Calcium (Ca) | mg/kg | 1590 | 1260 | 4271536 | 3990 | 4268700 | 4440 | 4271536 | 1770 | 4268700 | 1520 | 100 | 4271536 |
| Total Chromium (Cr) | mg/kg | 65 | 64 | 4271536 | 47 | 4268700 | 65 | 4271536 | 55 | 4268700 | 60 | 1 | 4271536 |
| Total Cobalt (Co) | mg/kg | 38.2 | 40.8 | 4271536 | 11.2 | 4268700 | 14.6 | 4271536 | 13.4 | 4268700 | 13.6 | 0.3 | 4271536 |
| Total Copper (Cu) | mg/kg | 80.3 | 74.0 | 4271536 | 33.9 | 4268700 | 35.9 | 4271536 | 51.0 | 4268700 | 64.4 | 0.5 | 4271536 |
| Total Iron (Fe) | mg/kg | 48900 | 38700 | 4271536 | 22000 | 4268700 | 25900 | 4271536 | 20500 | 4268700 | 21100 | 100 | 4271536 |
| Total Lead (Pb) | mg/kg | 7.4 | 6.0 | 4271536 | 25.4 | 4268700 | 28.8 | 4271536 | 7.6 | 4268700 | 6.3 | 0.1 | 4271536 |
| Total Magnesium (Mg) | mg/kg | 8610 | 8240 | 4271536 | 8190 | 4268700 | 13600 | 4271536 | 7060 | 4268700 | 7650 | 100 | 4271536 |
| Total Manganese (Mn) | mg/kg | 641 | 429 | 4271536 | 286 | 4268700 | 410 | 4271536 | 283 | 4268700 | 264 | 0.2 | 4271536 |
| Total Mercury (Hg) | mg/kg | <0.05 | <0.05 | 4271536 | <0.05 | 4268700 | <0.05 | 4271536 | <0.05 | 4268700 | <0.05 | 0.05 | 4271536 |
| Total Molybdenum (Mo) | mg/kg | 4.1 | 3.4 | 4271536 | 2.8 | 4268700 | 4.9 | 4271536 | 1.9 | 4268700 | 2.2 | 0.1 | 4271536 |
| Total Nickel (Ni) | mg/kg | 117 | 122 | 4271536 | 51.4 | 4268700 | 91.1 | 4271536 | 47.8 | 4268700 | 56.8 | 0.8 | 4271536 |
| Total Phosphorus (P) | mg/kg | 1690 | 1420 | 4271536 | 1590 | 4268700 | 1740 | 4271536 | 804 | 4268700 | 824 | 10 | 4271536 |
| Total Potassium (K) | mg/kg | 4510 | 4530 | 4271536 | 6960 | 4268700 | 7170 | 4271536 | 4440 | 4268700 | 4680 | 100 | 4271536 |
| Total Selenium (Se) | mg/kg | 0.7 | 0.5 | 4271536 | <0.5 | 4268700 | <0.5 | 4271536 | <0.5 | 4268700 | <0.5 | 0.5 | 4271536 |
| Total Silver (Ag) | mg/kg | 0.10 | 0.11 | 4271536 | 0.14 | 4268700 | 0.14 | 4271536 | 0.08 | 4268700 | 0.08 | 0.05 | 4271536 |
| Total Sodium (Na) | mg/kg | 467 | 274 | 4271536 | 268 | 4268700 | 396 | 4271536 | 319 | 4268700 | 295 | 100 | 4271536 |
| Total Strontium (Sr) | mg/kg | 17.6 | 10.8 | 4271536 | 21.1 | 4268700 | 36.2 | 4271536 | 16.6 | 4268700 | 11.3 | 0.1 | 4271536 |
| Total Thallium (Tl) | mg/kg | 0.42 | 0.38 | 4271536 | 0.43 | 4268700 | 0.46 | 4271536 | 0.24 | 4268700 | 0.30 | 0.05 | 4271536 |
| Total Tin (Sn) | mg/kg | 0.6 | 0.6 | 4271536 | 1.3 | 4268700 | 1.1 | 4271536 | 1.0 | 4268700 | 0.5 | 0.1 | 4271536 |
| Total Titanium (Ti) | mg/kg | 704 | 833 | 4271536 | 1010 | 4268700 | 969 | 4271536 | 667 | 4268700 | 692 | 1 | 4271536 |
| Total Vanadium (V) | mg/kg | 56 | 56 | 4271536 | 31 | 4268700 | 36 | 4271536 | 46 | 4268700 | 54 | 2 | 4271536 |
| Total Zinc (Zn) | mg/kg | 146 | 133 | 4271536 | 81 | 4268700 | 95 | 4271536 | 80 | 4268700 | 109 | 1 | 4271536 |
| Total Zirconium (Zr) | mg/kg | 1.5 | 2.0 | 4271536 | 4.6 | 4268700 | 4.1 | 4271536 | 0.8 | 4268700 | 1.2 | 0.5 | 4271536 |

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RDL = Reportable Detection Limit

## CSR/CCME METALS IN SOIL (SOIL)

| Maxxam ID | | W82424 | | W82425 | | W82426 | | W82440 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/02 | | 2010/09/04 | | 2010/09/04 | | 2010/09/01 | | |
| | **Units** | **REF-1** | **QC Batch** | **REF-2** | **QC Batch** | **REF-3** | **QC Batch** | **NI-1** | **RDL** | **QC Batch** |
| **Physical Properties** | | | | | | | | | | |
| Soluble (2:1) pH | pH Units | 6.16 | 4271543 | 6.02 | 4268744 | 5.68 | 4271543 | 7.62 | 0.01 | 4268744 |
| **Total Metals by ICPMS** | | | | | | | | | | |
| Total Aluminum (Al) | mg/kg | 18600 | 4271536 | 15900 | 4268700 | 15000 | 4271536 | 32400 | 100 | 4268700 |
| Total Antimony (Sb) | mg/kg | <0.1 | 4271536 | <0.1 | 4268700 | <0.1 | 4271536 | 0.4 | 0.1 | 4268700 |
| Total Arsenic (As) | mg/kg | 85.0 | 4271536 | 71.7 | 4268700 | 195 | 4271536 | 37.2 | 0.2 | 4268700 |
| Total Barium (Ba) | mg/kg | 149 | 4271536 | 127 | 4268700 | 123 | 4271536 | 322 | 0.1 | 4268700 |
| Total Beryllium (Be) | mg/kg | 0.5 | 4271536 | 0.6 | 4268700 | 0.5 | 4271536 | 0.4 | 0.1 | 4268700 |
| Total Bismuth (Bi) | mg/kg | 0.3 | 4271536 | 0.3 | 4268700 | 0.2 | 4271536 | 0.7 | 0.1 | 4268700 |
| Total Cadmium (Cd) | mg/kg | 0.22 | 4271536 | 0.26 | 4268700 | 0.27 | 4271536 | 0.71 | 0.05 | 4268700 |
| Total Calcium (Ca) | mg/kg | 1430 | 4271536 | 1320 | 4268700 | 1090 | 4271536 | 8910 | 100 | 4268700 |
| Total Chromium (Cr) | mg/kg | 66 | 4271536 | 58 | 4268700 | 50 | 4271536 | 129 | 1 | 4268700 |
| Total Cobalt (Co) | mg/kg | 35.9 | 4271536 | 20.6 | 4268700 | 32.6 | 4271536 | 26.3 | 0.3 | 4268700 |
| Total Copper (Cu) | mg/kg | 34.9 | 4271536 | 33.1 | 4268700 | 42.8 | 4271536 | 36.7 | 0.5 | 4268700 |
| Total Iron (Fe) | mg/kg | 63800 | 4271536 | 46800 | 4268700 | 72400 | 4271536 | 31600 | 100 | 4268700 |
| Total Lead (Pb) | mg/kg | 5.7 | 4271536 | 5.9 | 4268700 | 4.6 | 4271536 | 23.9 | 0.1 | 4268700 |
| Total Magnesium (Mg) | mg/kg | 9590 | 4271536 | 8410 | 4268700 | 6910 | 4271536 | 35900 | 100 | 4268700 |
| Total Manganese (Mn) | mg/kg | 3500 | 4271536 | 1220 | 4268700 | 1930 | 4271536 | 576 | 0.2 | 4268700 |
| Total Mercury (Hg) | mg/kg | <0.05 | 4271536 | <0.05 | 4268700 | <0.05 | 4271536 | <0.05 | 0.05 | 4268700 |
| Total Molybdenum (Mo) | mg/kg | 2.9 | 4271536 | 1.8 | 4268700 | 3.0 | 4271536 | 6.2 | 0.1 | 4268700 |
| Total Nickel (Ni) | mg/kg | 62.5 | 4271536 | 57.0 | 4268700 | 72.1 | 4271536 | 286 | 0.8 | 4268700 |
| Total Phosphorus (P) | mg/kg | 1220 | 4271536 | 1230 | 4268700 | 1810 | 4271536 | 3360 | 10 | 4268700 |
| Total Potassium (K) | mg/kg | 4960 | 4271536 | 4750 | 4268700 | 3740 | 4271536 | 9730 | 100 | 4268700 |
| Total Selenium (Se) | mg/kg | <0.5 | 4271536 | <0.5 | 4268700 | <0.5 | 4271536 | <0.5 | 0.5 | 4268700 |
| Total Silver (Ag) | mg/kg | 0.06 | 4271536 | 0.06 | 4268700 | 0.06 | 4271536 | 0.24 | 0.05 | 4268700 |
| Total Sodium (Na) | mg/kg | 212 | 4271536 | 202 | 4268700 | 162 | 4271536 | 661 | 100 | 4268700 |
| Total Strontium (Sr) | mg/kg | 11.0 | 4271536 | 10.0 | 4268700 | 9.2 | 4271536 | 113 | 0.1 | 4268700 |
| Total Thallium (Tl) | mg/kg | 0.34 | 4271536 | 0.27 | 4268700 | 0.30 | 4271536 | 0.53 | 0.05 | 4268700 |
| Total Tin (Sn) | mg/kg | 0.8 | 4271536 | 1.2 | 4268700 | 0.7 | 4271536 | 2.0 | 0.1 | 4268700 |
| Total Titanium (Ti) | mg/kg | 872 | 4271536 | 876 | 4268700 | 528 | 4271536 | 1150 | 1 | 4268700 |
| Total Vanadium (V) | mg/kg | 54 | 4271536 | 46 | 4268700 | 43 | 4271536 | 46 | 2 | 4268700 |
| Total Zinc (Zn) | mg/kg | 91 | 4271536 | 79 | 4268700 | 83 | 4271536 | 110 | 1 | 4268700 |
| Total Zirconium (Zr) | mg/kg | 1.1 | 4271536 | 1.0 | 4268700 | 0.5 | 4271536 | 5.8 | 0.5 | 4268700 |

RDL = Reportable Detection Limit

## CSR/CCME METALS IN SOIL (SOIL)

| Maxxam ID | | W82441 | W82442 | W82443 | W82444 | W82446 | W82447 | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/01 | 2010/09/01 | 2010/09/01 | 2010/09/01 | 2010/09/01 | 2010/09/01 | | |
| | **Units** | **NI-1 SURFACE** | **NI-1 MIDDLE** | **NI-1 BOTTOM** | **NI-2** | **NI-2 SURFACE** | **NI-2 MIDDLE** | **RDL** | **QC Batch** |
| **Physical Properties** | | | | | | | | | |
| Soluble (2:1) pH | pH Units | 8.20 | 8.12 | 7.17 | 8.24 | 8.21 | 7.22 | 0.01 | 4271543 |
| **Total Metals by ICPMS** | | | | | | | | | |
| Total Aluminum (Al) | mg/kg | 57000 | 32000 | 12700 | 26100 | 37600 | 12700 | 100 | 4271536 |
| Total Antimony (Sb) | mg/kg | 0.4 | 0.3 | <0.1 | 0.3 | 0.4 | <0.1 | 0.1 | 4271536 |
| Total Arsenic (As) | mg/kg | 29.7 | 14.5 | 25.1 | 10.0 | 15.7 | 101 | 0.2 | 4271536 |
| Total Barium (Ba) | mg/kg | 485 | 414 | 90.8 | 386 | 443 | 143 | 0.1 | 4271536 |
| Total Beryllium (Be) | mg/kg | 0.3 | 0.5 | 0.5 | 0.3 | 0.4 | 0.4 | 0.1 | 4271536 |
| Total Bismuth (Bi) | mg/kg | 0.6 | 1.0 | 0.3 | 0.8 | 0.9 | 0.9 | 0.1 | 4271536 |
| Total Cadmium (Cd) | mg/kg | 0.18 | 0.25 | 0.09 | 0.27 | 0.27 | 0.11 | 0.05 | 4271536 |
| Total Calcium (Ca) | mg/kg | 14000 | 9730 | 1290 | 11000 | 11500 | 1750 | 100 | 4271536 |
| Total Chromium (Cr) | mg/kg | 137 | 143 | 43 | 171 | 152 | 46 | 1 | 4271536 |
| Total Cobalt (Co) | mg/kg | 23.9 | 27.5 | 23.0 | 30.7 | 26.9 | 20.5 | 0.3 | 4271536 |
| Total Copper (Cu) | mg/kg | 28.7 | 37.0 | 25.5 | 32.9 | 35.6 | 29.2 | 0.5 | 4271536 |
| Total Iron (Fe) | mg/kg | 26100 | 30200 | 24600 | 31900 | 32200 | 32200 | 100 | 4271536 |
| Total Lead (Pb) | mg/kg | 18.1 | 26.2 | 4.2 | 23.4 | 23.2 | 6.3 | 0.1 | 4271536 |
| Total Magnesium (Mg) | mg/kg | 46900 | 41100 | 5770 | 48000 | 45500 | 6830 | 100 | 4271536 |
| Total Manganese (Mn) | mg/kg | 898 | 803 | 1370 | 667 | 855 | 4110 | 0.2 | 4271536 |
| Total Mercury (Hg) | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.05 | 4271536 |
| Total Molybdenum (Mo) | mg/kg | 8.0 | 7.0 | 1.6 | 8.7 | 10.4 | 2.2 | 0.1 | 4271536 |
| Total Nickel (Ni) | mg/kg | 337 | 345 | 30.2 | 419 | 345 | 39.8 | 0.8 | 4271536 |
| Total Phosphorus (P) | mg/kg | 4150 | 2320 | 704 | 1940 | 2780 | 784 | 10 | 4271536 |
| Total Potassium (K) | mg/kg | 7590 | 8480 | 3420 | 8610 | 9610 | 3860 | 100 | 4271536 |
| Total Selenium (Se) | mg/kg | <0.5 | <0.5 | <0.5 | 0.6 | <0.5 | <0.5 | 0.5 | 4271536 |
| Total Silver (Ag) | mg/kg | 0.12 | 0.20 | <0.05 | 0.22 | 0.21 | 0.07 | 0.05 | 4271536 |
| Total Sodium (Na) | mg/kg | 1140 | 715 | 199 | 626 | 771 | 221 | 100 | 4271536 |
| Total Strontium (Sr) | mg/kg | 224 | 132 | 11.3 | 143 | 161 | 15.4 | 0.1 | 4271536 |
| Total Thallium (Tl) | mg/kg | 0.44 | 0.49 | 0.20 | 0.50 | 0.57 | 0.20 | 0.05 | 4271536 |
| Total Tin (Sn) | mg/kg | 1.4 | 1.1 | 0.4 | 1.1 | 1.4 | 0.4 | 0.1 | 4271536 |
| Total Titanium (Ti) | mg/kg | 773 | 939 | 638 | 973 | 769 | 635 | 1 | 4271536 |
| Total Vanadium (V) | mg/kg | 42 | 49 | 36 | 53 | 55 | 37 | 2 | 4271536 |
| Total Zinc (Zn) | mg/kg | 83 | 104 | 49 | 102 | 109 | 51 | 1 | 4271536 |
| Total Zirconium (Zr) | mg/kg | 4.1 | 4.1 | 0.8 | 4.4 | 2.6 | 1.8 | 0.5 | 4271536 |

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RDL = Reportable Detection Limit

## General Comments

Sample W82387-01: ** SEM/AVS = 37.24 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82388-01: ** SEM/AVS = 7.94 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82389-01: ** SEM/AVS = 4.97 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82391-01: ** SEM/AVS = 17.62 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82392-01: ** SEM/AVS = 157.24 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82393-01: ** SEM/AVS RATIO CAN NOT BE CALCULATED DUE TO NON-DETECTABLE AVS **

Sample W82394-01: ** SEM/AVS = 4.54 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82395-01: ** SEM/AVS = 14.28 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82396-01: ** SEM/AVS = 110.74 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82419-01: ** SEM/AVS = 202.12 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82420-01: ** SEM/AVS = 37.83 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82421-01: ** SEM/AVS = 45.88 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82422-01: ** SEM/AVS = 5.82 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82423-01: ** SEM/AVS = 16.78 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82424-01: ** SEM/AVS RATIO CAN NOT BE CALCULATED DUE TO NON-DETECTABLE AVS **

Sample W82425-01: ** SEM/AVS = 66.60 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82426-01: ** SEM/AVS = 51.23 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82440-01: ** SEM/AVS = 0.13 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82441-01: ** SEM/AVS = 10.19 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82442-01: ** SEM/AVS = 1.33 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82443-01: ** SEM/AVS = 92.38 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82444-01: ** SEM/AVS = 6.10 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82446-01: ** SEM/AVS = 0.05 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

Sample W82447-01: ** SEM/AVS = 145.62 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

## QUALITY ASSURANCE REPORT

| | | | Matrix Spike | | Spiked Blank | | Method Blank | | RPD | | QC Standard | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **QC Batch** | **Parameter** | **Date** | **% Recovery** | **QC Limits** | **% Recovery** | **QC Limits** | **Value** | **Units** | **Value (%)** | **QC Limits** | **% Recovery** | **QC Limits** |
| 4268700 | Total Arsenic (As) | 2010/09/17 | 107 | 75 - 125 | 98 | 75 - 125 | <0.2 | mg/kg | NC | 30 | 100 | 70 - 130 |
| 4268700 | Total Beryllium (Be) | 2010/09/17 | 112 | 75 - 125 | 99 | 75 - 125 | <0.1 | mg/kg | NC | 30 | | |
| 4268700 | Total Cadmium (Cd) | 2010/09/17 | 109 | 75 - 125 | 100 | 75 - 125 | <0.05 | mg/kg | NC | 30 | 100 | 70 - 130 |
| 4268700 | Total Chromium (Cr) | 2010/09/17 | 104 | 75 - 125 | 95 | 75 - 125 | <1 | mg/kg | NC | 30 | 105 | 70 - 130 |
| 4268700 | Total Cobalt (Co) | 2010/09/17 | 105 | 75 - 125 | 96 | 75 - 125 | <0.3 | mg/kg | NC | 30 | 101 | 70 - 130 |
| 4268700 | Total Copper (Cu) | 2010/09/17 | 106 | 75 - 125 | 100 | 75 - 125 | <0.5 | mg/kg | NC | 30 | 98 | 70 - 130 |
| 4268700 | Total Lead (Pb) | 2010/09/17 | 107 | 75 - 125 | 101 | 75 - 125 | <0.1 | mg/kg | 5.5 | 35 | 107 | 70 - 130 |
| 4268700 | Total Mercury (Hg) | 2010/09/17 | 95 | 75 - 125 | 92 | 75 - 125 | <0.05 | mg/kg | NC | 35 | | |
| 4268700 | Total Nickel (Ni) | 2010/09/17 | 105 | 75 - 125 | 97 | 75 - 125 | <0.8 | mg/kg | NC | 30 | 106 | 70 - 130 |
| 4268700 | Total Selenium (Se) | 2010/09/17 | 106 | 75 - 125 | 102 | 75 - 125 | <0.5 | mg/kg | NC | 30 | | |
| 4268700 | Total Vanadium (V) | 2010/09/17 | 103 | 75 - 125 | 97 | 75 - 125 | <2 | mg/kg | NC | 30 | 106 | 70 - 130 |
| 4268700 | Total Zinc (Zn) | 2010/09/17 | 110 | 75 - 125 | 103 | 75 - 125 | <1 | mg/kg | 1.1 | 30 | 98 | 70 - 130 |
| 4268700 | Total Aluminum (Al) | 2010/09/17 | | | | | <100 | mg/kg | 1.1 | 35 | 103 | 70 - 130 |
| 4268700 | Total Antimony (Sb) | 2010/09/17 | | | | | <0.1 | mg/kg | NC | 30 | 95 | 70 - 130 |
| 4268700 | Total Barium (Ba) | 2010/09/17 | | | | | 0.1, RDL=0.1 | mg/kg | 3.3 | 35 | 109 | 70 - 130 |
| 4268700 | Total Calcium (Ca) | 2010/09/17 | | | | | <100 | mg/kg | 4.2 | 30 | 100 | 70 - 130 |
| 4268700 | Total Iron (Fe) | 2010/09/17 | | | | | <100 | mg/kg | 0.2 | 30 | 100 | 70 - 130 |
| 4268700 | Total Magnesium (Mg) | 2010/09/17 | | | | | <100 | mg/kg | 2.1 | 30 | 99 | 70 - 130 |
| 4268700 | Total Manganese (Mn) | 2010/09/17 | | | | | <0.2 | mg/kg | 0.5 | 30 | 103 | 70 - 130 |
| 4268700 | Total Molybdenum (Mo) | 2010/09/17 | | | | | <0.1 | mg/kg | NC | 35 | 107 | 70 - 130 |
| 4268700 | Total Phosphorus (P) | 2010/09/17 | | | | | <10 | mg/kg | 0.2 | 30 | 101 | 70 - 130 |
| 4268700 | Total Silver (Ag) | 2010/09/17 | | | | | <0.05 | mg/kg | NC | 35 | 67 (1) | N/A |
| 4268700 | Total Strontium (Sr) | 2010/09/17 | | | | | <0.1 | mg/kg | 1.9 | 35 | 99 | 70 - 130 |
| 4268700 | Total Thallium (Tl) | 2010/09/17 | | | | | <0.05 | mg/kg | NC | 30 | 90 | 70 - 130 |
| 4268700 | Total Titanium (Ti) | 2010/09/17 | | | | | <1 | mg/kg | 1.8 | 35 | 104 | 70 - 130 |
| 4268700 | Total Bismuth (Bi) | 2010/09/17 | | | | | <0.1 | mg/kg | NC | 30 | | |
| 4268700 | Total Potassium (K) | 2010/09/17 | | | | | <100 | mg/kg | NC | 35 | | |
| 4268700 | Total Sodium (Na) | 2010/09/17 | | | | | <100 | mg/kg | NC | 35 | | |
| 4268700 | Total Tin (Sn) | 2010/09/17 | | | | | <0.1 | mg/kg | NC | 35 | | |
| 4268700 | Total Zirconium (Zr) | 2010/09/17 | | | | | <0.5 | mg/kg | NC | 30 | | |
| 4268744 | Soluble (2:1) pH | 2010/09/17 | | | 101 | 96 - 104 | | | 1.1 | 20 | | |
| 4271536 | Total Arsenic (As) | 2010/09/20 | NC | 75 - 125 | 99 | 75 - 125 | <0.2 | mg/kg | 1.9 | 30 | 86 | 70 - 130 |
| 4271536 | Total Beryllium (Be) | 2010/09/20 | 106 | 75 - 125 | 102 | 75 - 125 | <0.1 | mg/kg | 11.7 | 30 | | |
| 4271536 | Total Cadmium (Cd) | 2010/09/20 | 108 | 75 - 125 | 103 | 75 - 125 | <0.05 | mg/kg | 4.0 | 30 | 99 | 70 - 130 |
| 4271536 | Total Chromium (Cr) | 2010/09/20 | NC | 75 - 125 | 101 | 75 - 125 | <1 | mg/kg | 2.3 | 30 | 92 | 70 - 130 |
| 4271536 | Total Cobalt (Co) | 2010/09/20 | NC | 75 - 125 | 101 | 75 - 125 | <0.3 | mg/kg | 0.9 | 30 | 90 | 70 - 130 |
| 4271536 | Total Copper (Cu) | 2010/09/20 | NC | 75 - 125 | 105 | 75 - 125 | <0.5 | mg/kg | 2.0 | 30 | 92 | 70 - 130 |
| 4271536 | Total Lead (Pb) | 2010/09/20 | 108 | 75 - 125 | 106 | 75 - 125 | <0.1 | mg/kg | 2.2 | 35 | 100 | 70 - 130 |
| 4271536 | Total Mercury (Hg) | 2010/09/20 | 98 | 75 - 125 | 95 | 75 - 125 | <0.05 | mg/kg | NC | 35 | | |

## QUALITY ASSURANCE REPORT

| | | | Matrix Spike | | Spiked Blank | | Method Blank | | RPD | | QC Standard | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| QC Batch | Parameter | Date | % Recovery | QC Limits | % Recovery | QC Limits | Value | Units | Value (%) | QC Limits | % Recovery | QC Limits |
| 4271536 | Total Nickel (Ni) | 2010/09/20 | NC | 75 - 125 | 102 | 75 - 125 | <0.8 | mg/kg | 2.2 | 30 | 94 | 70 - 130 |
| 4271536 | Total Selenium (Se) | 2010/09/20 | 110 | 75 - 125 | 106 | 75 - 125 | <0.5 | mg/kg | NC | 30 | | |
| 4271536 | Total Vanadium (V) | 2010/09/20 | NC | 75 - 125 | 104 | 75 - 125 | <2 | mg/kg | 3.9 | 30 | 93 | 70 - 130 |
| 4271536 | Total Zinc (Zn) | 2010/09/20 | NC | 75 - 125 | 108 | 75 - 125 | <1 | mg/kg | 2.0 | 30 | 95 | 70 - 130 |
| 4271536 | Total Aluminum (Al) | 2010/09/20 | | | | | <100 | mg/kg | 3.0 | 35 | 91 | 70 - 130 |
| 4271536 | Total Antimony (Sb) | 2010/09/20 | | | | | <0.1 | mg/kg | NC | 30 | 75 | 70 - 130 |
| 4271536 | Total Barium (Ba) | 2010/09/20 | | | | | <0.1 | mg/kg | 1.7 | 35 | 104 | 70 - 130 |
| 4271536 | Total Calcium (Ca) | 2010/09/20 | | | | | <100 | mg/kg | 2.5 | 30 | 98 | 70 - 130 |
| 4271536 | Total Iron (Fe) | 2010/09/20 | | | | | <100 | mg/kg | 1.1 | 30 | 88 | 70 - 130 |
| 4271536 | Total Magnesium (Mg) | 2010/09/20 | | | | | <100 | mg/kg | 2.7 | 30 | 92 | 70 - 130 |
| 4271536 | Total Manganese (Mn) | 2010/09/20 | | | | | <0.2 | mg/kg | 1.5 | 30 | 98 | 70 - 130 |
| 4271536 | Total Molybdenum (Mo) | 2010/09/20 | | | | | <0.1 | mg/kg | 1.4 | 35 | 81 | 70 - 130 |
| 4271536 | Total Phosphorus (P) | 2010/09/20 | | | | | <10 | mg/kg | 3.6 | 30 | 95 | 70 - 130 |
| 4271536 | Total Silver (Ag) | 2010/09/20 | | | | | <0.05 | mg/kg | NC | 35 | 66(1) | N/A |
| 4271536 | Total Strontium (Sr) | 2010/09/20 | | | | | <0.1 | mg/kg | 1.3 | 35 | 97 | 70 - 130 |
| 4271536 | Total Thallium (Tl) | 2010/09/20 | | | | | <0.05 | mg/kg | 1.8 | 30 | 78 | 70 - 130 |
| 4271536 | Total Titanium (Ti) | 2010/09/20 | | | | | 2, RDL=1 | mg/kg | 0.08 | 35 | 85 | 70 - 130 |
| 4271536 | Total Bismuth (Bi) | 2010/09/20 | | | | | <0.1 | mg/kg | 12.0 | 30 | | |
| 4271536 | Total Potassium (K) | 2010/09/20 | | | | | <100 | mg/kg | 4.8 | 35 | | |
| 4271536 | Total Sodium (Na) | 2010/09/20 | | | | | <100 | mg/kg | NC | 35 | | |
| 4271536 | Total Tin (Sn) | 2010/09/20 | | | | | <0.1 | mg/kg | 4.3 | 35 | | |
| 4271536 | Total Zirconium (Zr) | 2010/09/20 | | | | | <0.5 | mg/kg | NC | 30 | | |
| 4271543 | Soluble (2:1) pH | 2010/09/20 | | | 102 | 96 - 104 | | | 2.2 | 20 | | |
| 4271670 | Total Arsenic (As) | 2010/09/20 | 108 | 75 - 125 | 104 | 75 - 125 | <0.2 | mg/kg | NC | 30 | 99 | 70 - 130 |
| 4271670 | Total Beryllium (Be) | 2010/09/20 | 107 | 75 - 125 | 106 | 75 - 125 | <0.1 | mg/kg | NC | 30 | | |
| 4271670 | Total Cadmium (Cd) | 2010/09/20 | 112 | 75 - 125 | 111 | 75 - 125 | <0.05 | mg/kg | NC | 30 | 103 | 70 - 130 |
| 4271670 | Total Chromium (Cr) | 2010/09/20 | 107 | 75 - 125 | 106 | 75 - 125 | <1 | mg/kg | NC | 30 | 106 | 70 - 130 |
| 4271670 | Total Cobalt (Co) | 2010/09/20 | 105 | 75 - 125 | 106 | 75 - 125 | <0.3 | mg/kg | NC | 30 | 102 | 70 - 130 |
| 4271670 | Total Copper (Cu) | 2010/09/20 | 106 | 75 - 125 | 109 | 75 - 125 | <0.5 | mg/kg | NC | 30 | 97 | 70 - 130 |
| 4271670 | Total Lead (Pb) | 2010/09/20 | 108 | 75 - 125 | 109 | 75 - 125 | <0.1 | mg/kg | 7.6 | 35 | 106 | 70 - 130 |
| 4271670 | Total Mercury (Hg) | 2010/09/20 | 98 | 75 - 125 | 93 | 75 - 125 | <0.05 | mg/kg | NC | 35 | | |
| 4271670 | Total Nickel (Ni) | 2010/09/20 | 109 | 75 - 125 | 108 | 75 - 125 | <0.8 | mg/kg | NC | 30 | 103 | 70 - 130 |
| 4271670 | Total Selenium (Se) | 2010/09/20 | 110 | 75 - 125 | 108 | 75 - 125 | <0.5 | mg/kg | NC | 30 | | |
| 4271670 | Total Vanadium (V) | 2010/09/20 | 107 | 75 - 125 | 106 | 75 - 125 | <2 | mg/kg | NC | 30 | 111 | 70 - 130 |
| 4271670 | Total Zinc (Zn) | 2010/09/20 | 113 | 75 - 125 | 111 | 75 - 125 | <1 | mg/kg | 1.9 | 30 | 99 | 70 - 130 |
| 4271670 | Total Aluminum (Al) | 2010/09/20 | | | | | <100 | mg/kg | 13.0 | 35 | 113 | 70 - 130 |
| 4271670 | Total Antimony (Sb) | 2010/09/20 | | | | | <0.1 | mg/kg | NC | 30 | 93 | 70 - 130 |
| 4271670 | Total Barium (Ba) | 2010/09/20 | | | | | <0.1 | mg/kg | 7.3 | 35 | 109 | 70 - 130 |
| 4271670 | Total Calcium (Ca) | 2010/09/20 | | | | | <100 | mg/kg | 3.1 | 30 | 107 | 70 - 130 |

## QUALITY ASSURANCE REPORT

| | | | Matrix Spike | | Spiked Blank | | Method Blank | | RPD | | QC Standard | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| QC Batch | Parameter | Date | % Recovery | QC Limits | % Recovery | QC Limits | Value | Units | Value (%) | QC Limits | % Recovery | QC Limits |
| 4271670 | Total Iron (Fe) | 2010/09/20 | | | | | <100 | mg/kg | 1.3 | 30 | 102 | 70 - 130 |
| 4271670 | Total Magnesium (Mg) | 2010/09/20 | | | | | <100 | mg/kg | 10.0 | 30 | 105 | 70 - 130 |
| 4271670 | Total Manganese (Mn) | 2010/09/20 | | | | | <0.2 | mg/kg | 1 | 30 | 107 | 70 - 130 |
| 4271670 | Total Molybdenum (Mo) | 2010/09/20 | | | | | <0.1 | mg/kg | NC | 35 | 120 | 70 - 130 |
| 4271670 | Total Phosphorus (P) | 2010/09/20 | | | | | <10 | mg/kg | 0.5 | 30 | 103 | 70 - 130 |
| 4271670 | Total Silver (Ag) | 2010/09/20 | | | | | <0.05 | mg/kg | NC | 35 | 67 (1) | N/A |
| 4271670 | Total Strontium (Sr) | 2010/09/20 | | | | | <0.1 | mg/kg | 0.4 | 35 | 106 | 70 - 130 |
| 4271670 | Total Thallium (Tl) | 2010/09/20 | | | | | <0.05 | mg/kg | NC | 30 | 87 | 70 - 130 |
| 4271670 | Total Titanium (Ti) | 2010/09/20 | | | | | <1 | mg/kg | 6.7 | 35 | 105 | 70 - 130 |
| 4271670 | Total Bismuth (Bi) | 2010/09/20 | | | | | <0.1 | mg/kg | NC | 30 | | |
| 4271670 | Total Potassium (K) | 2010/09/20 | | | | | <100 | mg/kg | NC | 35 | | |
| 4271670 | Total Sodium (Na) | 2010/09/20 | | | | | <100 | mg/kg | NC | 35 | | |
| 4271670 | Total Tin (Sn) | 2010/09/20 | | | | | <0.1 | mg/kg | NC | 35 | | |
| 4271670 | Total Zirconium (Zr) | 2010/09/20 | | | | | <0.5 | mg/kg | NC | 30 | | |
| 4271680 | Soluble (2:1) pH | 2010/09/20 | | | 101 | 96 - 104 | | | 2.9 | 20 | | |
| 4273873 | Sulphide | 2010/09/20 | 3.9 (1) | 75 - 125 | 102 | 75 - 125 | 0.2, RDL=0.2 | ug/g | NC (2) | 30 | | |
| 4273892 | Available (KCl) Orthophosphate (P) | 2010/09/20 | NC | 75 - 125 | 98 | 75 - 125 | <0.5 | ug/g | 1 | 30 | | |
| 4275367 | % sand by hydrometer | 2010/09/21 | | | | | <2 | % | 1.9 | 25 | 93 | 75 - 125 |
| 4275367 | % silt by hydrometer | 2010/09/21 | | | | | <2 | % | 1.4 | 25 | 108 | 75 - 125 |
| 4275367 | Clay Content | 2010/09/21 | | | | | <2 | % | 0.3 | 25 | 99 | 75 - 125 |
| 4275367 | Gravel | 2010/09/21 | | | | | <2 | % | NC | 25 | | |
| 4275727 | % sand by hydrometer | 2010/09/21 | | | | | <2 | % | 0.4 | 25 | 100 | 75 - 125 |
| 4275727 | % silt by hydrometer | 2010/09/21 | | | | | <2 | % | 0.2 | 25 | 102 | 75 - 125 |
| 4275727 | Clay Content | 2010/09/21 | | | | | <2 | % | 0 | 25 | 101 | 75 - 125 |
| 4275727 | Gravel | 2010/09/21 | | | | | <2 | % | NC | 25 | | |
| 4275750 | SEM Cadmium (Cd) | 2010/09/20 | | | | | <0.0002 | umole/g | NC | 30 | | |
| 4275750 | SEM Copper (Cu) | 2010/09/20 | | | | | <0.004 | umole/g | 4.3 | 30 | | |
| 4275750 | SEM Lead (Pb) | 2010/09/20 | | | | | <0.0002 | umole/g | 2.2 | 30 | | |
| 4275750 | SEM Mercury (Hg) | 2010/09/20 | | | | | <0.0003 | umole/g | NC | 30 | | |
| 4275750 | SEM Nickel (Ni) | 2010/09/20 | | | | | <0.004 | umole/g | 0.07 | 30 | | |
| 4275750 | SEM Zinc (Zn) | 2010/09/20 | | | | | <0.008 | umole/g | 1.7 | 30 | | |
| 4332191 | % sand by hydrometer | 2010/10/13 | | | | | <2 | % | 11.0 | 25 | 87 | 75 - 125 |
| 4332191 | % silt by hydrometer | 2010/10/13 | | | | | <2 | % | 3.4 | 25 | 108 | 75 - 125 |

## QUALITY ASSURANCE REPORT

| | | | Matrix Spike | | Spiked Blank | | Method Blank | | RPD | | QC Standard | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **QC Batch** | **Parameter** | **Date** | **% Recovery** | **QC Limits** | **% Recovery** | **QC Limits** | **Value** | **Units** | **Value (%)** | **QC Limits** | **% Recovery** | **QC Limits** |
| 4332191 | Clay Content | 2010/10/13 | | | | | <2 | % | NC | 25 | 107 | 75 - 125 |
| 4332191 | Gravel | 2010/10/13 | | | | | <2 | % | NC | 25 | | |

N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.
(2) - Matrix spike exceeds acceptance limits due to matrix interference. Re-analysis yields similar results.
RDL raised due to sample dilution.

B082579

# CHAIN-OF-CUSTODY / TEST REQUEST FORM

№ 5455

Golder Associates
500 - 4260 Still Creek Drive
Burnaby, B.C.
Canada V5C 6C6
Tel: 604-296-4200
Fax: 604-298-5253
www.golder.com

Client Name DDMI /Golder
Address Ryan Steverson
500-4260 Stillcrk Dr.
Burnaby V5C 6C6

Client Contact Ryan Stevenson + Cathy McPherson
Phone 604 297 2006/604 297 2007
Fax 604 298 5253
Sampled by RWS

Ship to Maxxam
4606 Canada Way
Burnaby BC
Attn. Kristen Pelvde 604 639 8050
Shipping Date 2010.09.06

| Collection Date (DD/MMM/YYYY) 1 | Time (24-h clock) 1 | Sample Identification | Type of Each Sample 2 | Material Safety Data Sheet Attached? (✓) | Sample Collection Method G=grab C=composite | Number of Sample Containers x Volume of Sample Containers (1 x 20L) | Sample Container Type by Code 3 | Test(s) Requested: AVS-SEM | Metals, TOC, TP, Reagents, Moisture | Archive / Backup | Grain Size | | Sample Notes (preserved, saltwater, freshwater, may contain sewage...) 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01/SEP/2010 | | NI-2 Bottom | Sed | | CORE | 2 x 250mL<br>1 x 500mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| 01/Sept/2010 | | Field Replicate | Sed | | C | 3 x 250mL<br>1 x 500mL | GJ<br>BAG | ✓ | ✓ | ✓ | ✓ | | |
| 03/Sept/2010 | | NI-3 ~~Bott~~ Surface | Sed | | C | 3 x 250mL | GJ | ✓ | ✓ | ✓ | | | |
| 03/Sept/2010 | | NI-3 | Sed | | C | 1 x 500mL | BAJ | | | | ✓ | | |
| 03/Sept/2010 | | NI-3 Surface | Sed | | CORE | 2 x 250mL<br>1 x 500mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| 03/Sept/2010 | | NI-3 Middle | Sed | | CORE | 2 x 250mL<br>1 x 500mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| 03/Sept/2010 | | NI-3 Bottom | Sed | | CORE | 2 x 250mL<br>1 x 500mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| 03/Sept 2010 | | NI-4 | Sed | | C | 3 x 250mL<br>1 x 500mL | GJ<br>BAG | ✓ | ✓ | ✓ | ✓ | | |
| 03/Sept/2010 | | NI-4 surface | Sed | | CORE | 2 x 250mL<br>1 x 500mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| 03/Sept/2010 | | NI-4 Middle | Sed | | CORE | 2 x 250mL<br>1 x 500mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |

PO/Reference No. 10-1328-0028/700
Project Title Diavik - North Inlet
Results Needed By Standard TAT

Comments/Instructions

1) Released by: Date:
Company: Time:
Courier Name:

2) Released by: Date:
Company: Time:
Courier Name:

3) Released by: Date:
Company: Time:
Courier Name:

1) Received by: C. ROSEN Date: 080910
Company: 14,13,14 | 14,12,14 Time: 930

2) Received by: Date:
Company: Time:

3) Received by: Date:
Company: Time:

1 For composite effluent or water samples, the sample collection date/time is the end of the compositing period.
2 Receiving Water (RW): Effluent (E); Elutriate (ELU); Sediment (SED); Chemical (CHEM); Stormwater (SW); Other (Please Specify)
3 Collapsible Carboy (CC); glass jar (GJ); Jerry Can (JC); Plastic HDPE (P); Other (Please Specify)
4 Please note any conditions the lab should be aware of for safety and storage concerns

*Please see instructions for completion on back of form*

Distribution of copies:
White, Yellow—accompany the shipment
Pink—kept by consignor (e.g. shipper)
Yellow—kept by consignee (e.g. receiver)
White—returned to consignor by consignee

Revision Date: March 20, 2009

B082579

# CHAIN-OF-CUSTODY / TEST REQUEST FORM

**Golder Associates**

Nº 5452

500 - 4260 Still Creek Drive
Burnaby, B.C.
Canada V5C 6C6

Tel: 604-296-4200
Fax: 604-298-5253
www.golder.com

Client Name DDMI/Golder
Address Ryan Stevenson
500-4260 stillcrk Dr.
Burnaby V5C 6C6

Client Contact Ryan Stevenson
Phone 604 297 2006
Fax 604 298 5253
Sampled by RWS

Ship to Maxxam
4606 Canada Way
Burnaby BC
Attn. Kristen Pelude 604 638 8050

Shipping Date 2010.09.06

| Collection Date (DD/MMM/YYYY) 1 | Time (24-h clock) 1 | Sample Identification | Type of Each Sample 2 | Material Safety Data Sheet Attached? (✓) | Sample Collection Method G=grab C=composite | Number of Sample Containers x Volume of Sample Containers (1 x 20L) | Sample Container Type by Code 3 | Test(s) Requested: AVS - SEM | Metals, TOC, TP Reagents, Moisture | Archive / Backup | Grain size | | Sample Notes (preserved, saltwater, freshwater, may contain sewage...) 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03/Sept/2010 | | NI-4 Bottom | Sed | | CORE | 2x250mL<br>1x500 mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| 03/Sept2010 | | NI-5 | Sed | | C | 3x250mL<br>1x500mL | GJ<br>BAG | ✓ | ✓ | ✓ | ✓ | | |
| 03/Sept2010 | | NI-5 Surface | Sed | | CORE | 2x250mL<br>1x500mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| 03/Sept/2010 | | NI-5 Middle | Sed | | CORE | 2x250mL<br>1x500mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| 03/Sept/2010 | | NI-5 Bottom | Sed | | CORE | 2x250mL<br>1x500mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| ~~04~~ 03/Sept/2010 | | REF-1 | Sed | | C | 2x250mL<br>1x500mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| 04/Sept2010 | | REF-2 | Sed | | C | 2x250mL<br>1x500mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| 04/Sept/2010 | | REF-3 | Sed | | C | 2x250mL<br>1x500mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

PO/Reference No. 10-1328-0028/700
Project Title Diavik-North Inlet
Results Needed By Standard TAT

Comments/Instructions

| | | |
|---|---|---|
| 1) Released by: Date:<br>Company: Time:<br>Courier Name: | 2) Released by: Date:<br>Company: Time:<br>Courier Name: | 3) Released by: Date:<br>Company: Time:<br>Courier Name: |
| 1) Received by: C.ROSEN Date: 080910<br>Company: 141314 141214 Time: [redacted] 0930 | 2) Received by: Date:<br>Company: Time: | 3) Received by: Date:<br>Company: Time: |

1 For composite effluent or water samples, the sample collection date/time is the **end** of the compositing period.
2 Receiving Water (RW): Effluent (E); Elutriate (ELU); Sediment (SED); Chemical (CHEM); Stormwater (SW); Other (Please Specify)
3 Collapsible Carboy (CC); glass jar (GJ); Jerry Can (JC); Plastic HDPE (P); Other (Please Specify)
4 Please note any conditions the lab should be aware of for safety and storage concerns

Distribution of copies:
White, Yellow—accompany the shipment
Pink—kept by consignor (e.g. shipper)
Yellow—kept by consignee (e.g. receiver)
White—returned to consignor by consignee

*Please see instructions for completion on back of form*

Revision Date: March 20, 2009

B0B2014

# CHAIN-OF-CUSTODY / TEST REQUEST FORM

№ 5451

**Golder Associates**
500 - 4260 Still Creek Drive
Burnaby, B.C.
Canada V5C 6C6
Tel: 604-296-4200
Fax: 604-298-5253
www.golder.com

Client Name ~~DDMI / GOLDER~~ DDMI / GOLDER
Address # RYAN STEVENSON
500-4260 STILL CRIK DRIVE
BURNABY V5C 6C6

Client Contact RYAN STEVENSON + CATHY MCPHERSON
Phone 604 297 2006 / 604 297 2007
Fax 604 298 5253
Sampled by RWS

Ship to MAXXAM
4606 CANADA WAY
BURNABY BC
Attn. KRISTA PERDUE 604 638 8050
Shipping Date 2010.09.06

| Collection Date (DD/MMM/YYYY) 1 | Time (24-h clock) 1 | Sample Identification | Type of Each Sample 2 | Material Safety Data Sheet Attached? (✓) | Sample Collection Method G=grab C=composite | Number of Sample Containers x Volume of Sample Containers (1 x 20L) | Sample Container Type by Code 3 | Test(s) Requested: AVS-SEM | METALS, TOC, TP, REAGENTS, MOISTURE | ARCHIVE/BACKUP | GRAIN SIZE | | Sample Notes (preserved, saltwater, freshwater, may contain sewage...) 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01/SEP/2010 | | NI-1 | SED | | C | 3x250ml | GJ | ✓ | ✓ | ✓ | | | |
| ~~"~~ | | ~~"~~ | ~~"~~ | | ~~C~~ | ~~1x500ml~~ | ~~GJ~~ | | | | | | |
| " | | " | " | | C | 1x500ml | BAG | | | | ✓ | | |
| " | | NI-1 SURFACE | " | | CORE | 2x250ml<br>1x500ml | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| " | | NI-1 MIDDLE | " | | CORE | 2x250ml<br>1x500ml | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| " | | NI-1 BOTTOM | " | | CORE | 2x250ml<br>1x500ml | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| 08/Sep/2010 | | NI-2 | Sed | | C | 3x250mL | GJ | ✓ | ✓ | ✓ | | | |
| 01/Sep/2010 | | NI-2 | Sed | | C | 1x500mL | BAG | | | | ✓ | | |
| " | | NI-2 Surface | Sed | | CORE | 2x250mL<br>1x500mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |
| " | | NI-2 Middle | Sed | | CORE | 2x250mL<br>1x500mL | GJ<br>BAG | ✓ | ✓ | | ✓ | | |

PO/Reference No. 10-1328-0028 / 7000
Project Title DIAVIK - NORTH INLET
Results Needed By STANDARD TAT

Comments/Instructions MDLS TO MEET CCME SEDIMENT QUALITY GUIDELINES

1) Released by: Date:
Company: Time:
Courier Name:

2) Released by: Date:
Company: Time:
Courier Name:

3) Released by: Date:
Company: Time:
Courier Name:

1) Received by: C. ROSEN Date: 080910
Company: 141314 141214 Time: 0930

2) Received by: Date:
Company: Time:

3) Received by: Date:
Company: Time:

1 For composite effluent or water samples, the sample collection date/time is the **end** of the compositing period.
2 Receiving Water (RW): Effluent (E); Elutriate (ELU); Sediment (SED); Chemical (CHEM); Stormwater (SW); Other (Please Specify)
3 Collapsible Carboy (CC); glass jar (GJ); Jerry Can (JC); Plastic HDPE (P); Other (Please Specify)
4 Please note any conditions the lab should be aware of for safety and storage concerns

Distribution of copies:
White, Yellow—accompany the shipment
Pink—kept by consignor (e.g. shipper)
Yellow—kept by consignee (e.g. receiver)
White—returned to consignor by consignee

*Please see instructions for completion on back of form*

Revision Date: March 20, 2009

AcmeLabs Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada

www.acmelab.com

|  |  |
|---|---|
| **Client:** | **Maxxam Analytics**<br>4606 Canada Way<br>Burnaby BC V5G 1K5 Canada |
| Submitted By: | Ivy Rajan |
| Receiving Lab: | Canada-Vancouver |
| Received: | September 17, 2010 |
| Report Date: | October 12, 2010 |
| Page: | 1 of 2 |

# CERTIFICATE OF ANALYSIS VAN10004725.1

## CLIENT JOB INFORMATION

|  |  |
|---|---|
| Project: | 2-21-900 |
| Shipment ID: |  |
| P.O. Number | Proj. Golder Diavik North Inlet 2-21-900 |
| Number of Samples: | 24 |

## SAMPLE DISPOSAL

|  |  |
|---|---|
| DISP-PLP | Dispose of Pulp After 90 days |

Acme does not accept responsibility for samples left at the laboratory after 90 days without prior written instructions for sample storage or return.

Invoice To: Maxxam Analytics
4606 Canada Way
Burnaby BC V5G 1K5
Canada

CC:

## SAMPLE PREPARATION AND ANALYTICAL PROCEDURES

| Method Code | Number of Samples | Code Description | Test Wgt (g) | Report Status | Lab |
|---|---|---|---|---|---|
| No Prep | 23 | Sorting of samples on arrival and labeling |  |  | VAN |
| 4A | 23 | LiBO2/LiB4O7 fusion ICP-ES analysis | 0.2 | Completed | VAN |
| 2A10 | 23 | Org/C - Total C minus Graphite C & CO2 | 0.1 | Completed | VAN |

## ADDITIONAL COMMENTS

BRITISH COLUMBIA CERTIFIED ASSAYER
CLARENCE LEONG
GENERAL MANAGER

AcmeLabs Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

**Client:** **Maxxam Analytics**
4606 Canada Way
Burnaby BC V5G 1K5 Canada

Project: 2-21-900
Report Date: October 12, 2010

Page: 2 of 2 Part 1

# CERTIFICATE OF ANALYSIS VAN10004725.1

| | Method | 4A | 2A-C |
|---|---|---|---|
| | Analyte | CaO | C/ORG |
| | Unit | % | % |
| | MDL | 0.01 | 0.02 |
| NI-2 BOTTOM | Rock Pulp | 1.51 | 0.65 |
| FIELD REPLICATE | Rock Pulp | 1.60 | 1.78 |
| NI-3 | Rock Pulp | 1.66 | 1.30 |
| NI-3 SURFACE | Rock Pulp | 1.65 | 1.44 |
| NI-3 MIDDLE | Rock Pulp | 1.58 | 1.57 |
| NI-3 BOTTOM | Rock Pulp | 1.36 | 3.14 |
| NI-4 | Rock Pulp | 1.51 | 1.55 |
| NI-4 SURFACE | Rock Pulp | 1.48 | 1.57 |
| NI-4 MIDDLE | Rock Pulp | 1.19 | 3.79 |
| NI-4 BOTTOM | Rock Pulp | 1.26 | 2.73 |
| NI-5 | Rock Pulp | 1.12 | 0.44 |
| NI-5 SURFACE | Rock Pulp | 1.12 | 0.73 |
| NI-5 MIDDLE | Rock Pulp | 1.26 | 3.77 |
| NI-5 BOTTOM | Rock Pulp | 1.22 | 3.57 |
| REF 1 | Rock Pulp | 1.19 | 1.84 |
| REF 2 | Rock Pulp | 1.31 | 1.60 |
| REF 3 | Rock Pulp | 1.13 | 2.43 |
| NI-1 | Rock Pulp | 1.60 | 1.67 |
| NI-1 SURFACE | Rock Pulp | 2.20 | 4.15 |
| NI-1 MIDDLE | Rock Pulp | L.N.R. | L.N.R. |
| NI-1 BOTTOM | Rock Pulp | 1.49 | 0.77 |
| NI-2 | Rock Pulp | 2.01 | 1.63 |
| NI-2 SURFACE | Rock Pulp | 1.87 | 2.95 |
| NI-2 MIDDLE | Rock Pulp | 1.54 | 0.76 |

**AcmeLabs** Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
**www.acmelab.com**

**Client:** **Maxxam Analytics**
4606 Canada Way
Burnaby BC V5G 1K5 Canada

Project: 2-21-900
Report Date: October 12, 2010

Page: 1 of 1 Part 1

# QUALITY CONTROL REPORT VAN10004725.1

| | **Method** | **4A** | **2A-C** |
|---|---|---|---|
| | **Analyte** | **CaO** | **C/ORG** |
| | **Unit** | **%** | **%** |
| | **MDL** | **0.01** | **0.02** |
| NI-3 MIDDLE | Rock Pulp | 1.58 | 1.57 |
| Pulp Duplicates | | | |
| NI-3 | Rock Pulp | 1.66 | 1.30 |
| REP NI-3 | QC | | |
| NI-4 | Rock Pulp | 1.51 | 1.55 |
| REP NI-4 | QC | 1.53 | |
| NI-4 MIDDLE | Rock Pulp | 1.19 | 3.79 |
| REP NI-4 MIDDLE | QC | 1.20 | |
| Reference Materials | | | |
| STD CSC | Standard | | |
| STD CSC | Standard | | |
| STD SO-18 | Standard | 6.38 | |
| STD SO-18 | Standard | 6.32 | |
| STD SO-18 | Standard | 6.36 | |
| STD SO-18 | Standard | 6.31 | |
| STD CSC Expected | | | 0.71 |
| STD SO-18 Expected | | 6.42 | |
| BLK | Blank | <0.01 | |
| BLK | Blank | | |
| BLK | Blank | <0.01 | |

Your Project #: DIAVIK NORTH INLET
Your C.O.C. #: G035843, 40216

**Attention: Cathy McPherson**
GOLDER ASSOCIATES LTD
4260 STILL CREEK DRIVE
Suite 500
BURNABY, BC
Canada V5C 6C6

**Report Date: 2010/11/03**
This report supersedes all previous reports with the same Maxxam job number

# CERTIFICATE OF ANALYSIS

**MAXXAM JOB #: B089603**
**Received: 2010/09/20, 12:45**

Sample Matrix: Soil
# Samples Received: 1

| Analyses | Quantity | Date Extracted | Date Analyzed | Laboratory Method | Analytical Method |
|---|---|---|---|---|---|
| Texture by Hydrometer, incl Gravel (Wet) (1) | 1 | 2010/09/29 | 2010/09/29 | EENVSOP-00076 | MMFSPA Ch9 |

Sample Matrix: SLUDGE
# Samples Received: 1

| Analyses | Quantity | Date Extracted | Date Analyzed | Laboratory Method | Analytical Method |
|---|---|---|---|---|---|
| Elements by ICPMS (total) | 1 | 2010/09/29 | 2010/09/30 | BRN SOP-00203 R5.0 | Based on EPA 200.8 |
| Simultaneously Extractable Metals-ICPMS | 1 | 2010/09/29 | 2010/09/30 | BRN SOP-00203 5.0 | Based on EPA 200.8 |
| Moisture | 1 | N/A | 2010/09/23 | BRN SOP-00321 R5.0 | Ont MOE -E 3139 |
| pH (2:1 DI Water Extract) | 1 | 2010/09/29 | 2010/09/30 | BRN SOP-00266 R6.0 | Carter, SSMA 16.2 |
| Available Phosphate | 1 | 2010/10/04 | 2010/10/04 | BRN SOP-00235 R5.0 | SM SECTION 4500 PE |
| Sulfide (AVS) (soil) - Calc for umole/g | 1 | 2010/09/21 | 2010/09/29 | BRN SOP-00229 R2.0 | Based EPA821-R91-100 |
| Sulfide (AVS) (soil) | 1 | 2010/09/29 | 2010/09/29 | BRN SOP-00229 R2.0 | Based EPA821-R91-100 |

* Results relate only to the items tested.

(1) This test was performed by Maxxam Edmonton Environmental

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

VJ OCO, Burnaby Customer Service
Email: VOco@maxxam.ca
Phone# (604) 639-8422

====================================================================
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

## RESULTS OF CHEMICAL ANALYSES OF SOIL

| Maxxam ID | | X23347 | | |
|---|---|---|---|---|
| Sampling Date | | 2010/09/02 | | |
| | **Units** | **NIWTP SLUDGE (0-13CM)** | **RDL** | **QC Batch** |
| **Physical Properties** | | | | |
| % sand by hydrometer | % | 76 | 2 | 4289760 |
| % silt by hydrometer | % | 10 | 2 | 4289760 |
| Clay Content | % | 14 | 2 | 4289760 |
| Gravel | % | <2 | 2 | 4289760 |

## RESULTS OF CHEMICAL ANALYSES OF SLUDGE

| Maxxam ID | | X11743 | | |
|---|---|---|---|---|
| Sampling Date | | 2010/09/03 | | |
| | **Units** | **NIWTP SLUDGE** | **RDL** | **QC Batch** |
| **Calculated Parameters** | | | | |
| Sulphide | umole/g | 9.1 | 0.6 | 4278727 |
| **MISCELLANEOUS** | | | | |
| Sulphide | ug/g | 291 | 20 | 4299314 |
| **Nutrients** | | | | |
| Available (KCl) Orthophosphate (P) | ug/g | 28.2 | 0.5 | 4308463 |

## PHYSICAL TESTING (SLUDGE)

| Maxxam ID | | X11743 | | |
|---|---|---|---|---|
| Sampling Date | | 2010/09/03 | | |
| | **Units** | **NIWTP SLUDGE** | **RDL** | **QC Batch** |
| **Physical Properties** | | | | |
| Moisture | % | 97 | 0.3 | 4281990 |

---

RDL = Reportable Detection Limit

## ELEMENTS BY ATOMIC SPECTROSCOPY (SLUDGE)

| Maxxam ID |  | X11743 |  |  |
|---|---|---|---|---|
| Sampling Date |  | 2010/09/03 |  |  |
|  | **Units** | **NIWTP SLUDGE** | **RDL** | **QC Batch** |
| **SEM Metals by ICPMS** |  |  |  |  |
| SEM Cadmium (Cd) | umole/g | <0.0002 | 0.0002 | 4297156 |
| SEM Copper (Cu) | umole/g | 0.006 | 0.004 | 4297156 |
| SEM Lead (Pb) | umole/g | 0.0021 | 0.0002 | 4297156 |
| SEM Mercury (Hg) | umole/g | <0.0003 | 0.0003 | 4297156 |
| SEM Nickel (Ni) | umole/g | 0.077 | 0.004 | 4297156 |
| SEM Zinc (Zn) | umole/g | 0.021 | 0.008 | 4297156 |

RDL = Reportable Detection Limit

## CSR/CCME METALS IN SOIL (SLUDGE)

| Maxxam ID | | X11743 | | |
|---|---|---|---|---|
| Sampling Date | | 2010/09/03 | | |
| | **Units** | **NIWTP SLUDGE** | **RDL** | **QC Batch** |
| **Physical Properties** | | | | |
| Soluble (2:1) pH | pH Units | 7.14 | 0.01 | 4299322 |
| **Total Metals by ICPMS** | | | | |
| Total Aluminum (Al) | mg/kg | 150000 | 100 | 4299317 |
| Total Antimony (Sb) | mg/kg | 1.0 | 0.1 | 4299317 |
| Total Arsenic (As) | mg/kg | 136 | 0.2 | 4299317 |
| Total Barium (Ba) | mg/kg | 98.2 | 0.1 | 4299317 |
| Total Beryllium (Be) | mg/kg | <0.1 | 0.1 | 4299317 |
| Total Bismuth (Bi) | mg/kg | 0.3 | 0.1 | 4299317 |
| Total Cadmium (Cd) | mg/kg | 0.14 | 0.05 | 4299317 |
| Total Calcium (Ca) | mg/kg | 3110 | 100 | 4299317 |
| Total Chromium (Cr) | mg/kg | 14 | 1 | 4299317 |
| Total Cobalt (Co) | mg/kg | 4.8 | 0.3 | 4299317 |
| Total Copper (Cu) | mg/kg | 12.7 | 0.5 | 4299317 |
| Total Iron (Fe) | mg/kg | 3150 | 100 | 4299317 |
| Total Lead (Pb) | mg/kg | 4.7 | 0.1 | 4299317 |
| Total Magnesium (Mg) | mg/kg | 4940 | 100 | 4299317 |
| Total Manganese (Mn) | mg/kg | 637 | 0.2 | 4299317 |
| Total Mercury (Hg) | mg/kg | <0.05 | 0.05 | 4299317 |
| Total Molybdenum (Mo) | mg/kg | 68.8 | 0.1 | 4299317 |
| Total Nickel (Ni) | mg/kg | 56.9 | 0.8 | 4299317 |
| Total Phosphorus (P) | mg/kg | 6150 | 10 | 4299317 |
| Total Potassium (K) | mg/kg | 1500 | 100 | 4299317 |
| Total Selenium (Se) | mg/kg | <2(1) | 2 | 4299317 |
| Total Silver (Ag) | mg/kg | <0.05 | 0.05 | 4299317 |
| Total Sodium (Na) | mg/kg | 993 | 100 | 4299317 |
| Total Strontium (Sr) | mg/kg | 96.5 | 0.1 | 4299317 |
| Total Thallium (Tl) | mg/kg | <0.05 | 0.05 | 4299317 |
| Total Tin (Sn) | mg/kg | 0.7 | 0.1 | 4299317 |
| Total Titanium (Ti) | mg/kg | 100 | 1 | 4299317 |
| Total Vanadium (V) | mg/kg | 15 | 2 | 4299317 |
| Total Zinc (Zn) | mg/kg | 16 | 1 | 4299317 |
| Total Zirconium (Zr) | mg/kg | 3.1 | 0.5 | 4299317 |

---

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

## General Comments

Sample X11743-01: ** SEM/AVS = 0.01 [SEM IS THE SUM OF CD CU HG NI PB AND ZN] **

## QUALITY ASSURANCE REPORT

| | | | Matrix Spike | | Spiked Blank | | Method Blank | | RPD | | QC Standard | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **QC Batch** | **Parameter** | **Date** | **% Recovery** | **QC Limits** | **% Recovery** | **QC Limits** | **Value** | **Units** | **Value (%)** | **QC Limits** | **% Recovery** | **QC Limits** |
| 4281990 | Moisture | 2010/09/23 | | | | | <0.3 | % | 2.5 | 20 | | |
| 4289760 | % sand by hydrometer | 2010/09/27 | | | | | <2 | % | 9.3 | 25 | 96 | 75 - 125 |
| 4289760 | % silt by hydrometer | 2010/09/27 | | | | | <2 | % | 12.0 | 25 | 106 | 75 - 125 |
| 4289760 | Clay Content | 2010/09/27 | | | | | <2 | % | | | 99 | 75 - 125 |
| 4289760 | Gravel | 2010/09/27 | | | | | <2 | % | 7.0 | 25 | | |
| 4297156 | SEM Cadmium (Cd) | 2010/09/30 | | | | | <0.0002 | umole/g | | | | |
| 4297156 | SEM Copper (Cu) | 2010/09/30 | | | | | <0.004 | umole/g | | | | |
| 4297156 | SEM Lead (Pb) | 2010/09/30 | | | | | <0.0002 | umole/g | | | | |
| 4297156 | SEM Mercury (Hg) | 2010/09/30 | | | | | <0.0003 | umole/g | | | | |
| 4297156 | SEM Nickel (Ni) | 2010/09/30 | | | | | <0.004 | umole/g | | | | |
| 4297156 | SEM Zinc (Zn) | 2010/09/30 | | | | | <0.008 | umole/g | | | | |
| 4299314 | Sulphide | 2010/09/29 | 38(1) | 75 - 125 | 106 | 75 - 125 | <0.2 | ug/g | 3.7(2) | 30 | | |
| 4299317 | Total Arsenic (As) | 2010/09/30 | 105 | 75 - 125 | 93 | 75 - 125 | <0.2 | mg/kg | 1.6 | 30 | 95 | 70 - 130 |
| 4299317 | Total Beryllium (Be) | 2010/09/30 | 110 | 75 - 125 | 96 | 75 - 125 | <0.1 | mg/kg | NC | 30 | | |
| 4299317 | Total Cadmium (Cd) | 2010/09/30 | 106 | 75 - 125 | 97 | 75 - 125 | <0.05 | mg/kg | 6.0 | 30 | 88 | 70 - 130 |
| 4299317 | Total Chromium (Cr) | 2010/09/30 | 100 | 75 - 125 | 87 | 75 - 125 | <1 | mg/kg | 7.4 | 30 | 89 | 70 - 130 |
| 4299317 | Total Cobalt (Co) | 2010/09/30 | 99 | 75 - 125 | 88 | 75 - 125 | <0.3 | mg/kg | 3.2 | 30 | 88 | 70 - 130 |
| 4299317 | Total Copper (Cu) | 2010/09/30 | 102 | 75 - 125 | 92 | 75 - 125 | <0.5 | mg/kg | 13.1 | 30 | 86 | 70 - 130 |
| 4299317 | Total Lead (Pb) | 2010/09/30 | NC | 75 - 125 | 94 | 75 - 125 | <0.1 | mg/kg | 0.9 | 35 | 98 | 70 - 130 |
| 4299317 | Total Mercury (Hg) | 2010/09/30 | 87 | 75 - 125 | 88 | 75 - 125 | <0.05 | mg/kg | NC | 35 | | |
| 4299317 | Total Nickel (Ni) | 2010/09/30 | 105 | 75 - 125 | 89 | 75 - 125 | <0.8 | mg/kg | 1.4 | 30 | 90 | 70 - 130 |
| 4299317 | Total Selenium (Se) | 2010/09/30 | 107 | 75 - 125 | 99 | 75 - 125 | <0.5 | mg/kg | NC | 30 | | |
| 4299317 | Total Vanadium (V) | 2010/09/30 | NC | 75 - 125 | 88 | 75 - 125 | <2 | mg/kg | 2.7 | 30 | 91 | 70 - 130 |
| 4299317 | Total Zinc (Zn) | 2010/09/30 | NC | 75 - 125 | 94 | 75 - 125 | <1 | mg/kg | 0.8 | 30 | 86 | 70 - 130 |
| 4299317 | Total Aluminum (Al) | 2010/09/30 | | | | | <100 | mg/kg | 5.1 | 35 | 89 | 70 - 130 |
| 4299317 | Total Antimony (Sb) | 2010/09/30 | | | | | <0.1 | mg/kg | NC | 30 | 82 | 70 - 130 |
| 4299317 | Total Barium (Ba) | 2010/09/30 | | | | | <0.1 | mg/kg | 2.0 | 35 | 102 | 70 - 130 |
| 4299317 | Total Calcium (Ca) | 2010/09/30 | | | | | <100 | mg/kg | 1.4 | 30 | 90 | 70 - 130 |
| 4299317 | Total Iron (Fe) | 2010/09/30 | | | | | <100 | mg/kg | 3.6 | 30 | 87 | 70 - 130 |
| 4299317 | Total Magnesium (Mg) | 2010/09/30 | | | | | <100 | mg/kg | 6.4 | 30 | 86 | 70 - 130 |
| 4299317 | Total Manganese (Mn) | 2010/09/30 | | | | | <0.2 | mg/kg | 0.4 | 30 | 90 | 70 - 130 |
| 4299317 | Total Molybdenum (Mo) | 2010/09/30 | | | | | <0.1 | mg/kg | 4.8 | 35 | 84 | 70 - 130 |
| 4299317 | Total Phosphorus (P) | 2010/09/30 | | | | | <10 | mg/kg | 3.7 | 30 | 90 | 70 - 130 |
| 4299317 | Total Silver (Ag) | 2010/09/30 | | | | | <0.05 | mg/kg | NC | 35 | 59(1) | N/A |
| 4299317 | Total Strontium (Sr) | 2010/09/30 | | | | | <0.1 | mg/kg | 9.6 | 35 | 90 | 70 - 130 |
| 4299317 | Total Thallium (Tl) | 2010/09/30 | | | | | <0.05 | mg/kg | NC | 30 | 79 | 70 - 130 |
| 4299317 | Total Titanium (Ti) | 2010/09/30 | | | | | <1 | mg/kg | 4.9 | 35 | 91 | 70 - 130 |
| 4299317 | Total Bismuth (Bi) | 2010/09/30 | | | | | <0.1 | mg/kg | NC | 30 | | |
| 4299317 | Total Potassium (K) | 2010/09/30 | | | | | <100 | mg/kg | NC | 35 | | |
| 4299317 | Total Sodium (Na) | 2010/09/30 | | | | | <100 | mg/kg | NC | 35 | | |

## QUALITY ASSURANCE REPORT

| | | | Matrix Spike | | Spiked Blank | | Method Blank | | RPD | | QC Standard | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **QC Batch** | **Parameter** | **Date** | **% Recovery** | **QC Limits** | **% Recovery** | **QC Limits** | **Value** | **Units** | **Value (%)** | **QC Limits** | **% Recovery** | **QC Limits** |
| 4299317 | Total Tin (Sn) | 2010/09/30 | | | | | <0.1 | mg/kg | NC | 35 | | |
| 4299317 | Total Zirconium (Zr) | 2010/09/30 | | | | | <0.5 | mg/kg | NC | 30 | | |
| 4299322 | Soluble (2:1) pH | 2010/09/30 | | | 102 | 96 - 104 | | | 0.3 | 20 | | |
| 4308463 | Available (KCl) Orthophosphate (P) | 2010/10/04 | NC | 75 - 125 | 106 | 75 - 125 | <0.5 | ug/g | 0.1 | 30 | | |

---

N/A = Not Applicable

RPD = Relative Percent Difference

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

(1) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

(2) - Matrix spike exceeds acceptance limits due to matrix interference. Re-analysis yields similar results.

Maxxam

4606 Canada Way, Burnaby, BC Canada V5G 1K5 Ph: 604 734 7276 Toll Free: 1 800 665 8566 Fax: 604 731 2386

Maxxam Job#: B089603

**CHAIN OF CUSTODY RECORD**

Page: ___ of ___

G 035843

**Invoice To:** Require Report? Yes ☐ No ☐
Company Name: GOLDER BURNABY
Contact Name: CATHY McPHERSON
Address:
BURNABY PC: V5C 6C6
Phone / Fax#: Ph 604 297 2007 Fax:
E-mail: cmcpherson@golder.com

**Report To:**
Company Name:
Contact Name: Same
Address:
PC:
Phone / Fax#: Ph: Fax:
E-mail:

PO #:
Quotation #:
Project #:
Proj. Name: Diavik North In.
Location:
Sampled By:

**REGULATORY REQUIREMENTS SERVICE REQUESTED:**

☐ CSR
☒ CCME
☐ BC Water Quality
☐ Other
☐ DRINKING WATER

☒ Regular Turn Around Time (TAT)
(5 days for most tests)
☐ RUSH (Please contact the lab)
☐ 1 Day ☐ 2 Day ☐ 3 Day
Date Required:

**Special Instructions:**
Return Cooler ☐ Ship Sample Bottles (please specify) ☐

**ANALYSIS REQUESTED**

| # | Sample Identification | Lab Identification | Sample Type | Date/Time Sampled | ☐ BTEX/VPH<br>☐ MTBE | ☐ VOC/VPH | ☐ EPH<br>☐ TEH | ☐ PAH<br>☐ LEPH/HEPH | CCME-PHC (Fractions 1-4 Plus BTEX) | CCME-PHC (Fractions 2-4) | CCME BTEX (Fraction 1 Plus BTEX) | ☐ PCB | ☐ Phenols by 4AAP<br>☐ Phenols by GCMS | ☐ TOG<br>☐ MOG<br>☐ SWOG | Dissolved<br>Field Filtered?<br>Y ☐ N ☐ | Metals<br>Field Acidified?<br>Y ☐ N ☐ | Total Metals Field Acidified?<br>Y ☐ N ☐ | ☐ Nitrate<br>☐ Nitrite<br>☐ Ammonia | ☐ Chloride<br>☐ Fluoride<br>☐ Sulphate | ☐ Total Suspended Solids-TSS<br>☐ TDS | ☐ pH<br>☐ Conductivity<br>☐ Alkalinity | ☐ BOD | ☐ COD | Coliform, Total & E.coli<br>☐ Fecal ☐ | ☐ Asbestos | AUS/Sem (1JAR) | ARD PREP - [illegible] (ext+V) | (metals logs | to Bollards) | | | ☐ HOLD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | NIWTP Sludge | | Sludge | Sept. 3/10 | | | | | | | | | | | | | | | | | | | | | | X | X | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Samples are from a Drinking Water Source? YES ☐ NO ☐
Does source supply multiple households? YES ☐ NO ☐

Laboratory Use Only

| *Relinquished by: | Date (YY/MM/DD): | Time: | Received by: | Date (YY/MM/DD): | Time: | Time Sensitive | Temperature on Receipt (°C) | Custody Seal Intact on Cooler? |
|---|---|---|---|---|---|---|---|---|
| | | | NICK SANDIK | 10/09/20 | 12:45 | ☐ | 18/17/18 | ~~Yes~~ ~~No~~ |
| | | | | | | | | |

*IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: Maxxam Yellow: Client

COC-1020 (05/10)

Maxxam International Corporation o/a Maxxam Analytics

N/A.

**ACME ANALYTICAL LABORATORIES LTD.** **Final Report**

| | |
|---|---|
| **Client:** | Maxxam Analytics |
| **File Created:** | 22-Oct-2010 |
| **Job Number:** | VAN10005127 |
| **Number of Samples:** | 1 |
| **Project:** | 2-21-900 |
| **P.O. Number:** | Proj. Golder-Diavik North Inlet 2-21-900 |
| **Received:** | 01-Oct-2010 |

| | | **Method** | 4A | 2A-C |
|---|---|---|---|---|
| | | **Analyte** | CaO | C/ORG |
| | | **Unit** | % | % |
| | | **MDL** | 0.01 | 0.02 |
| **Sample** | **Type** | | | |
| NI WTP SLUDGE | Rock Pulp | | 0.46 | 9.94 |
| **QAQC** | | | | |
| Pulp Duplicates | | | | |
| Reference Materials | | | | |
| STD SO-18 | STD | | 6.35 | |
| STD SO-18 | STD | | 6.32 | |
| BLK | BLK | | <0.01 | |

C/Org is Total Organic Carbon

# APPENDIX C

## Laboratory Report - Water Chemistry (Maxxam Analytics)

Your C.O.C. #: A017489, A017490, A017491, A017492

**Attention: Cathy McPherson**
GOLDER ASSOCIATES LTD
4260 STILL CREEK DRIVE
Suite 500
BURNABY, BC
Canada V5C 6C6

**Report Date: 2010/10/26**

# CERTIFICATE OF ANALYSIS

**MAXXAM JOB #: B099438**
**Received: 2010/10/15, 08:55**

Sample Matrix: Water
# Samples Received: 40

| Analyses | Quantity | Date Extracted | Date Analyzed | Laboratory Method | Analytical Method |
|---|---|---|---|---|---|
| Hardness Total (calculated as CaCO3) | 1 | N/A | 2010/10/26 | | |
| Hardness (calculated as CaCO3) | 39 | N/A | 2010/10/22 | | |
| Na, K, Ca, Mg, S by CRC ICPMS (diss.) | 39 | N/A | 2010/10/22 | BRN SOP-00206 | Based on EPA 200.8 |
| Elements by CRC ICPMS (dissolved) | 19 | N/A | 2010/10/21 | BRN SOP-00206 | Based on EPA 200.8 |
| Elements by CRC ICPMS (dissolved) | 20 | N/A | 2010/10/22 | BRN SOP-00206 | Based on EPA 200.8 |
| Na, K, Ca, Mg, S by CRC ICPMS (total) | 1 | 2010/10/18 | 2010/10/26 | BRN SOP-00206 | Based on EPA 200.8 |
| Elements by CRC ICPMS (total) | 1 | 2010/10/20 | 2010/10/26 | BRN SOP-00206 | Based on EPA 200.8 |
| Filter and HNO3 Preserve for Metals | 39 | N/A | 2010/10/15 | BRN WI-00006 R1.0 | Based on EPA 200.2 |

* Results relate only to the items tested.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

VJ OCO, Burnaby Customer Service
Email: VOco@maxxam.ca
Phone# (604) 639-8422

====================================================================
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

## RESULTS OF CHEMICAL ANALYSES OF WATER

| Maxxam ID | | X69563 | X69564 | X69565 | X69566 | X69567 | X69568 | X69569 | X69570 | X69571 | X69572 | X69573 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356 CTL CT FINAL** | **10-1356 CTL HA INITIAL** | **10-1356 CTL HA FINAL** | **10-1356-1 CTL CT INITIAL** | **10-1356-1 CTL CT FINAL** | **10-1356-1 CTL HA INITIAL** | **10-1356-1 CTL HA FINAL** | **10-1356-2 CTL CT INITIAL** | **10-1356-2 CTL CT FINAL** | **10-1356-2 CTL HA INITIAL** | **10-1356-2 CTL HA FINAL** | **RDL** | **QC Batch** |
| **Calculated Parameters** | | | | | | | | | | | | | | |
| Filter and HNO3 Preservation | N/A | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | N/A | ONSITE |

| Maxxam ID | | X69590 | X69591 | X69592 | X69593 | X69594 | X69595 | X69596 | X69597 | X69598 | X69599 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356-3 CT INITIAL** | **10-1356-3 CT FINAL** | **10-1356-3 HA INITIAL** | **10-1356-3 HA FINAL** | **10-1356-4 CT INITIAL** | **10-1356-4 CT FINAL** | **10-1356-4 HA INITIAL** | **10-1356-4 HA FINAL** | **10-1356-5 CT INITIAL** | **10-1356-5 HA INITIAL** | **RDL** | **QC Batch** |
| **Calculated Parameters** | | | | | | | | | | | | | |
| Filter and HNO3 Preservation | N/A | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | N/A | ONSITE |

| Maxxam ID | | X69600 | X69601 | X69613 | X69614 | X69615 | X69616 | X69617 | X69618 | X69619 | X69620 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356-5 CT FINAL** | **10-1356-5 HA FINAL** | **10-1356-6 CT INITIAL** | **10-1356-6 CT FINAL** | **10-1356-6 HA INITIAL** | **10-1356-6 HA FINAL** | **10-1356-7 CT INITIAL** | **10-1356-7 CT FINAL** | **10-1356-7 HA INITIAL** | **10-1356-7 HA FINAL** | **RDL** | **QC Batch** |
| **Calculated Parameters** | | | | | | | | | | | | | |
| Filter and HNO3 Preservation | N/A | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | N/A | ONSITE |

| Maxxam ID | | X69621 | X69622 | X69623 | X69624 | X69633 | X69634 | X69635 | X69636 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356-8 CT INITIAL** | **10-1356-8 CT FINAL** | **10-1356-8 HA INITIAL** | **10-1356-8 HA FINAL** | **10-1392 CT INITIAL** | **10-1392 CT FINAL** | **10-1392 HA INITIAL** | **10-1392 HA FINAL** | **RDL** | **QC Batch** |
| **Calculated Parameters** | | | | | | | | | | | |
| Filter and HNO3 Preservation | N/A | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | N/A | ONSITE |

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N/A = Not Applicable
RDL = Reportable Detection Limit

## CCME DISSOLVED METALS IN WATER (WATER)

| Maxxam ID | | X69563 | X69564 | X69565 | X69566 | X69567 | X69568 | X69569 | X69570 | X69571 | X69572 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356 CTL CT FINAL** | **10-1356 CTL HA INITIAL** | **10-1356 CTL HA FINAL** | **10-1356-1 CTL CT INITIAL** | **10-1356-1 CTL CT FINAL** | **10-1356-1 CTL HA INITIAL** | **10-1356-1 CTL HA FINAL** | **10-1356-2 CTL CT INITIAL** | **10-1356-2 CTL CT FINAL** | **10-1356-2 CTL HA INITIAL** | **RDL** | **QC Batch** |
| **Misc. Inorganics** | | | | | | | | | | | | | |
| Dissolved Hardness (CaCO3) | mg/L | 235 | 331 | 357 | 253 | 249 | 301 | 380 | 286 | 258 | 278 | 0.5 | 4342718 |

RDL = Reportable Detection Limit

## CCME DISSOLVED METALS IN WATER (WATER)

| Maxxam ID | | X69563 | X69564 | X69565 | X69566 | X69567 | X69568 | X69569 | X69570 | X69571 | X69572 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356 CTL CT FINAL** | **10-1356 CTL HA INITIAL** | **10-1356 CTL HA FINAL** | **10-1356-1 CTL CT INITIAL** | **10-1356-1 CTL CT FINAL** | **10-1356-1 CTL HA INITIAL** | **10-1356-1 CTL HA FINAL** | **10-1356-2 CTL CT INITIAL** | **10-1356-2 CTL CT FINAL** | **10-1356-2 CTL HA INITIAL** | **RDL** | **QC Batch** |
| **Dissolved Metals by ICPMS** | | | | | | | | | | | | | |
| Dissolved Aluminum (Al) | mg/L | 0.279 | 1.23 | 0.228 | 1.37 | 0.565 | 0.766 | 0.896 | 4.08 | 1.08 | 0.562 | 0.003 | 4348791 |
| Dissolved Antimony (Sb) | mg/L | <0.0005 | <0.0005 | <0.0005 | 0.0005 | <0.0005 | 0.0005 | 0.0009 | 0.0005 | 0.0008 | 0.0006 | 0.0005 | 4348791 |
| Dissolved Arsenic (As) | mg/L | 0.0018 | 0.0010 | 0.0016 | 0.0283 | 0.0157 | 0.0250 | 0.0085 | 0.0256 | 0.0100 | 0.0141 | 0.0001 | 4348791 |
| Dissolved Barium (Ba) | mg/L | 0.084 | 0.179 | 0.163 | 0.154 | 0.119 | 0.195 | 0.216 | 0.318 | 0.215 | 0.280 | 0.001 | 4348791 |
| Dissolved Beryllium (Be) | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0001 | 4348791 |
| Dissolved Bismuth (Bi) | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | 4348791 |
| Dissolved Boron (B) | mg/L | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.05 | 4348791 |
| Dissolved Cadmium (Cd) | mg/L | 0.00005 | 0.00012 | 0.00004 | 0.00003 | 0.00002 | 0.00003 | 0.00003 | 0.00009 | 0.00004 | 0.00004 | 0.00001 | 4348791 |
| Dissolved Chromium (Cr) | mg/L | <0.001 | 0.003 | 0.001 | 0.003 | <0.001 | 0.002 | 0.002 | 0.023 | 0.005 | 0.003 | 0.001 | 4348791 |
| Dissolved Cobalt (Co) | mg/L | 0.0008 | 0.0014 | 0.0006 | 0.0009 | 0.0007 | 0.0006 | 0.0008 | 0.0051 | 0.0017 | 0.0010 | 0.0005 | 4348791 |
| Dissolved Copper (Cu) | mg/L | 0.0053 | 0.0031 | 0.0034 | 0.0017 | 0.0008 | 0.0011 | 0.0015 | 0.0048 | 0.0014 | 0.0054 | 0.0002 | 4348791 |
| Dissolved Iron (Fe) | mg/L | 0.423 | 2.05 | 0.248 | 0.823 | 0.120 | 0.409 | 0.426 | 4.35 | 1.02 | 0.569 | 0.005 | 4348791 |
| Dissolved Lead (Pb) | mg/L | 0.0005 | 0.0019 | 0.0004 | 0.0016 | 0.0003 | 0.0008 | 0.0007 | 0.0056 | 0.0011 | 0.0009 | 0.0002 | 4348791 |
| Dissolved Lithium (Li) | mg/L | 0.008 | 0.008 | 0.007 | 0.008 | <0.005 | 0.007 | <0.005 | 0.017 | 0.008 | 0.010 | 0.005 | 4348791 |
| Dissolved Manganese (Mn) | mg/L | 0.027 | 0.154 | 0.019 | 0.279 | 0.159 | 0.416 | 0.098 | 0.464 | 0.170 | 0.363 | 0.001 | 4348791 |
| Dissolved Mercury (Hg) | mg/L | 0.00004 | 0.00002 | 0.00003 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | 0.00002 | 4348791 |
| Dissolved Molybdenum (Mo) | mg/L | 0.007 | 0.006 | 0.006 | 0.023 | 0.018 | 0.023 | 0.031 | 0.029 | 0.034 | 0.029 | 0.001 | 4348791 |
| Dissolved Nickel (Ni) | mg/L | 0.004 | 0.004 | 0.002 | 0.019 | 0.026 | 0.014 | 0.027 | 0.078 | 0.056 | 0.027 | 0.001 | 4348791 |
| Dissolved Selenium (Se) | mg/L | 0.0007 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0001 | <0.0001 | 0.0002 | 0.0002 | <0.0001 | 0.0001 | 4348791 |
| Dissolved Silicon (Si) | mg/L | 4.9 | 5.0 | 4.1 | 3.7 | 2.5 | 3.2 | 2.6 | 10.0 | 4.5 | 4.5 | 0.1 | 4348791 |
| Dissolved Silver (Ag) | mg/L | <0.00002 | 0.00003 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | 0.00004 | <0.00002 | <0.00002 | 0.00002 | 4348791 |
| Dissolved Strontium (Sr) | mg/L | 0.371 | 0.263 | 0.322 | 0.700 | 0.607 | 0.810 | 0.831 | 0.823 | 0.771 | 0.824 | 0.001 | 4348791 |
| Dissolved Thallium (Tl) | mg/L | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | 0.00008 | <0.00005 | <0.00005 | 0.00005 | 4348791 |
| Dissolved Tin (Sn) | mg/L | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 | 4348791 |
| Dissolved Titanium (Ti) | mg/L | <0.005 | 0.014 | <0.005 | 0.028 | <0.005 | 0.013 | 0.024 | 0.154 | 0.051 | 0.023 | 0.005 | 4348791 |
| Dissolved Uranium (U) | mg/L | 0.0014 | 0.0007 | 0.0007 | 0.0629 | 0.0694 | 0.0623 | 0.0789 | 0.0587 | 0.0609 | 0.0514 | 0.0001 | 4348791 |
| Dissolved Vanadium (V) | mg/L | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.007 | <0.005 | <0.005 | 0.005 | 4348791 |
| Dissolved Zinc (Zn) | mg/L | <0.005 | 0.010 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.016 | 0.005 | <0.005 | 0.005 | 4348791 |
| Dissolved Zirconium (Zr) | mg/L | <0.0005 | 0.0006 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.0011 | <0.0005 | <0.0005 | 0.0005 | 4348791 |
| Dissolved Calcium (Ca) | mg/L | 53.5 | 90.9 | 98.6 | 41.9 | 50.7 | 59.7 | 91.8 | 51.7 | 54.4 | 61.1 | 0.05 | 4339906 |
| Dissolved Magnesium (Mg) | mg/L | 24.6 | 25.3 | 27.0 | 36.1 | 29.7 | 37.0 | 36.6 | 38.1 | 29.8 | 30.5 | 0.05 | 4339906 |
| Dissolved Potassium (K) | mg/L | 4.53 | 4.75 | 8.39 | 17.8 | 12.7 | 21.0 | 19.7 | 20.8 | 14.4 | 22.0 | 0.05 | 4339906 |
| Dissolved Sodium (Na) | mg/L | 18.9 | 36.4 | 45.4 | 24.6 | 21.5 | 41.3 | 54.3 | 26.6 | 23.6 | 40.1 | 0.05 | 4339906 |
| Dissolved Sulphur (S) | mg/L | 34 | 19 | 21 | 11 | 16 | 5 | 19 | 17 | 24 | 9 | 3 | 4339906 |

RDL = Reportable Detection Limit

## CCME DISSOLVED METALS IN WATER (WATER)

| Maxxam ID | | X69573 | X69590 | X69591 | X69592 | X69593 | X69594 | X69595 | X69596 | X69597 | X69598 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356-2 CTL HA FINAL** | **10-1356-3 CT INITIAL** | **10-1356-3 CT FINAL** | **10-1356-3 HA INITIAL** | **10-1356-3 HA FINAL** | **10-1356-4 CT INITIAL** | **10-1356-4 CT FINAL** | **10-1356-4 HA INITIAL** | **10-1356-4 HA FINAL** | **10-1356-5 CT INITIAL** | **RDL** | **QC Batch** |
| **Misc. Inorganics** | | | | | | | | | | | | | |
| Dissolved Hardness (CaCO3) | mg/L | 386 | 274 | 273 | 268 | 344 | 196 | 225 | 223 | 324 | 187 | 0.5 | 4342718 |

RDL = Reportable Detection Limit

## CCME DISSOLVED METALS IN WATER (WATER)

| Maxxam ID | | X69573 | X69590 | X69591 | X69592 | X69593 | X69594 | X69595 | X69596 | X69597 | X69598 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356-2 CTL HA FINAL** | **10-1356-3 CT INITIAL** | **10-1356-3 CT FINAL** | **10-1356-3 HA INITIAL** | **10-1356-3 HA FINAL** | **10-1356-4 CT INITIAL** | **10-1356-4 CT FINAL** | **10-1356-4 HA INITIAL** | **10-1356-4 HA FINAL** | **10-1356-5 CT INITIAL** | **RDL** | **QC Batch** |
| **Dissolved Metals by ICPMS** | | | | | | | | | | | | | |
| Dissolved Aluminum (Al) | mg/L | 0.206 | 2.89 | 0.589 | 0.327 | 0.137 | 1.95 | 0.488 | 0.417 | 0.139 | 1.18 | 0.003 | 4348791 |
| Dissolved Antimony (Sb) | mg/L | 0.0005 | 0.0008 | <0.0005 | 0.0007 | 0.0007 | <0.0005 | 0.0006 | <0.0005 | 0.0006 | <0.0005 | 0.0005 | 4348791 |
| Dissolved Arsenic (As) | mg/L | 0.0114 | 0.0162 | 0.0065 | 0.0103 | 0.0047 | 0.0153 | 0.0048 | 0.0089 | 0.0023 | 0.0204 | 0.0001 | 4348791 |
| Dissolved Barium (Ba) | mg/L | 0.332 | 0.223 | 0.143 | 0.186 | 0.198 | 0.331 | 0.255 | 0.341 | 0.369 | 0.104 | 0.001 | 4348791 |
| Dissolved Beryllium (Be) | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0001 | 4348791 |
| Dissolved Bismuth (Bi) | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | 4348791 |
| Dissolved Boron (B) | mg/L | 0.05 | <0.05 | 0.05 | <0.05 | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.05 | 0.05 | 4348791 |
| Dissolved Cadmium (Cd) | mg/L | 0.00003 | 0.00008 | 0.00002 | 0.00004 | 0.00003 | 0.00005 | 0.00003 | 0.00003 | 0.00003 | 0.00004 | 0.00001 | 4348791 |
| Dissolved Chromium (Cr) | mg/L | <0.001 | 0.012 | 0.003 | 0.001 | <0.001 | 0.010 | 0.002 | 0.002 | <0.001 | 0.003 | 0.001 | 4348791 |
| Dissolved Cobalt (Co) | mg/L | 0.0008 | 0.0028 | 0.0011 | 0.0005 | 0.0006 | 0.0025 | 0.0013 | 0.0010 | 0.0012 | 0.0016 | 0.0005 | 4348791 |
| Dissolved Copper (Cu) | mg/L | 0.0014 | 0.0037 | 0.0012 | 0.0040 | 0.0013 | 0.0032 | 0.0013 | 0.0014 | 0.0010 | 0.0041 | 0.0002 | 4348791 |
| Dissolved Iron (Fe) | mg/L | 0.146 | 3.56 | 0.559 | 0.331 | 0.077 | 2.23 | 0.491 | 0.546 | 0.076 | 1.63 | 0.005 | 4348791 |
| Dissolved Lead (Pb) | mg/L | 0.0003 | 0.0119 | 0.0012 | 0.0025 | 0.0004 | 0.0038 | 0.0009 | 0.0011 | 0.0003 | 0.0074 | 0.0002 | 4348791 |
| Dissolved Lithium (Li) | mg/L | 0.006 | 0.033 | 0.018 | 0.025 | 0.022 | 0.022 | 0.012 | 0.017 | 0.013 | 0.032 | 0.005 | 4348791 |
| Dissolved Manganese (Mn) | mg/L | 0.273 | 0.456 | 0.116 | 0.325 | 0.128 | 1.73 | 0.835 | 1.62 | 1.08 | 0.526 | 0.001 | 4348791 |
| Dissolved Mercury (Hg) | mg/L | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | 0.00002 | 4348791 |
| Dissolved Molybdenum (Mo) | mg/L | 0.028 | 0.045 | 0.023 | 0.041 | 0.030 | 0.036 | 0.037 | 0.034 | 0.039 | 0.015 | 0.001 | 4348791 |
| Dissolved Nickel (Ni) | mg/L | 0.039 | 0.033 | 0.038 | 0.014 | 0.031 | 0.044 | 0.051 | 0.028 | 0.053 | 0.013 | 0.001 | 4348791 |
| Dissolved Selenium (Se) | mg/L | 0.0001 | 0.0002 | 0.0002 | <0.0001 | 0.0001 | 0.0001 | 0.0002 | <0.0001 | 0.0001 | 0.0001 | 0.0001 | 4348791 |
| Dissolved Silicon (Si) | mg/L | 4.4 | 11.3 | 6.9 | 6.7 | 7.3 | 9.1 | 6.8 | 7.9 | 6.9 | 10.7 | 0.1 | 4348791 |
| Dissolved Silver (Ag) | mg/L | <0.00002 | 0.00005 | <0.00002 | <0.00002 | <0.00002 | 0.00002 | <0.00002 | <0.00002 | 0.00003 | 0.00003 | 0.00002 | 4348791 |
| Dissolved Strontium (Sr) | mg/L | 0.991 | 0.753 | 0.692 | 0.732 | 0.782 | 0.631 | 0.603 | 0.626 | 0.739 | 0.636 | 0.001 | 4348791 |
| Dissolved Thallium (Tl) | mg/L | <0.00005 | 0.00008 | <0.00005 | <0.00005 | <0.00005 | 0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | 0.00005 | 4348791 |
| Dissolved Tin (Sn) | mg/L | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 | 4348791 |
| Dissolved Titanium (Ti) | mg/L | 0.005 | 0.191 | 0.030 | 0.019 | <0.005 | 0.125 | 0.025 | 0.025 | <0.005 | 0.058 | 0.005 | 4348791 |
| Dissolved Uranium (U) | mg/L | 0.0468 | 0.0357 | 0.0246 | 0.0296 | 0.0239 | 0.0407 | 0.0461 | 0.0280 | 0.0367 | 0.0247 | 0.0001 | 4348791 |
| Dissolved Vanadium (V) | mg/L | <0.005 | 0.007 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 | 4348791 |
| Dissolved Zinc (Zn) | mg/L | <0.005 | 0.018 | <0.005 | <0.005 | <0.005 | 0.011 | <0.005 | <0.005 | <0.005 | 0.007 | 0.005 | 4348791 |
| Dissolved Zirconium (Zr) | mg/L | <0.0005 | 0.0008 | <0.0005 | <0.0005 | <0.0005 | 0.0010 | <0.0005 | <0.0005 | <0.0005 | 0.0008 | 0.0005 | 4348791 |
| Dissolved Calcium (Ca) | mg/L | 95.0 | 57.5 | 62.5 | 63.9 | 88.4 | 35.8 | 50.8 | 53.5 | 87.6 | 39.6 | 0.05 | 4339906 |
| Dissolved Magnesium (Mg) | mg/L | 36.2 | 31.7 | 28.5 | 26.4 | 29.9 | 25.8 | 23.9 | 21.7 | 25.7 | 21.4 | 0.05 | 4339906 |
| Dissolved Potassium (K) | mg/L | 22.0 | 19.4 | 13.7 | 19.9 | 19.1 | 16.2 | 11.2 | 16.6 | 15.9 | 15.2 | 0.05 | 4339906 |
| Dissolved Sodium (Na) | mg/L | 54.1 | 26.8 | 24.6 | 40.2 | 51.3 | 27.0 | 23.1 | 39.0 | 47.1 | 26.4 | 0.05 | 4339906 |
| Dissolved Sulphur (S) | mg/L | 17 | 18 | 22 | 10 | 19 | 20 | 28 | 12 | 29 | 14 | 3 | 4339906 |

RDL = Reportable Detection Limit

## CCME DISSOLVED METALS IN WATER (WATER)

| Maxxam ID |  | X69599 | X69600 | X69601 | X69613 | X69614 | X69615 | X69616 |  | X69617 | X69618 |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | **Units** | **10-1356-5 HA INITIAL** | **10-1356-5 CT FINAL** | **10-1356-5 HA FINAL** | **10-1356-6 CT INITIAL** | **10-1356-6 CT FINAL** | **10-1356-6 HA INITIAL** | **10-1356-6 HA FINAL** | **QC Batch** | **10-1356-7 CT INITIAL** | **10-1356-7 CT FINAL** | **RDL** | **QC Batch** |
| **Misc. Inorganics** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Dissolved Hardness (CaCO3) | mg/L | 197 | 217 | 264 | 89.5 | 102 | 113 | 188 | 4342718 | 89.1 | 103 | 0.5 | 4342718 |

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RDL = Reportable Detection Limit

## CCME DISSOLVED METALS IN WATER (WATER)

| Maxxam ID | | X69599 | X69600 | X69601 | X69613 | X69614 | X69615 | X69616 | | X69617 | X69618 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356-5 HA INITIAL** | **10-1356-5 CT FINAL** | **10-1356-5 HA FINAL** | **10-1356-6 CT INITIAL** | **10-1356-6 CT FINAL** | **10-1356-6 HA INITIAL** | **10-1356-6 HA FINAL** | **QC Batch** | **10-1356-7 CT INITIAL** | **10-1356-7 CT FINAL** | **RDL** | **QC Batch** |
| **Dissolved Metals by ICPMS** | | | | | | | | | | | | | |
| Dissolved Aluminum (Al) | mg/L | 0.202 | 0.838 | 0.456 | 1.34 | 0.300 | 0.167 | 0.294 | 4348796 | 1.58 | 0.091 | 0.003 | 4348796 |
| Dissolved Antimony (Sb) | mg/L | <0.0005 | 0.0007 | 0.0006 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 4348796 | <0.0005 | <0.0005 | 0.0005 | 4348796 |
| Dissolved Arsenic (As) | mg/L | 0.0099 | 0.0153 | 0.0075 | 0.0029 | 0.0022 | 0.0009 | 0.0016 | 4348796 | 0.0046 | 0.0034 | 0.0001 | 4348796 |
| Dissolved Barium (Ba) | mg/L | 0.100 | 0.090 | 0.116 | 0.038 | 0.030 | 0.054 | 0.110 | 4348796 | 0.045 | 0.034 | 0.001 | 4348796 |
| Dissolved Beryllium (Be) | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 4348796 | <0.0001 | <0.0001 | 0.0001 | 4348796 |
| Dissolved Bismuth (Bi) | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 4348796 | <0.001 | <0.001 | 0.001 | 4348796 |
| Dissolved Boron (B) | mg/L | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 4348796 | <0.05 | <0.05 | 0.05 | 4348796 |
| Dissolved Cadmium (Cd) | mg/L | 0.00003 | 0.00003 | 0.00003 | 0.00008 | 0.00004 | 0.00015 | 0.00022 | 4348796 | 0.00007 | 0.00004 | 0.00001 | 4348796 |
| Dissolved Chromium (Cr) | mg/L | <0.001 | 0.003 | 0.001 | 0.005 | 0.001 | <0.001 | <0.001 | 4348796 | 0.007 | <0.001 | 0.001 | 4348796 |
| Dissolved Cobalt (Co) | mg/L | 0.0006 | 0.0017 | 0.0010 | 0.0031 | 0.0018 | 0.0024 | 0.0013 | 4348796 | 0.0046 | 0.0019 | 0.0005 | 4348796 |
| Dissolved Copper (Cu) | mg/L | 0.0017 | 0.0044 | 0.0047 | 0.0075 | 0.0054 | 0.0020 | 0.0048 | 4348796 | 0.0063 | 0.0064 | 0.0002 | 4348796 |
| Dissolved Iron (Fe) | mg/L | 0.305 | 1.09 | 0.575 | 2.87 | 0.456 | 0.385 | 0.545 | 4348796 | 4.56 | 0.346 | 0.005 | 4348796 |
| Dissolved Lead (Pb) | mg/L | 0.0014 | 0.0036 | 0.0025 | 0.0007 | 0.0006 | 0.0003 | 0.0003 | 4348796 | 0.0007 | <0.0002 | 0.0002 | 4348796 |
| Dissolved Lithium (Li) | mg/L | 0.021 | 0.017 | 0.018 | <0.005 | <0.005 | <0.005 | 0.006 | 4348796 | 0.006 | <0.005 | 0.005 | 4348796 |
| Dissolved Manganese (Mn) | mg/L | 0.566 | 0.148 | 0.061 | 3.06 | 2.99 | 4.26 | 2.20 | 4348796 | 3.55 | 3.15 | 0.001 | 4348796 |
| Dissolved Mercury (Hg) | mg/L | 0.00004 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | 4348796 | <0.00002 | <0.00002 | 0.00002 | 4348796 |
| Dissolved Molybdenum (Mo) | mg/L | 0.011 | 0.020 | 0.015 | <0.001 | 0.001 | <0.001 | <0.001 | 4348796 | <0.001 | 0.002 | 0.001 | 4348796 |
| Dissolved Nickel (Ni) | mg/L | 0.008 | 0.022 | 0.017 | 0.011 | 0.014 | 0.019 | 0.029 | 4348796 | 0.014 | 0.014 | 0.001 | 4348796 |
| Dissolved Selenium (Se) | mg/L | <0.0001 | 0.0003 | 0.0001 | 0.0003 | 0.0003 | <0.0001 | <0.0001 | 4348796 | 0.0003 | 0.0003 | 0.0001 | 4348796 |
| Dissolved Silicon (Si) | mg/L | 7.8 | 8.7 | 9.0 | 4.8 | 4.7 | 2.8 | 5.3 | 4348796 | 6.8 | 5.3 | 0.1 | 4348796 |
| Dissolved Silver (Ag) | mg/L | <0.00002 | <0.00002 | <0.00002 | 0.00002 | <0.00002 | <0.00002 | <0.00002 | 4348796 | <0.00002 | <0.00002 | 0.00002 | 4348796 |
| Dissolved Strontium (Sr) | mg/L | 0.510 | 0.603 | 0.596 | 0.147 | 0.167 | 0.085 | 0.162 | 4348796 | 0.126 | 0.165 | 0.001 | 4348796 |
| Dissolved Thallium (Tl) | mg/L | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | 0.00010 | 4348796 | 0.00006 | <0.00005 | 0.00005 | 4348796 |
| Dissolved Tin (Sn) | mg/L | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 4348796 | <0.005 | <0.005 | 0.005 | 4348796 |
| Dissolved Titanium (Ti) | mg/L | 0.012 | 0.050 | 0.022 | 0.102 | 0.018 | 0.012 | 0.017 | 4348796 | 0.134 | <0.005 | 0.005 | 4348796 |
| Dissolved Uranium (U) | mg/L | 0.0132 | 0.0522 | 0.0241 | 0.0005 | 0.0006 | <0.0001 | 0.0003 | 4348796 | 0.0004 | 0.0003 | 0.0001 | 4348796 |
| Dissolved Vanadium (V) | mg/L | <0.005 | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 4348796 | 0.005 | <0.005 | 0.005 | 4348796 |
| Dissolved Zinc (Zn) | mg/L | <0.005 | 0.006 | <0.005 | 0.009 | <0.005 | <0.005 | <0.005 | 4348796 | 0.011 | <0.005 | 0.005 | 4348796 |
| Dissolved Zirconium (Zr) | mg/L | <0.0005 | 0.0006 | 0.0011 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 4348796 | <0.0005 | <0.0005 | 0.0005 | 4348796 |
| Dissolved Calcium (Ca) | mg/L | 54.2 | 50.0 | 75.3 | 21.3 | 23.9 | 35.4 | 57.9 | 4339906 | 21.2 | 24.3 | 0.05 | 4342789 |
| Dissolved Magnesium (Mg) | mg/L | 15.1 | 22.3 | 18.4 | 8.82 | 10.3 | 6.07 | 10.6 | 4339906 | 8.81 | 10.3 | 0.05 | 4342789 |
| Dissolved Potassium (K) | mg/L | 13.7 | 11.5 | 15.4 | 2.26 | 3.40 | 3.02 | 7.56 | 4339906 | 2.57 | 3.15 | 0.05 | 4342789 |
| Dissolved Sodium (Na) | mg/L | 33.8 | 22.4 | 41.0 | 4.69 | 9.68 | 16.6 | 29.3 | 4339906 | 4.78 | 9.62 | 0.05 | 4342789 |
| Dissolved Sulphur (S) | mg/L | 6 | 27 | 13 | 18 | 25 | 7 | 12 | 4339906 | 17 | 26 | 3 | 4342789 |

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RDL = Reportable Detection Limit

## CCME DISSOLVED METALS IN WATER (WATER)

| Maxxam ID | | X69619 | X69620 | X69621 | X69622 | X69623 | X69624 | X69633 | X69634 | X69635 | X69636 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356-7 HA INITIAL** | **10-1356-7 HA FINAL** | **10-1356-8 CT INITIAL** | **10-1356-8 CT FINAL** | **10-1356-8 HA INITIAL** | **10-1356-8 HA FINAL** | **10-1392 CT INITIAL** | **10-1392 CT FINAL** | **10-1392 HA INITIAL** | **10-1392 HA FINAL** | **RDL** | **QC Batch** |
| **Misc. Inorganics** | | | | | | | | | | | | | |
| Dissolved Hardness (CaCO3) | mg/L | 105 | 150 | 70.3 | 82.2 | 98.5 | 149 | 177 | 190 | 194 | 228 | 0.5 | 4342718 |

RDL = Reportable Detection Limit

## CCME DISSOLVED METALS IN WATER (WATER)

| Maxxam ID | | X69619 | X69620 | X69621 | X69622 | X69623 | X69624 | X69633 | X69634 | X69635 | X69636 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356-7 HA INITIAL** | **10-1356-7 HA FINAL** | **10-1356-8 CT INITIAL** | **10-1356-8 CT FINAL** | **10-1356-8 HA INITIAL** | **10-1356-8 HA FINAL** | **10-1392 CT INITIAL** | **10-1392 CT FINAL** | **10-1392 HA INITIAL** | **10-1392 HA FINAL** | **RDL** | **QC Batch** |
| **Dissolved Metals by ICPMS** | | | | | | | | | | | | | |
| Dissolved Aluminum (Al) | mg/L | 0.291 | 0.051 | 1.77 | 0.057 | 1.53 | 0.108 | 3.26 | 4.66 | 2.51 | 0.429 | 0.003 | 4348796 |
| Dissolved Antimony (Sb) | mg/L | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.0006 | <0.0005 | 0.0007 | 0.0005 | 4348796 |
| Dissolved Arsenic (As) | mg/L | 0.0017 | 0.0018 | 0.0116 | 0.0106 | 0.0068 | 0.0057 | 0.0213 | 0.0271 | 0.0183 | 0.0122 | 0.0001 | 4348796 |
| Dissolved Barium (Ba) | mg/L | 0.070 | 0.104 | 0.055 | 0.042 | 0.116 | 0.142 | 0.091 | 0.079 | 0.106 | 0.099 | 0.001 | 4348796 |
| Dissolved Beryllium (Be) | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0001 | 4348796 |
| Dissolved Bismuth (Bi) | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | 4348796 |
| Dissolved Boron (B) | mg/L | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.05 | 4348796 |
| Dissolved Cadmium (Cd) | mg/L | 0.00022 | 0.00036 | 0.00008 | 0.00004 | 0.00030 | 0.00040 | 0.00001 | 0.00001 | <0.00001 | 0.00001 | 0.00001 | 4348796 |
| Dissolved Chromium (Cr) | mg/L | 0.001 | <0.001 | 0.006 | <0.001 | 0.005 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | 4348796 |
| Dissolved Cobalt (Co) | mg/L | 0.0057 | 0.0027 | 0.0085 | 0.0027 | 0.0231 | 0.0075 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.0005 | 4348796 |
| Dissolved Copper (Cu) | mg/L | 0.0021 | 0.0056 | 0.0087 | 0.0050 | 0.0077 | 0.0072 | 0.0005 | 0.0005 | 0.0005 | 0.0003 | 0.0002 | 4348796 |
| Dissolved Iron (Fe) | mg/L | 0.832 | 0.184 | 5.74 | 0.593 | 4.28 | 0.306 | 0.136 | 0.090 | 0.101 | 0.015 | 0.005 | 4348796 |
| Dissolved Lead (Pb) | mg/L | 0.0003 | <0.0002 | 0.0009 | <0.0002 | 0.0007 | 0.0002 | 0.0002 | 0.0003 | 0.0002 | <0.0002 | 0.0002 | 4348796 |
| Dissolved Lithium (Li) | mg/L | <0.005 | 0.006 | 0.007 | <0.005 | 0.007 | 0.006 | 0.006 | 0.006 | 0.005 | <0.005 | 0.005 | 4348796 |
| Dissolved Manganese (Mn) | mg/L | 5.94 | 6.13 | 3.28 | 2.57 | 8.35 | 9.24 | 2.46 | 1.75 | 3.14 | 2.22 | 0.001 | 4348796 |
| Dissolved Mercury (Hg) | mg/L | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | 0.00002 | <0.00002 | <0.00002 | 0.00002 | 4348796 |
| Dissolved Molybdenum (Mo) | mg/L | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | 0.015 | 0.014 | 0.005 | 0.019 | 0.001 | 4348796 |
| Dissolved Nickel (Ni) | mg/L | 0.032 | 0.065 | 0.018 | 0.014 | 0.055 | 0.063 | 0.005 | 0.006 | 0.003 | 0.005 | 0.001 | 4348796 |
| Dissolved Selenium (Se) | mg/L | <0.0001 | 0.0001 | 0.0002 | 0.0003 | <0.0001 | 0.0001 | 0.0003 | 0.0002 | 0.0003 | 0.0001 | 0.0001 | 4348796 |
| Dissolved Silicon (Si) | mg/L | 4.0 | 6.5 | 7.8 | 8.6 | 8.1 | 11.6 | 1.2 | 1.1 | 1.1 | 0.4 | 0.1 | 4348796 |
| Dissolved Silver (Ag) | mg/L | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | 0.00002 | 4348796 |
| Dissolved Strontium (Sr) | mg/L | 0.067 | 0.108 | 0.111 | 0.132 | 0.066 | 0.104 | 0.337 | 0.262 | 0.206 | 0.157 | 0.001 | 4348796 |
| Dissolved Thallium (Tl) | mg/L | 0.00007 | 0.00013 | 0.00008 | 0.00007 | 0.00018 | 0.00023 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | 0.00005 | 4348796 |
| Dissolved Tin (Sn) | mg/L | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 | 4348796 |
| Dissolved Titanium (Ti) | mg/L | 0.023 | <0.005 | 0.121 | <0.005 | 0.111 | 0.006 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 | 4348796 |
| Dissolved Uranium (U) | mg/L | <0.0001 | <0.0001 | 0.0005 | <0.0001 | 0.0005 | <0.0001 | 0.0090 | 0.0108 | 0.0058 | 0.0033 | 0.0001 | 4348796 |
| Dissolved Vanadium (V) | mg/L | <0.005 | <0.005 | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 | 4348796 |
| Dissolved Zinc (Zn) | mg/L | <0.005 | 0.009 | 0.013 | <0.005 | 0.016 | 0.009 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 | 4348796 |
| Dissolved Zirconium (Zr) | mg/L | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.0005 | 4348796 |
| Dissolved Calcium (Ca) | mg/L | 33.5 | 47.0 | 15.8 | 19.4 | 30.8 | 47.1 | 40.4 | 41.6 | 56.7 | 70.2 | 0.05 | 4342789 |
| Dissolved Magnesium (Mg) | mg/L | 5.15 | 8.00 | 7.51 | 8.18 | 5.27 | 7.59 | 18.5 | 21.0 | 12.6 | 12.7 | 0.05 | 4342789 |
| Dissolved Potassium (K) | mg/L | 2.94 | 7.16 | 2.37 | 3.35 | 3.34 | 8.21 | 11.4 | 10.8 | 13.2 | 13.0 | 0.05 | 4342789 |
| Dissolved Sodium (Na) | mg/L | 16.1 | 26.7 | 4.54 | 10.0 | 16.5 | 29.7 | 18.7 | 20.9 | 32.4 | 35.5 | 0.05 | 4342789 |
| Dissolved Sulphur (S) | mg/L | 8 | 12 | 16 | 26 | 6 | 13 | 40 | 55 | 35 | 48 | 3 | 4342789 |

RDL = Reportable Detection Limit

## CCME TOTAL METALS IN WATER (WATER)

| Maxxam ID | | X69562 | | |
|---|---|---|---|---|
| | **Units** | **10-1356 CTL CT INITIAL** | **RDL** | **QC Batch** |
| **Calculated Parameters** | | | | |
| Total Hardness (CaCO3) | mg/L | 1040 | 0.5 | 4343719 |
| **Total Metals by ICPMS** | | | | |
| Total Aluminum (Al) | mg/L | 20.7 | 0.003 | 4356678 |
| Total Antimony (Sb) | mg/L | 0.0008 | 0.0005 | 4356678 |
| Total Arsenic (As) | mg/L | 0.0138 | 0.0001 | 4356678 |
| Total Barium (Ba) | mg/L | 0.888 | 0.001 | 4356678 |
| Total Beryllium (Be) | mg/L | 0.0011 | 0.0001 | 4356678 |
| Total Bismuth (Bi) | mg/L | <0.001 | 0.001 | 4356678 |
| Total Boron (B) | mg/L | 0.06 | 0.05 | 4356678 |
| Total Cadmium (Cd) | mg/L | 0.00095 | 0.00001 | 4356678 |
| Total Chromium (Cr) | mg/L | 0.038 | 0.001 | 4356678 |
| Total Cobalt (Co) | mg/L | 0.0142 | 0.0005 | 4356678 |
| Total Copper (Cu) | mg/L | 0.0489 | 0.0002 | 4356678 |
| Total Iron (Fe) | mg/L | 32.8 | 0.005 | 4356678 |
| Total Lead (Pb) | mg/L | 0.0189 | 0.0002 | 4356678 |
| Total Lithium (Li) | mg/L | 0.035 | 0.005 | 4356678 |
| Total Manganese (Mn) | mg/L | 1.44 | 0.001 | 4356678 |
| Total Mercury (Hg) | mg/L | 0.00008 | 0.00002 | 4356678 |
| Total Molybdenum (Mo) | mg/L | 0.011 | 0.001 | 4356678 |
| Total Nickel (Ni) | mg/L | 0.041 | 0.001 | 4356678 |
| Total Selenium (Se) | mg/L | 0.0012 | 0.0001 | 4356678 |
| Total Silicon (Si) | mg/L | 37.3 | 0.1 | 4356678 |
| Total Silver (Ag) | mg/L | 0.00020 | 0.00002 | 4356678 |
| Total Strontium (Sr) | mg/L | 0.604 | 0.001 | 4356678 |
| Total Thallium (Tl) | mg/L | 0.00043 | 0.00005 | 4356678 |
| Total Tin (Sn) | mg/L | <0.005 | 0.005 | 4356678 |
| Total Titanium (Ti) | mg/L | 0.195 | 0.005 | 4356678 |
| Total Uranium (U) | mg/L | 0.0030 | 0.0001 | 4356678 |
| Total Vanadium (V) | mg/L | 0.048 | 0.005 | 4356678 |
| Total Zinc (Zn) | mg/L | 0.113 | 0.005 | 4356678 |
| Total Zirconium (Zr) | mg/L | 0.0047 | 0.0005 | 4356678 |
| Total Calcium (Ca) | mg/L | 287 | 0.05 | 4343722 |
| Total Magnesium (Mg) | mg/L | 79.3 | 0.05 | 4343722 |
| Total Potassium (K) | mg/L | 7.10 | 0.05 | 4343722 |
| Total Sodium (Na) | mg/L | 21.6 | 0.05 | 4343722 |
| Total Sulphur (S) | mg/L | 33 | 3 | 4343722 |

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RDL = Reportable Detection Limit

## QUALITY ASSURANCE REPORT

| | | | Matrix Spike | | Spiked Blank | | Method Blank | | RPD | |
|---|---|---|---|---|---|---|---|---|---|---|
| QC Batch | Parameter | Date | % Recovery | QC Limits | % Recovery | QC Limits | Value | Units | Value (%) | QC Limits |
| 4348791 | Dissolved Arsenic (As) | 2010/10/22 | 93 | 80 - 120 | 97 | 80 - 120 | <0.0001 | mg/L | 0.6 | 20 |
| 4348791 | Dissolved Beryllium (Be) | 2010/10/22 | 86 | 80 - 120 | 92 | 80 - 120 | <0.0001 | mg/L | NC | 20 |
| 4348791 | Dissolved Cadmium (Cd) | 2010/10/22 | 89 | 80 - 120 | 98 | 80 - 120 | <0.00001 | mg/L | NC | 20 |
| 4348791 | Dissolved Chromium (Cr) | 2010/10/22 | 95 | 80 - 120 | 98 | 80 - 120 | <0.001 | mg/L | NC | 20 |
| 4348791 | Dissolved Cobalt (Co) | 2010/10/22 | 96 | 80 - 120 | 100 | 80 - 120 | <0.0005 | mg/L | NC | 20 |
| 4348791 | Dissolved Copper (Cu) | 2010/10/22 | NC | 80 - 120 | 99 | 80 - 120 | <0.0002 | mg/L | 3.2 | 20 |
| 4348791 | Dissolved Lead (Pb) | 2010/10/22 | 86 | 80 - 120 | 97 | 80 - 120 | <0.0002 | mg/L | NC | 20 |
| 4348791 | Dissolved Lithium (Li) | 2010/10/22 | NC | 80 - 120 | 89 | 80 - 120 | <0.005 | mg/L | NC | 20 |
| 4348791 | Dissolved Nickel (Ni) | 2010/10/22 | 95 | 80 - 120 | 96 | 80 - 120 | <0.001 | mg/L | NC | 20 |
| 4348791 | Dissolved Selenium (Se) | 2010/10/22 | 93 | 80 - 120 | 99 | 80 - 120 | <0.0001 | mg/L | 10.4 | 20 |
| 4348791 | Dissolved Uranium (U) | 2010/10/22 | 85 | 80 - 120 | 94 | 80 - 120 | <0.0001 | mg/L | 3.6 | 20 |
| 4348791 | Dissolved Vanadium (V) | 2010/10/22 | 97 | 80 - 120 | 99 | 80 - 120 | <0.005 | mg/L | NC | 20 |
| 4348791 | Dissolved Zinc (Zn) | 2010/10/22 | 95 | 80 - 120 | 95 | 80 - 120 | <0.005 | mg/L | NC | 20 |
| 4348791 | Dissolved Aluminum (Al) | 2010/10/22 | | | | | <0.003 | mg/L | 5.9 | 20 |
| 4348791 | Dissolved Antimony (Sb) | 2010/10/22 | | | | | <0.0005 | mg/L | NC | 20 |
| 4348791 | Dissolved Barium (Ba) | 2010/10/22 | | | | | <0.001 | mg/L | 1.9 | 20 |
| 4348791 | Dissolved Bismuth (Bi) | 2010/10/22 | | | | | <0.001 | mg/L | NC | 20 |
| 4348791 | Dissolved Boron (B) | 2010/10/22 | | | | | <0.05 | mg/L | NC | 20 |
| 4348791 | Dissolved Iron (Fe) | 2010/10/22 | | | | | <0.005 | mg/L | 14.4 | 20 |
| 4348791 | Dissolved Manganese (Mn) | 2010/10/22 | | | | | <0.001 | mg/L | 2.0 | 20 |
| 4348791 | Dissolved Mercury (Hg) | 2010/10/22 | | | | | <0.00002 | mg/L | NC | 20 |
| 4348791 | Dissolved Molybdenum (Mo) | 2010/10/22 | | | | | <0.001 | mg/L | 1.9 | 20 |
| 4348791 | Dissolved Silicon (Si) | 2010/10/22 | | | | | <0.1 | mg/L | 14.3 | 20 |
| 4348791 | Dissolved Silver (Ag) | 2010/10/22 | | | | | <0.00002 | mg/L | NC | 20 |
| 4348791 | Dissolved Strontium (Sr) | 2010/10/22 | | | | | <0.001 | mg/L | 0.9 | 20 |
| 4348791 | Dissolved Thallium (Tl) | 2010/10/22 | | | | | <0.00005 | mg/L | NC | 20 |
| 4348791 | Dissolved Tin (Sn) | 2010/10/22 | | | | | <0.005 | mg/L | NC | 20 |
| 4348791 | Dissolved Titanium (Ti) | 2010/10/22 | | | | | <0.005 | mg/L | NC | 20 |
| 4348791 | Dissolved Zirconium (Zr) | 2010/10/22 | | | | | <0.0005 | mg/L | NC | 20 |
| 4348796 | Dissolved Arsenic (As) | 2010/10/21 | NC | 80 - 120 | 100 | 80 - 120 | <0.0001 | mg/L | 0.8 | 20 |
| 4348796 | Dissolved Beryllium (Be) | 2010/10/21 | 87 | 80 - 120 | 88 | 80 - 120 | <0.0001 | mg/L | NC | 20 |
| 4348796 | Dissolved Cadmium (Cd) | 2010/10/21 | 91 | 80 - 120 | 100 | 80 - 120 | <0.00001 | mg/L | NC | 20 |
| 4348796 | Dissolved Chromium (Cr) | 2010/10/21 | 95 | 80 - 120 | 100 | 80 - 120 | <0.001 | mg/L | NC | 20 |
| 4348796 | Dissolved Cobalt (Co) | 2010/10/21 | 94 | 80 - 120 | 103 | 80 - 120 | <0.0005 | mg/L | NC | 20 |
| 4348796 | Dissolved Copper (Cu) | 2010/10/21 | 92 | 80 - 120 | 102 | 80 - 120 | <0.0002 | mg/L | 0.6 | 20 |
| 4348796 | Dissolved Lead (Pb) | 2010/10/21 | 88 | 80 - 120 | 98 | 80 - 120 | <0.0002 | mg/L | 1.3 | 20 |
| 4348796 | Dissolved Lithium (Li) | 2010/10/21 | NC | 80 - 120 | 85 | 80 - 120 | <0.005 | mg/L | NC | 20 |
| 4348796 | Dissolved Nickel (Ni) | 2010/10/21 | NC | 80 - 120 | 100 | 80 - 120 | <0.001 | mg/L | 3.4 | 20 |
| 4348796 | Dissolved Selenium (Se) | 2010/10/21 | 96 | 80 - 120 | 100 | 80 - 120 | <0.0001 | mg/L | NC | 20 |
| 4348796 | Dissolved Uranium (U) | 2010/10/21 | NC | 80 - 120 | 95 | 80 - 120 | <0.0001 | mg/L | 0.9 | 20 |

## QUALITY ASSURANCE REPORT

| | | | Matrix Spike | | Spiked Blank | | Method Blank | | RPD | |
|---|---|---|---|---|---|---|---|---|---|---|
| **QC Batch** | **Parameter** | **Date** | **% Recovery** | **QC Limits** | **% Recovery** | **QC Limits** | **Value** | **Units** | **Value (%)** | **QC Limits** |
| 4348796 | Dissolved Vanadium (V) | 2010/10/21 | 99 | 80 - 120 | 100 | 80 - 120 | <0.005 | mg/L | NC | 20 |
| 4348796 | Dissolved Zinc (Zn) | 2010/10/21 | 104 | 80 - 120 | 98 | 80 - 120 | <0.005 | mg/L | NC | 20 |
| 4348796 | Dissolved Aluminum (Al) | 2010/10/21 | | | | | <0.003 | mg/L | 1.3 | 20 |
| 4348796 | Dissolved Antimony (Sb) | 2010/10/21 | | | | | <0.0005 | mg/L | NC | 20 |
| 4348796 | Dissolved Barium (Ba) | 2010/10/21 | | | | | <0.001 | mg/L | 0.2 | 20 |
| 4348796 | Dissolved Bismuth (Bi) | 2010/10/21 | | | | | <0.001 | mg/L | NC | 20 |
| 4348796 | Dissolved Boron (B) | 2010/10/21 | | | | | <0.05 | mg/L | NC | 20 |
| 4348796 | Dissolved Iron (Fe) | 2010/10/21 | | | | | <0.005 | mg/L | 1.4 | 20 |
| 4348796 | Dissolved Manganese (Mn) | 2010/10/21 | | | | | <0.001 | mg/L | 3.2 | 20 |
| 4348796 | Dissolved Mercury (Hg) | 2010/10/21 | | | | | <0.00002 | mg/L | NC | 20 |
| 4348796 | Dissolved Molybdenum (Mo) | 2010/10/21 | | | | | <0.001 | mg/L | 0.2 | 20 |
| 4348796 | Dissolved Silicon (Si) | 2010/10/21 | | | | | <0.1 | mg/L | 0.5 | 20 |
| 4348796 | Dissolved Silver (Ag) | 2010/10/21 | | | | | <0.00002 | mg/L | NC | 20 |
| 4348796 | Dissolved Strontium (Sr) | 2010/10/21 | | | | | <0.001 | mg/L | 0.9 | 20 |
| 4348796 | Dissolved Thallium (Tl) | 2010/10/21 | | | | | <0.00005 | mg/L | NC | 20 |
| 4348796 | Dissolved Tin (Sn) | 2010/10/21 | | | | | <0.005 | mg/L | NC | 20 |
| 4348796 | Dissolved Titanium (Ti) | 2010/10/21 | | | | | <0.005 | mg/L | NC | 20 |
| 4348796 | Dissolved Zirconium (Zr) | 2010/10/21 | | | | | <0.0005 | mg/L | NC | 20 |
| 4356678 | Total Arsenic (As) | 2010/10/26 | 108 | 80 - 120 | 104 | 80 - 120 | <0.0001 | mg/L | NC | 20 |
| 4356678 | Total Beryllium (Be) | 2010/10/26 | 115 | 80 - 120 | 114 | 80 - 120 | <0.0001 | mg/L | NC | 20 |
| 4356678 | Total Cadmium (Cd) | 2010/10/26 | 110 | 80 - 120 | 94 | 80 - 120 | <0.00001 | mg/L | NC | 20 |
| 4356678 | Total Chromium (Cr) | 2010/10/26 | 112 | 80 - 120 | 109 | 80 - 120 | <0.001 | mg/L | NC | 20 |
| 4356678 | Total Cobalt (Co) | 2010/10/26 | 109 | 80 - 120 | 105 | 80 - 120 | <0.0005 | mg/L | NC | 20 |
| 4356678 | Total Copper (Cu) | 2010/10/26 | 98 | 80 - 120 | 104 | 80 - 120 | 0.0004, RDL=0.0002 | mg/L | 11.8 | 20 |
| 4356678 | Total Lead (Pb) | 2010/10/26 | 111 | 80 - 120 | 111 | 80 - 120 | <0.0002 | mg/L | NC | 20 |
| 4356678 | Total Lithium (Li) | 2010/10/26 | 114 | 80 - 120 | 122(1, 2) | 80 - 120 | <0.005 | mg/L | | |
| 4356678 | Total Nickel (Ni) | 2010/10/26 | 100 | 80 - 120 | 111 | 80 - 120 | <0.001 | mg/L | NC | 20 |
| 4356678 | Total Selenium (Se) | 2010/10/26 | 104 | 80 - 120 | 103 | 80 - 120 | <0.0001 | mg/L | NC | 20 |
| 4356678 | Total Uranium (U) | 2010/10/26 | 110 | 80 - 120 | 105 | 80 - 120 | <0.0001 | mg/L | NC | 20 |
| 4356678 | Total Vanadium (V) | 2010/10/26 | 111 | 80 - 120 | 101 | 80 - 120 | <0.005 | mg/L | NC | 20 |
| 4356678 | Total Zinc (Zn) | 2010/10/26 | NC | 80 - 120 | 115 | 80 - 120 | <0.005 | mg/L | NC | 20 |
| 4356678 | Total Aluminum (Al) | 2010/10/26 | | | | | 0.004, RDL=0.003 | mg/L | 16.4 | 20 |
| 4356678 | Total Antimony (Sb) | 2010/10/26 | | | | | <0.0005 | mg/L | NC | 20 |
| 4356678 | Total Barium (Ba) | 2010/10/26 | | | | | <0.001 | mg/L | 7.7 | 20 |
| 4356678 | Total Bismuth (Bi) | 2010/10/26 | | | | | <0.001 | mg/L | NC | 20 |
| 4356678 | Total Boron (B) | 2010/10/26 | | | | | <0.05 | mg/L | NC | 20 |
| 4356678 | Total Iron (Fe) | 2010/10/26 | | | | | 0.008, RDL=0.005 | mg/L | 4.9 | 20 |
| 4356678 | Total Manganese (Mn) | 2010/10/26 | | | | | <0.001 | mg/L | 7.5 | 20 |
| 4356678 | Total Mercury (Hg) | 2010/10/26 | | | | | <0.00002 | mg/L | | |
| 4356678 | Total Molybdenum (Mo) | 2010/10/26 | | | | | <0.001 | mg/L | 0.7 | 20 |

## QUALITY ASSURANCE REPORT

| | | | Matrix Spike | | Spiked Blank | | Method Blank | | RPD | |
|---|---|---|---|---|---|---|---|---|---|---|
| QC Batch | Parameter | Date | % Recovery | QC Limits | % Recovery | QC Limits | Value | Units | Value (%) | QC Limits |
| 4356678 | Total Silicon (Si) | 2010/10/26 | | | | | <0.1 | mg/L | 0.9 | 20 |
| 4356678 | Total Silver (Ag) | 2010/10/26 | | | | | <0.00002 | mg/L | NC | 20 |
| 4356678 | Total Strontium (Sr) | 2010/10/26 | | | | | <0.001 | mg/L | 5.3 | 20 |
| 4356678 | Total Thallium (Tl) | 2010/10/26 | | | | | <0.00005 | mg/L | NC | 20 |
| 4356678 | Total Tin (Sn) | 2010/10/26 | | | | | <0.005 | mg/L | NC | 20 |
| 4356678 | Total Titanium (Ti) | 2010/10/26 | | | | | <0.005 | mg/L | NC | 20 |
| 4356678 | Total Zirconium (Zr) | 2010/10/26 | | | | | <0.0005 | mg/L | NC | 20 |

---

N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.
(2) - Blank Spike outside acceptance criteria (10% of analytes failure allowed)

Maxxam

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**Chain of Custody** A017489

B099438

Page: 1 of 4

**Company:** **Invoice To:** Golder Associates Ltd.
**C/O Report Address** ☐
**Contact:** Cathy McPherson
**Address:** 500-4260 Still Creek Drive
Prov: Burnaby, BC PC: V5C 6C6
**Contact #s:** Ph: 1-604-297-2007 Cell:

**Report To:** **Same as Invoice** ☑
Prov: PC:
Ph: Cell:

**Report Distribution (E-Mail):**
cmcpherson@golder.com

**REGULATORY GUIDELINES:**
☐ AT1
☐ CCME
☐ Regulated Drinking Water
☐ Other:

All samples are held for 60 calendar days after sample receipt, unless specified otherwise.

**PO #:** contact Cathy.
**Project # / Name:** Diavik North Inlet.
**Site Location:** DNI
**Quote #:** B10-145-KP
**Sampled By:**

**SERVICE REQUESTED:**
☐ **RUSH** (Contact lab to reserve)
**Date Required:**
☐ REGULAR (5 to 7 Days)

*See reverse for package specifics*

| | Sample ID | Depth (unit) | Matrix GW / SW Soil | Date/Time Sampled YY/MM/DD 24:00 | SOIL | | | | | | | | | WATER | | | | | | | Other Analysis | | | | | | | | | | | HOLD - Do not Analyze | # of Containers Submitted |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | BTEX F1-F4 | Sieve (75 micron) | Regulated Metals (CCME / AT1) | Salinity 4 | Assessment ICP Metals | Basic Class II Landfill | | | | ☐ BTEX F1 ☐ VOCs | ☐ BTEX F1-F2 ☐ BTEX F1-F4 | ☐ Routine Water ☐ Turb ☐ F | ☐ TOC ☐ DOC | Regulated Metals (CCME/AT1) | | Mercury ☐ Total ☐ Dissolved | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | Total | Dissolved | | | | | | | | | | | | | | |
| 1 | 10-1356 CTL CT initial | | sedmt | | | | | | | | | | | | | | | | ✓ | | | | | | | | | | | | | | |
| 2 | 10-1356 CTL CT final | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | | | | | | | |
| 3 | 10-1356 CTL HA initial | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | | | | | | | |
| 4 | 10-1356 CTL HA final | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | | | | | | | |
| 5 | 10-1356-1 CT initial | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | | | | | | | |
| 6 | 10-1356-1 CT final | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | | | | | | | |
| 7 | 10-1356-1 HA initial | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | | | | | | | |
| 8 | 10-1356-1 HA final | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | | | | | | | |
| 9 | 10-1356-2 CT initial | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | | | | | | | |
| 10 | 10-1356-2 CT final | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | | | | | | | |
| 11 | 10-1356-2 HA initial | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | | | | | | | |
| 12 | 10-1356-2 HA final | | ↓ | | | | | | | | | | | | | | | | ✓ | | | | | | | | | | | | | | |
| | *Please indicate Filtered, Preserved or Both (F, P, F/P)* → | | | | | | | | | | | | | | | | | | P | | | | | | | | | | | | | | F/P |

Relinquished By (Signature/Print): Date (YY/MM/DD): Time (24:00):
Relinquished By (Signature/Print): Date (YY/MM/DD): Time (24:00):

**Special Instructions:**

**# of Jars Used & Not Submitted**

**LAB USE ONLY**
**Received By:** **Date:** **Time:** 0855
**Maxxam Job #:**
Custody Seal
Temperature 14 13 14
Ice
Lab Comments:
C Rosen 10 10 15

**Maxxam**

Calgary: 4000 19st St. NE, T2E 6P8. Ph: (403) 291-3077, Fax: (403) 735-2240, Toll free: (800) 386-7247
Edmonton: 9331 - 48 Street, T6B 2R4. Ph: (780) 577-7100, Fax: (780) 450-4187, Toll free: (877) 465-8889
www.maxxamanalytics.com

**Chain of Custody** A017490

Page: 2 of 4

**Company:** **Invoice To:** Golder Associates Ltd. **C/O Report Address** ☐
**Contact:** Cathy McPherson
**Address:** 500-4260 Still Creek Drive
Prov: Burnaby, BC PC: V5C 6C6
**Contact #s:** Ph: 1-604-297-2007 Cell:

**Report To:** **Same as Invoice** ☑
Prov:
PC:
Ph:
Cell:

**Report Distribution (E-Mail):** cmcpherson@golder.com

**REGULATORY GUIDELINES:**
☐ AT1
☐ CCME
☐ Regulated Drinking Water
☐ Other:

All samples are held for 60 calendar days after sample receipt, unless specified otherwise.

**PO #:** Contact Cathy
**Project # / Name:** Diavik North Inlet
**Site Location:** DNI
**Quote #:** B10-145-KP
**Sampled By:**

**SERVICE REQUESTED:**
☐ **RUSH** (Contact lab to reserve)
**Date Required:**
☐ REGULAR (5 to 7 Days)

See reverse for package specifics

| | Sample ID | Depth (unit) | Matrix GW / SW Soil | Date/Time Sampled YY/MM/DD 24:00 | SOIL: BTEX F1-F4 | SOIL: Sieve (75 micron) | SOIL: Regulated Metals (CCME / AT1) | SOIL: Salinity 4 | SOIL: Assessment ICP Metals | SOIL: Basic Class II Landfill | WATER: ☐ BTEX F1 | WATER: ☐ BTEX F1-F2 | WATER: ☐ Routine Water ☐ Turb ☐ F | WATER: ☐ TOC ☐ DOC | WATER: Regulated Metals (CCME / AT1) Total | WATER: Regulated Metals (CCME / AT1) Dissolved | WATER: Mercury ☐ Total ☐ Dissolved | Other Analysis | HOLD - Do not Analyze | # of Containers Submitted |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10-1356-3 CT initial | | Sedmt | | | | | | | | | | | | | ✓ | | | | |
| 2 | 10-1356-3 CT final | | | | | | | | | | | | | | | ✓ | | | | |
| 3 | 10-1356-3 HA initial | | | | | | | | | | | | | | | ✓ | | | | |
| 4 | 10-1356-3 HA final | | | | | | | | | | | | | | | ✓ | | | | |
| 5 | 10-1356-4 CT initial | | | | | | | | | | | | | | | ✓ | | | | |
| 6 | 10-1356-4 CT final | | | | | | | | | | | | | | | ✓ | | | | |
| 7 | 10-1356-4 HA initial | | | | | | | | | | | | | | | ✓ | | | | |
| 8 | 10-1356-4 HA final | | | | | | | | | | | | | | | ✓ | | | | |
| 9 | 10-1356-5 CT initial | | | | | | | | | | | | | | | ✓ | | | | |
| 10 | 10-1356-5 HA initial | | | | | | | | | | | | | | | ✓ | | | | |
| 11 | 10-1356-5 CT final | | | | | | | | | | | | | | | ✓ | | | | |
| 12 | 10-1356-5 HA final | | | | | | | | | | | | | | | ✓ | | | | |
| | *Please indicate Filtered, Preserved or Both (F, P, F/P)* → | | | | | | | | | | | | | | P | | | | F/P | |

Relinquished By (Signature/Print): Date (YY/MM/DD): Time (24:00):

Relinquished By (Signature/Print): Date (YY/MM/DD): Time (24:00):

**Special Instructions:**

**# of Jars Used & Not Submitted**

**LAB USE ONLY**

**Received By:** **Date:** **Time:** 0855

Maxxam Job #:

**Lab Comments:** C Rosen 10/10/15

| Custody Seal | Temperature | Ice |
|---|---|---|
| | 14 13 14 | |

Maxxam

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**Chain of Custody** A017491

Page: 3 of 4

| | | |
|---|---|---|
| **Company:** | **Invoice To:** **C/O Report Address** ☐ <br> Golder Associates Ltd. | **Report To:** **Same as Invoice** ☒ |
| **Contact:** | Cathy McPherson | |
| **Address:** | 500-4260 Still Creek Dr. <br> Prov: Burnaby, BC PC: V5C 6C6 | Prov: PC: |
| **Contact #s:** | Ph: 604-297-2007 Cell: | Ph: Cell: |

**Report Distribution (E-Mail):** cmcpherson@golder.com

**REGULATORY GUIDELINES:**
- ☐ AT1
- ☐ CCME
- ☐ Regulated Drinking Water
- ☐ Other:

All samples are held for 60 calendar days after sample receipt, unless specified otherwise.

**PO #:** contact Cathy
**Project # / Name:** Diavik North Inlet
**Site Location:** DN1
**Quote #:** B10-145-KP.
**Sampled By:**

**SERVICE REQUESTED:** ☐ **RUSH** (Contact lab to reserve) **Date Required:** ☐ REGULAR (5 to 7 Days)

*See reverse for package specifics*

| | Sample ID | Depth (unit) | Matrix GW / SW Soil | Date/Time Sampled YY/MM/DD 24:00 | SOIL: BTEX F1-F4 | Sieve (75 micron) | Regulated Metals (CCME / AT1) | Salinity 4 | Assessment ICP Metals | Basic Class II Landfill | | | | WATER: ☐ BTEX F1 ☐ VOCs | ☐ BTEX F1-F2 ☐ BTEX F1-F4 | ☐ Routine Water ☐ Turb ☐ F | ☐ TOC ☐ DOC | Regulated Metals (CCME / AT1) Total | Dissolved | Mercury ☐ Total ☐ Dissolved | Other Analysis | HOLD - Do not Analyze | # of Containers Submitted |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10-1356-6 CT initial | | sediment | | | | | | | | | | | | | | | | ✓ | | | | |
| 2 | 10-1356-6 CT final | | | | | | | | | | | | | | | | | | ✓ | | | | |
| 3 | 10-1356-6 HA initial | | | | | | | | | | | | | | | | | | ✓ | | | | |
| 4 | 10-1356-6 HA final | | | | | | | | | | | | | | | | | | ✓ | | | | |
| 5 | 10-1356-7 CT initial | | | | | | | | | | | | | | | | | | ✓ | | | | |
| 6 | 10-1356-7 CT final | | | | | | | | | | | | | | | | | | ✓ | | | | |
| 7 | 10-1356-7 HA initial | | | | | | | | | | | | | | | | | | ✓ | | | | |
| 8 | 10-1356-7 HA final | | | | | | | | | | | | | | | | | | ✓ | | | | |
| 9 | 10-1356-8 CT initial | | | | | | | | | | | | | | | | | | ✓ | | | | |
| 10 | 10-1356-8 CT final | | | | | | | | | | | | | | | | | | ✓ | | | | |
| 11 | 10-1356-8 HA initial | | ✓ | | | | | | | | | | | | | | | | ✓ | | | | |
| 12 | 10-1356-8 HA final | | | | | | | | | | | | | | | | | | ✓ | | | | |
| | ***Please indicate Filtered, Preserved or Both (F, P, F/P)*** → | | | | | | | | | | | | | | | | | | P | | | | F/P |

| | | |
|---|---|---|
| Relinquished By (Signature/Print): | Date (YY/MM/DD): | Time (24:00): |
| Relinquished By (Signature/Print): | Date (YY/MM/DD): | Time (24:00): |

**Special Instructions:**

**# of Jars Used & Not Submitted**

**LAB USE ONLY**

| **Received By:** | **Date:** | **Time:** | Maxxam Job #: | | |
|---|---|---|---|---|---|
| | | 0855 | Custody Seal | Temperature | Ice |
| Lab Comments: C.ROSEN 10615 | | | | 14 13 14 | |

Calgary: 4000 19st St. NE, T2E 6P8. Ph: (403) 291-3077, Fax: (403) 735-2240, Toll free: (800) 386-7247
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**Chain of Custody** A017492

Page: 4 of 4

**Company:** Invoice To: Golder Associates Ltd. C/O Report Address ☐
**Contact:**
**Address:**
Prov: PC:
**Contact #s:** Ph: Cell:

**Report To:** Same as Invoice ☐
Prov: PC:
Ph: Cell:

**Report Distribution (E-Mail):**

**REGULATORY GUIDELINES:**
- ☐ AT1
- ☐ CCME
- ☐ Regulated Drinking Water
- ☐ Other:

All samples are held for 60 calendar days after sample receipt, unless specified otherwise.

**PO #:**
**Project # / Name:**
**Site Location:**
**Quote #:**
**Sampled By:**

**SERVICE REQUESTED:** ☐ **RUSH** (Contact lab to reserve)
**Date Required:**
☐ REGULAR (5 to 7 Days)

See reverse for package specifics

| # | Sample ID | Depth (unit) | Matrix GW / SW Soil | Date/Time Sampled YY/MM/DD 24:00 | SOIL: BTEX F1-F4 | Sieve (75 micron) | Regulated Metals (CCME / AT1) | Salinity 4 | Assessment ICP Metals | Basic Class II Landfill | WATER: ☐ BTEX F1 [illegible] | ☐ BTEX F1-F2 [illegible] | ☐ Routine Water ☐ Tier 1 | ☐ TOC ☐ DOC | Regulated Metals (CCME / AT1): Total | Regulated Metals (CCME / AT1): Dissolved | Mercury ☐ Total ☐ Dissolved | HOLD - Do not Analyze | # of Containers Submitted |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10-1392 CT initial | | | | | | | | | | | | | | | ✓ | | | |
| 2 | 10-1392 CT final | | | | | | | | | | | | | | | ✓ | | | |
| 3 | 10-1392 HA initial | | | | | | | | | | | | | | | ✓ | | | |
| 4 | 10-1392 HA final | | | | | | | | | | | | | | | ✓ | | | |
| 5 | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | |
| | ***Please indicate Filtered, Preserved or Both (F, P, F/P)*** | | | | | | | | | | | | | | P | | | F/P | |

Relinquished By (Signature/Print): Date (YY/MM/DD): Time (24:00):
Relinquished By (Signature/Print): Date (YY/MM/DD): Time (24:00):
**Special Instructions:**
**# of Jars Used & Not Submitted**

**LAB USE ONLY**
**Received By:** **Date:** **Time:** C855
Maxxam Job #:
Lab Comments: C Rosen 101015

| Custody Seal | Temperature | Ice |
|---|---|---|
| | 14 \| 13 \| 14 | |

AB FCD-00331 Rev3 2010/05

Maxxam Analytics International Corporation o/a Maxxam Analytics

Your Project #: DIAVIK NORTH INLET
Site: DN1
Your C.O.C. #: A017493, 71368, 71367, A017494

**Attention: Cathy McPherson**
GOLDER ASSOCIATES LTD
4260 STILL CREEK DRIVE
Suite 500
BURNABY, BC
Canada V5C 6C6

**Report Date: 2010/10/21**

# CERTIFICATE OF ANALYSIS

**MAXXAM JOB #: B099496**
**Received: 2010/10/15, 08:55**

Sample Matrix: Water
# Samples Received: 40

| Analyses | Quantity | Date Extracted | Date Analyzed | Laboratory Method | Analytical Method |
|---|---|---|---|---|---|
| Phosphorus-P (Total, dissolved) | 40 | 2010/10/18 | 2010/10/19 | BRN SOP-00236 R6.0 | SM-4500PF |

* Results relate only to the items tested.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

VJ OCO, Burnaby Customer Service
Email: VJ.Oco@MaxxamAnalytics.com
Phone# (604) 639-8422

==================================================================

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

Maxxam Job #: B099496
Report Date: 2010/10/21

GOLDER ASSOCIATES LTD
Client Project #: DIAVIK NORTH INLET
Site Reference: DN1

# RESULTS OF CHEMICAL ANALYSES OF WATER

| Maxxam ID | | X69965 | X69966 | | X69967 | | X69968 | X69969 | X69970 | X69971 | X69972 | X69973 | X69974 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356 CTL CT INITIAL** | **10-1356 CTL CT FINAL** | **RDL** | **10-1356 CTL HA INITIAL** | **RDL** | **10-1356 CTL HA FINAL** | **10-1356-1 CT INITIAL** | **10-1356-1 CT FINAL** | **10-1356-1 HA INITIAL** | **10-1356-1 HA FINAL** | **10-1356-2 CT INITIAL** | **10-1356-2 CT FINAL** | **RDL** | **QC Batch** |
| **Nutrients** | | | | | | | | | | | | | | | |
| Dissolved Phosphorus (P) | mg/L | 0.034 | 0.104 | 0.005 | 0.82 | 0.05 | 0.189 | 0.241 | 0.255 | 0.381 | 0.098 | 0.182 | 0.255 | 0.005 | 4348150 |

| Maxxam ID | | X69975 | X69976 | X69977 | X69978 | X69979 | X69980 | X69981 | X69982 | X69983 | X69984 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356-2 HA INITIAL** | **10-1356-2 HA FINAL** | **10-1356-3 CT INITIAL** | **10-1356-3 CT FINAL** | **10-1356-3 HA INITIAL** | **10-1356-3 HA FINAL** | **10-1356-4 CT INITIAL** | **10-1356-4 CT FINAL** | **10-1356-4 HA INITIAL** | **10-1356-4 HA FINAL** | **RDL** | **QC Batch** |
| **Nutrients** | | | | | | | | | | | | | |
| Dissolved Phosphorus (P) | mg/L | 0.231 | 0.101 | 0.370 | 0.372 | 0.386 | 0.128 | 0.184 | 0.137 | 0.409 | 0.095 | 0.005 | 4348150 |

| Maxxam ID | | X69985 | X69986 | X69987 | X69988 | X69999 | X70000 | X70001 | X70002 | X70003 | X70004 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356-5 CT INITIAL** | **10-1356-5 CT FINAL** | **10-1356-5 HA INITIAL** | **10-1356-5 HA FINAL** | **10-1356-6 CT INITIAL** | **10-1356-6 CT FINAL** | **10-1356-6 HA INITIAL** | **10-1356-6 HA FINAL** | **10-1356-7 CT INITIAL** | **10-1356-7 CT FINAL** | **RDL** | **QC Batch** |
| **Nutrients** | | | | | | | | | | | | | |
| Dissolved Phosphorus (P) | mg/L | 0.192 | 0.325 | 0.148 | 0.207 | 0.064 | 0.115 | 0.041 | 0.093 | 0.039 | 0.138 | 0.005 | 4348150 |

| Maxxam ID | | X70005 | X70006 | X70007 | X70008 | X70009 | X70010 | | X70013 | | X70014 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Units** | **10-1356-7 HA INITIAL** | **10-1356-7 HA FINAL** | **10-1356-8 CT INITIAL** | **10-1356-8 CT FINAL** | **10-1356-8 HA INITIAL** | **10-1356-8 HA FINAL** | **RDL** | **10-1392 CT INITIAL** | **RDL** | **10-1392 CT FINAL** | **RDL** | **QC Batch** |
| **Nutrients** | | | | | | | | | | | | | |
| Dissolved Phosphorus (P) | mg/L | 0.017 | 0.174 | 0.035 | 0.160 | 0.010 | 0.158 | 0.005 | 0.96 | 0.05 | 0.430 | 0.005 | 4348150 |

| Maxxam ID | | X70015 | | X70016 | | |
|---|---|---|---|---|---|---|
| | **Units** | **10-1392 HA INITIAL** | **RDL** | **10-1392 HA FINAL** | **RDL** | **QC Batch** |
| **Nutrients** | | | | | | |
| Dissolved Phosphorus (P) | mg/L | 0.51 | 0.05 | 0.053 | 0.005 | 4348150 |

---

RDL = Reportable Detection Limit

## QUALITY ASSURANCE REPORT

| | | | Matrix Spike | | Spiked Blank | | Method Blank | | RPD | |
|---|---|---|---|---|---|---|---|---|---|---|
| **QC Batch** | **Parameter** | **Date** | **% Recovery** | **QC Limits** | **% Recovery** | **QC Limits** | **Value** | **Units** | **Value (%)** | **QC Limits** |
| 4348150 | Dissolved Phosphorus (P) | 2010/10/19 | 99 | 80 - 120 | 90 | 80 - 120 | <0.005 | mg/L | 2.9 | 20 |

---

N/A = Not Applicable

RPD = Relative Percent Difference

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Maxxam

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**Chain of Custody** A017493

Page: 1 of 4

**Company:** **Invoice To:** Golder Associates Ltd **C/O Report Address** ☐
**Contact:** Cathy McPherson
**Address:** 500-4260 Still creek Dr.
Prov: Burnaby, BC PC: V5C 6C6
**Contact #s:** Ph: 1-604-297-2007 Cell:

**Report To:** **Same as Invoice** ☑
Prov: PC:
Ph: Cell:

**Report Distribution (E-Mail):** cmcpherson@golder.com

**REGULATORY GUIDELINES:**
☐ AT1
☐ CCME
☐ Regulated Drinking Water
☐ Other:

All samples are held for 60 calendar days after sample receipt, unless specified otherwise.

**PO #:**
**Project # / Name:** Diavik North Inlet
**Site Location:** DNI
**Quote #:** B10-145-FP
**Sampled By:**

**SERVICE REQUESTED:** ☐ **RUSH** (Contact lab to reserve) **Date Required:**
☐ REGULAR (5 to 7 Days)

*See reverse for package specifics*

| | Sample ID | Depth (unit) | Matrix GW / SW Soil | Date/Time Sampled YY/MM/DD 24:00 | SOIL: BTEX F1-F4 | SOIL: Sieve (75 micron) | SOIL: Regulated Metals (CCME / AT1) | SOIL: Salinity 4 | SOIL: Assessment ICP Metals | SOIL: Basic Class II Landfill | WATER: [illegible] | Other Analysis: Dissolved Phosphorus | HOLD - Do not Analyze | # of Containers Submitted |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10-1356 CTL CT initial | | | | | | | | | | | ✓ | | |
| 2 | 10-1356 CTL CT final | | | | | | | | | | | ✓ | | |
| 3 | 10-1356 CTL HA initial | | | | | | | | | | | ✓ | | |
| 4 | 10-1356 CTL HA final | | | | | | | | | | | ✓ | | |
| 5 | 10-1356-1 CT initial | | | | | | | | | | | ✓ | | |
| 6 | 10-1356-1 CT final | | | | | | | | | | | ✓ | | |
| 7 | 10-1356-1 HA initial | | | | | | | | | | | ✓ | | |
| 8 | 10-1356-1 HA final | | | | | | | | | | | ✓ | | |
| 9 | 10-1356-2 CT initial | | | | | | | | | | | ✓ | | |
| 10 | 10-1356-2 CT final | | | | | | | | | | | ✓ | | |
| 11 | 10-1356-2 HA initial | | | | | | | | | | | ✓ | | |
| 12 | 10-1356-2 HA final | | | | | | | | | | | ✓ | | |
| | ***Please indicate Filtered, Preserved or Both (F, P, F/P)*** → | | | | | | | | | | | P | | F/P |

Relinquished By (Signature/Print): Date (YY/MM/DD): Time (24:00):
Relinquished By (Signature/Print): Date (YY/MM/DD): Time (24:00):

**Special Instructions:**
**# of Jars Used & Not Submitted**

**LAB USE ONLY**
**Received By:** **Date:** **Time:**
Maxxam Job #: B099446
Custody Seal | Temperature | Ice
Lab Comments: C. Rosen 101015 0855

14 11/15

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71368 **CHAIN OF CUSTODY**
Page: 2 of 4

**Invoice To:** Require Report? Yes ☐ No ☐
**Company Name:**
**Contact Name:**
**Address:**
**Prov:** **PC:**
**Contact #s:** **Ph:** **Fax:**

**Report To:**
**Prov:** **PC:**
**Ph:** **Fax:**

PO # / AFE #:
Quotation #:
Project #:
Project Name:
Location:
Sampler's Initials:

**DETECTION LIMIT REQUIREMENTS:**
Check the applicable criterion and indicate land use
☐ AT1
☐ CCME
☐ OTHER

**REPORT DISTRIBUTION:**
**EMAIL ADDRESS(S):**

**SERVICE REQUESTED:**
☐ **RUSH** (Please ensure you contact the lab to reserve)
**Date Required:**
☐ REGULAR Turnaround (5 to 7 Days)

|  | Sample Identification | Matrix S/W | Date & Time Sampled Year/Month/Day | SOILS (footnotes defined on back) |  |  |  |  |  |  |  |  |  | WATERS (footnotes defined on back) |  |  |  |  |  |  |  | OTHER TEST(S) |  |  |  |  |  |  | *HOLD for 60 Days | # of Containers Submitted |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  | BTEX F1-F4 | Sieve (75 micron) | Salinity 4 | Regulated Metals (CCME / AT1)[1] | Assessment ICP Metals[2] | ☐ Paint Filter ☐ Flashpoint ☐ pH (1:1) | TCLP ☐ BTEX ☐ Metals |  |  |  | ☐ BTEX F1 ☐ VOCs | ☐ BTEX F1-F2 ☐ BTEX F1-F4 | Routine Water Package ☐ Turb ☐ F | REGULATED METALS (CCME / AT1)[1] Total ☐ Preserved ☐ Not Preserved | Dissolved ☐ Preserved ☐ Not Preserved ☐ Filtered ☐ Not Filtered | Mercury ☐ Total ☐ Dissolved | ☐ Ammonia ☐ TKN ☐ COD | ☐ TOC ☐ DOC | Dissolved Phosphorus |  |  |  |  |  |  |  |  |
| 1 | 10-1356-3 CT initial |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |
| 2 | 10-1356-3 CT final |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |
| 3 | 10-1356-3 HA initial |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |
| 4 | 10-1356-3 HA final |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |
| 5 | 10-1356-4 CT-initial |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |
| 6 | 10-1356-4 CT final |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |
| 7 | 10-1356-4 HA initial |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |
| 8 | 10-1356-4 HA final |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |
| 9 | 10-1356-5 CT initial |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |
| 10 | 10-1356-5 CT final |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |
| 11 | 10-1356-5 HA initial |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |
| 12 | 10-1356-5 HA final |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |

**All samples are held for 60 calendar days after sample receipt. For long term storage please contact your project manager.*

P **Maxxam Job #:** B0A4496

**Relinquished By:** **Date/Time:**
**Sign and Print:**
**COMMENTS/SPECIAL INSTRUCTIONS:**

| # JARS USED & NOT SUBMITTED | Received By | Temperature |  |  | Ice |
|---|---|---|---|---|---|
|  | 10 1015 0855<br>C.Rosen | 14 | 14 | 15 |  |
|  | CUSTODY SEAL YES / NO |  |  |  |  |

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**71367** **CHAIN OF CUSTODY**
Page: 3 of 4

**Invoice To:** Require Report? Yes ☐ No ☐
**Company Name:**
**Contact Name:**
**Address:**
**Prov:** **PC:**
**Contact #s:** **Ph:** **Fax:**

**Report To:**
**Prov:** **PC:**
**Ph:** **Fax:**

PO # / AFE #:
Quotation #:
Project #:
Project Name:
Location:
Sampler's Initials:

**DETECTION LIMIT REQUIREMENTS:**
Check the applicable criterion and indicate land use
☐ AT1
☐ CCME
☐ OTHER

**REPORT DISTRIBUTION:**
**EMAIL ADDRESS(S):**

**SERVICE REQUESTED:**
☐ **RUSH** (Please ensure you contact the lab to reserve)
**Date Required:**
☐ REGULAR Turnaround (5 to 7 Days)

| | | | | **SOILS** (footnotes defined on back) | | | | | | | | | | **WATERS** (footnotes defined on back) | | | | | | | | **OTHER TEST(S)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sample Identification | Matrix S/W | Date & Time Sampled Year/Month/Day | BTEX F1-F4 | Sieve (75 micron) | Salinity 4 | Regulated Metals (CCME / AT1)[1] | Assessment ICP Metals[2] | ☐ Paint Filter ☐ Flashpoint ☐ pH (1:1) | TCLP ☐ BTEX ☐ Metals | | | | ☐ BTEX F1 ☐ VOCs | ☐ BTEX F1-F2 ☐ BTEX F1-F4 | Routine Water Package ☐ Turb ☐ F | REGULATED METALS (CCME / AT1)[4]: Total ☐ Preserved ☐ Not Preserved | REGULATED METALS (CCME / AT1)[4]: Dissolved ☐ Preserved ☐ Not Preserved ☐ Filtered ☐ Not Filtered | Mercury ☐ Total ☐ Dissolved | ☐ Ammonia ☐ TKN ☐ COD | ☐ TOC ☐ DOC | DISSOLVED PHOSPHORUS | | | | | | | *HOLD for 60 Days | # of Containers Submitted |
| 1 | 10-1356-6 CT initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 2 | 10-1356-6 CT final | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 3 | 10-1356-6 HA initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 4 | 10-1356-6 CT initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 5 | 10-1356-7 CT initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 6 | 10-1356-7 CT final | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 7 | 10-1356-7 HA initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 8 | 10-1356-7 HA final | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 9 | 10-1356-8 CT initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 10 | 10-1356-8 CT final | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 11 | 10-1356-8 HA initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 12 | 10-1356-8 HA final | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |

*All samples are held for 60 calendar days after sample receipt. For long term storage please contact your project manager.*

**Maxxam Job #:** B099496

**Relinquished By:** **Date/Time:**

**Sign and Print:**

**COMMENTS/SPECIAL INSTRUCTIONS:**

| # JARS USED & NOT SUBMITTED | Received By | Temperature | | | Ice |
|---|---|---|---|---|---|
| | 10 10 15<br>C. Rosen 0855 | 14 | 14 | 15 | |
| | CUSTODY SEAL YES / NO | | | | |

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**Chain of Custody** A017494

Page: 4 of 4

| | Invoice To: C/O Report Address ☐ | Report To: Same as Invoice ☐ | Report Distribution (E-Mail): |
|---|---|---|---|
| Company: | | | |
| Contact: | | | |
| Address: | | | |
| | Prov: PC: | Prov: PC: | |
| Contact #s: | Ph: Cell: | Ph: Cell: | |

**REGULATORY GUIDELINES:**
- ☐ AT1
- ☐ CCME
- ☐ Regulated Drinking Water
- ☐ Other:

All samples are held for 60 calendar days after sample receipt, unless specified otherwise.

PO #:
Project # / Name:
Site Location:
Quote #:
Sampled By:

**SERVICE REQUESTED:**
☐ **RUSH** (Contact lab to reserve)
**Date Required:**
☐ REGULAR (5 to 7 Days)

*See reverse for package specifics*

| | | | | | SOIL | | | | | | WATER | Other Analysis | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sample ID | Depth (unit) | Matrix GW / SW Soil | Date/Time Sampled YY/MM/DD 24:00 | BTEX F1-F4 | Sieve (75 micron) | Regulated Metals (CCME / AT1) | Salinity 4 | Assessment ICP Metals | Basic Class II Landfill | [illegible] | DISSOLVED PHOSPHORUS | HOLD - Do not Analyze | # of Containers Submitted |
| 1 | 10-1392 CT initial | | | | | | | | | | | ✓ | | |
| 2 | 10-1392 CT final | | | | | | | | | | | ✓ | | |
| 3 | 10-1392 HA initial | | | | | | | | | | | ✓ | | |
| 4 | 10-1392 HA final | | | | | | | | | | | ✓ | | |
| 5 | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | |
| | ***Please indicate Filtered, Preserved or Both (F, P, F/P)*** → | | | | | | | | | | | P. | | F/P |

| Relinquished By (Signature/Print): | Date (YY/MM/DD): | Time (24:00): |
|---|---|---|
| Relinquished By (Signature/Print): | Date (YY/MM/DD): | Time (24:00): |

**Special Instructions:**

**# of Jars Used & Not Submitted**

LAB USE ONLY

| Received By: | Date: 101015 | Time: 0855 | Maxxam Job #: B099496 | | |
|---|---|---|---|---|---|
| | | | Custody Seal | Temperature | Ice |
| Lab Comments: C. Risew | | | 14 | 14 15 | |

Your Project #: DIAVIK NORTH INLET
Your C.O.C. #: 097117, 097116, 097113

**Attention: Cathy McPherson**
GOLDER ASSOCIATES LTD
4260 STILL CREEK DRIVE
Suite 500
BURNABY, BC
Canada V5C 6C6

**Report Date: 2010/10/21**

# CERTIFICATE OF ANALYSIS

**MAXXAM JOB #: B099458**
**Received: 2010/10/15, 08:55**

Sample Matrix: Water
# Samples Received: 29

| Analyses | Quantity | Date Extracted | Date Analyzed | Laboratory Method | Analytical Method |
|---|---|---|---|---|---|
| Sulphide | 29 | N/A | 2010/10/20 | BRN SOP-00228 R5.0 | SM - 4500 S2 D |

* Results relate only to the items tested.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

VJ OCO, Burnaby Customer Service
Email: VJ.Oco@MaxxamAnalytics.com
Phone# (604) 639-8422

==================================================================

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

# RESULTS OF CHEMICAL ANALYSES OF WATER

| Maxxam ID | | X69731 | X69732 | X69733 | X69734 | X69735 | X69736 | X69737 | X69738 | X69739 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/28 | 2010/09/30 | 2010/09/28 | 2010/09/30 | 2010/09/28 | 2010/09/28 | 2010/09/30 | 2010/09/28 | 2010/09/28 | | |
| | **Units** | **10-1356 CTL CT INITIAL** | **10-1356 CTL HA INITIAL** | **10-1356-1 CT INITIAL** | **10-1356-1 HA INITIAL** | **10-1356-1-INT** | **10-1356-2 CT INITIAL** | **10-1356-2 HA INITIAL** | **10-1356-2-INT** | **10-1356-3 CT INITIAL** | **RDL** | **QC Batch** |
| **MISCELLANEOUS** | | | | | | | | | | | | |
| Sulphide | mg/L | <0.005 | <0.005 | 0.015 | 0.009 | <0.005 | 0.006 | 0.006 | <0.005 | 0.010 | 0.005 | 4353558 |

| Maxxam ID | | X69740 | X69741 | X69742 | X69756 | X69757 | X69758 | X69759 | X69760 | X69761 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/30 | 2010/09/28 | 2010/09/28 | 2010/09/30 | 2010/09/28 | 2010/09/28 | 2010/09/30 | 2010/09/28 | 2010/09/28 | | |
| | **Units** | **10-1356-3 HA INITIAL** | **10-1356-3-INT** | **10-1356-4 CT INITIAL** | **10-1356-4 HA INITIAL** | **10-1356-4-INT** | **10-1356-5 CT INITIAL** | **10-1356-5 HA INITIAL** | **10-1356-5-INT** | **10-1356-6 CT INITIAL** | **RDL** | **QC Batch** |
| **MISCELLANEOUS** | | | | | | | | | | | | |
| Sulphide | mg/L | 0.009 | <0.005 | <0.005 | 0.005 | 0.047 | <0.005 | 0.006 | 0.007 | <0.005 | 0.005 | 4353558 |

| Maxxam ID | | X69762 | X69763 | X69764 | X69765 | X69766 | X69767 | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/30 | 2010/09/28 | 2010/09/28 | 2010/09/30 | 2010/09/28 | 2010/09/28 | | |
| | **Units** | **10-1356-6 HA INITIAL** | **10-1356-6-INT** | **10-1356-7 CT INITIAL** | **10-1356-7 HA INITIAL** | **10-1356-7-INT** | **10-1356-8 CT INITIAL** | **RDL** | **QC Batch** |
| **MISCELLANEOUS** | | | | | | | | | |
| Sulphide | mg/L | 0.006 | 0.010 | <0.005 | 0.005 | 0.006 | <0.005 | 0.005 | 4353558 |

| Maxxam ID | | X69769 | X69770 | X69771 | X69772 | | X69773 | | |
|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2010/09/30 | 2010/09/28 | 2010/09/30 | 2010/09/28 | | 2010/09/28 | | |
| | **Units** | **10-1356-8 HA INITIAL** | **10-1356-8-INT** | **10-1392 HA INITIAL** | **10-1392 CT INITIAL** | **RDL** | **10-1392-INT** | **RDL** | **QC Batch** |
| **MISCELLANEOUS** | | | | | | | | | |
| Sulphide | mg/L | <0.005 | 0.007 | 0.032 | 0.029 | 0.005 | 27.3 | 0.5 | 4353558 |

---

RDL = Reportable Detection Limit

## QUALITY ASSURANCE REPORT

| | | | Matrix Spike | | Spiked Blank | | Method Blank | | RPD | |
|---|---|---|---|---|---|---|---|---|---|---|
| **QC Batch** | **Parameter** | **Date** | **% Recovery** | **QC Limits** | **% Recovery** | **QC Limits** | **Value** | **Units** | **Value (%)** | **QC Limits** |
| 4353558 | Sulphide | 2010/10/20 | 87 | 80 - 120 | 104 | 80 - 120 | <0.005 | mg/L | NC | 20 |

---

N/A = Not Applicable

RPD = Relative Percent Difference

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

**Maxxam** Analytics

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www.maxxamanalytics.com

097117 **CHAIN OF CUSTODY**

Page: 1 of 3

**Invoice To:** Require Report? Yes ☑ No ☐
**Company Name:** Golder Associates Ltd.
**Contact Name:** Cathy McPherson
**Address:** 500-4260 Still Creek Dr. Burnaby
**Prov:** BC **PC:** V5C 6C6
**Contact #s:** **Ph:** (604-297-2007 **Fax:**

**Report To:** SAME AS INVOICE
**Prov:** **PC:**
**Ph:** **Fax:**

PO # / AFE #: CONTACT CATHY
Quotation #: B10-145-KP
Project #:
Project Name: DIAVIK NORTH INLET
Location: DNI
Sampler's Initials:

**DETECTION LIMIT REQUIREMENTS:**
Check the applicable criterion and indicate land use
☐ AT1
☐ CCME
☐ OTHER

**REPORT DISTRIBUTION:**
**EMAIL ADDRESS(S):**

**SERVICE REQUESTED:**
☐ **RUSH** (Please ensure you contact the lab to reserve)
**Date Required:**
☐ REGULAR Turnaround (5 to 7 Days)

| | | | | SOILS (footnotes defined on back) | | | | | | | | | | WATERS (footnotes defined on back) | | | | | | | | OTHER TEST(S) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sample Identification | Matrix S/W | Date & Time Sampled Year/Month/Day | BTEX F1-F4 | Sieve (75 micron) | Salinity 4 | Regulated Metals (CCME / AT1)[1] | Assessment ICP Metals[2] | ☐ Paint Filter ☐ Flashpoint ☐ pH (1:1) | TCLP ☐ BTEX ☐ Metals | | | | ☐ BTEX F1 ☐ VOCs | ☐ BTEX F1-F2 ☐ BTEX F1-F4 | Routine Water Package ☐ Turb ☐ F | REGULATED METALS (CCME / AT1)[2] Total ☐ Preserved ☐ Not Preserved | REGULATED METALS (CCME / AT1)[2] Dissolved ☐ Preserved ☐ Not Preserved ☐ Filtered ☐ Not Filtered | Mercury ☐ Total ☐ Dissolved | ☒ Ammonia ☐ TKN ☐ COD | ☐ TOC ☐ DOC | Sulphide | | | | | | | *HOLD for 60 Days | # of Containers Submitted |
| 1 | 10-1356 CTL CT initial | grd water | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 2 | 10-1356 CTL HA initial | ↓ | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 3 | 10-1356-1 CT initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 4 | 10-1356-1 HA initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 5 | 10-1356-1-INT | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 6 | 10-1356-2 CT initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 7 | 10-1356-2 HA initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 8 | 10-1356-2-INT | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 9 | 10-1356-3 CT initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 10 | 10-1356-3 HA initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 11 | 10-1356-3-INT | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |
| 12 | 10-1356-4 CT initial | ✓ | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | | |

**All samples are held for 60 calendar days after sample receipt. For long term storage please contact your project manager.*

P **Maxxam Job #:** B099458

**Relinquished By:** **Date/Time:**
**Sign and Print:**
**COMMENTS/SPECIAL INSTRUCTIONS:**

| # JARS USED & NOT SUBMITTED | Received By | Temperature | | | Ice |
|---|---|---|---|---|---|
| | 101015<br>C.Rosen 0855 | 11 | 12 | 11 | |
| | CUSTODY SEAL YES / NO | | | | |

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097116 **CHAIN OF CUS**

Page: 2 of

**Invoice To:** Require Report? Yes ☐ No ☐

**Company Name:**

**Contact Name:**

**Address:**

**Prov:** **PC:**

**Contact #s:** **Ph:** **Fax:**

**Report To:**

**Prov:** **PC:**

**Ph:** **Fax:**

PO # / AFE #:

Quotation #:

Project #:

Project Name:

Location:

Sampler's Initials:

**DETECTION LIMIT REQUIREMENTS:**

Check the applicable criterion and indicate land use

☐ AT1

☐ CCME

☐ OTHER

**REPORT DISTRIBUTION:**

**EMAIL ADDRESS(S):**

**SERVICE REQUESTED:**

☐ **RUSH** (Please ensure you contact the lab to reserve)

**Date Required:**

☐ REGULAR Turnaround (5 to 7 Days)

| | | | | SOILS (footnotes defined on back) | | | | | | | | | | WATERS (footnotes defined on back) | | | | | | | | OTHER TEST(S) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sample Identification | Matrix S/W | Date & Time Sampled Year/Month/Day | BTEX F1-F4 | Sieve (75 micron) | Salinity 4 | Regulated Metals (CCME / AT1)[1] | Assessment ICP Metals[2] | ☐ Paint Filter ☐ Flashpoint ☐ pH (1:1) | TCLP ☐ BTEX ☐ Metals | | | | ☐ BTEX F1 ☐ VOCs | ☐ BTEX F1-F2 ☐ BTEX F1-F4 | Routine Water Package ☐ Turb ☐ F | REGULATED METALS (CCME / AT1)[3] Total ☐ Preserved ☐ Not Preserved | Dissolved ☐ Preserved ☐ Filtered ☐ Not Preserved ☐ Not Filtered | Mercury ☐ Total ☐ Dissolved | ☐ Ammonia ☐ TKN ☐ COD | ☐ TOC ☐ DOC | Sulphide | | | | | | |
| 1 | 10-1356-4 HA initial | ~~soil~~ water | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | |
| 2 | 10-1356-4-INT | ↓ | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | |
| 3 | 10-1356-5 CT initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | |
| 4 | 10-1356-5 HA initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | |
| 5 | 10-1356-5-INT | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | |
| 6 | 10-1356-6 CT initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | |
| 7 | 10-1356-6-HA initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | |
| 8 | 10-1356-6-INT | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | |
| 9 | 10-1356-7 CT initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | |
| 10 | 10-1356-7 HA initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | |
| 11 | 10-1356-7-INT | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | |
| 12 | 10-1356-8 CT initial | ↓ | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | |

**All samples are held for 60 calendar days after sample receipt. For long term storage please contact your project manager.*

P **Maxxam Job #:** B09q

**Relinquished By:** **Date/Time:**

**Sign and Print:**

**COMMENTS/SPECIAL INSTRUCTIONS:**

| # JARS USED & NOT SUBMITTED | Received By | Temperature | | |
|---|---|---|---|---|
| | 10 10 15 0855<br>C. Rusen | 11 | 12 | 11 |
| | CUSTODY SEAL YES / NO | | | |

Page 5 of 6

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097113 **CHAIN OF CUS**

Page: 3 o

**Invoice To:** Require Report? Yes ☐ No ☐

**Company Name:**
**Contact Name:**
**Address:**
**Prov:** **PC:**
**Contact #s:** **Ph:** **Fax:**

**Report To:**

**Prov:** **PC:**
**Ph:** **Fax:**

PO # / AFE #:
Quotation #:
Project #:
Project Name:
Location:
Sampler's Initials:

**DETECTION LIMIT REQUIREMENTS:**

Check the applicable criterion and indicate land use

☐ AT1
☐ CCME
☐ OTHER

**REPORT DISTRIBUTION:**

**EMAIL ADDRESS(S):**

**SERVICE REQUESTED:**

☐ **RUSH** (Please ensure you contact the lab to reserve)
**Date Required:**
☐ REGULAR Turnaround (5 to 7 Days)

| | | | | SOILS (footnotes defined on back) | | | | | | | | | | WATERS (footnotes defined on back) | | | | | | | | OTHER TEST(S) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sample Identification | Matrix S/W | Date & Time Sampled Year/Month/Day | BTEX F1-F4 | Sieve (75 micron) | Salinity 4 | Regulated Metals (CCME / AT1)$^1$ | Assessment ICP Metals$^2$ | ☐ Paint Filter ☐ Flashpoint ☐ pH (1:1) | TCLP ☐ BTEX ☐ Metals | | | | ☐ BTEX F1 ☐ VOCs | ☐ BTEX F1-F2 ☐ BTEX F1-F4 | Routine Water Package ☐ Turb ☐ F | REGULATED METALS (CCME / AT1)$^3$ Total ☐ Preserved ☐ Not Preserved | REGULATED METALS (CCME / AT1)$^3$ Dissolved ☐ Preserved ☐ Not Preserved ☐ Filtered ☐ Not Filtered | Mercury ☐ Total ☐ Dissolved | ☐ Ammonia ☐ TKN ☐ COD | ☐ TOC. ☐ DOC | Sulphide | | | | | | | |
| 1 | 10-1356-8 HA initial | Water | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | |
| 2 | 10-1356-8-INT | ↓ | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | |
| 3 | 10-1392 HA initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | |
| 4 | 10-1392 CT initial | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | |
| 5 | 10-1392-INT | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**All samples are held for 60 calendar days after sample receipt. For long term storage please contact your project manager.*

P **Maxxam Job #:** B 0994

**Relinquished By:** **Date/Time:**
**Sign and Print:**
**COMMENTS/SPECIAL INSTRUCTIONS:**

| # JARS USED & NOT SUBMITTED | Received By | Temperature | | |
|---|---|---|---|---|
| | 10 10 15 0855 C. Rosen | 11 | 12 | 11 |
| | CUSTODY SEAL YES / NO | | | |

# APPENDIX D

## Laboratory Report - Sediment Toxicity Tests (HydroQual Laboratories)

**HydroQual**
Laboratories Ltd.

# *Hyalella* (single concentration) Test Report

Client: DIA102
Reference: 10-1356-HAS

## Contents

## Result Summary

**Client:** Diavik Diamond Mines; operation Yellowknife

**Sample:** NI-1, NI-2, NI-3, NI-4, NI-5

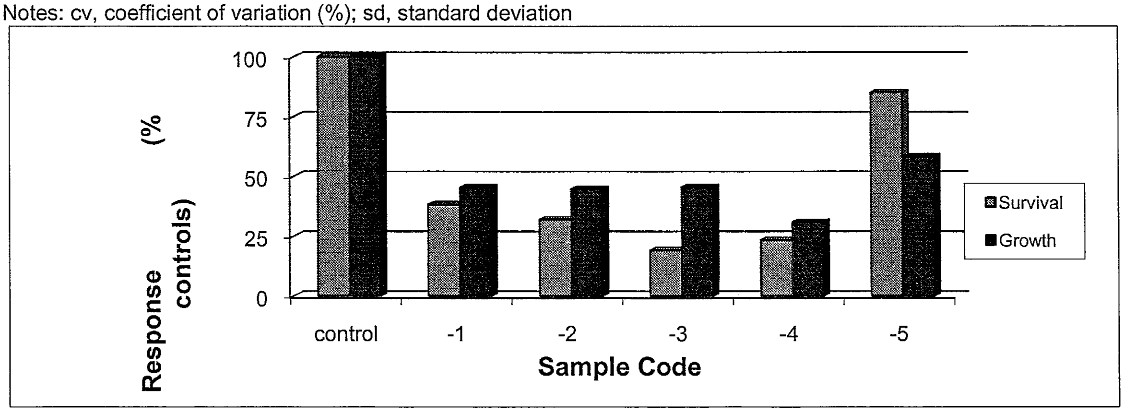
**Collection:** collected on 2010/09/03 at not given by SED
**Receipt:** received on 2010/09/05 at 1400 by H. Stewart
**Containers:** received 48 x 500 ml glass jars at 14 °C, in good condition* (see test comments) with no seals and no
**Description:** type: sediment, collection method: not given

**Test:** started on 2010/09/30 ; ended on 2010/10/15

**Result:**

| Sample | Description | Survival mean | Survival sd | Survival cv(%) | Growth (dry wt (mg) / organism) mean | Growth (dry wt (mg) / organism) sd | Growth (dry wt (mg) / organism) cv(%) |
|---|---|---|---|---|---|---|---|
| | lab control | 9 | 0.5 | 6 | 0.2 | 0.03 | 15 |
| 1 | NI-1 | 4 | 1.8 | 50 | 0.1 | 0.02 | 25 |
| 2 | NI-2 | 3 | 1.0 | 33 | 0.1 | 0.03 | 35 |
| 3 | NI-3 | 2 | 0.8 | 46 | 0.1 | 0.03 | 33 |
| 4 | NI-4 | 2 | 1.8 | 81 | 0.1 | 0.04 | 56 |
| 5 | NI-5 | 8 | 1.0 | 13 | 0.1 | 0.03 | 22 |

Notes: cv, coefficient of variation (%); sd, standard deviation



Technical Lead

Quality Coordinator

## Test Conditions

Client: DIA102
Reference: 10-1356-HAS

**Method:** Biological Test Method: Test for Survival and Growth in Sediment Using the Freshwater Amphipod *Hyalella azteca,* 1997. Environment Canada EPS 1/RM/33.

**Test type:** 14 day Static *Hyalella azteca* Survival and Growth Test (4.4.3.5)
**Species:** *Hyalella azteca*
**Age:** 3-4 days old; 1.2-1.4 mm
**Organism source:** Chesapeake Cultures Inc., Hayes, Virginia (Batch 20100928HA)
**Shipped:** 2010/09/27
**Organisms upon receipt:** mortality, < 1 %; temperature, 22°C: dissolved oxygen, 22.8 mg/L
The EC guidance document on the importation of test organisms (1999) has been followed. Test organisms were received in good condition.
**Acclimation:** 2 days prior to testing at 23 ± 1°C
**Organism observation:** No unusual behaviour or appearance or treatment of test organisms was noted prior to shipping, upon arrival, preceding or during the test.

**Initial Sample Characterization:**

| | control |
|---|---|
| Total Organic Carbon (%) | 0.6 |
| % Water | 1.4 |
| Particle Size: (% sand) | 84.5 |
| (% silt) | 15.5 |
| (% Clay) | <0.1 |

**Sample holding time:** 27 days (must be ≤ 6 weeks)
**Sample storage:** 4 ± 2°C in darkness

**Test vessel:** The tests were conducted in 375 mL glass jars;
**Test volume:** 100 mL of sediment; 175 mL of overlying dilution/control water; no replenishing
**Control/dilution water:** The control water was moderately hard reconstitued dechlorinated water (Borgmann's); used within 4 weeks
**Control sediment:** Sediment (%sand: 84.5, %silt: 15.5, %clay: <0.1)
**Test concentrations:** Undiluted sample plus a negative control
**Test replicates:** 5 field replicates of each concentration tested as received; 10 organisms per replicate
**Feeding:** The test organisms were fed three times per week (on non-consecutive days) 3.5 mL daily a mixture of fermented trout chow, yeast and alfalfa powder.

Note: Outlined sections are protocol deviations explained on the comment page

## Test Conditions

Client: DIA102
Reference: 10-1356-HAS

| | |
|---|---|
| **Measurements:** | pH, conductivity, dissolved oxygen and temperature were measured daily on replicate 'E'; overlying hardness, alkalinity and ammonia at test initiation and termination |
| **Sample pre-treatment:** | The sample was homogenized with hand mixing, dispensed into test vessels and allowed to settle overnight with aeration ~ 2-3 bubbles per second.<br>The sample was not filtered or seived prior to testing. |
| **Lighting:** | Overhead full spectrum fluorescent lights; 500-1000 lux at surface |
| **Photoperiod:** | 16h light:8h dark |
| **Test temperature:** | 23 ± 1°C |
| **Endpoints:** | Survival at 14-d<br>Growth, average individual dry weight at 14-d |
| **Test validity:** | The control had 94% survival (must ≥ 80%);<br>The control had mean dry weight of 0.21 mg/amphipod (must ≥ 0.1 mg/amphipod) |
| **Reference toxicant:** | 96 hour test with $CuSO_4$ initiated September 28, 2010;<br>current results: (96 hour LC50 and 95% confidence limits) =<br>2.27 (2.11-2.46) log µg/L CuSO4 |

Note: Outlined sections are protocol deviations explained on the comment page

## Test Data

Client: DIA102
Reference: 10-1356-HAS

**Test Log:**

| Date | Day | Time | Technicians |
|---|---|---|---|
| 2010/09/30 | 0 | 1100 | E. Petho/T. Kloschinsky |
| 2010/10/01 | 1 | 1545 | E. Petho/R. McCurdy |
| 2010/10/02 | 2 | 1050 | E. Blais/C. Velasco |
| 2010/10/03 | 3 | 1120 | E.Blais/C. Velasco |
| 2010/10/04 | 4 | 1220 | R. McCurdy/H. Stewart |
| 2010/10/05 | 5 | 1345 | R. McCurdy/H. Stewart |
| 2010/10/06 | 6 | 1530 | R. McCurdy/H. Stewart |
| 2010/10/07 | 7 | 1500 | R. McCurdy/H. Stewart |
| 2010/10/08 | 8 | 1220 | R. McCurdy/H. Stewart |
| 2010/10/09 | 9 | 1200 | E. Blais/H. Stewart |
| 2010/10/10 | 10 | 1140 | E. Blais/H. Stewart |
| 2010/10/11 | 11 | 1055 | E. Blais/A. Hart |
| 2010/10/12 | 12 | 1500 | R. McCurdy/H. Stewart |
| 2010/10/13 | 13 | 1430 | E. Petho/T. Kloschinsky |
| 2010/10/14 | 14 | 1000 | E. Petho/T. Kloschinsky |

**Physical & Chemical Data:**

| Parameter | Sample | | | | | |
|---|---|---|---|---|---|---|
| | control | -1 | -2 | -3 | -4 | -5 |
| porewater ammonia (mg/L) | 0.10 | 1.35 | 1.81 | 1.80 | 3.21 | 3.51 |
| overlying ammonia (mg/L) | | | | | | |
| Day 0 | <0.05 | 3.37 | 3.13 | 3.48 | <0.05 | 2.07 |
| Day 14 | 0.32 | 2.83 | <0.05 | <0.05 | <0.05 | <0.05 |
| hardness (mg/L) | | | | | | |
| initial | 250 | 250 | 250 | 425 | 250 | 250 |
| final | 425 | 425 | 425 | 425 | 425 | 425 |
| alkalinity (mg/L) | | | | | | |
| initial | 80 | >240 | >240 | >240 | 180 | 240 |
| final | 120 | 240 | 240 | 240 | 120 | 120 |
| average daily values | | | | | | |
| pH | 7.3 | 7.4 | 7.6 | 7.7 | 7.6 | 7.5 |
| EC (µS/cm) | 651 | 936 | 927 | 826 | 775 | 718 |
| DO (mg/L) | 7.0 | 5.7 | 5.5 | 6.2 | 5.9 | 5.7 |
| temp (°C) | 23 | 23 | 23 | 23 | 23 | 23 |

## Test Data

Client: DIA102
Reference: 10-1356-HAS

**Biology Summary Data:**

| | Sample | | | | | |
|---|---|---|---|---|---|---|
| replicate | control | -1 | -2 | -3 | -4 | -5 |

Survival (number of live organisms in each replicate)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 10 | 3 | 2 | 1 | 2 | 8 |
| b | 9 | 2 | 4 | 3 | 1 | 9 |
| c | 9 | 6 | 2 | 2 | 4 | 9 |
| d | 10 | 5 | 3 | 2 | 4 | 7 |
| e | 9 | 2 | 4 | 1 | 0 | 7 |

| | | | | | | |
|---|---|---|---|---|---|---|
| average | 9 | 4 | 3 | 2 | 2.2 | 8.0 |
| sd | 0.5 | 1.8 | 1.0 | 0.8 | 1.8 | 1.0 |
| cv (%) | 6 | 50 | 33 | 46 | 81 | 13 |
| % survival | 94 | 36 | 30 | 18 | 22 | 80 |
| % controls | 100 | 38 | 32 | 19 | 23 | 85 |

Growth (dry weight)

Total dry weight per replicate (mg)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 2.05 | 0.31 | 0.15 | 0.11 | 0.17 | 1.16 |
| b | 2.15 | 0.13 | 0.27 | 0.40 | 0.08 | 1.30 |
| c | 1.46 | 0.50 | 0.30 | 0.10 | 0.31 | 1.22 |
| d | 2.35 | 0.48 | 0.26 | 0.21 | 0.32 | 0.64 |
| e | 1.87 | 0.26 | 0.36 | 0.08 | 0.00 | 0.66 |

Average dry weight per live organism (mg/organism)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 0.21 | 0.10 | 0.07 | 0.11 | 0.09 | 0.15 |
| b | 0.24 | 0.06 | 0.07 | 0.13 | 0.08 | 0.14 |
| c | 0.16 | 0.08 | 0.15 | 0.05 | 0.08 | 0.14 |
| d | 0.24 | 0.10 | 0.09 | 0.11 | 0.08 | 0.09 |
| e | 0.21 | 0.13 | 0.09 | 0.08 | 0.00 | 0.09 |

| | | | | | | |
|---|---|---|---|---|---|---|
| average | 0.21 | 0.10 | 0.09 | 0.10 | 0.06 | 0.12 |
| sd | 0.03 | 0.02 | 0.03 | 0.03 | 0.04 | 0.03 |
| cv (%) | 15 | 25 | 35 | 33 | 56 | 22 |
| % controls | 100 | 46 | 45 | 46 | 31 | 58 |

Notes: cv, coefficient of variation (%); sd, standard deviation

## Test Data

Client: DIA102
Reference: 10-1356-HAS

**Chemistry:**

| | | Sample | | | | | |
|---|---|---|---|---|---|---|---|
| | day | control | -1 | -2 | -3 | -4 | -5 |
| pH<br>(units) | 0 | 7.6 | 7.9 | 8.0 | 8.2 | 8.0 | 7.9 |
| | 14 | 6.9 | 6.9 | 7.1 | 7.1 | 7.1 | 7.1 |
| EC<br>(µS/cm) | 0 | 343 | 787 | 764 | 710 | 649 | 619 |
| | 14 | 958 | 1085 | 1089 | 942 | 900 | 816 |
| DO<br>(mg/L) | 0 | 7.9 | 7.9 | 7.6 | 7.5 | 7.6 | 7.7 |
| | 1 | 8.0 | 7.0 | 6.3 | 6.3 | 6.8 | 7.4 |
| | 2 | 7.1 | 7.1 | 6.7 | 6.5 | 6.5 | 7.1 |
| | 3 | 6.3 | 6.3 | 6.8 | 6.3 | 6.1 | 6.9 |
| | 4 | 6.8 | 4.0 | 3.4 | 2.7 | 7.9 | 2.5 |
| | 5 | 6.6 | 5.9 | 3.0 | 6.4 | 5.6 | 6.2 |
| | 6 | 7.3 | 1.0 | 1.7 | 6.4 | 4.0 | 5.6 |
| | 7 | 6.5 | 4.5 | 4.4 | 5.2 | 5.4 | 5.6 |
| | 8 | 7.4 | 3.9 | 3.5 | 6.2 | 2.6 | 3.5 |
| | 9 | 6.9 | 6.7 | 5.3 | 5.8 | 4.9 | 4.7 |
| | 10 | 7.1 | 6.8 | 6.3 | 6.4 | 5.2 | 5.3 |
| | 11 | 6.6 | 6.5 | 5.8 | 5.9 | 5.4 | 6.1 |
| | 12 | 5.5 | 3.2 | 6.8 | 7.0 | 6.8 | 2.4 |
| | 13 | 7.3 | 7.2 | 7.0 | 7.1 | 7.1 | 7.1 |
| | 14 | 8.4 | 7.8 | 7.4 | 7.2 | 6.9 | 6.7 |
| temp.<br>($^oC$) | 0 | 24 | 24 | 24 | 24 | 24 | 24 |
| | 1 | 24 | 24 | 24 | 24 | 24 | 24 |
| | 2 | 23 | 23 | 23 | 23 | 23 | 23 |
| | 3 | 23 | 23 | 23 | 23 | 23 | 23 |
| | 4 | 23 | 23 | 23 | 23 | 23 | 23 |
| | 5 | 23 | 23 | 23 | 23 | 23 | 23 |
| | 6 | 23 | 23 | 23 | 23 | 23 | 23 |
| | 7 | 24 | 24 | 24 | 24 | 24 | 24 |
| | 8 | 24 | 24 | 24 | 24 | 24 | 24 |
| | 9 | 23 | 23 | 23 | 23 | 23 | 23 |
| | 10 | 23 | 23 | 23 | 23 | 23 | 23 |
| | 11 | 23 | 23 | 23 | 23 | 23 | 23 |
| | 12 | 23 | 23 | 23 | 23 | 23 | 23 |
| | 13 | 24 | 24 | 24 | 24 | 24 | 24 |
| | 14 | 23 | 23 | 23 | 23 | 23 | 23 |

## Comments/Statistics

Client: DIA102
Reference: 10-1356-HAS

**Test Result Comments:**
NI-3-TOX-D replicate arrived broken so the NI-3-Ammonia sample replaced this field replicate.

**Data Analysis:**
None

**Protocol Deviations:**
None

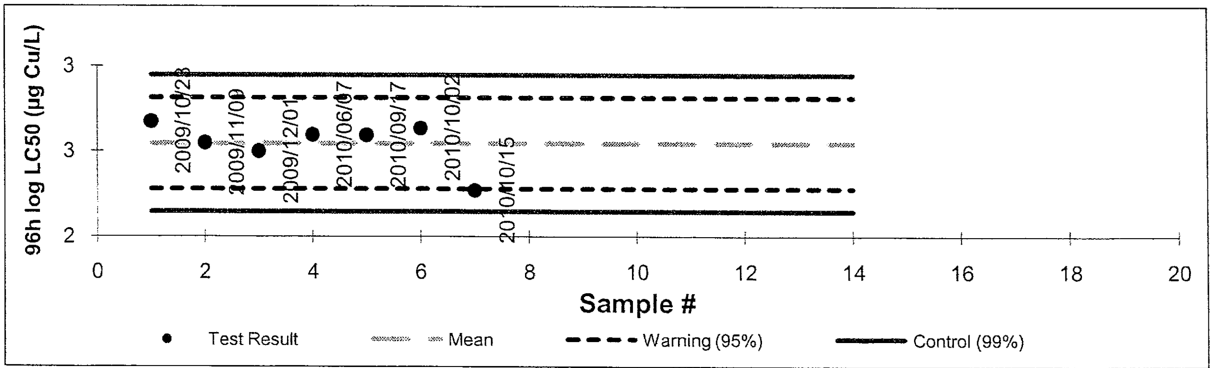
# Quality Assurance Information

**Test Method:** 96 hours Acute Lethality Test with *Hyalella azteca*
HydroQual Test Method Manual, section: 4.4.3.5
**Reference:** Biological Test Method: Acute Test for Sediment Toxicity using the Freshwater Amphipod *Hyalella azteca*, 1997. Environment Canada, EPS 1/RM/33.

**Test Organism:**
test species: *Hyalella azteca*
culture source: Chesapeake Cultures Inc.
Hayes, VA, USA
culture vessels: 10 L glass aquarium
dilution water: Borgmann's Water
control sediment: sterile cotton gauze
organism age: 3-4 days
food source: YAT
culture batch: 20101013HA

**Test Design:** **Reftox**
test duration (d): 4
toxicant: copper sulfate ($CuSO_4 \times H_2O$ )
test temperature: 23 ± 1°C
test jar volume: 375mL
sediment volume: 3 $cm^2$ mesh
water volume: 200mL
light levels (lux): 500-1000
photoperiod (h): 16 h light: 8 h dark
reps./treatment: 1
organisms/replicates: 10
feeding: 0.5mL/jar on day 0 and 2

**Warning Chart:** mortality LC50 at 96 hours
toxicant: Copper (Cu)
**Current Test:** started on 2010/09/28 ended on 2010/10/02
result (96 h LC50): 2.27 (2.11-2.46) log µg Cu/L (95% confidence limits are in brackets)
**Historical:** mean: 2.5 std.dev: 0.1 CV(%): 5
warning limits: 2.3 2.8 (lower and upper 95% confidence limit, two standard deviations)
control limits: 2.1 2.9 (lower and upper 99% confidence limit, three standard deviations)



The data and results are authorized and verified correct.

Technical Lead

Quality Coordinator

**HydroQual**
Laboratories Ltd.

# *Hyalella* (single concentration) Test Report

Client: DIA102
Reference: 10-1392-HAS

## Result Summary

**Client:** Diavik Diamond Mines; operation Yellowknife

**Sample:** sludge

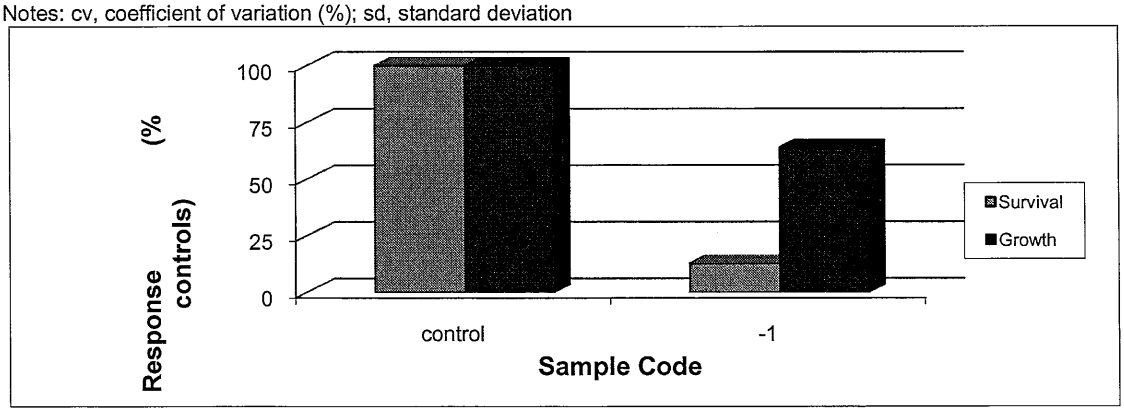
**Collection:** collected on 2010/09/02 at not given by not given
**Receipt:** received on 2010/09/13 at 1330 by C. Ehman
**Containers:** received 1 x 20L pail at 14 °C, in good with no seals and no initials
**Description:** type: sludge, collection method: not given

**Test:** started on 2010/09/30 ; ended on 2010/10/14

**Result:**

| Sample | Description | Survival | | | Growth (dry wt (mg) / organism) | | |
|---|---|---|---|---|---|---|---|
| | | mean | sd | cv(%) | mean | sd | cv(%) |
| | lab control | 9 | 0.5 | 6 | 0.2 | 0.03 | 15 |
| 1 | sludge | 1 | 0.4 | 37 | 0.1 | 0.05 | 35 |

Notes: cv, coefficient of variation (%); sd, standard deviation



Technical Lead

Quality Coordinator

## Test Conditions

Client: DIA102
Reference: 10-1392-HAS

**Method:** Biological Test Method: Test for Survival and Growth in Sediment Using the Freshwater Amphipod *Hyalella azteca,* 1997. Environment Canada EPS 1/RM/33.

**Test type:** 14 day Static *Hyalella azteca* Survival and Growth Test (4.4.3.5)
**Species:** *Hyalella azteca*
**Age:** 3-4 days old; 1.2-1.4 mm
**Organism source:** Chesapeake Cultures Inc., Hayes, Virginia (Batch 20100928HA)
**Shipped:** 2010/09/27
**Organisms upon receipt:** mortality, < 1 %; temperature, 22°C: dissolved oxygen, 22.8 mg/L
The EC guidance document on the importation of test organisms (1999) has been followed. Test organisms were received in good condition
**Acclimation:** 2 days prior to testing at 23 ± 1°C
**Organism observation:** No unusual behaviour or appearance or treatment of test organisms was noted prior to shipping, upon arrival, preceding or during the test.

**Initial Sample Characterization:**

| | control |
|---|---|
| Total Organic Carbon (%) | 0.6 |
| % Water | 1.4 |
| Particle Size: (% sand) | 84.5 |
| (% silt) | 15.5 |
| (% Clay) | <0.1 |

**Sample holding time:** 28 days (≤ 6 weeks)
**Sample storage:** 4 ± 2°C in darkness

**Test vessel:** The tests were conducted in 375 mL glass jars;
**Test volume:** 100 mL of sediment; 175 mL of overlying dilution/control water; no replenishing
**Control/dilution water:** The control water was moderately hard reconstitued dechlorinated water (Borgmann's); used within 4 weeks
**Control sediment:** Sediment (%sand: 84.5, %silt: 15.5, %clay: <1)
**Test concentrations:** Undiluted sample plus a negative control
**Test replicates:** 5 replicates of each concentration; 10 organisms per replicate
**Feeding:** The test organisms were fed three times per week (on non-consecutive days) 3.5 mL daily a mixture of fermented trout chow, yeast and alfalfa powder.

Note: Outlined sections are protocol deviations explained on the comment page

## Test Conditions

Client: DIA102
Reference: 10-1392-HAS

| | |
|---|---|
| **Measurements:** | pH, conductivity, dissolved oxygen and temperature were measured daily on replicate 'E'; overlying hardness, alkalinity and ammonia at test initiation and termination |
| **Sample pre-treatment:** | The sample was homogenized with hand mixing, dispensed into test vessels and allowed to settle overnight with aeration ~ 2-3 bubbles per second.<br>The sample was not filtered or seived prior to testing. |
| **Lighting:** | Overhead full spectrum fluorescent lights; 500-1000 lux at surface |
| **Photoperiod:** | 16h light:8h dark |
| **Test temperature:** | 23 ± 1°C |
| **Endpoints:** | Survival at 14-d<br>Growth, average individual dry weight at 14-d |
| **Test validity:** | The control had 94% survival (must ≥ 80%);<br>The control had mean dry weight of 0.21 mg/amphipod (must ≥ 0.1 mg/amphipod) |
| **Reference toxicant:** | 96 hour test with $CuSO_4$ initiated September 28, 2010;<br>current results: (96 hour LC50 and 95% confidence limits) =<br>2.27 (2.11-2.46) log µg/L CuSO4 |

Note: Outlined sections are protocol deviations explained on the comment page

## Test Data

Client: DIA102
Reference: 10-1392-HAS

**Test Log:**

| Date | Day | Time | Technicians |
|---|---|---|---|
| 2010/09/30 | 0 | 1100 | E. Petho/T. Kloschinsky |
| 2010/10/01 | 1 | 1545 | E. Petho/R. McCurdy |
| 2010/10/02 | 2 | 1050 | E. Blais/C. Velasco |
| 2010/10/03 | 3 | 1120 | E.Blais/C. Velasco |
| 2010/10/04 | 4 | 1220 | R. McCurdy/H. Stewart |
| 2010/10/05 | 5 | 1345 | R. McCurdy/H. Stewart |
| 2010/10/06 | 6 | 1530 | R. McCurdy/H. Stewart |
| 2010/10/07 | 7 | 1500 | R. McCurdy/H. Stewart |
| 2010/10/08 | 8 | 1220 | R. McCurdy/H. Stewart |
| 2010/10/09 | 9 | 1200 | E. Blais/H. Stewart |
| 2010/10/10 | 10 | 1140 | E. Blais/H. Stewart |
| 2010/10/11 | 11 | 1055 | E. Blais/A. Hart |
| 2010/10/12 | 12 | 1500 | R. McCurdy/H. Stewart |
| 2010/10/13 | 13 | 1430 | E. Petho/T. Kloschinsky |
| 2010/10/14 | 14 | 1000 | E. Petho/T. Kloschinsky |

**Physical & Chemical Data:**

| Parameter | Sample | | | | | |
|---|---|---|---|---|---|---|
| | control | -1 | | | | |
| porewater ammonia (mg/L) | 0.16 | 0.62 | | | | |
| overlying ammonia (mg/L) | | | | | | |
| Day 0 | <0.05 | 3.76 | | | | |
| Day 14 | 0.32 | 3.79 | | | | |
| hardness (mg/L) | | | | | | |
| initial | 250 | 120 | | | | |
| final | 425 | 425 | | | | |
| alkalinity (mg/L) | | | | | | |
| initial | 80 | 80 | | | | |
| final | 120 | 40 | | | | |
| average daily values | | | | | | |
| pH | 7.3 | 6.7 | | | | |
| EC (µS/cm) | 651 | 752 | | | | |
| DO (mg/L) | 7.0 | 5.3 | | | | |
| temp ($^{o}$C) | 23 | 23 | | | | |

## Test Data

Client: DIA102
Reference: 10-1392-HAS

**Biology Summary Data:**

| | Sample | | | | | |
|---|---|---|---|---|---|---|
| replicate | control | -1 | | | | |

Survival (number of live organisms in each replicate)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 10 | 2 | | | | |
| b | 9 | 1 | | | | |
| c | 9 | 1 | | | | |
| d | 10 | 1 | | | | |
| e | 9 | 1 | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| average | 9 | 1 | | | | |
| sd | 0.5 | 0.4 | | | | |
| cv (%) | 6 | 37 | | | | |
| % survival | 94 | 12 | | | | |
| % controls | 100 | 13 | | | | |

Growth (dry weight)

Total dry weight per replicate (mg)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 2.05 | 0.24 | | | | |
| b | 2.15 | 0.15 | | | | |
| c | 1.46 | 0.07 | | | | |
| d | 2.35 | 0.13 | | | | |
| e | 1.87 | 0.20 | | | | |

Average dry weight per live organism (mg/organism)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 0.21 | 0.12 | | | | |
| b | 0.24 | 0.15 | | | | |
| c | 0.16 | 0.07 | | | | |
| d | 0.24 | 0.13 | | | | |
| e | 0.21 | 0.20 | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| average | 0.21 | 0.13 | | | | |
| sd | 0.03 | 0.05 | | | | |
| cv (%) | 15 | 35 | | | | |
| % controls | 100 | 64 | | | | |

Notes: cv, coefficient of variation (%); sd, standard deviation

# *Hyalella* (single concentration) Test Report

## Test Data

Client: DIA102
Reference: 10-1392-HAS

**Chemistry:**

| | | Sample | | | | | |
|---|---|---|---|---|---|---|---|
| | day | control | -1 | | | | |
| pH (units) | 0 | 7.6 | 6.6 | | | | |
| | 14 | 6.9 | 6.7 | | | | |
| EC (µS/cm) | 0 | 343 | 667 | | | | |
| | 14 | 958 | 836 | | | | |
| DO (mg/L) | 0 | 7.9 | 7.3 | | | | |
| | 1 | 8.0 | 7.1 | | | | |
| | 2 | 7.1 | 6.6 | | | | |
| | 3 | 6.3 | 6.6 | | | | |
| | 4 | 6.8 | 0.7 | | | | |
| | 5 | 6.6 | 3.9 | | | | |
| | 6 | 7.3 | 1.6 | | | | |
| | 7 | 6.5 | 5.2 | | | | |
| | 8 | 7.4 | 7.0 | | | | |
| | 9 | 6.9 | 6.1 | | | | |
| | 10 | 7.1 | 5.9 | | | | |
| | 11 | 6.6 | 5.3 | | | | |
| | 12 | 5.5 | 1.1 | | | | |
| | 13 | 7.3 | 7.0 | | | | |
| | 14 | 8.4 | 7.4 | | | | |
| temp. (°C) | 0 | 24 | 24 | | | | |
| | 1 | 24 | 24 | | | | |
| | 2 | 23 | 23 | | | | |
| | 3 | 23 | 23 | | | | |
| | 4 | 23 | 23 | | | | |
| | 5 | 23 | 23 | | | | |
| | 6 | 23 | 23 | | | | |
| | 7 | 24 | 24 | | | | |
| | 8 | 24 | 24 | | | | |
| | 9 | 23 | 23 | | | | |
| | 10 | 23 | 23 | | | | |
| | 11 | 23 | 23 | | | | |
| | 12 | 23 | 23 | | | | |
| | 13 | 24 | 24 | | | | |
| | 14 | 23 | 23 | | | | |

## Comments/Statistics

Client: DIA102
Reference: 10-1392-HAS

**Test Result Comments:**
None

**Data Analysis:**

**Protocol Deviations:**
None

# Quality Assurance Information

**Test Method:** 96 hours Acute Lethality Test with *Hyalella azteca*
HydroQual Test Method Manual, section: 4.4.3.5

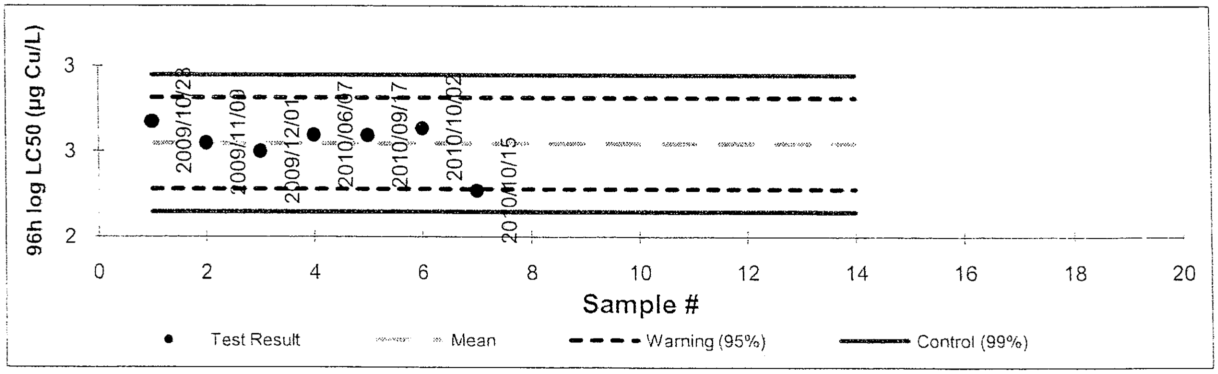
**Reference:** Biological Test Method: Acute Test for Sediment Toxicity using the Freshwater Amphipod *Hyalella azteca*, 1997. Environment Canada, EPS 1/RM/33.

| **Test Organism:** | |
|---|---|
| test species: | *Hyalella azteca* |
| culture source: | Chesapeake Cultures Inc.<br>Hayes, VA, USA |
| culture vessels: | 10 L glass aquarium |
| dilution water: | Borgmann's Water |
| control sediment: | sterile cotton gauze |
| organism age: | 3-4 days |
| food source: | YAT |
| culture batch: | 20101013HA |

| **Test Design:** | **Reftox** |
|---|---|
| test duration (d): | 4 |
| toxicant: | copper sulfate ($CuSO_4 \times H_2O$ ) |
| test temperature: | 23 ± 1°C |
| test jar volume: | 375mL |
| sediment volume: | 3 $cm^2$ mesh |
| water volume: | 200mL |
| light levels (lux): | 500-1000 |
| photoperiod (h): | 16 h light: 8 h dark |
| reps./treatment: | 1 |
| organisms/replicates: | 10 |
| feeding: | 0.5mL/jar on day 0 and 2 |

**Warning Chart:** mortality LC50 at 96 hours
toxicant: Copper (Cu)

| | | | | | | |
|---|---|---|---|---|---|---|
| **Current Test:** | started on | 2010/09/28 | ended on 2010/10/02 | | | |
| result (96 h LC50): | 2.27 | (2.11-2.46) | log µg Cu/L | (95% confidence limits are in brackets) | | |
| **Historical:** | mean: | 2.5 | std.dev: | 0.1 | CV(%): | 5 |
| warning limits: | 2.3 | 2.8 | (lower and upper 95% confidence limit, two standard deviations) | | | |
| control limits: | 2.1 | 2.9 | (lower and upper 99% confidence limit, three standard deviations) | | | |



The data and results are authorized and verified correct.

Technical Lead

Quality Coordinator

**HydroQual**
Laboratories Ltd.

# *Hyalella* (single concentration) Test Report

Client: DIA102
Reference: 10-1356-HAS

## Result Summary

**Contents**

**Client:** Diavik Diamond Mines; operation Yellowknife

**Sample:** REF-1, REF-2, REF-3

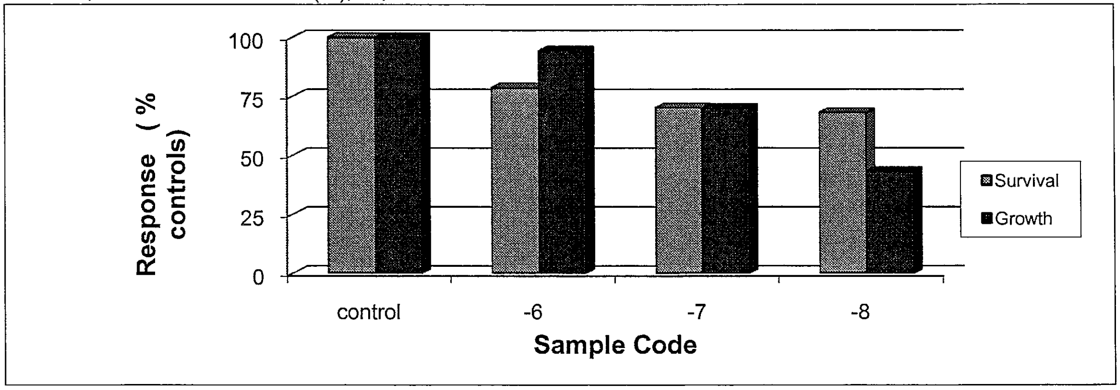
**Collection:** collected on 2010/09/03 at not given by SED
**Receipt:** received on 2010/09/05 at 1400 by H. Stewart
**Containers:** received 48 x 500 ml glass jars at 14 °C, in good condition* (see test comments) with no seals and no
**Description:** type: sediment, collection method: not given

**Test:** started on 2010/09/30 ; ended on 2010/10/15

**Result:**

| Sample | Description | Survival |  |  | Growth (dry wt (mg) / organism) |  |  |
|---|---|---|---|---|---|---|---|
|  |  | mean | sd | cv(%) | mean | sd | cv(%) |
|  | lab control | 9 | 0.5 | 6 | 0.2 | 0.03 | 15 |
| 6 | REF-1 | 7 | 1.8 | 25 | 0.2 | 0.03 | 18 |
| 7 | REF-2 | 7 | 3.6 | 54 | 0.1 | 0.02 | 16 |
| 8 | REF-3 | 6 | 1.7 | 26 | 0.1 | 0.02 | 27 |

Notes: cv, coefficient of variation (%); sd, standard deviation



Technical Lead

Quality Coordinator

## Test Conditions

Client: DIA102
Reference: 10-1356-HAS

**Method:** Biological Test Method: Test for Survival and Growth in Sediment Using the Freshwater Amphipod *Hyalella azteca,* 1997. Environment Canada EPS 1/RM/33.

**Test type:** 14 day Static *Hyalella azteca* Survival and Growth Test (4.4.3.5)
**Species:** *Hyalella azteca*
**Age:** 3-4 days old; 1.2-1.4 mm
**Organism source:** Chesapeake Cultures Inc., Hayes, Virginia (Batch 20100928HA)
**Shipped:** 2010/09/27
**Organisms upon receipt:** mortality, < 1 %; temperature, 22°C: dissolved oxygen, 22.8 mg/L
The EC guidance document on the importation of test organisms (1999) has been followed. Test organisms were received in good condition
**Acclimation:** 2 days prior to testing at 23 ± 1°C
**Organism observation:** No unusual behaviour or appearance or treatment of test organisms was noted prior to shipping, upon arrival, preceding or during the test.

**Initial Sample Characterization:**

| | control |
|---|---|
| Total Organic Carbon (%) | 0.6 |
| % Water | 1.4 |
| Particle Size: (% sand) | 84.5 |
| (% silt) | 15.5 |
| (% Clay) | <0.1 |

**Sample holding time:** 27 days (must be ≤ 6 weeks)
**Sample storage:** 4 ± 2°C in darkness

**Test vessel:** The tests were conducted in 375 mL glass jars;
**Test volume:** 100 mL of sediment; 175 mL of overlying dilution/control water; no replenishing
**Control/dilution water:** The control water was moderately hard reconstitued dechlorinated water (Borgmann's); used within 4 weeks
**Control sediment:** Sediment (%sand: 84.5, %silt: 15.5, %clay: <0.1)
**Test concentrations:** Undiluted sample plus a negative control
**Test replicates:** 5 field replicates of each concentration tested as received; 10 organisms per replicate
**Feeding:** The test organisms were fed three times per week (on non-consecutive days) 3.5 mL daily a mixture of fermented trout chow, yeast and alfalfa powder.

Note: Outlined sections are protocol deviations explained on the comment page

## Test Conditions

Client: DIA102
Reference: 10-1356-HAS

**Measurements:** pH, conductivity, dissolved oxygen and temperature were measured daily on replicate 'E'; overlying hardness, alkalinity and ammonia at test initiation and termination

**Sample pre-treatment:** The sample was homogenized with hand mixing, dispensed into test vessels and allowed to settle overnight with aeration ~ 2-3 bubbles per second.
The sample was not filtered or seived prior to testing.

**Lighting:** Overhead full spectrum fluorescent lights; 500-1000 lux at surface

**Photoperiod:** 16h light:8h dark

**Test temperature:** 23 ± 1°C

**Endpoints:** Survival at 14-d
Growth, average individual dry weight at 14-d

**Test validity:** The control had 94% survival (must ≥ 80%);
The control had mean dry weight of 0.21 mg/amphipod (must ≥ 0.1 mg/amphipod)

**Reference toxicant:** 96 hour test with $CuSO_4$ initiated September 28, 2010;
current results: (96 hour LC50 and 95% confidence limits) =
2.27 (2.11-2.46) log µg/L CuSO4

Note: Outlined sections are protocol deviations explained on the comment page

## Test Data

Client: DIA102
Reference: 10-1356-HAS

**Test Log:**

| Date | Day | Time | Technicians |
|---|---|---|---|
| 2010/09/30 | 0 | 1100 | E. Petho/T. Kloschinsky |
| 2010/10/01 | 1 | 1545 | E. Petho/R. McCurdy |
| 2010/10/02 | 2 | 1050 | E. Blais/C. Velasco |
| 2010/10/03 | 3 | 1120 | E.Blais/C. Velasco |
| 2010/10/04 | 4 | 1220 | R. McCurdy/H. Stewart |
| 2010/10/05 | 5 | 1345 | R. McCurdy/H. Stewart |
| 2010/10/06 | 6 | 1530 | R. McCurdy/H. Stewart |
| 2010/10/07 | 7 | 1500 | R. McCurdy/H. Stewart |
| 2010/10/08 | 8 | 1220 | R. McCurdy/H. Stewart |
| 2010/10/09 | 9 | 1200 | E. Blais/H. Stewart |
| 2010/10/10 | 10 | 1140 | E. Blais/H. Stewart |
| 2010/10/11 | 11 | 1055 | E. Blais/A. Hart |
| 2010/10/12 | 12 | 1500 | R. McCurdy/H. Stewart |
| 2010/10/13 | 13 | 1430 | E. Petho/T. Kloschinsky |
| 2010/10/14 | 14 | 1000 | E. Petho/T. Kloschinsky |

**Physical & Chemical Data:**

| Parameter | Sample | | | | | |
|---|---|---|---|---|---|---|
| | control | -6 | -7 | -8 | | |
| porewater ammonia (mg/L) | 0.10 | 0.49 | 0.40 | 0.35 | | |
| overlying ammonia (mg/L) | | | | | | |
| Day 0 | <0.05 | <0.05 | 0.18 | 0.23 | | |
| Day 14 | 0.32 | 0.47 | 2.48 | 1.93 | | |
| hardness (mg/L) | | | | | | |
| initial | 250 | 120 | 120 | 250 | | |
| final | 425 | 425 | 425 | 425 | | |
| alkalinity (mg/L) | | | | | | |
| initial | 80 | 66 | 66 | 66 | | |
| final | 120 | 66 | 66 | 66 | | |
| average daily values | | | | | | |
| pH | 7.8 | 7.5 | 7.2 | 7.0 | | |
| EC (µS/cm) | 651 | 508 | 504 | 508 | | |
| DO (mg/L) | 7.0 | 5.6 | 6.1 | 5.7 | | |
| temp ($^{o}$C) | 23 | 23 | 23 | 23 | | |

## Test Data

Client: DIA102
Reference: 10-1356-HAS

**Biology Summary Data:**

| | Sample | | | | | |
|---|---|---|---|---|---|---|
| replicate | control | -6 | -7 | -8 | | |

Survival (number of live organisms in each replicate)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 10 | 9 | 9 | 6 | | |
| b | 9 | 8 | 9 | 5 | | |
| c | 9 | 5 | 5 | 9 | | |
| d | 10 | 6 | 1 | 7 | | |
| e | 9 | 9 | 9 | 5 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| average | 9 | 7 | 7 | 6 | | |
| sd | 0.5 | 1.8 | 3.6 | 1.7 | | |
| cv (%) | 6 | 25 | 54 | 26 | | |
| % survival | 94 | 74 | 66 | 64 | | |
| % controls | 100 | 79 | 70 | 68 | | |

Growth (dry weight)

Total dry weight per replicate (mg)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 2.05 | 2.14 | 1.17 | 0.64 | | |
| b | 2.15 | 1.85 | 1.56 | 0.29 | | |
| c | 1.46 | 0.86 | 0.65 | 0.98 | | |
| d | 2.35 | 0.96 | 0.13 | 0.76 | | |
| e | 1.87 | 1.70 | 1.53 | 0.36 | | |

Average dry weight per live organism (mg/organism)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 0.21 | 0.24 | 0.13 | 0.11 | | |
| b | 0.24 | 0.23 | 0.17 | 0.06 | | |
| c | 0.16 | 0.17 | 0.13 | 0.11 | | |
| d | 0.24 | 0.16 | 0.13 | 0.11 | | |
| e | 0.21 | 0.19 | 0.17 | 0.07 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| average | 0.21 | 0.20 | 0.15 | 0.09 | | |
| sd | 0.03 | 0.03 | 0.02 | 0.02 | | |
| cv (%) | 15 | 18 | 16 | 27 | | |
| % controls | 100 | 94 | 70 | 43 | | |

Notes: cv, coefficient of variation (%); sd, standard deviation

## Test Data

Client: DIA102
Reference: 10-1356-HAS

**Chemistry:**

| | | Sample | | | | | |
|---|---|---|---|---|---|---|---|
| | day | control | -6 | -7 | -8 | | |
| pH | 0 | 7.9 | 7.9 | 7.7 | 7.5 | | |
| (units) | 14 | 7.6 | 7.1 | 6.7 | 6.5 | | |
| EC | 0 | 343 | 354 | 371 | 354 | | |
| (µS/cm) | 14 | 958 | 662 | 637 | 662 | | |
| DO | 0 | 7.9 | 7.7 | 7.7 | 7.7 | | |
| (mg/L) | 1 | 8.0 | 7.5 | 7.6 | 7.6 | | |
| | 2 | 7.1 | 7.0 | 6.8 | 6.8 | | |
| | 3 | 6.3 | 6.9 | 6.6 | 6.8 | | |
| | 4 | 6.8 | 3.7 | 3.9 | 2.1 | | |
| | 5 | 6.6 | 6.9 | 5.3 | 6.1 | | |
| | 6 | 7.3 | 2.1 | 3.6 | 5.4 | | |
| | 7 | 6.5 | 4.0 | 6.3 | 3.5 | | |
| | 8 | 7.4 | 6.1 | 7.0 | 6.8 | | |
| | 9 | 6.9 | 5.8 | 6.9 | 6.4 | | |
| | 10 | 7.1 | 5.8 | 5.4 | 6.1 | | |
| | 11 | 6.6 | 5.9 | 6.1 | 5.5 | | |
| | 12 | 5.5 | 1.4 | 5.1 | 1.2 | | |
| | 13 | 7.3 | 7.0 | 7.0 | 6.6 | | |
| | 14 | 8.4 | 6.7 | 6.7 | 6.6 | | |
| temp. | 0 | 24 | 24 | 24 | 24 | | |
| (°C) | 1 | 24 | 24 | 24 | 24 | | |
| | 2 | 23 | 23 | 23 | 23 | | |
| | 3 | 23 | 23 | 23 | 23 | | |
| | 4 | 23 | 23 | 23 | 23 | | |
| | 5 | 23 | 23 | 23 | 23 | | |
| | 6 | 23 | 23 | 23 | 23 | | |
| | 7 | 24 | 24 | 24 | 24 | | |
| | 8 | 24 | 24 | 24 | 24 | | |
| | 9 | 23 | 23 | 23 | 23 | | |
| | 10 | 23 | 23 | 23 | 23 | | |
| | 11 | 23 | 23 | 23 | 23 | | |
| | 12 | 23 | 23 | 23 | 23 | | |
| | 13 | 24 | 24 | 24 | 24 | | |
| | 14 | 23 | 23 | 23 | 23 | | |

## Comments/Statistics

Client: DIA102
Reference: 10-1356-HAS

**Test Result Comments:**
None

**Data Analysis:**
None

**Protocol Deviations:**
None

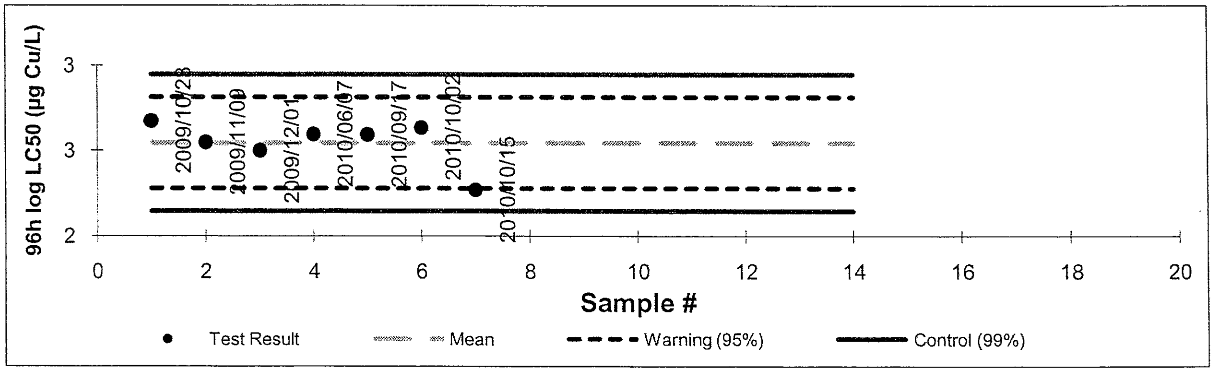
## Quality Assurance Information

**Test Method:** 96 hours Acute Lethality Test with *Hyalella azteca*
HydroQual Test Method Manual, section: 4.4.3.5
**Reference:** Biological Test Method: Acute Test for Sediment Toxicity using the Freshwater Amphipod *Hyalella azteca*, 1997. Environment Canada, EPS 1/RM/33.

| **Test Organism:** | | **Test Design:** | **Reftox** |
|---|---|---|---|
| test species: | *Hyalella azteca* | test duration (d): | 4 |
| culture source: | Chesapeake Cultures Inc.<br>Hayes, VA, USA | toxicant: | copper sulfate ($CuSO_4 \times H_2O$ ) |
| | | test temperature: | 23 ± 1°C |
| culture vessels: | 10 L glass aquarium | test jar volume: | 375mL |
| dilution water: | Borgmann's Water | sediment volume: | 3 $cm^2$ mesh |
| control sediment: | sterile cotton gauze | water volume: | 200mL |
| organism age: | 3-4 days | light levels (lux): | 500-1000 |
| food source: | YAT | photoperiod (h): | 16 h light: 8 h dark |
| culture batch: | 20101013HA | reps./treatment: | 1 |
| | | organisms/replicates: | 10 |
| | | feeding: | 0.5mL/jar on day 0 and 2 |

**Warning Chart:** mortality LC50 at 96 hours
toxicant: Copper (Cu)

| | | | | | | |
|---|---|---|---|---|---|---|
| **Current Test:** | started on | 2010/09/28 | ended on | 2010/10/02 | | |
| result (96 h LC50): | 2.27 | (2.11-2.46) | log µg Cu/L | (95% confidence limits are in brackets) | | |
| **Historical:** | mean: | 2.5 | std.dev: | 0.1 | CV(%): | 5 |
| warning limits: | 2.3 | 2.8 | (lower and upper 95% confidence limit, two standard deviations) | | | |
| control limits: | 2.1 | 2.9 | (lower and upper 99% confidence limit, three standard deviations) | | | |



The data and results are authorized and verified correct.

Technical Lead

Quality Coordinator

## Test Conditions

Client: DIA102
Reference: 10-1356-CTS

**Method:** Biological Test Method: Test for Survival and Growth in Sediment Using the Larvae of Freshwater Midges (*Chironomus dilutus* or *Chironomus riparius* ), 1997. Environment Canada EPS 1/RM/32.

**Test type:** 10 day Static Chironomid Survival and Growth Test (4.4.3.16)
**Species:** *Chironomus dilutus*
**Age:** third instar; 12 days after hatching; average head capsule width 0.40 mm
**Organism source:** Aquatic Biosystems Inc., Fort Collins, Co, USA (Batch 20100924CT)
**Shipped:** 2010/09/23
**Organisms upon receipt:** mortality, < 1 %; temperature, 23°C: dissolved oxygen, 10.6 mg/L
The EC guidance document on the importation of test organisms (1999) has been followed. Test organisms were received in good condition
**Acclimation:** 4 days prior to testing at 23 ± 1°C
**Organism observation:** No unusual behaviour or appearance or treatment of test organisms was noted prior to shipping, upon arrival, preceding or during the test.

**Initial Sample Characterization:**

| | control |
|---|---|
| Total Organic Carbon (%) | 0.6 |
| % Water | 1.4 |
| Particle Size: (% sand) | 84.5 |
| (% silt) | 15.5 |
| (% Clay) | <0.1 |

**Sample holding time:** 25 days (must be ≤ 6 weeks)
**Sample storage:** 4 ± 2°C in darkness
**Test vessel:** The tests were conducted in 375 mL glass jars;
**Test volume:** 100 mL of sediment; 175 mL of overlying dilution/control water; no replenishing
**Control/dilution water:** The control water was dechlorinated City of Calgary tap water preaerated for at least 24 hours.
**Control sediment:** Sediment (%sand: 84.5, %silt: 15.5, %clay: <0.1)
**Test concentrations:** Undiluted samples plus a negative control
**Test replicates:** 5 field replicates of each concentration tested as received; 10 organisms per replicate
**Feeding:** The test organisms were fed three times per week (on non-consecutive days) 3.75 mL of a ground Nutrafin™ slurry
**Measurements:** pH, conductivity, dissolved oxygen and temperature were measured daily on replicate 'E'; overlying hardness, alkalinity and ammonia at test initiation and termination
**Sample pre-treatment:** The sample was homogenized with hand mixing, dispensed into test vessels and allowed to settle overnight with aeration ~ 2-3 bubbles per second.
The sample was not filtered or seived prior to testing.
**Lighting:** Overhead full spectrum fluorescent lights; 500-1000 lux at surface
**Photoperiod:** 16h light:8h dark
**Test temperature:** 23 ± 1°C

Note: Outlined sections are protocol deviations explained on the comment page

## Test Conditions

Client: DIA102
Reference: 10-1356-CTS

| | |
|---|---|
| **Endpoints:** | Survival at 10-d<br>Growth, average individual dry weight at 10-d |
| **Test validity:** | The control had 82% survival (must > 70%);<br>The control had mean dry weight of 2.71 mg/organism (must > 0.6 mg/organism) |
| **Reference toxicant:** | 96 hour test with KCl initiated September 28, 2010;<br>current results: (96 hour LC50 and 95% confidence limits) =<br>0.68 (0.54-0.81) log (g KCl/L) |

## Test Data

Client: DIA102
Reference: 10-1356-CTS

**Test Log:**

| Date | Day | Time | Technicians |
|---|---|---|---|
| 2010/09/28 | 0 | 1530 | E. Petho/H. Stewart |
| 2010/09/29 | 1 | 1100 | E.Petho/G. Diaz |
| 2010/09/30 | 2 | 1100 | R. McCurdy/E. Petho |
| 2010/10/01 | 3 | 1515 | R. McCurdy/E. Petho |
| 2010/10/02 | 4 | 1050 | E. Blais/C. Velasco |
| 2010/10/03 | 5 | 1120 | E. Blais/C. Velasco |
| 2010/10/04 | 6 | 1220 | H. Stewart/R. McCurdy |
| 2010/10/05 | 7 | 1340 | H. Stewart/R. McCurdy |
| 2010/10/06 | 8 | 1530 | H. Stewart/R. McCurdy |
| 2010/10/07 | 9 | 1430 | H. Stewart/R. McCurdy |
| 2010/10/08 | 10 | 1010 | T. Kloschinsky/R. McCurdy |

**Physical & Chemical Data:**

| Parameter | Sample | | | | | |
|---|---|---|---|---|---|---|
| | control | -1 | -2 | -3 | -4 | -5 |
| porewater ammonia (mg/L) | 0.10 | 1.35 | 1.81 | 1.80 | 3.21 | 3.51 |
| overlying ammonia (mg/L) | | | | | | |
| Day 0 | 0.16 | 3.43 | 3.39 | 3.33 | 0.61 | 2.28 |
| Day 10 | 1.52 | 2.83 | 1.25 | 2.30 | 0.10 | 0.09 |
| hardness (mg/L) | | | | | | |
| initial | >425 | 250 | 250 | 250 | 250 | 250 |
| final | 425 | 425 | 425 | 425 | 425 | 425 |
| alkalinity (mg/L) | | | | | | |
| initial | >180 | 240 | >240 | >240 | >240 | >240 |
| final | >240 | >240 | >240 | >240 | >240 | >240 |
| average daily values | | | | | | |
| pH | 8.1 | 8.3 | 8.2 | 8.3 | 8.3 | 7.9 |
| EC (µS/cm) | 513 | 597 | 630 | 628 | 576 | 547 |
| DO (mg/L) | 6.4 | 5.5 | 5.6 | 5.5 | 5.7 | 5.2 |
| temp ($^oC$) | 24 | 24 | 24 | 24 | 24 | 24 |

## Test Data

Client: DIA102
Reference: 10-1356-CTS

**Biology Summary Data:**

| | Sample | | | | | |
|---|---|---|---|---|---|---|
| replicate | control | -1 | -2 | -3 | -4 | -5 |

Survival (number of live organisms in each replicate)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 8 | 2 | 2 | 5 | 2 | 5 |
| b | 9 | 5 | 6 | 6 | 5 | 6 |
| c | 9 | 9 | 6 | 2 | 6 | 7 |
| d | 7 | 3 | 5 | 6 | 2 | 10 |
| e | 8 | 5 | 8 | 5 | 6 | 7 |

| | | | | | | |
|---|---|---|---|---|---|---|
| average | 8 | 5 | 5 | 5 | 4.2 | 7.0 |
| sd | 0.8 | 2.7 | 2.2 | 1.6 | 2.0 | 1.9 |
| cv (%) | 10 | 56 | 41 | 34 | 49 | 27 |
| % survival | 82 | 48 | 54 | 48 | 42 | 70 |
| % controls | 100 | 59 | 66 | 59 | 51 | 85 |

Growth (dry weight)

Total dry weight per replicate (mg)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 17.86 | 0.31 | 1.80 | 1.31 | 1.77 | 9.82 |
| b | 21.62 | 1.76 | 2.62 | 1.20 | 2.34 | 10.54 |
| c | 21.56 | 5.57 | 2.64 | 0.91 | 1.20 | 9.72 |
| d | 24.70 | 1.85 | 1.21 | 1.93 | 0.30 | 8.83 |
| e | 19.04 | 1.99 | 3.02 | 1.33 | 1.97 | 7.89 |

Average dry weight per live organism (mg/organism)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 2.55 | 0.16 | 0.90 | 0.26 | 0.89 | 1.96 |
| b | 2.40 | 0.35 | 0.44 | 0.20 | 0.47 | 1.76 |
| c | 2.70 | 0.62 | 0.44 | 0.45 | 0.20 | 1.39 |
| d | 3.53 | 0.62 | 0.24 | 0.32 | 0.15 | 0.88 |
| e | 2.38 | 0.40 | 0.38 | 0.27 | 0.33 | 1.13 |

| | | | | | | |
|---|---|---|---|---|---|---|
| average | 2.71 | 0.43 | 0.48 | 0.30 | 0.41 | 1.42 |
| sd | 0.47 | 0.20 | 0.25 | 0.10 | 0.29 | 0.44 |
| cv (%) | 17 | 46 | 52 | 32 | 73 | 31 |
| % controls | 100 | 16 | 18 | 11 | 15 | 53 |

Notes: cv, coefficient of variation (%); sd, standard deviation

## Test Data

Client: DIA102
Reference: 10-1356-CTS

**Chemistry:**

| | | Sample | | | | | |
|---|---|---|---|---|---|---|---|
| | day | control | -1 | -2 | -3 | -4 | -5 |
| pH (units) | 0 | 7.9 | 8.1 | 8.2 | 8.3 | 8.2 | 8.1 |
| | 10 | 8.3 | 8.4 | 8.2 | 8.3 | 8.3 | 7.7 |
| EC (µS/cm) | 0 | 485 | 640 | 690 | 684 | 565 | 547 |
| | 10 | 541 | 554 | 570 | 571 | 586 | 547 |
| DO (mg/L) | 0 | 7.8 | 7.8 | 7.7 | 7.7 | 7.7 | 7.7 |
| | 1 | 7.8 | 7.6 | 7.5 | 7.2 | 7.4 | 7.4 |
| | 2 | 7.9 | 6.9 | 7.0 | 6.9 | 7.0 | 5.1 |
| | 3 | 3.0 | 4.8 | 5.0 | 6.1 | 6.1 | 5.0 |
| | 4 | 5.1 | 5.4 | 5.5 | 5.9 | 6.0 | 6.0 |
| | 5 | 6.2 | 5.0 | 5.8 | 5.9 | 6.1 | 6.3 |
| | 6 | 7.0 | 2.1 | 3.0 | 3.0 | 1.7 | 2.4 |
| | 7 | 7.0 | 5.1 | 5.4 | 3.0 | 2.4 | 3.4 |
| | 8 | 5.0 | 1.2 | 1.5 | 2.5 | 5.4 | 5.8 |
| | 9 | 6.5 | 6.7 | 6.7 | 6.8 | 6.8 | 4.0 |
| | 10 | 7.5 | 7.4 | 6.6 | 5.4 | 5.7 | 4.1 |
| temp. (°C) | 0 | 24 | 24 | 24 | 24 | 24 | 24 |
| | 1 | 24 | 24 | 24 | 24 | 24 | 24 |
| | 2 | 23 | 23 | 23 | 23 | 23 | 23 |
| | 3 | 24 | 24 | 24 | 24 | 24 | 24 |
| | 4 | 23 | 23 | 23 | 23 | 23 | 23 |
| | 5 | 23 | 23 | 23 | 23 | 23 | 23 |
| | 6 | 23 | 23 | 23 | 23 | 23 | 23 |
| | 7 | 23 | 23 | 23 | 23 | 23 | 23 |
| | 8 | 24 | 24 | 24 | 24 | 24 | 24 |
| | 9 | 24 | 24 | 24 | 24 | 24 | 24 |
| | 10 | 24 | 24 | 24 | 24 | 24 | 24 |

## Comments/Statistics

Client: DIA102
Reference: 10-1356-CTS

**Test Result Comments:**
NI-3-TOX-D replicate arrived broken so the NI-3-Ammonia sample replaced this field replicate.

**Data Analysis:**
One fly was found in each of control replicates 'a' and 'c'. These were included in the survival calculations, but were not included in the dry weight.

**Protocol Deviations:**
None

# Chironomid Test Report

## Quality Assurance Information

**Test Method:** 96 hours Acute Lethality Test with *Chironomus dilutus*

**Reference:** Biological Test Method: Test for Survival and Growth in Sediment Using the Larvae of Freshwater Midges (*Chironomus dilutus* or *Chironomus riparius*), 1997. Environment Canada EPS 1RM/32.

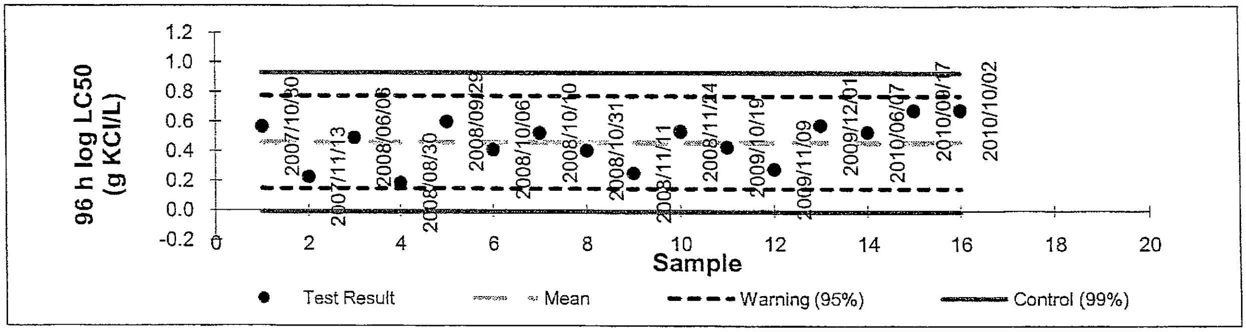
**Test Organism:**

test species: *Chironomus dilutus (formerly Chironomus tentans)*
culture source: Aquatic Biosystems, Inc. Fort Collins, CO, USA
culture batch 20100928CT
culture vessels: 15 L glass aquaria
dilution water: dechlorinated tap water
control sediment: silica sand or formulated soil
organism age: third instar (9 days old)
food source: Nutrafin (4g/L)

| **Test Design:** | **Reftox** |
|---|---|
| test duration (days): | 4 |
| test temperature: | 23 ± 1°C |
| test jar volume: | 375mL |
| sediment volume: | N/A |
| water volume: | 200mL |
| light levels (lux): | 500-1000 |
| photoperiod (hours): | 16 hours light: 8 hours dark |
| replicates/treatment: | 1 |
| organisms/replicate: | 10 |
| feeding: | 1.25 mL/jar on day 0 and 2 |

**Warning Chart:** mortality LC50 at 96 hours
toxicant: Potassium chloride (KCl)
**Current Test:** started on 2010/09/28 ended on 2010/10/02
result (96 h LC50): 0.68 (0.54-0.81) log (g KCl/L) (95% confidence limits are in brackets)

| | | | | | | |
|---|---|---|---|---|---|---|
| **Historical Mean:** | mean: | 0.5 | std.dev: | 0.2 | cv(%): | 34 |
| warning limits: | 0.1 | 0.8 | (lower and upper 95% confidence limit, two standard deviations) | | | |
| control limits: | 0.0 | 0.9 | (lower and upper 99% confidence limit, three standard deviations) | | | |



The data and results are authorized and verified correct.

E. Kenson for

E. Blais, B.Sc., Technical Lead

S. Krishnappa, B.Sc., Quality Coordinator

**HydroQual**
Laboratories Ltd.

# *Chironomid* (single concentration)
# Test Report
### Re-issued 2011/03/07

Client: DIA102
Reference: 10-1356-CTS

**Contents**

## Result Summary

**Client:** Diavik Diamond Mines; operation Yellowknife

**Sample:** REF-1, REF-2, REF-3

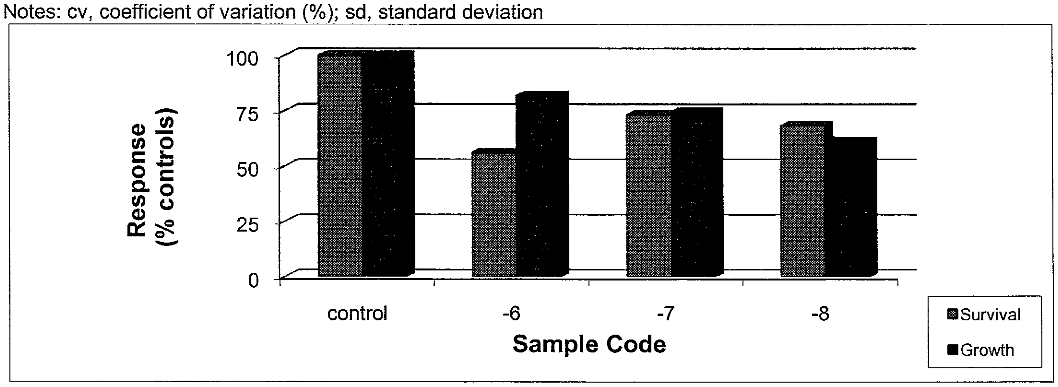
**Collection:** collected on 2010/09/03 at not given by SED
**Receipt:** received on 2010/09/05 at 1400 by H. Stewart
**Containers:** received 48 x 500 ml glass jars at 14 °C, in good condition* (see test comments) with no seals and no
**Description:** type: sediment, collection method: not given

**Test:** started on 2010/09/28 ; ended on 2010/10/08

**Result:**

| Sample | Description | Survival | | | Growth (dry wt (mg) / organism) | | |
|---|---|---|---|---|---|---|---|
| | | mean | sd | cv(%) | mean | sd | cv(%) |
| | lab control | 8 | 0.8 | 10 | 2.7 | 0.47 | 17 |
| 6 | REF-1 | 5 | 1.7 | 36 | 2.2 | 0.30 | 14 |
| 7 | REF-2 | 6 | 1.9 | 31 | 2.0 | 0.29 | 14 |
| 8 | REF-3 | 6 | 0.9 | 16 | 1.7 | 0.34 | 21 |

Notes: cv, coefficient of variation (%); sd, standard deviation



Technical Lead

Quality Coordinator

## Test Conditions

Client: DIA102
Reference: 10-1356-CTS

**Method:** Biological Test Method: Test for Survival and Growth in Sediment Using the Larvae of Freshwater Midges (*Chironomus dilutus* or *Chironomus riparius*), 1997. Environment Canada EPS 1/RM/32.

**Test type:** 10 day Static Chironomid Survival and Growth Test (4.4.3.16)
**Species:** *Chironomus dilutus*
**Age:** third instar; 12 days after hatching; average head capsule width 0.40 mm
**Organism source:** Aquatic Biosystems Inc., Fort Collins, Co, USA (Batch 20100924CT)
**Shipped:** 2010/09/23
**Organisms upon receipt:** mortality, < 1 %; temperature, 23°C: dissolved oxygen, 10.6 mg/L The EC guidance document on the importation of test organisms (1999) has been followed. Test organisms were received in good condition
**Acclimation:** 4 days prior to testing at 23 ± 1°C
**Organism observation:** No unusual behaviour or appearance or treatment of test organisms was noted prior to shipping, upon arrival, preceding or during the test.

**Initial Sample Characterization:**

| | control |
|---|---|
| Total Organic Carbon (%) | 0.6 |
| % Water | 1.4 |
| Particle Size: (% sand) | 84.5 |
| (% silt) | 15.5 |
| (% Clay) | <0.1 |

**Sample holding time:** 25 days (must be ≤ 6 weeks)
**Sample storage:** 4 ± 2°C in darkness
**Test vessel:** The tests were conducted in 375 mL glass jars;
**Test volume:** 100 mL of sediment; 175 mL of overlying dilution/control water; no replenishing
**Control/dilution water:** The control water was dechlorinated City of Calgary tap water preaerated for at least 24 hours.
**Control sediment:** Sediment (%sand: 84.5, %silt: 15.5, %clay: <0.1)
**Test concentrations:** Undiluted samples plus a negative control
**Test replicates:** 5 field replicates of each concentration tested as received; 10 organisms per replicate
**Feeding:** The test organisms were fed three times per week (on non-consecutive days) 3.75 mL of a ground Nutrafin™ slurry
**Measurements:** pH, conductivity, dissolved oxygen and temperature were measured daily on replicate 'E'; overlying hardness, alkalinity and ammonia at test initiation and termination
**Sample pre-treatment:** The sample was homogenized with hand mixing, dispensed into test vessels and allowed to settle overnight with aeration ~ 2-3 bubbles per second. The sample was not filtered or seived prior to testing.
**Lighting:** Overhead full spectrum fluorescent lights; 500-1000 lux at surface
**Photoperiod:** 16h light:8h dark
**Test temperature:** 23 ± 1°C

Note: Outlined sections are protocol deviations explained on the comment page

## Test Conditions

Client: DIA102
Reference: 10-1356-CTS

| | |
|---|---|
| **Endpoints:** | Survival at 10-d<br>Growth, average individual dry weight at 10-d |
| **Test validity:** | The control had 82% survival (must > 70%);<br>The control had mean dry weight of 2.71 mg/organism (must > 0.6 mg/organism) |
| **Reference toxicant:** | 96 hour test with KCl initiated September 28, 2010;<br>current results: (96 hour LC50 and 95% confidence limits) =<br>0.68 (0.54-0.81) log (g KCl/L) |

## Test Data

Client: DIA102
Reference: 10-1356-CTS

**Test Log:**

| Date | Day | Time | Technicians |
|---|---|---|---|
| 2010/09/28 | 0 | 1530 | E. Petho/H. Stewart |
| 2010/09/29 | 1 | 1100 | E.Petho/G. Diaz |
| 2010/09/30 | 2 | 1100 | R. McCurdy/E. Petho |
| 2010/10/01 | 3 | 1515 | R. McCurdy/E. Petho |
| 2010/10/02 | 4 | 1050 | E. Blais/C. Velasco |
| 2010/10/03 | 5 | 1120 | E. Blais/C. Velasco |
| 2010/10/04 | 6 | 1220 | H. Stewart/R. McCurdy |
| 2010/10/05 | 7 | 1340 | H. Stewart/R. McCurdy |
| 2010/10/06 | 8 | 1530 | H. Stewart/R. McCurdy |
| 2010/10/07 | 9 | 1430 | H. Stewart/R. McCurdy |
| 2010/10/08 | 10 | 1010 | T. Kloschinsky/R. McCurdy |

**Physical & Chemical Data:**

| Parameter | Sample | | | | | |
|---|---|---|---|---|---|---|
| | control | -6 | -7 | -8 | | |
| porewater ammonia (mg/L) | 0.10 | 0.49 | 0.40 | 0.35 | | |
| overlying ammonia (mg/L) | | | | | | |
| Day 0 | 0.16 | 0.14 | 0.18 | 0.17 | | |
| Day 10 | 1.52 | 1.90 | 2.48 | 2.52 | | |
| hardness (mg/L) | | | | | | |
| initial | >425 | 120 | 120 | 120 | | |
| final | 425 | 100 | 100 | 100 | | |
| alkalinity (mg/L) | | | | | | |
| initial | >180 | 40 | 80 | 40 | | |
| final | >240 | 80 | 80 | 80 | | |
| average daily values | | | | | | |
| pH | 8.1 | 8.1 | 7.6 | 7.6 | | |
| EC (µS/cm) | 513 | 296 | 275 | 615 | | |
| DO (mg/L) | 6.4 | 5.5 | 5.3 | 5.4 | | |
| temp (°C) | 24 | 24 | 24 | 24 | | |

## Test Data

Client: DIA102
Reference: 10-1356-CTS

**Biology Summary Data:**

| | Sample | | | | | |
|---|---|---|---|---|---|---|
| replicate | control | -6 | -7 | -8 | | |

Survival (number of live organisms in each replicate)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 8 | 2 | 6 | 7 | | |
| b | 9 | 6 | 8 | 6 | | |
| c | 9 | 5 | 6 | 5 | | |
| d | 7 | 6 | 3 | 5 | | |
| e | 8 | 4 | 7 | 5 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| average | 8 | 5 | 6 | 6 | | |
| sd | 0.8 | 1.7 | 1.9 | 0.9 | | |
| cv (%) | 10 | 36 | 31 | 16 | | |
| % survival | 82 | 46 | 60 | 56 | | |
| % controls | 100 | 56 | 73 | 68 | | |

Growth (dry weight)

Total dry weight per replicate (mg)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 17.86 | 4.86 | 10.02 | 8.30 | | |
| b | 21.62 | 11.77 | 16.08 | 12.20 | | |
| c | 21.56 | 9.27 | 11.56 | 8.75 | | |
| d | 24.70 | 13.71 | 7.41 | 7.27 | | |
| e | 19.04 | 10.24 | 14.17 | 9.49 | | |

Average dry weight per live organism (mg/organism)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 2.55 | 2.43 | 1.67 | 1.19 | | |
| b | 2.40 | 1.96 | 2.01 | 2.03 | | |
| c | 2.70 | 1.85 | 1.93 | 1.75 | | |
| d | 3.53 | 2.29 | 2.47 | 1.45 | | |
| e | 2.38 | 2.56 | 2.02 | 1.90 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| average | 2.71 | 2.22 | 2.02 | 1.66 | | |
| sd | 0.47 | 0.30 | 0.29 | 0.34 | | |
| cv (%) | 17 | 14 | 14 | 21 | | |
| % controls | 100 | 82 | 75 | 61 | | |

Notes: cv, coefficient of variation (%); sd, standard deviation

## Test Data

Client: DIA102
Reference: 10-1356-CTS

**Chemistry:**

| | | Sample | | | | | |
|---|---|---|---|---|---|---|---|
| | day | control | -6 | -7 | -8 | | |
| pH (units) | 0 | 7.9 | 8.2 | 7.9 | 7.8 | | |
| | 10 | 8.3 | 7.9 | 7.3 | 7.4 | | |
| EC (µS/cm) | 0 | 485 | 253 | 257 | 598 | | |
| | 10 | 541 | 339 | 292 | 632 | | |
| DO (mg/L) | 0 | 7.8 | 7.7 | 7.7 | 7.7 | | |
| | 1 | 7.8 | 7.4 | 7.4 | 7.1 | | |
| | 2 | 7.9 | 5.4 | 5.6 | 5.6 | | |
| | 3 | 3.0 | 4.0 | 3.1 | 4.3 | | |
| | 4 | 5.1 | 5.8 | 5.3 | 5.0 | | |
| | 5 | 6.2 | 6.1 | 6.1 | 5.7 | | |
| | 6 | 7.0 | 1.2 | 2.2 | 2.2 | | |
| | 7 | 7.0 | 2.8 | 3.2 | 2.8 | | |
| | 8 | 5.0 | 6.4 | 6.5 | 6.9 | | |
| | 9 | 6.5 | 4.5 | 6.3 | 6.7 | | |
| | 10 | 7.5 | 8.9 | 5.2 | 5.4 | | |
| temp. (°C) | 0 | 24 | 24 | 24 | 24 | | |
| | 1 | 24 | 24 | 24 | 24 | | |
| | 2 | 23 | 23 | 23 | 23 | | |
| | 3 | 24 | 24 | 24 | 24 | | |
| | 4 | 23 | 23 | 23 | 23 | | |
| | 5 | 23 | 23 | 23 | 23 | | |
| | 6 | 23 | 23 | 23 | 23 | | |
| | 7 | 23 | 23 | 23 | 23 | | |
| | 8 | 24 | 24 | 24 | 24 | | |
| | 9 | 24 | 24 | 24 | 24 | | |
| | 10 | 24 | 24 | 24 | 24 | | |

## Comments/Statistics

Client: DIA102
Reference: 10-1356-CTS

**Test Result Comments:**
None

**Data Analysis:**
One fly was found in each of control replicates 'a' and 'c'. These were included in the survival calculations, but were not included in the dry weight.

**Protocol Deviations:**
None

**HydroQual**
Laboratories Ltd.

# Chironomid Test Report

## Quality Assurance Information

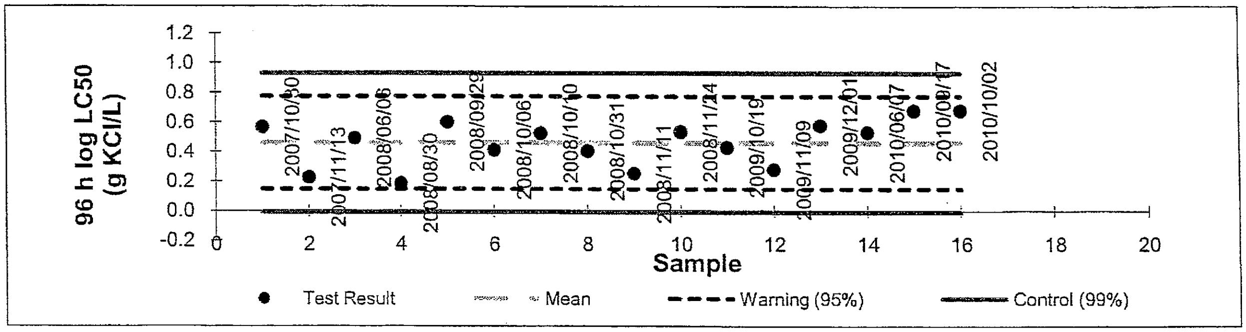
**Test Method:** 96 hours Acute Lethality Test with *Chironomus dilutus*
**Reference:** Biological Test Method: Test for Survival and Growth in Sediment Using the Larvae of Freshwater Midges (*Chironomus dilutus* or *Chironomus riparius*), 1997. Environment Canada EPS 1RM/32.

**Test Organism:**
test species: *Chironomus dilutus (formerly Chironomus tentans)*
culture source: Aquatic Biosystems, Inc.
Fort Collins, CO, USA
culture batch 20100928CT
culture vessels: 15 L glass aquaria
dilution water: dechlorinated tap water
control sediment: silica sand or formulated soil
organism age: third instar (9 days old)
food source: Nutrafin (4g/L)

**Test Design:** **Reftox**
test duration (days): 4
test temperature: 23 ± 1°C
test jar volume: 375mL
sediment volume: N/A
water volume: 200mL
light levels (lux): 500-1000
photoperiod (hours): 16 hours light: 8 hours dark
replicates/treatment: 1
organisms/replicate: 10
feeding: 1.25 mL/jar on day 0 and 2

**Warning Chart:** mortality LC50 at 96 hours
toxicant: Potassium chloride (KCl)
**Current Test:** started on 2010/09/28 ended on 2010/10/02
result (96 h LC50): 0.68 (0.54-0.81) log (g KCl/L) (95% confidence limits are in brackets)

| | | | | | | |
|---|---|---|---|---|---|---|
| **Historical Mean:** | mean: | 0.5 | std.dev: | 0.2 | cv(%): | 34 |
| warning limits: | 0.1 | 0.8 | (lower and upper 95% confidence limit, two standard deviations) | | | |
| control limits: | 0.0 | 0.9 | (lower and upper 99% confidence limit, three standard deviations) | | | |



The data and results are authorized and verified correct.

E. Blais, B.Sc., Technical Lead

S. Krishnappa, B.Sc., Quality Coordinator

**HydroQual**
Laboratories Ltd.

# *Chironomid* (single concentration)
# Test Report
**Re-issued 2011/03/07**

| |
|---|
| Client: DIA102 |
| Reference: 10-1392-CTS |

**Contents**

## Result Summary

**Client:** Diavik Diamond Mines; operation Yellowknife

**Sample:** sludge

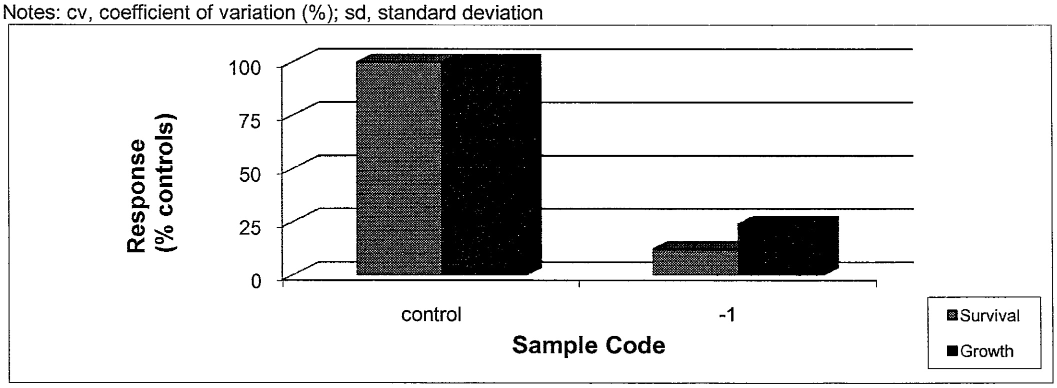
**Collection:** collected on 2010/09/02 at not given by not given
**Receipt:** received on 2010/09/13 at 1330 by C. Ehman
**Containers:** received 1 x 20L pail at 14 °C, in good with no seals and no initials
**Description:** type: sludge, collection method: not given

**Test:** started on 2010/09/28 ; ended on 2010/10/08

**Result:**

| Sample | Description | Survival | | | Growth (dry wt (mg) / organism) | | |
|---|---|---|---|---|---|---|---|
| | | mean | sd | cv(%) | mean | sd | cv(%) |
| | lab control | 8 | 0.8 | 10 | 2.7 | 0.47 | 17 |
| 1 | sludge | 1 | 1.0 | 100 | 0.7 | 0.29 | 44 |

Notes: cv, coefficient of variation (%); sd, standard deviation



Technical Lead

Quality Coordinator

## Test Conditions

Client: DIA102
Reference: 10-1392-CTS

**Method:** Biological Test Method: Test for Survival and Growth in Sediment Using the Larvae of Freshwater Midges (*Chironomus dilutus* or *Chironomus riparius*), 1997. Environment Canada EPS 1/RM/32.

**Test type:** 10 day Static Chironomid Survival and Growth Test (4.4.3.16)
**Species:** *Chironomus dilutus*
**Age:** third instar; 12 days after hatching; average head capsule width 0.40 mm
**Organism source:** Aquatic Biosystems Inc., Fort Collins, Co, USA (Batch 20100924CT)
**Shipped:** 2010/09/23
**Organisms upon receipt:** mortality, < 1 %; temperature, 23.4°C: dissolved oxygen, 10.6 mg/L
The EC guidance document on the importation of test organisms (1999) has been followed. Test organisms were received in good condition
**Acclimation:** 4 days prior to testing at 23 ± 1°C
**Organism observation:** No unusual behaviour or appearance or treatment of test organisms was noted prior to shipping, upon arrival, preceding or during the test.

**Initial Sample Characterization:**

| | control |
|---|---|
| Total Organic Carbon (%) | 0.6 |
| % Water | 1.4 |
| Particle Size: (% sand) | 84.5 |
| (% silt) | 15.5 |
| (% Clay) | <0.1 |

**Sample holding time:** 26 days (≤ 6 weeks)
**Sample storage:** 4 ± 2°C in darkness

**Test vessel:** The tests were conducted in 375 mL glass jars;
**Test volume:** 100 mL of sediment; 175 mL of overlying dilution/control water; no replenishing
**Control/dilution water:** The control water was dechlorinated City of Calgary tap water preaerated for at least 24 hours.
**Control sediment:** Sediment (%sand: 84.5, %silt: 15.5, %clay: <1)
**Test concentrations:** Undiluted sample plus a negative control
**Test replicates:** 5 replicates of each concentration; 10 organisms per replicate
**Feeding:** The test organisms were fed three times per week (on non-consecutive days) 3.75 mL of a ground Nutrafin™ slurry
**Measurements:** pH, conductivity, dissolved oxygen and temperature were measured daily on replicate 'E'; overlying hardness, alkalinity and ammonia at test initiation and termination
**Sample pre-treatment:** The sample was homogenized with hand mixing, dispensed into test vessels and allowed to settle overnight with aeration ~ 2-3 bubbles per second.
The sample was not filtered or seived prior to testing.
**Lighting:** Overhead full spectrum fluorescent lights; 500-1000 lux at surface
**Photoperiod:** 16h light:8h dark
**Test temperature:** 23 ± 1°C

Note: Outlined sections are protocol deviations explained on the comment page

Client: DIA102
Reference: 10-1392-CTS

## Test Conditions

**Endpoints:** Survival at 10-d
Growth, average individual dry weight at 10-d

**Test validity:** The control had 82% survival (must > 70%);
The control had mean dry weight of 2.71 mg/organism (must > 0.6 mg/organism)

**Reference toxicant:** 96 hour test with KCl initiated September 28, 2010;
current results: (96 hour LC50 and 95% confidence limits) =
0.68 (0.54-0.81) log (g KCl/L)

Note: Outlined sections are protocol deviations explained on the comment page

## Test Data

Client: DIA102
Reference: 10-1392-CTS

**Test Log:**

| Date | Day | Time | Technicians |
|---|---|---|---|
| 2010/09/28 | 0 | 1530 | E. Petho/H. Stewart |
| 2010/09/29 | 1 | 1100 | E.Petho/G. Diaz |
| 2010/09/30 | 2 | 1100 | R. McCurdy/E. Petho |
| 2010/10/01 | 3 | 1515 | R. McCurdy/E. Petho |
| 2010/10/02 | 4 | 1050 | E. Blais/C. Velasco |
| 2010/10/03 | 5 | 1120 | E. Blais/C. Velasco |
| 2010/10/04 | 6 | 1220 | H. Stewart/R. McCurdy |
| 2010/10/05 | 7 | 1340 | H. Stewart/R. McCurdy |
| 2010/10/06 | 8 | 1530 | H. Stewart/R. McCurdy |
| 2010/10/07 | 9 | 1430 | H. Stewart/R. McCurdy |
| 2010/10/08 | 10 | 1010 | T. Kloschinsky/R. McCurdy |

**Physical & Chemical Data:**

| Parameter | Sample | | | | | |
|---|---|---|---|---|---|---|
| | control | -1 | | | | |
| porewater ammonia (mg/L) | 0.16 | 0.62 | | | | |
| overlying ammonia (mg/L) | | | | | | |
| Day 0 | 0.16 | 3.72 | | | | |
| Day 10 | 1.52 | 3.59 | | | | |
| hardness (mg/L) | | | | | | |
| initial | >425 | 250 | | | | |
| final | 425 | 425 | | | | |
| alkalinity (mg/L) | | | | | | |
| initial | >180 | 240 | | | | |
| final | >240 | >240 | | | | |
| average daily values | | | | | | |
| pH | 8.1 | 7.4 | | | | |
| EC (μS/cm) | 513 | 615 | | | | |
| DO (mg/L) | 6.4 | 5.0 | | | | |
| temp ($^{o}$C) | 24 | 24 | | | | |

## Test Data

Client: DIA102
Reference: 10-1392-CTS

**Biology Summary Data:**

| | Sample | | | | | |
|---|---|---|---|---|---|---|
| replicate | control | -1 | | | | |

Survival (number of live organisms in each replicate)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 8 | 2 | | | | |
| b | 9 | 0 | | | | |
| c | 9 | 2 | | | | |
| d | 7 | 1 | | | | |
| e | 8 | 0 | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| average | 8 | 1 | | | | |
| sd | 0.8 | 1.0 | | | | |
| cv (%) | 10 | 100 | | | | |
| % survival | 82 | 10 | | | | |
| % controls | 100 | 12 | | | | |

Growth (dry weight)

Total dry weight per replicate (mg)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 17.86 | 0.72 | | | | |
| b | 21.62 | 0.00 | | | | |
| c | 21.56 | 1.34 | | | | |
| d | 24.70 | 0.93 | | | | |
| e | 19.04 | 0.00 | | | | |

Average dry weight per live organism (mg/organism)

| | | | | | | |
|---|---|---|---|---|---|---|
| a | 2.55 | 0.36 | | | | |
| b | 2.40 | - | | | | |
| c | 2.70 | 0.67 | | | | |
| d | 3.53 | 0.93 | | | | |
| e | 2.38 | - | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| average | 2.71 | 0.65 | | | | |
| sd | 0.47 | 0.29 | | | | |
| cv (%) | 17 | 44 | | | | |
| % controls | 100 | 24 | | | | |

Notes: cv, coefficient of variation (%); sd, standard deviation

Client: DIA102
Reference: 10-1392-CTS

**Chemistry:**

| | | Sample | | | | | |
|---|---|---|---|---|---|---|---|
| | day | control | -1 | | | | |
| pH (units) | 0 | 7.9 | 7.7 | | | | |
| | 10 | 8.3 | 7.0 | | | | |
| EC (µS/cm) | 0 | 485 | 598 | | | | |
| | 10 | 541 | 632 | | | | |
| DO (mg/L) | 0 | 7.8 | 6.9 | | | | |
| | 1 | 7.8 | 4.0 | | | | |
| | 2 | 7.9 | 4.3 | | | | |
| | 3 | 3.0 | 5.0 | | | | |
| | 4 | 5.1 | 5.0 | | | | |
| | 5 | 6.2 | 5.1 | | | | |
| | 6 | 7.0 | 1.6 | | | | |
| | 7 | 7.0 | 1.5 | | | | |
| | 8 | 5.0 | 7.3 | | | | |
| | 9 | 6.5 | 7.0 | | | | |
| | 10 | 7.5 | 7.2 | | | | |
| temp. (°C) | 0 | 24 | 24 | | | | |
| | 1 | 24 | 24 | | | | |
| | 2 | 23 | 23 | | | | |
| | 3 | 24 | 24 | | | | |
| | 4 | 23 | 23 | | | | |
| | 5 | 23 | 23 | | | | |
| | 6 | 23 | 23 | | | | |
| | 7 | 23 | 23 | | | | |
| | 8 | 24 | 24 | | | | |
| | 9 | 24 | 24 | | | | |
| | 10 | 24 | 24 | | | | |

## Comments/Statistics

Client: DIA102
Reference: 10-1392-CTS

**Test Result Comments:**
None

**Data Analysis:**
One fly was found in each of control replicates 'a' and 'c'. These were included in the survival calculations, but were not included in the dry weight.

**Protocol Deviations:**
None

## Quality Assurance Information

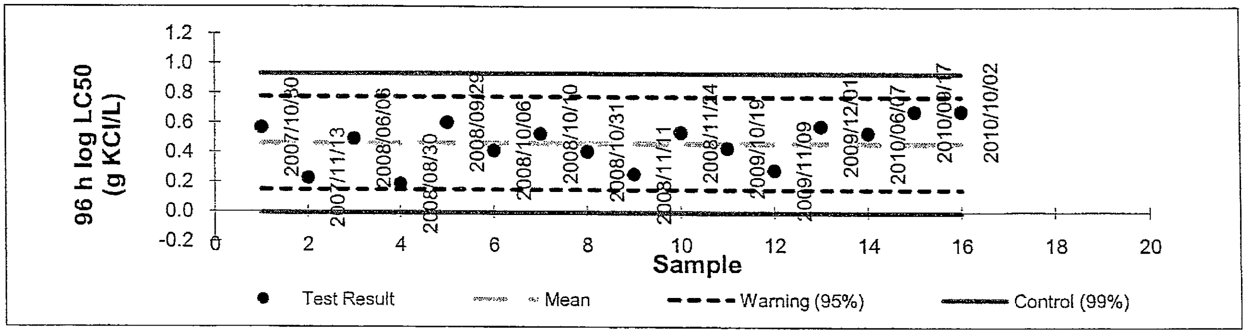
**Test Method:** 96 hours Acute Lethality Test with *Chironomus dilutus*
**Reference:** Biological Test Method: Test for Survival and Growth in Sediment Using the Larvae of Freshwater Midges (*Chironomus dilutus* or *Chironomus riparius*), 1997. Environment Canada EPS 1RM/32.

| **Test Organism:** | |
|---|---|
| test species: | *Chironomus dilutus (formerly Chironomus tentans)* |
| culture source: | Aquatic Biosystems, Inc.<br>Fort Collins, CO, USA |
| culture batch | 20100928CT |
| culture vessels: | 15 L glass aquaria |
| dilution water: | dechlorinated tap water |
| control sediment: | silica sand or formulated soil |
| organism age: | third instar (9 days old) |
| food source: | Nutrafin (4g/L) |

| **Test Design:** | **Reftox** |
|---|---|
| test duration (days): | 4 |
| test temperature: | 23 ± 1°C |
| test jar volume: | 375mL |
| sediment volume: | N/A |
| water volume: | 200mL |
| light levels (lux): | 500-1000 |
| photoperiod (hours): | 16 hours light: 8 hours dark |
| replicates/treatment: | 1 |
| organisms/replicate: | 10 |
| feeding: | 1.25 mL/jar on day 0 and 2 |

**Warning Chart:** mortality LC50 at 96 hours
toxicant: Potassium chloride (KCl)
**Current Test:** started on 2010/09/28 ended on 2010/10/02
result (96 h LC50): 0.68 (0.54-0.81) log (g KCl/L) (95% confidence limits are in brackets)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Historical Mean:** | mean: | 0.5 | std.dev: | 0.2 | cv(%): | 34 | |
| warning limits: | 0.1 | 0.8 | (lower and upper 95% confidence limit, two standard deviations) | | | | |
| control limits: | 0.0 | 0.9 | (lower and upper 99% confidence limit, three standard deviations) | | | | |



The data and results are authorized and verified correct.

E. Blais, B.Sc., Technical Lead

S. Krishnappa, B.Sc., Quality Coordinator

# APPENDIX E

## Benthic Invertebrate Taxonomy and Biomass Data (Dr. Jack Zloty)

**DDMI 2010, North Inlet - Benthic Invertebrate Data**

| | | | | | NI-1 | | | | | NI-2 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Major Group** | **Family** | **Subfamily** | **Tribe** | **Genus** | **A** | **B** | **C** | **D** | **E** | **A** | **B** | **C** | **D** | **E** |
| Turbellaria | Typhloplanidae | - | - | *Mesostoma* | | | | | | | | | | |
| Nematoda | - | - | - | - | | | | | | | | | | |
| Oligochaeta | Enchytraeidae | - | - | - | | | | | | | | | | |
| | Lumbriculidae | - | - | - | | | | | | | | | | |
| | Naididae | - | - | - | | | | | | | | | | |
| | Tubificidae | - | - | - | | | | | | | | | | |
| Pelecypoda | Pisidiidae | - | - | (i/d) | | | | | | | | | | |
| | | - | - | *Sphaerium* | | | | | | | | | | |
| Hydracarina | - | - | - | - | | | | | | | | | | |
| Copepoda - Calanoida | - | - | - | - | | | 1 | | | | | | 1 | |
| Copepoda - Cyclopoida | - | - | - | - | 25 | | 3 | | 10 | 5 | 4 | 1 | 3 | 5 |
| Copepoda - Harpacticoida | - | - | - | - | | | | | | | | | | |
| Ostracoda | - | - | - | - | 1 | | | | | | | | | |
| Cladocera | Chydoridae | - | - | *Eurycercus* | | | | | | | | | | |
| | Daphniidae | - | - | *Daphnia* | | | | | | | | | | |
| Trichoptera | Limnephilidae | Limnephilinae | Chilostigmini | *Grensia praeterita* | | | | | | | | | | |
| Diptera | Chironomidae | Tanypodinae | Procladiini | *Procladius* | | | | | | | | | | |
| | | Diamesinae | Protanypini | *Protanypus* | | | | | | | | | | |
| | | Prodiamesinae | - | *Monodiamesa* | | | 1 | | | | | | | |
| | | Orthocladiinae | - | (i/d) | | | | | | | | | | |
| | | | | *Abiskomyia* | | | | | | | | | | |
| | | | | *Cricotopus/Orthocladius* | | | 1 | | | | 1 | | | |
| | | | | *Heterotrissocladius* | | | | | | | | | | |
| | | | | *Psectrocladius* | | | 1 | 1 | 1 | | | | | |
| | | | | *Pseudosmittia* | | | | | | | | | | |
| | | | | *Zalutschia* | | | | | | | | | | |
| | | Chironominae | Chironomini | *Dicrotendipes* | | | | | | | | | | |
| | | | | *Endochironomus* | | | | | | 1 | | | | |
| | | | | *Microtendipes* | 1 | | | | | | | | | |
| | | | | *Stictochironomus* | | | | | | | | | | |
| | | | Tanytarsini | *Micropsectra* | | | | | | | | | | |
| | | | | *Micropsectra/Tanytarsus* | | | | | | | | | | |
| | | | | *Paratanytarsus* | | | 1 | | | | | | | |
| | | | | *Stempellina ?* | | | | | | | | | | |
| | | | | *Tanytarsus* | | | | | | | | | | |
| Terrestrial | - | - | - | - | | 0 | | | | | 1 | | 1 | |
| ***Total*** | | | | | ***27*** | ***0*** | ***8*** | ***1*** | ***11*** | ***6*** | ***6*** | ***1*** | ***5*** | ***5*** |

Biomass (g)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Chironomidae | 0.0001 | | 0.0050 | 0.0026 | 0.0002 | 0.0002 | 0.0001 | | | |
| Other taxa | 0.0019 | 0.0000 | 0.0002 | | 0.0007 | 0.0003 | 0.0010 | 0.00005 | 0.0008 | 0.0002 |
| ***Total*** | ***0.0020*** | ***0.0000*** | ***0.0052*** | ***0.0026*** | ***0.0009*** | ***0.0005*** | ***0.0011*** | ***0.0001*** | ***0.0008*** | ***0.0002*** |

**DDMI 2010, North Inlet - Benthic Invertebrate Data**

| | | | | | NI | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | NI-3 | | | | | NI-4 | | | | |
| **Major Group** | **Family** | **Subfamily** | **Tribe** | **Genus** | **A** | **B** | **C** | **D** | **E** | **A** | **B** | **C** | **D** | **E** |
| Turbellaria | Typhloplanidae | - | - | *Mesostoma* | | | | | | | | | | |
| Nematoda | - | - | - | - | | | | | | | | | | |
| Oligochaeta | Enchytraeidae | - | - | - | | | | | | | | | | |
| | Lumbriculidae | - | - | - | | | | | | | | | | |
| | Naididae | - | - | - | | | | | | | | | | |
| | Tubificidae | - | - | - | 1 | 1 | | | | | | | 3 | 2 |
| Pelecypoda | Pisidiidae | - | - | (i/d) | | | | | | | | | | |
| | | - | - | *Sphaerium* | | | | | | | | | | |
| Hydracarina | - | - | - | - | | | | | | | | | | |
| Copepoda - Calanoida | - | - | - | - | 6 | | 1 | | 1 | | 11 | 9 | 15 | 19 |
| Copepoda - Cyclopoida | - | - | - | - | 5 | 1 | | 1 | 6 | 5 | 11 | 1 | 6 | 4 |
| Copepoda - Harpacticoida | - | - | - | - | | | | | | | | | | |
| Ostracoda | - | - | - | - | | | | | | | | | | |
| Cladocera | Chydoridae | - | - | *Eurycercus* | | | | | | | | | | |
| | Daphniidae | - | - | *Daphnia* | | | | | | 1 | | | | |
| Trichoptera | Limnephilidae | Limnephilinae | Chilostigmini | *Grensia praeterita* | | | | | | | | | | |
| Diptera | Chironomidae | Tanypodinae | Procladiini | *Procladius* | | | | | | | | | | |
| | | Diamesinae | Protanypini | *Protanypus* | | | | | | | | | | |
| | | Prodiamesinae | - | *Monodiamesa* | | | | | | | | | | |
| | | Orthocladiinae | - | (i/d) | | | | | | | | | | |
| | | | | *Abiskomyia* | | | | | | | | | | |
| | | | | *Cricotopus/Orthocladius* | | | | | | | | | | |
| | | | | *Heterotrissocladius* | | | | | | | | | | |
| | | | | *Psectrocladius* | | | | | | 1 | 1 | | 1 | |
| | | | | *Pseudosmittia* | | | | | | 1 | | | | |
| | | | | *Zalutschia* | | | | | | | | | | |
| | | Chironominae | Chironomini | *Dicrotendipes* | | | | | | | | | | |
| | | | | *Endochironomus* | | | | | | | | | | |
| | | | | *Microtendipes* | | | | | | | | | | |
| | | | | *Stictochironomus* | | | | | | | | | | |
| | | | Tanytarsini | *Micropsectra* | | | | | | | | | | |
| | | | | *Micropsectra/Tanytarsus* | | | | | | | | | | |
| | | | | *Paratanytarsus* | | | | | | | | | | |
| | | | | *Stempellina ?* | | | | | | | | | | |
| | | | | *Tanytarsus* | | | | | | | | | | |
| Terrestrial | - | - | - | - | | | | | 2 | | | | | |
| ***Total*** | | | | | ***12*** | ***2*** | ***1*** | ***1*** | ***9*** | ***8*** | ***23*** | ***10*** | ***25*** | ***25*** |

Biomass (g)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Chironomidae | | | | | | 0.0023 | 0.0027 | | 0.0001 | |
| Other taxa | 0.0012 | 0.0026 | 0.00005 | 0.00005 | 0.0028 | 0.0004 | 0.0015 | 0.0006 | 0.0045 | 0.0027 |
| ***Total*** | ***0.0012*** | ***0.0026*** | ***0.0001*** | ***0.0001*** | ***0.0028*** | ***0.0027*** | ***0.0042*** | ***0.0006*** | ***0.0046*** | ***0.0027*** |

**DDMI 2010, North Inlet - Benthic Invertebrate Data**

| | | | | | NI-5 | | | | | REF-1 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Major Group** | **Family** | **Subfamily** | **Tribe** | **Genus** | **A** | **B** | **C** | **D** | **E** | **A** | **B** | **C** | **D** | **E** |
| Turbellaria | Typhloplanidae | - | - | *Mesostoma* | | | | | | 3 | | 1 | 1 | 6 |
| Nematoda | - | - | - | - | | | | | | 1 | | 1 | 4 | 3 |
| Oligochaeta | Enchytraeidae | - | - | - | | | | | | | 1 | 1 | 11 | 11 |
| | Lumbriculidae | - | - | - | | | | | | | | | | |
| | Naididae | - | - | - | | | | | | 9 | | | | |
| | Tubificidae | - | - | - | 1658 | 55 | 17 | 32 | 1451 | | 3 | 1 | 1 | 1 |
| Pelecypoda | Pisidiidae | - | - | (i/d) | | | | | | 10 | 1 | 4 | 4 | 10 |
| | | - | - | *Sphaerium* | | | | | | 1 | | | | |
| Hydracarina | - | - | - | - | | | | | | 1 | | 1 | | 4 |
| Copepoda - Calanoida | - | - | - | - | | 1 | 1 | | | | 2 | 1 | | |
| Copepoda - Cyclopoida | - | - | - | - | 3 | 16 | 4 | | 3 | | | | | |
| Copepoda - Harpacticoida | - | - | - | - | | | | | | | | | | 2 |
| Ostracoda | - | - | - | - | | | | | | | | 2 | 1 | 3 |
| Cladocera | Chydoridae | - | - | *Eurycercus* | | | | | | | | | | 1 |
| | Daphniidae | - | - | *Daphnia* | | | | | | | | | | |
| Trichoptera | Limnephilidae | Limnephilinae | Chilostigmini | *Grensia praeterita* | | | | | | | | | | |
| Diptera | Chironomidae | Tanypodinae | Procladiini | *Procladius* | | | | | | 4 | 1 | 2 | 3 | 7 |
| | | Diamesinae | Protanypini | *Protanypus* | | | | | | 2 | 2 | 3 | 1 | 10 |
| | | Prodiamesinae | - | *Monodiamesa* | | | | | | 1 | | 2 | | 1 |
| | | Orthocladiinae | - | (i/d) | | | | | | | | | | 2 |
| | | | | *Abiskomyia* | | | | | | | | | | 1 |
| | | | | *Cricotopus/Orthocladius* | | 1 | | | | 1 | | | | |
| | | | | *Heterotrissocladius* | | | | | | 2 | | 3 | 3 | 10 |
| | | | | *Psectrocladius* | | 1 | | 1 | | | | | | 2 |
| | | | | *Pseudosmittia* | | | | | | | | | | |
| | | | | *Zalutschia* | | | | | | 6 | 4 | 8 | 3 | 24 |
| | | Chironominae | Chironomini | *Dicrotendipes* | | | | | | | | | | |
| | | | | *Endochironomus* | | | | | | | | | | |
| | | | | *Microtendipes* | | | | | | 31 | 11 | 75 | 34 | 167 |
| | | | | *Stictochironomus* | | | | | | | | | 1 | 2 |
| | | | Tanytarsini | *Micropsectra* | | | | | | | | | 2 | 12 |
| | | | | *Micropsectra/Tanytarsus* | | | | | | | | | 1 | 1 |
| | | | | *Paratanytarsus* | | | | | | | 1 | 1 | | 2 |
| | | | | *Stempellina ?* | | | | | | | | | | |
| | | | | *Tanytarsus* | | | | | | 1 | | | | |
| Terrestrial | - | - | - | - | | | | | | | | 1 | | |
| ***Total*** | | | | | ***1661*** | ***74*** | ***22*** | ***33*** | ***1454*** | ***73*** | ***26*** | ***107*** | ***70*** | ***282*** |

Biomass (g)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Chironomidae | | 0.0003 | | 0.0020 | | 0.0313 | 0.0121 | 0.0279 | 0.0221 | 0.0424 |
| Other taxa | 2.1281 | 0.0611 | 0.0128 | 0.0540 | 1.8338 | 0.0968 | 0.0051 | 0.0058 | 0.0073 | 0.0192 |
| ***Total*** | ***2.1281*** | ***0.0614*** | ***0.0128*** | ***0.0560*** | ***1.8338*** | ***0.1281*** | ***0.0172*** | ***0.0337*** | ***0.0294*** | ***0.0616*** |

**DDMI 2010, North Inlet - Benthic Invertebrate Data**

| | | | | | REF | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | REF-2 | | | | | REF-3 | | | | |
| **Major Group** | **Family** | **Subfamily** | **Tribe** | **Genus** | **A** | **B** | **C** | **D** | **E** | **A** | **B** | **C** | **D** | **E** |
| Turbellaria | Typhloplanidae | - | - | *Mesostoma* | | | | | | | | | | |
| Nematoda | - | - | - | - | 1 | | | 3 | | | 4 | 9 | 2 | |
| Oligochaeta | Enchytraeidae | - | - | - | 6 | | | | | | | | 1 | |
| | Lumbriculidae | - | - | - | | 1 | | 1 | | 2 | 1 | 2 | 1 | |
| | Naididae | - | - | - | | | | | | | | | | |
| | Tubificidae | - | - | - | 3 | | 3 | | | 2 | 1 | 1 | | |
| Pelecypoda | Pisidiidae | - | - | (i/d) | 7 | 2 | | | | | 6 | 4 | 1 | 1 |
| | | - | - | *Sphaerium* | | | | | | | 1 | | | |
| Hydracarina | - | - | - | - | | | | 1 | | | | | 1 | |
| Copepoda - Calanoida | - | - | - | - | 2 | | | 2 | | | 1 | 1 | 3 | 2 |
| Copepoda - Cyclopoida | - | - | - | - | | | | | | | | 1 | 6 | |
| Copepoda - Harpacticoida | - | - | - | - | | | | | | | | | | |
| Ostracoda | - | - | - | - | | | | | 2 | 1 | 1 | 1 | | |
| Cladocera | Chydoridae | - | - | *Eurycercus* | | | | | | 1 | | | 1 | |
| | Daphniidae | - | - | *Daphnia* | | 1 | | | | | | | | |
| Trichoptera | Limnephilidae | Limnephilinae | Chilostigmini | *Grensia praeterita* | | | | | 1 | | | | | |
| Diptera | Chironomidae | Tanypodinae | Procladiini | *Procladius* | 4 | 4 | 1 | 7 | | 3 | 12 | 4 | 2 | 1 |
| | | Diamesinae | Protanypini | *Protanypus* | 3 | 2 | 2 | 2 | | 1 | 2 | 3 | 1 | 4 |
| | | Prodiamesinae | - | *Monodiamesa* | 4 | 1 | 2 | 1 | | | 12 | 1 | 1 | 8 |
| | | Orthocladiinae | - | (i/d) | | | | | | | | | | |
| | | | | *Abiskomyia* | | | | | | | | | | |
| | | | | *Cricotopus/Orthocladius* | | | | | | | | | | |
| | | | | *Heterotrissocladius* | 1 | | | 1 | | | | | | |
| | | | | *Psectrocladius* | | | | | | | | | | |
| | | | | *Pseudosmittia* | | | | | | | | | | |
| | | | | *Zalutschia* | 6 | | 2 | | 1 | 1 | | 5 | 8 | 3 |
| | | Chironominae | Chironomini | *Dicrotendipes* | | | | | | 1 | | | 1 | |
| | | | | *Endochironomus* | | | | | | | | | | |
| | | | | *Microtendipes* | 9 | 1 | 2 | 1 | | 14 | 27 | 54 | 59 | 46 |
| | | | | *Stictochironomus* | 1 | 4 | 9 | | | 4 | | 2 | | |
| | | | Tanytarsini | *Micropsectra* | 7 | 1 | 2 | 2 | 2 | | | | | |
| | | | | *Micropsectra/Tanytarsus* | | | | | | | | | | |
| | | | | *Paratanytarsus* | 6 | | | 1 | | | 1 | | 3 | |
| | | | | *Stempellina ?* | 1 | | | | | | | | | |
| | | | | *Tanytarsus* | 2 | | | | | 1 | | | | |
| Terrestrial | - | - | - | - | | | | | | | | | | |
| ***Total*** | | | | | ***63*** | ***17*** | ***23*** | ***22*** | ***6*** | ***31*** | ***69*** | ***88*** | ***91*** | ***65*** |

Biomass (g)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Chironomidae | 0.0309 | 0.0127 | 0.0087 | 0.0079 | 0.0002 | 0.0379 | 0.0237 | 0.0826 | 0.0142 | 0.0192 |
| Other taxa | 0.0079 | 0.0199 | 0.0015 | 0.0178 | 0.0528 | 0.0471 | 0.0242 | 0.0198 | 0.0125 | 0.0016 |
| ***Total*** | ***0.0388*** | ***0.0326*** | ***0.0102*** | ***0.0257*** | ***0.0530*** | ***0.0850*** | ***0.0479*** | ***0.1024*** | ***0.0267*** | ***0.0208*** |

## DDMI 2010, North Inlet - Benthic Invertebrate Data

### QA/QC data for re-sorted sample

| Major Group | Family | Subfamily | NI-1-A (C) | NI-1-A (1/1F) | NI-3-E (C) | NI-3-E (1/1F) | REF-1-C (C) | REF-1-C (1/1F) | REF-3-D (C) | REF-3-D (1/1F) |
|---|---|---|---|---|---|---|---|---|---|---|
|  | - | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total missed (accounting for subsampling factor) |  |  |  | **0** |  | **0** |  | **0** |  | **0** |
| Total in sample |  |  |  | **27** |  | **9** |  | **108** |  | **91** |
| % missed |  |  |  | **0.0** |  | **0.0** |  | **0.0** |  | **0.0** |
| Sorting efficiency |  |  |  | **100.0** |  | **100.0** |  | **100.0** |  | **100.0** |

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# APPENDIX XI

## DEVIATIONS FROM WEK’ÈEZHÌI LAND AND WATER BOARD TEMPLATE

# Appendix XI – Deviations from WLWB Report Outline

As directed by the WLWB, this ICRP was developed to conform with a new *Annotated Outline for Interim and Final Closure and Reclamation Plans*. This reporting template was developed by the Mackenzie Valley Land and Water Board (MVLWB) Standard Procedures and Consistency Working Group. Although it has not been approved by the MVLWB it has been reviewed by the WLWB and meets their expectations for this Interim Closure and Reclamation Plan (WLWB 2009).

In some areas this ICRP has deviated from the outline to improve readability. The deviations of note are:

1. The template uses “reclamation” and “closure” interchangeably. To avoid any confusion we will identify in the introduction that we will use “closure” to mean closure, reclamation or closure and reclamation.

2. *5.2.3 Alternative Closure Options, Identified Risks and Contingencies* – was changed to *Preferred and Alternative Closure Options* it is important to let the reader know where to find the preferred closure option.

3. *Risks* have been moved from 5.2.3 to 5.2.6 and renamed 5.2.6 *Uncertainties, Risks and Research Plans*. While risks are discussed in 5.2.3 they are in relation to advantages/disadvantages of closure options. Whereas 5.2.6 is specific to risks associated with the preferred closure option.

4. *Contingencies* have been moved from 5.2.3 to 5.2.9 which is already titled *Contingencies*. In 5.2.3 the contingencies are effectively the options. In 5.2.9 specific contingencies are identified that could be applied if the preferred option is not successful.

5. In section 5.2.5 *Residual Effects* the expected environmental effects that would remain post-closure for that specific closure area are listed. In Section 9 we provide an overall assessment of the combined environmental effects from all mine components.

# APPENDIX XII

## CONFORMANCE TABLES

**Table XII-1 Conformance Table with Class "A" Water Licence W2007L2-0003 Requirements. Part L, Conditions Applying to Closure and Reclamation**

| Water License Item # | Requirement(s) of the Interim Closure and Reclamation Plan | December 2009 ICRP Update |
|---|---|---|
| 1 a) | Specific closure and restoration objectives and criteria and an evaluation of alternatives for the closure of each mine component, including, but not limited to: i) open pits, water retention dikes, and related structures; ii) underground workings; iii) Processed Kimberlite Containment Facility, including the placement of coarse kimberlite material over PKC slimes, and water handling during placement; iv) Waste Rock Storage Facilities and the Drainage Control and Collection System; v) water management structures (dams, intake and delivery systems, treatment plants); vi) Dredged Sediment Containment Facility; vii) North Inlet Facility including, sediment containment, and water management; viii) borrow pits, ore storage stockpiles, and other disturbed areas; ix) surface infrastructure (Process Plant, camp, roads, and airstrip); x) all petroleum and chemical storage areas; xi) any other areas potentially contaminated with hazardous materials; xii) any facilities or areas, which may have been affected by development such that a potential pollution problem exists; xiii) contingencies for pit water treatment during closure; xiv) dike breach locations and sizes; and xv) restoration of aquatic habitat in all areas. | S. 2, S. 5 and Appendix V |
| 1 b) | A description of the detailed plans for reclamation, measures required, or actions to be taken, to achieve the objectives stated in the Board's Guidelines and Part L, Item 1 for each mine component. | S. 5, |
| 1 c) | A detailed description, including maps and other visual representation, of the pre-disturbance conditions for each site, accompanied by a detailed description of the proposed final landscape, with emphasis on the restoration of surface drainage over the restored units. | S. 5 |
| 1 d) | A comprehensive assessment of materials suitability, including geochemical and physical characterization, and schedule of availability for restoration needs, with attention to top-dressing materials, including maps where appropriate, showing sources and stockpile locations of all reclamation construction materials. | S. 4, S. 5 |
| 1 e) | A description of the procedure to be employed for progressive reclamation, including details of restoration scheduling and procedures for coordinating restoration activities within the overall mining sequence and materials balance. | S. 6 |
| 1 f) | A description of any post-closure treatment that may be required for drainage water that is not acceptable for discharge from any of the reclaimed mine components including a description for handling and disposing of post-closure treatment facility sludges. | S. 5.2, S. 5.2.4.3 |
| 1 g) | A description of the plan to assess and monitor any ground water contamination during post-closure. | S.5 and S 9 |
| 1 h) | An evaluation of the potential to re-vegetate disturbed sites that includes the identification of criteria to be used to determine technical feasibility and alternative restoration options. | S 5.2.5 and Appendix VIII-10 |

| Water License Item # | Requirement(s) of the Interim Closure and Reclamation Plan | December 2009 ICRP Update |
|---|---|---|
| 1 i) | An identification of the research needs for restoration. | S. 5 and Appendix VIII |
| 1 j) | A description of how progressive reclamation will be monitored throughout the life of the mine, including an evaluation of the effectiveness of any reclaimed areas. | S.5 and S.6 |
| 1 k) | Details of closure measures proposed in the event of a premature or temporary shutdown at any time throughout mine life. | Ch. 7 |
| 1 l) | A description of proposed means to provide long term maintenance of collection system and treatment plant. | S. 5 |
| 6 | A restoration monitoring program to evaluate the effectiveness of all progressive reclamation and to identify any modifications required to facilitate landscape restoration. | S.5 and Appendix VIII |

**Table XII-2 Conformance table: Water Licence Requirements Not Met in the 2006 Version of the ICRP (according to WL N7L2-1645)**

| # | Deficiencies in 2006 ICRP | Location Addressed in 2009 ICRP Update |
|---|---|---|
| 1 | There are no criteria presented that would indicate and/or measure the success or failure of closure for each mine component. | Appendix V |
| 2 | DDMI has not provided evidence of ongoing community engagement with respect to the development of the ICRP | S.2.4 |
| 3 | Include contingency plan for re-sloping of country rock and till storage | S. 5.2.2.9 |
| 4 | Address North Inlet rehabilitation potential for fish habitat and how backwash sediments from NIWTP may impact on NI use of fish habitat | S. 5.2.4.3 and Appendix VIII-9 |
| 5 | Address how much backwash sediments from NIWTP might impact the quality of discharges from NI to Lac de Gras | S. 5.2.4.3 and Appendix VIII-9 |
| 6 | Include alternatives for storage for NI backwash sediments | S. 5.2.4.3 |
| 7 | In chapter 8 of DDMI's 2006 ICRP, each mine component has "closure strategies" which touch on the goals for closure for that component but lacks a clear and explicit objective | S. 5.2 and Appendix V |
| 8 | There are no evaluations of alternatives discussed for the closure of each mine component, only a "Closure Strategy" and the "Proposed Closure Method" in chapters 7 and 8 of the 2006 ICRP | S. 5.2 |
| 9 | There are no detailed reclamation plans presented. DDMI has produced "Closure Factors" and "Closure Strategies" within the 2006 ICRP but they lack a focused objective which may attribute to the lack of a clear link between what action will be taken to fulfill which objective. | S 5.2 and Appendix V |
| 10 | A map which illustrates the pre and post operational condition at a general level (Figure 2-1 and 9-1) is present in the 2006 ICRP, but does not show surface drainage throughout the site or the final landscape for each altered site. | S 5.2 |
| 11 | A schedule of major operational activities has been included in Table 11-2, and some general reclamation events are listed in Figures 2-2 and 2-3, however there is no detailed schedule or description which outlines the dates for the commencement, completion and evaluation of all progressive reclamation studies and activities | S 5.2 and S.8 |
| 12 | A description of the processes that will be used during closure to treat unsafe water for each mine component has been provided. However, no contingency has been provided in the event that the remaining water does not meet discharge criteria post-closure. These details should be included in the ICRP. Also, additional detail is needed regarding the process for specific handling and disposal of facility sludges during closure and post-closure | S.5.2 |
| 13 | How will contaminated groundwater be assessed after closure? Plan not found. | S. 9 |

| # | Deficiencies in 2006 ICRP | Location Addressed in 2009 ICRP Update |
|---|---|---|
| 14 | Objectives of revegetation have been listed in 10.3-3 and alternative strategies for revegetation are listed in 3.2.1, however, no indication of the criteria that will be used to evaluate the success of the studies have been discussed. Much more investigation and detail is needed in section 3.2. | Appendix V and Appendix VIII-10 |
| 15 | Some areas of necessary research have been identified but it is not clear if it was with the participation of outside parties. DDMI has not provided evidence that parties have given input into the development of research gaps and requirements that will be investigated | S. 2.4 and Appendix IX-4 |
| 16 | In section 10.3, DDMI explains the current monitoring that is taking place within each mine component. However, no description of how reclamation activities will be monitored or evaluated during or after mine operations has been discussed | S.5.2, S.9 and Appendix VI |
| 17 | DFO are concerned that no specific habitat thresholds and criteria have been identified within the plan so how can reviewers be confident that the proposed restored aquatic habitat will support fish populations and components of the aquatic ecosystem. | Appendix V |
| 18 | LKDFN are concerned that Aboriginal Parties were not consulted on either version of the reclamation plan and the development of closure criteria. They also believe that EKATI and Diavik should collaborate on closure programs and develop consistent closure criteria to address the cumulative effects on the Lac de Gras ecosystem. | S.2.4 |
| 19 | The NSMA strongly encourage a public review process so interveners are given the opportunity to participate, whereas some of their compensation claim allows for funding to specifically be part of such a process. | S.2.4 |
| 20 | The Tlicho observed that the 'PKC Monitoring Plan' has never been carried out and submitted and thus relevant monitoring activities might not fulfil requirements set out in Schedule 2 of the Licence. Additional research needs and monitoring details have not been addressed and include areas such as: PKC Cover (technical feasibility of this strategy has not been assessed), Water Quality in the flooded pits (the impact of soluble metals on the pits walls has not been studied for this issue) and the breaching of dikes to meet water quality objectives | S.5.2, Appendix VIII-1, and VIII-5 |
| 21 | EMAB identified several uncertainties within the 2006 ICRP, most of which were not adequately addressed throughout the plan. This observation of remaining uncertainties is consistent with other reviewers conclusions. | S.5.2 |

# APPENDIX XIII

## EXCERPTS FROM:

## ENVIRONMENT CANADA. 2009. ENVIRONMENT CANADA CODE OF PRACTICE FOR METAL MINES. PRS, 1/MM/17 E. APRIL 2009.

## AND

## INAC (INDIAN AND NORTHERN AFFAIRS CANADA). 2007. *MINE SITE RECLAMATION GUIDELINES FOR THE NORTHWEST TERRITORIES*. JANUARY 2007.

Table 1-A. General guidance on closure objectives relevant to the open-pit and underground areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 1-B. Recommendations for decommissioning of underground and open-pit mine workings from *Environment Canada Code of Practice for Metal Mines* (Environment Canada 2009).

Table 1-C. Guidance for generic options for closure of open-pits and underground mine workings from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 1-D. General guidance on post-closure monitoring of the open-pit and underground areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 2A. General guidance on closure objectives relevant to waste rock and till areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 2B. Recommendations for decommissioning of waste rock piles from *Environment Canada Code of Practice for Metal Mines* (Environment Canada 2009).

Table 2C. Guidance for generic options for closure of waste rock and overburden areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 2-D. General guidance on post-closure monitoring of the waste rock and till areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 3A. General guidance on closure objectives relevant to the processed kimberlite containment area from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 3B. Recommendations for decommissioning of the processed kimberlite containment from *Environment Canada Code of Practice for Metal Mines* (Environment Canada 2009).

Table 3C. Guidance for generic options for closure of the processed kimberlite containment area from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 3-D.  General guidance on post-closure monitoring of the processed kimberlite containment facility from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 4A.  General guidance on closure objectives relevant to the North Inlet areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 4B.  Recommendations for decommissioning of water management and treatment systems from *Environment Canada Code of Practice for Metal Mines* (Environment Canada 2009).

Table 4C.  Guidance for generic options for closure of water management facilities from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 4-D.  General guidance on post-closure monitoring of the North Inlet from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 5A.  General guidance on closure objectives relevant to mine infrastructure areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 5B.  Recommendations for decommissioning of mine infrastructure from *Environment Canada Code of Practice for Metal Mines* (Environment Canada 2009).

Table 5C.  Guidance for generic options for closure of mine infrastructure areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 5-D.  General guidance on post-closure monitoring of the Infrastructure Areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

Table 1-A. General guidance on closure objectives relevant to the open-pit and underground areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

- Minimize access to open-pits to protect human and wildlife safety
- Allow emergency access and escape routes from flooded pits
- Implement water management strategies to minimize and control migration and discharge of contaminated drainage, and if required, collect and treat contaminated water
- Meet water quality objectives for any discharge from pits
- Stabilize slopes to minimize erosion and slumping
- Meet end land use target for resulting surface expression
- Establish original or desired new surface drainage patterns
- Establish in-pit water habitat where feasible for flooded pits
- Minimize access to underground workings and surface openings to protect human and wildlife safety
- Maximize the stability of underground workings so that there is no surface expression of underground failure
- Prevent collapse, stress transfer and flooding of adjacent mines
- Ensure that underground workings do not become a source of contamination to the surface environment
- Minimize potential for contamination and, if required, collect and treat
- Resurface, re-slope and contour surface disturbance as required to blend with surrounding topography or desired end land-use targets
- Minimize erosion, thaw settlement, slope failure, collapse or the release of contaminants or sediment
- Build to blend in with current topography, be compatible with wildlife use, and/or meet future land use targets
- Build to minimize the overall project footprint

Table 1-B. Recommendations for decommissioning of underground and open-pit mine workings from *Environment Canada Code of Practice for Metal Mines* (Environment Canada 2009).

- R506: If it is technically and economically feasible to do so, underground or in-pit infrastructure (e.g. crushers, rails, metal structures, water and air pipes) and equipment (e.g. fans and pumps) should be removed from the site. Any equipment to be left underground or in pit should be inspected and remediated as appropriate to ensure that there is no risk of leakage of any contaminants.
- R507: During the decommissioning of underground and open pit mines, any contamination associated with vehicles and equipment operations and maintenance should be identified and remediated, as appropriate.
- R508: Underground mine workings should be secured and signs should be posted warning the public of potential dangers associated with the facility.
- R509: The risk of subsidence in underground mines should be assessed. Appropriate measures should be taken to prevent subsidence in cases where the risk of subsidence is determined to be significant. The primary measure used to prevent subsidence is the backfilling of underground voids.
- R510: Open pits should be backfilled or flooded to the extent practicable to prevent unauthorized access and to protect public safety. In all cases, signs should be posted warning the public of potential dangers associated with the site.

Table 1-C. Guidance for generic options for closure of open-pits and underground mine workings from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

**Open Pit Workings**

- for multiple pits, sequentially backfill with wasterock and/or tailings as operations proceed
- backfill open pits with appropriate materials (e.g. waste rock, tailings)
- flood the pit (natural or accelerated)
- allow gradual slope failure of pits involving rock masses, or slope pit walls
- block open-pit access routes with boulder fences, berms and/or inulshuks (guidance from local communities and Elders should be sought)
- post warning signs (with visible symbols placed close enough so they are visible from one to another) and fences or berms around the perimeter for actively managed sites (not acceptable for remote sites into the long-term)
- long-term fencing to prevent access may only be appropriate if the mine site is located close to a community where regular access for maintenance is possible and where there is a higher risk of access by the general population
- clover slopes with rip rap thick enough to provide insulation or stabilization to minimize erosion or permafrost degradation
- Stabilize exposed soil along the pit crest or underlying poor quality bedrock that threatens to undermine the soil slope above the final pit water level
- Backbrush area to improve visibility
- Plug drill holes
- Maintain an access/egress ramp down to water level for flooded pits
- Contour to discourage or encourage surface water drainage into pits where appropriate
- Cover exposed pit walls to control reactions where necessary
- Collect waters in pit that do not meet the discharge criteria and treat passively (active treatment is not acceptable for the long term) or passively treat waters in the pit
- Breach diversion ditches and establish new water drainage channel
- Establish aquatic life in flooded pits

**Underground Workings**

- Seal all drill holes and other surface openings, especially those connecting the underground workings to the surface
- Backfill underground with benign tailings and wasterock
- Secure underground shafts and raise openings using concrete to ensure permanent closure;

wooden barricades are only suitable for temporary closure

- Construct a reinforced concrete wall or a plug of weakly cemented waste if the barricade is for access control only
- Flood and plug workings to control acid generation and associated reactions if appropriate (engineering designs must consider hydrostatic heads and rock mass conditions – reinforced slabs should be avoided)
- Construct pillars to retain long-term structural stability after mining activities cease and to sustain their own weight and, if applicable, the weight of unconsolidated deposits, water bodies and all other surface loads
- Permanent support boundary pillar if practical and necessary
- Avoid the use of fencing for barricades in remote northern mine sites where regular inspection is not feasible
- Use ditches or berms as barricades except in areas of continuous permafrost; where continuous permafrost exists, inukshuks, fencing or some other method may need to be considered
- Remove all hazardous materials from the underground shops, equipment and magazines (fuels, oils, glycol, batteries, explosives, etc.)
- Contour to establish natural drainage patterns and blend in with the surrounding topography or re-contour the surface to prevent natural surface and groundwater flows from becoming contaminated by mine water where appropriate

Table 1-D. General guidance on post-closure monitoring of the open-pit and underground areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

**Underground Workings**

- Inspect sealed areas
- Check for surface expression (subsidence) of underground failure
- Conduct geotechnical assessment of the overall safety and risk within the subsidence zone.
- Install and check thermistors where appropriate to monitor freeze-back in permafrost areas and to confirm that the ground thermal regime is not degraded
- Periodic backfilling of areas of subsidence may be required
- Inspect groundwater plumes and hydrogeology

**Open-pit**

- Identify areas that are not stable
- Check ground conditions to confirm permafrost conditions are being re-established as predicted
- Sample surface water and profiles of flooded ponds/pits
- Ensure that there is sufficient water supplied to maintain an appropriate water depth for flooded pits
- Sample quality of groundwater seeping from pit walls to assess potential for contamination of mine water due to melting permafrost and ARD/MLch from pit walls.
- Identify and test water management points (including seepage) that were not anticipated
- Inspect barriers such as berms, fences, signs and inukshuks

Inspect fish habitat in flooded pits where applicable

Table 2A. General guidance on closure objectives relevant to wasterock and till areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

- Minimize erosion, thaw settlement, slope failure, collapse or the release of contaminants or sediment
- Build to blend in with current topography, be compatible with wildlife use, and/or meet future land use targets
- Build to minimize the overall project footprint
- Develop and implement preventative and control strategies to effectively minimize the potential for ARD and ML to occur
- Where ARD and ML are occurring as a result of mine activities, mitigate and minimize impacts to the environment
- No reliance on long-term treatment as a management tool (e.g. effluent treatment facilities are not appropriate for final reclamation but may be used as a progressive reclamation tool)
- Minimal maintenance requirements in the long-term

Table 2B. Recommendations for decommissioning of wasterock piles from *Environment Canada Code of Practice for Metal Mines* (Environment Canada 2009).

- R 524: At the end of the mine operations phase, detailed inspections and assessments of wasterock piles and tailings management facilities, particularly dams and other containment structures, should be carried out. The objective of these inspections and assessments is to evaluate the actual performance against design projections related to anticipated post-closure conditions. Factors that should be considered include:
  - the extent of deformation;
  - the rate and quality of seepage;
  - the condition of foundations and sidewalls; and
  - design loads, which may be different after mine closure.
- R 525: At the end of the mine operations phase, comprehensive risk assessment should be conducted for mine closure to:
  - evaluate the long-term risk associated with possible failure modes for wasterock piles and tailings management facilities;
  - identify possible impacts on the environment and human health and safety in the event of a failure;
  - determine parameters critical to these failure modes and possible impacts; and
  - develop and implement long-term control strategies to manage the identified risks.
- R 527: At the end of mine operations phase, plans for management of wasterock and tailings to prevent, control and treat metal leaching and acidic drainage should be re-evaluated and revised as necessary, to ensure that they are consistent with the objectives and plans for mine closure and post closure. This evaluation should consider:
  - the results of the re-evaluation of the performance of these facilities;
  - the performance of progressive reclamation to date; and
  - possible alternative technologies for closure.

- R 529: At all mines that exist in permafrost conditions, downstream slopes of tailings containment structures should be revegetated.

Table 2C. Guidance for generic options for closure of wasterock and overburden areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

- Doze down crest if required or construct toe berm to flatten overall slope
- Remove weak or unstable materials from slopes and foundations
- Off-load materials from crest of the slope
- Leave waste piles composed of durable rock “as is” at the end of mining if there is no concern for deep-seated failure or erosion, and if the end land use targets can be achieved
- Cover to control reactions and/or migration (re-slope to allow for cover placement if necessary)
- Place riprap insulation/stabilization layer
- Freeze waste into permafrost
- Place potentially acid generating rock underwater or underground if available
- Place potentially acid generating within the centre of the waste pile so it is encapsulated be permafrost if conditions permit and underwater or underground disposal are not viable options
- Construct collection system to collect contaminated runoff or leachate
- Construct diversion ditches to divert uncontaminated runoff
- Install horizontal drains or pump leachate from relief wells at the toe of the slope
- Passively treat contaminated waters where necessary, active treatment is not acceptable for the long term
- Use benign waste rock as backfill in underground mine workings, to seal portals, to fill open-pits, or for construction material such as ramps or covers
- Revegetate using indigenous species or use other biotechnical measures (use of living organisms or other biological systems for environmental management) to reduce surface erosion
- Reslope, contour and/or construct ramps to facilitate wildlife access
- Use inukshuks to deter wildlife where appropriate (guidance from local communities and Elders should be sought)
- Include records of construction drawings, as-built drawings, location of landfill sites, and potential ARD material and other contaminated materials which are contained within the rock pile in the reclamation research plan.
- Control acid water at the source, preventing contaminated water flows, and allow contaminated water to be collected and treated (this would be incorporated into water management system)
- Divert or intercept surface and groundwater from ARD source

- Install covers and seals to prevent or reduce infiltration
- Induce or maintain freezing conditions to limit the formation and discharge of leachate
- Place acid generating materials in topographic lows or depressions where they are most likely to be submerged under water under natural conditions
- Mitigate consequences of ARD by the use of passive and active treatment systems, as appropriate for in-situ conditions
- Passive treatment measures include:
    - Chemical (alkali trenches, attenuation along flow path)
    - Biological (sulphate reduction, wetlands, metal uptake in plants)
    - Physical (physical removal – filtration by plants, attenuation)
- Active treatment measures may include:
    - Chemical (Lime neutralization, adsorptive process)
    - Biological (Sulphate reduction)
    - Physical (Solid/liquid separation)

Table 2-D. General guidance on post-closure monitoring of the wasterock and till areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

- Periodically inspect areas where stabilization measures may be required
- Periodic inspections by a geotechnical engineer to visually assess stability and performance of waste pile and cover(s)
- Periodically inspect ditches and diversion berms
- Examine ground conditions to confirm predicted permafrost conditions are being established as predicted
- Check thermistor data to determine thermal conditions within waste piles to confirm predicted permafrost aggradation/encapsulation where applicable
- Test water quality and measure volume from controlled discharge points of workings to confirm that drainage is performing as predicted and not adversely affecting the environment
- Identify water discharge areas (including volume and quality) that were not anticipated
- Inspect physical stability of the mine site to confirm that no erosion, slumping or subsidence that may expose potentially ARD/ML material to air and water are occurring
- Inspect any preventative and control measures (e.g. covers) to confirm that they minimize water and/or air exposure
- Confirm that predicted water quality and quantity of chemical reactions is occurring
- ▪ Develop monitoring locations and frequency on a site by site basis, incorporating locations where possible contaminated drainage may be generated, and where drainage may be released to the water management system or to the environment (also include downstream/down gradient locations)

Table 3A. General guidance on closure objectives relevant to the processed kimberlite containment area from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

- Stabilize slopes surrounding the tailings impoundment or containment system for flooded and/or dewatered conditions
- Minimize catastrophic and/or chronic release of the tailings based on associated risk
- Minimize wind migration of tailings dust
- Minimize the threat that the impoundment becomes a source of contamination (e.g. tailings migration outside of contained area, contamination of water outside of contained area)
- Blend with local topography and vegetation were appropriate
- Discourage human and wildlife access from physically and chemically unstable tailings sites

Table 3B. Recommendations for decommissioning of the processed kimberlite containment from *Environment Canada Code of Practice for Metal Mines* (Environment Canada 2009).

- R 524: At the end of the mine operations phase, detailed inspections and assessments of wasterock piles and tailings management facilities, particularly dams and other containment structures, should be carried out. The objective of these inspections and assessments is to evaluate the actual performance against design projections related to anticipated post-closure conditions. Factors that should be considered include:
  - the extent of deformation;
  - the rate and quality of seepage;
  - the condition of foundations and sidewalls; and
  - design loads, which may be different after mine closure.
- R 525: At the end of the mine operations phase, comprehensive risk assessment should be conducted for mine closure to:
  - evaluate the long-term risk associated with possible failure modes for wasterock piles and tailings management facilities;
  - identify possible impacts on the environment and human health and safety in the event of a failure;
  - determine parameters critical to these failure modes and possible impacts; and
  - develop and implement long-term control strategies to manage the identified risks.
- R 527: At the end of mine operations phase, plans for management of wasterock and tailings to prevent, control and treat metal leaching and acidic drainage should be re-evaluated and revised as necessary, to ensure that they are consistent with the objectives and plans for mine closure and post closure. This evaluation should consider:
  - the results of the re-evaluation of the performance of these facilities;
  - the performance of progressive reclamation to date; and
  - possible alternative technologies for closure.
- R 529: At all mines that exist in permafrost conditions, downstream slopes of tailings containment structures should be revegetated.

Table 3C. Guidance for generic options for closure of the processed kimberlite containment area from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

- Stabilize embankments by removing weak or unstable materials from slopes and foundations and/or construct toe berms to flatten overall slope
- Breach water retention dams and drain impoundments, avoid post closure impoundment of water when possible
- Use a natural body of water that has sufficient storage capacity to hold the tailings and also a natural unimpeded flow via the drainage outlet if a permanent water cover is used (this may not be viable if the supernatant water quality does not meet discharge water quality standards)
- Increase freeboard and/or upgrade spillway to prevent overtopping and possible erosion by extreme events
- Relocate and/or deposit tailings into underground mine workings or into flooded pits, depending on water quality considerations
- Flood to control acid generation and related reactions
- Cover to control acid generation and related reaction and surface erosion
- Promote neutralization reactions by use of alkaline materials for acid tailings
- Divert non-contact runoff away from the tailings facility to avoid contamination
- Promote freezing of tailings mass into permafrost if suitable conditions exits.
- Collect waters that do not meet the discharge criteria and treat passively, active treatment is not acceptable for the long term
- Remove structures, decant towers, pipes and drains where they already exist
- Plug decant towers, pipes, and drains with high slump (relatively liquid concrete which will flow to fill all voids) or preferably, expansive concrete, as a last resort
- Assess the soil around pipes for stability under the hydraulic gradients through the embankment, as this may be a potential zone of piping failure
- Avoid using diversion structures and ditching, especially in permafrost soils (diversion structures are not the preferred option into the long-term)
- Where diversion dams and channels are necessary, maintain them indefinitely to meet long term stability and hydraulic design requirements; design diversions and spillways for extreme events suitable for long term stability
- Provide frost protection cap over the phreatic surface for water-retaining dams
- Ditch, berm, fence or use alternative methods to deter access to motorized vehicles if compatible with end-use plans
- Establish indigenous vegetation, soil, riprap or water cover to control erosion

Table 3-D. General guidance on post-closure monitoring of the processed kimberlite containment facility from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

- conduct periodic dam safety and stability reviews of structures that remain after closure
- Inspect seepage collection system for water quality flows
- Check for degradation or aggradation of permafrost for tailings containment structures where permafrost was used in the design
- Assess dust dispersion and vegetation uptake with wind dispersion of tailings

Table 4A. General guidance on closure objectives relevant to the North Inlet areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

- Dismantle and remove/dispose of as much of the system as possible and restore natural or establish new drainage patterns
- Stabilize and protect from erosion and failure for the long term
- Maintain controlled release from water dams, ditches and all points of water discharge to the environment
- Achieve approved water quality limits, and in the case of existing mines, implement long term treatment only if necessary and ensure that minimal maintenance is required.

Table 4B. Recommendations for decommissioning of water management and treatment systems from *Environment Canada Code of Practice for Metal Mines* (Environment Canada 2009).

- R531: At the end of the mine operations phase, water management plans should be evaluated and revised as necessary to ensure that they are consistent with the objectives and plans for mine closure and post closure. This evaluation should consider:
    - The results of an evaluation of the performance of the existing water management plan;
    - Expected changes in water flow and water balance on site; and
    - Expected changes in wastewater volume and composition

Based on this evaluation, the following should be identified:

- Water management structures, such as dams and diversion ditches, that will no longer be needed, methods to be used for decommissioning these structures, and the timing of decommissioning;
- Water management structures that will continue to be needed and any long-term maintenance or replacement requirements associated with these structures;
- Water management structures that will need to be modified, methods to be used to modify these structures, the timing of modification, and any long-term maintenance requirements associated with these structures; and
- Long-term monitoring requirements to ensure that the water management system continues to function as designed.

- R532: At sites where it is determined that long-term treatment of wastewater will be necessary during post closure, a long-term wastewater treatment plan should be developed and implemented. This plan should include the following elements:
    - Identification of roles and responsibilities of persons to be involved in operation and maintenance of the treatment system;
    - Identification of the types of treatment system to be used;
    - Identification of any by-products from the treatment system, such as treatment sludge and management plans for the disposal of those by-products;
    - Identification of routine maintenance activities to be conducted on the treatment system and the frequency;
    - Identification of monitoring to assess ongoing performance of the treatment system and the frequency;
    - Identification of reporting requirements for internal management and regulatory agencies; and
    - Description of contingency plans to address any problems associated with the treatment system.

Table 4C. Guidance for generic options for closure of water management facilities from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

- Water management facilities including ditching and settling ponds that are not required for long-term use should be treated and discharged, sediment should be removed and disposed of properly, and the embankments, dams and culverts should be breached if not required
- Use passive treatment systems as the preferred method for dealing with contaminated waters if it can be demonstrated to be effective
- Locate permanent spillways in competent rock
- Drain, dismantle and remove tanks and pipelines from the site or fill and cover them with appropriate materials if they are approved to remain
- Cover embankments, ditches, culverts, and other drainage channel slopes with erosion resistant material (e.g. soil, riprap, vegetation)

Table 4-D. General guidance on post-closure monitoring of the North Inlet from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

- Periodically inspections are required in the post-closure period to assess the performance of the existing water management structures
- Check the performance of erosion protection on embankment structures such as rip rap or vegetation and the physical stability of water management systems including permafrost integrity where applicable
- Check water quality and flows to ensure system is working as predicted
- Conduct ongoing inspection and maintenance of passive or active water treatment facilities associated with non-compliant mine water or runoff discharges
- Sample surface and groundwater if site specific conditions dictate
- Check the smell and taste of water and fish (guidance from local communities and Elders should be sought)

Table 5A. General guidance on closure objectives relevant to mine infrastructure areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

- Ensure buildings and equipment do not become a source of contamination or a safety hazard to wildlife and humans
- Return area to its original state or to a condition compatible with the end-use targets
- Remediate any sources of contamination that may have been created during the development and operation of the mine site in order to protect humans, wildlife and environmental health
- Prevent significant releases of substances that could damage the receiving environment
- Remediate contaminated soil such that the area is compatible with future uses of the surrounding local area
- Re-establish the pre-mining ground cover, which may involve encouraging self-sustaining indigenous vegetation growth
- Provide wildlife habitat where appropriate and feasible
- Assist with providing physical stability of mine components

Table 5B. Recommendations for decommissioning of mine infrastructure from *Environment Canada Code of Practice for Metal Mines* (Environment Canada 2009).

- R514: On-site facilities and equipment that are no longer needed should be removed and disposed of in a safe manner, unless facilities or equipment are to be preserved for post-closure land use. Efforts should be made to sell equipment for reuse elsewhere or to send equipment for recycling, rather than disposing of it in landfill facilities.
- R515: The walls of on-site buildings should be razed to the ground, except in cases where they are to be preserved for post-closure land use. Foundations should be removed or covered with a sufficient thick layer of soil to support revegetation.
- R516: If buildings are to be preserved, either as a heritage resource or for some other post-closure land use, structures and foundations should be inspected to ensure that no contamination is present. If the structures or foundations are contaminated, they should be remediated as necessary to ensure public health and safety for post-closure land use.
- R517: Support infrastructure, such as fuel storage tanks, pipelines, conveyors and underground services should be removed, except in cases where it is to be preserved for post-closure land use.
- R518: The main access road to the site (or runway in the case of remote sites) and other on-site roads, as appropriate, should be preserved in a sufficient condition to allow post-closure access for monitoring, inspection and maintenance activities.
- R519: Roads, runways or railways that will not be preserved for post-closure should be reclaimed:
    - Bridges, culverts and pipes should be removed, natural stream flow should be restored, and stream banks should be stabilized by revegetating or by using rip-rap.
    - Surfaces, shoulders, escarpments, steep slopes, regular and irregular benches, etc. should be rehabilitated to prevent erosion; and
    - Surfaces and shoulders should be scarified, blended into natural contours, and revegetated.
- R520: electrical infrastructure, including pylons, electric cables and transformers should be dismantled and removed, except in cases where this infrastructure is to be preserved for post-closure land use or will be needed for post-closure monitoring, inspection and maintenance. This includes infrastructure on site, as well as any off-site infrastructure owned by the mining company.
- R522: Waste from the decommissioning of ore processing facilities and site infrastructure, such as waste from the demolition of buildings and the removal of equipment, should be removed from the site and stored in an appropriate waste disposal site or disposed of on site in an appropriate manner in accordance with relevant regulatory requirements. If material is disposed of on site, the location and contents of the disposal site should be documented.
- R523: Sampling and analysis of soils and other materials should be conducted to ensure that none of the material is contaminated, e.g. with asbestos and mercury from buildings. If

contaminated materials are identified, they should be handled and disposed of in an appropriate manner in accordance with all applicable regulatory requirements.

Table 5C. Guidance for generic options for closure of mine infrastructure areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

- Dismantling all buildings that are not necessary to achieve the future land use target
- Raze/level all walls to the ground and remove foundations
- Cover remaining foundations with materials conducive to vegetation growth
- Remove buildings and equipment during the winter to minimize damage to the land where appropriate
- remove and dispose concrete in an approved landfill if it contains contaminants such as hydrocarbons or PCB's that may pose a hazard over time
- where approved, break or perforate concrete floor slabs and walls to create a free draining condition in order that vegetation can be established
- backfill all excavations below final grade to achieve the final desired surface contours to restore the natural drainage or a new acceptable drainage
- cover excavated sites which have exposed permafrost with a rock cap to prevent thermokarst erosion
- Bury materials in the unsaturated zone or below the active layer
- Decontaminate equipment (free of any batteries, fuels, oils or other deleterious substances) and reuse or sell (local communities may have interest in some of the materials)
- If sale or salvage or equipment is not possible, dispose of decontaminated equipment in an approved landfill or as recommended by the regulatory authorities
- Cut, shred or crush and break demolition debris to minimize the void volume during disposal
- Maintain photographic records of major items placed into landfills, as well as a plan showing the location of various classes of demolition debris (e.g. concrete, structural steel, piping, metal sheeting and cladding)
- Leave non-salvageable materials and equipment from underground operations in the underground mine upon approval from the regulatory authorities
- Remove all hazardous materials and chemicals prior to demolition to national approved hazardous material treatment facilities, recycle, reuse, or dispose of in a appropriate manner upon approval from the regulatory authorities (check for PCBs in fluorescent light fixtures, lead-based paints, mercury switches or radioactive instrument controls)
- Backhaul materials for recycling or disposal to a southern location
- Excavate and remove contaminated soil and place into a designated and properly managed containment area on-site
- Treat contaminated soil in-situ (bioremediation, soil leaching, washing, etc.)
- Immobilize contaminated soil (cement solidification, lime/silicate stabilization, etc.)

- Excavate and relocate contaminated soil to approved facilities off-site.
- Some low level contaminated soil may be used progressively to cover landfills if the entire landfill is designed to be ultimately encapsulated in permafrost
- Dispose of wastes in quarries, borrow pits, underground mine workings, tailings impoundments, and waste rock piles
- Burn domestic waste in an incinerator during operations and at closure as part of camp maintenance
- Burn waste oils, solvents and other hydrocarbons on-site with an incinerator if approved (chlorinated substances should not be burned)
- Cover landfills and other waste disposal areas with erosion resistant material (e.g. soil, riprap, vegetation)
- Divert runoff with ditches or covers
- Ditch, berm, fence or use alternative methods to limit access to waste storage areas
- Contour/blend to match the natural topography or a new desired topography and re-vegetate with indigenous species to meet end use land targets
- Consider surface application of sewage for re-vegetation
- Begin revegetation efforts as soon as possible for mine site areas/components (progressively reclaim)
- Contour, scarify, and seed are using native seed mixes to establish vegetative cover
- Apply gravel barriers or other underlying cover systems where desired to control or limit the upward movement of acidic pore water or heavy metals that may inhibit plant growth or for moisture retention near the surface
- Apply stripped/stockpiled soil or growth medium to a depth sufficient to maintain root growth and nutrient enrichments
- Incorporate organic materials, mulches, fertilizers, or other amendments based upon local soil assessment
- Establish appropriate temporary or permanent wind breaks where necessary to establish vegetation
- Transplant vegetation that would otherwise be lost to mine disturbance where feasible
- Select indigenous vegetation for reclaimed sites that have a low potential for metal accumulation
- Re-vegetate with indigenous vegetation not used by wildlife or people if uptake of metals is a concern
- Place a gravel or coarse cover to discourage vegetation growth where desired

Table 5-D. General guidance on post-closure monitoring of the Infrastructure Areas from *Mine Site Reclamation Guidelines for the Northwest Territories* (INAC 2007).

- Maintain all buildings and equipment left onsite
- Inspect disposal areas periodically to establish if buried materials are being pushed to surface as a result of frost heaving
- Maintain access infrastructure to support on-going reclamation and closure monitoring
- Monitor wildlife/fish use of area to ensure mitigation measures are successful
- Monitor other land users access and activity in the area
- Check stream crossing remediation and any degradation associated with decommissioned roads such as erosion and ponding of water.
- Carry out periodic inspections to investigate the quality of air, groundwater, discharge water, and water body sediment where contaminated soils have occurred
- Carry out periodic inspections to investigate thermal degradation, and physical stability where contaminants have occurred
- An assessment of residual contamination should be carried out to confirm the success of the remediation
- Inspect re-vegetation areas periodically following initial planting until vegetation is successfully established and self sustaining in accordance with the agreed criteria
- Conduct soil analysis for nutrients an pH until the vegetation is successfully established and self-sustaining
- Inspect vegetated areas that may be obscuring possible cracks and other problems on dams and embankments
- Inspect for root systems that are penetrating protective covers or decaying/rotting providing tunnels for water to pass through protective covers
- Identify excessive vegetation stress or poorly established areas and implement contingency measures if required.
- Sample water treatment sludge periodically to determine the chemical characteristics, sludge stability, and leachability under the proposed long-term storage conditions
- Test water quality and quantity to measure the success of the mitigation measures for waste disposal areas
- Identify and unpredicted sources of potential contamination
- Check the ground thermal regime (by means of thermistors) and cover performance to check if permafrost has aggraded into the landfill and if the seasonal active zone remains within the cover
- Check for cracking or slumping of the cover and for underlying waste material pushing its way

up through the cover