Interim Environmental Monitoring Program: Vangorda Creek (2007) and Rose Creek (2008)

Report Prepared for:

Assessment and Abandoned Mines Branch
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EXECUTIVE SUMMARY

A study was conducted to fill data gaps and thus allow for development of an effective and cost-efficient, long-term, post-closure monitoring program for the Faro Mine complex, Yukon. Under the current Water License for the Faro Mine complex, water, sediment and benthic invertebrate samples have been collected by Laberge Environmental Services (LES) in alternate years in the Vangorda and Rose/Anvil Creek systems, respectively. These studies have involved artificial substrate deployment for five to six weeks in the summer to allow for benthic invertebrate colonization and community assessment in creek areas upstream and downstream of mine drainage. Coincident with retrieval of the artificial substrates, sediment samples have been collected for analysis of metal content in the fine fraction (<0.15 mm). Water samples were also collected when artificial substrates were both deployed (mid-July) and retrieved (late August), along with measurements of flow and *in situ* water quality (conductivity, temperature, pH, dissolved oxygen) and collection of water and sediment quality.

For this study, additional samples were collected by Minnow Environmental Inc. at the time of artificial substrate retrieval by LES at the Vangorda site in August 2007 and in the Rose Creek drainage in 2008. The sampling program included: 1) collection of one water sample per area for analysis of various inorganic and conventional parameters as well as a low-level metal scan by inductively coupled plasma mass spectrometry (ICPMS); 2) collection of water samples from two mine-exposed areas and one reference area for laboratory toxicity testing; 3) collection of sediment samples in three mine-exposed areas and two reference areas for toxicity testing, particle size analysis, and analysis of metals in both the whole sample and fine fraction; 4) collection of resident benthic invertebrate communities using a Hess sampler (2007 and 2008) and kick net (2008); 5) benthic invertebrate sample collection from areas that have been included in past studies for monitoring under the Water License, as well as additional reference areas which have not been sampled in the past; and 6) collection of supporting field water quality data (temperature, dissolved oxygen, conductivity and pH) and habitat observations.

Analyses of water samples collected in August of 2007 and 2008 showed relatively good water quality at mine-exposed areas compared to water quality benchmarks based on the protection of aquatic life. However, elevated metal levels and increased aquatic toxicity were observed in the Rose Creek drainage in January 2009 compared to August 2008, indicating potential for groundwater contaminant sources to affect biota during periods of limited surface water dilution.

Sediment metal concentrations were about three times higher in the fine sediment fraction (<0.15mm) compared to whole sediment, indicating that a large proportion of metals present were associated with fine sediment particles. However, fine sediments represented a small proportion of the whole sediment sample in most areas. Sediments collected from V27, X2 and R2 which contained elevated concentrations of arsenic, lead, manganese, and zinc were not toxic to the amphipod *Hyallela azteca* in 14-day laboratory tests measuring surivival and growth. Inclusion of sediment analyses in long-term monitoring is of questionable value, unless triggered by substantial increases in metal and/or suspended solids loadings from the mine.

Benthic community assessments based on artificial substrates were less sensitive than Hess or kick sample collection for detecting differences in mine-exposed benthic communities relative to those in reference areas. Within a traditional control-impact (CI) sampling design (ANOVA and pre-planned reference-exposure contrasts), Hess and kick sampling produced the same number of significant reference-exposure differences, but based on different benthic community metrics.

Based on a reference condition approach (RCA) for the sampling design, the kick sampling method was slightly more sensitive for detecting differences between the exposure and reference areas than the Hess sampling method and represents the most cost-effective approach for long-term monitoring at the Faro Mine complex. An alternative, modified control-impact design was also identified that would involve slightly greater cost but involves statistical procedures more familiar to most practitioners than those required for RCA.

Overall, the data may reflect subtle mine-related effects on benthic invertebrate community composition, but none of the mine-exposed areas evaluated in this study were conclusively outside the range of reference area conditions. Statistical power would be improved if additional reference areas could be found near the Faro Mine complex possessing similar habitat characteristics to exposure areas. Candidate areas could be selected in advance of the next field program based on geographic information system (GIS) characteristics that were strongly related to benthic community characteristics (e.g., percent volcanic bedrock geology and percent coniferous cover). All reference areas that may be included in future monitoring should be investigated to ensure they are not affected by current or historical anthropogenic influences. After selection and initial sampling at all reference areas, only a subset of areas would need to be revisited in each future survey on a rotational basis (i.e., not all areas every survey).

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ACKNOWLEDGEMENTS

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- Field measurements and sample collections were completed by Ms. Kim Connors (2007), Ms. Tammy Hansen (2008) and Ms. Cynthia Russel (2008) of Minnow and Dr. Michelle Bowman (2008).
- Benthic sample taxonomy (2007, 2008) was completed by Ms. Sue Salter of Cordillera Consulting.
- Data organization and management was supported by Ms. Deb McMillan and Mr. Kevin Martens of Minnow.
- Summary statistics of benthic community characteristics (metrics) and area comparisons by ANOVA (2007, 2008) were completed by Dr. Ian Martin of Ian Martin Biological Consulting, Elora, ON.
- Analysis of benthic invertebrate communities using the Reference Condition Approach (2008) was done by Dr. Michelle Bowman.

We would also like to thank Ms. Bonnie Brown of Laberge Environmental Services (LES) for support in the field and for sharing the data from the monitoring programs conducted by LES in 2007 and 2008. We thank Mr. Stephen Mead of the Assessment and Abandoned Mines Branch of the Yukon Ministry of Energy, Mines and Resources and Mr. Bill Slater of Bill Slater Environmental Consulting for their support throughout this project and their vision in recognizing the importance of this work for optimizing the cost-effectiveness of long-term aquatic ecological monitoring at the Faro Mine complex.

1.0 INTRODUCTION

1.1 Background

The Faro Mine complex, near Faro, Yukon, includes two mines: the Faro Mine and Mill (Faro site) and Vangorda/Grum Mines (Vangorda site), which are located approximately 12 km apart (Figure 1.1). The complex was formerly owned by the Anvil Range Mining Corporation and produced lead and zinc concentrates to be extracted for lead, zinc, silver, and gold. The Faro site was mined between 1969 and 1992, while the Vangorda site was developed and mined between 1986 and 1998. Milling continued at Faro until April 1998, when all operations were terminated due to poor economic circumstances and projections, and the site went into receivership. Until early 2009, management of the mine property has been under the direction of Deloitte and Touche Inc., acting as the court appointed Interim Receiver. Site Care and Maintenance responsibilities are now being transferred to a contractor acting on behalf of the Yukon Government.

The Yukon government and its consultants, working with the federal government, Selkirk First Nation, and Ross River Dena Council, are currently preparing a comprehensive closure plan for the abandoned Faro Mine complex. Before the closure plan can be implemented, it will be subject to regulatory assessment and approval processes. The plan requires regulatory approval in the form of a Water License issued under the *Waters Act* by the Yukon Water Board and will need to be acceptable to relevant government agencies, the First Nations and the public. The assessment process will be carried out through the Yukon Environmental and Socio-Economic Assessment Board under the *Yukon Environmental and Socio-Economic Assessment Act* (YESAA).

Technical studies conducted at the site, which are nearing completion, have indicated that acidification and leaching processes have the potential to result in dramatic increases in metal loadings to surface waters downstream of the Faro Mine complex over the next several to many decades (SRK 2004, 2005). Consequently, the closure process is proceeding to phases focused on identifying the mitigation measures required to protect the aquatic ecosystem downstream of the mines. Related to this, Minnow Environmental Inc. was requested to assist in identifying the requirements of a comprehensive, site-wide environmental monitoring program to be implemented upon closure.

As first steps, Minnow reviewed and re-evaluated the results of previous studies and monitoring (Minnow 2007a) and proposed a general framework for the long-term monitoring program (Minnow 2007b). Key information gaps were identified that needed to be addressed in order to optimize the long-term monitoring program design (Minnow

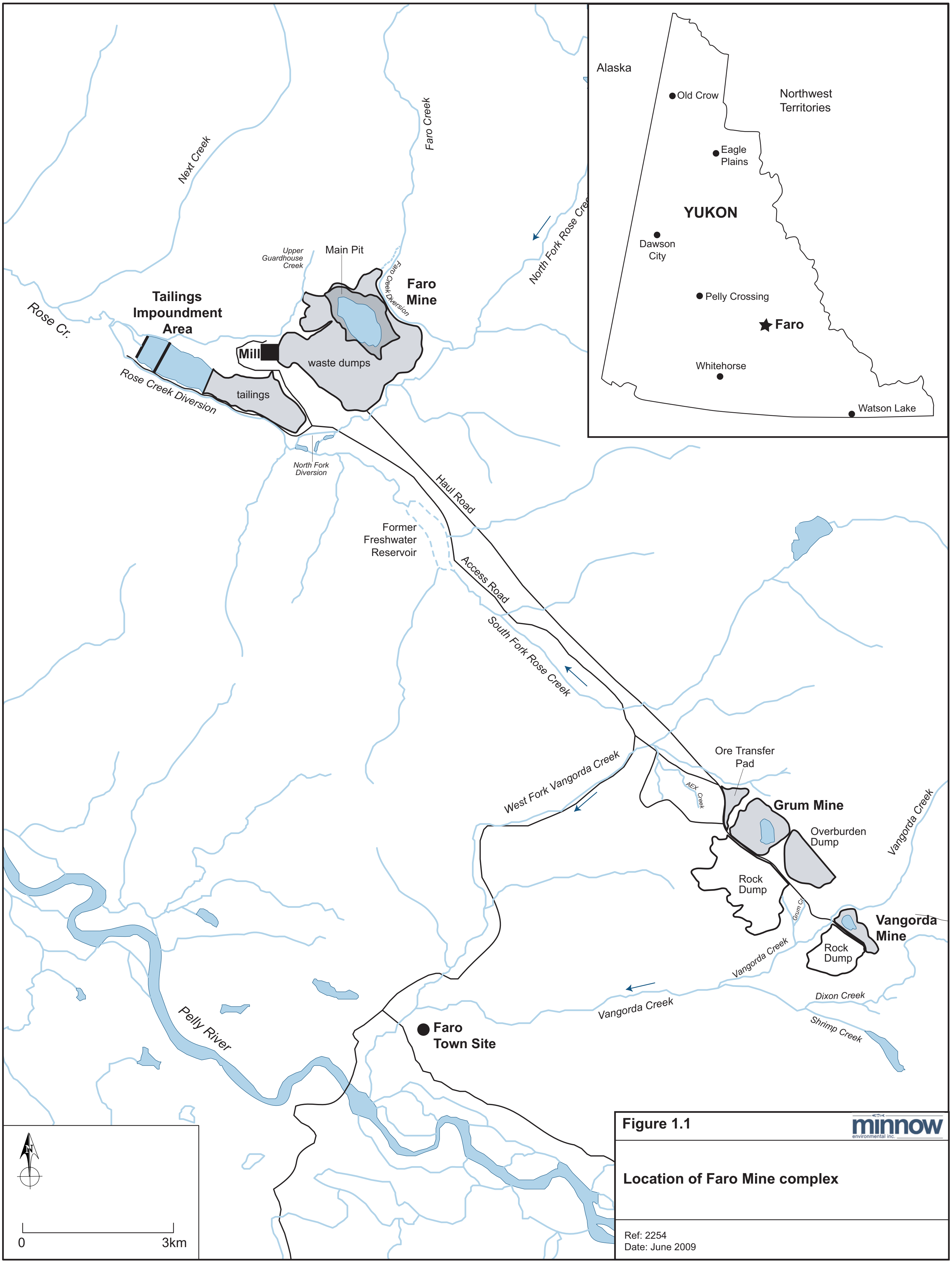

Figure 1.1

Location of Faro Mine complex

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Date: June 2009

2007b). It was thus proposed that an Interim Aquatic Ecosystem Monitoring Program (IAEMP) be implemented in the short-term, in conjunction with monitoring being undertaken at the Vangorda site in 2007 and Rose/Anvil Creeks in 2008 under the current Water License (Minnow 2007b). This report presents the findings from the sampling programs that ensued in 2007 and 2008. This information will be used to update the long-term monitoring program requirements later in 2009.

1.2 Project Objectives

The overall objective of the project was to fill some of the critical data gaps previously identified by Minnow (2007b) to allow for development of an effective and cost-efficient, long-term, post-closure monitoring program. The specific objectives for the 2007-08 studies included:

1. Evaluate potential mine-related effects based on water, sediment and benthic invertebrate data.
2. Determine the optimum sampling method (artificial substrates, Hess, kick and sweep) and statistical sampling design (control-impact or reference condition approach) to serve as a sensitive indicator of mine-related effects on downstream aquatic ecosystems.
3. Evaluate the relevance of future sediment sampling and analysis based on characterization of sediment particle sizes, chemistry, and toxicity in near-field versus reference areas.
4. Evaluate the suitability of additional reference areas for potential inclusion in future benthic invertebrate and/or fish surveys.

The information from this study, combined with results from the parallel sampling program implemented by Laberge Environmental Services Inc. in 2007 and 2008 (in accordance with requirements of the current Water License), allows for development of a streamlined program for long-term aquatic ecosystem monitoring at the Faro Mine complex.

1.3 Report Organization

Methods used for sample collection and for the analysis of samples and data are outlined in Section 2.0. Study results are presented in Sections 3.0 to 5.0 for water, sediment, and benthic invertebrate samples, respectively. Conclusions and recommendations are presented in Sections 6.0. References cited throughout this document are listed in Section 7.0.

2.0 METHODS

2.1 Overview

Under the current Water License for the Faro Mine complex, water, sediment and benthic invertebrate samples have been collected by Laberge Environmental Services (LES) in alternate years in the Vangorda and Rose/Anvil Creek systems, respectively (Burns 1991-2007). In these studies, artificial substrates were deployed for five to six weeks in the summer to allow for benthic invertebrate colonization and community assessment in creek areas upstream and downstream of mine drainage. Coincident with retrieval of the artificial substrates, sediment samples were collected for analysis of metal content in the fine fraction (<0.15 mm). Water samples were also collected when artificial substrates were both deployed (mid-July) and retrieved (late August), along with measurements of flow and *in situ* water quality (conductivity, temperature, pH, dissolved oxygen) and collection of water and sediment quality.

Additional samples were collected by Minnow Environmental Inc. at the time of artificial substrate retrieval by LES at the Vangorda site in August 2007 and in the Rose Creek drainage in 2008 to serve the objectives of this project (Section 1.2). The supplementary sampling included:

- collection of one water sample per area for analysis of various inorganic and conventional parameters as well as a low-level metal scan by inductively coupled plasma mass spectrometry (ICPMS);
- collection of water samples from two mine-exposed areas and one reference area for laboratory toxicity testing;
- collection of sediment samples in three mine-exposed areas and two reference areas for toxicity testing, particle size analysis, and analysis of metals in both the whole sample and fine fraction;
- collection of resident benthic invertebrate communities using a Hess sampler (2007 and 2008) and kick net (2008);
- benthic invertebrate sample collection from areas that have been included in past studies for monitoring under the Water License, as well as additional reference areas which have not been sampled in the past; and
- collection of supporting field water quality data (temperature, dissolved oxygen, conductivity and pH) and habitat observations.

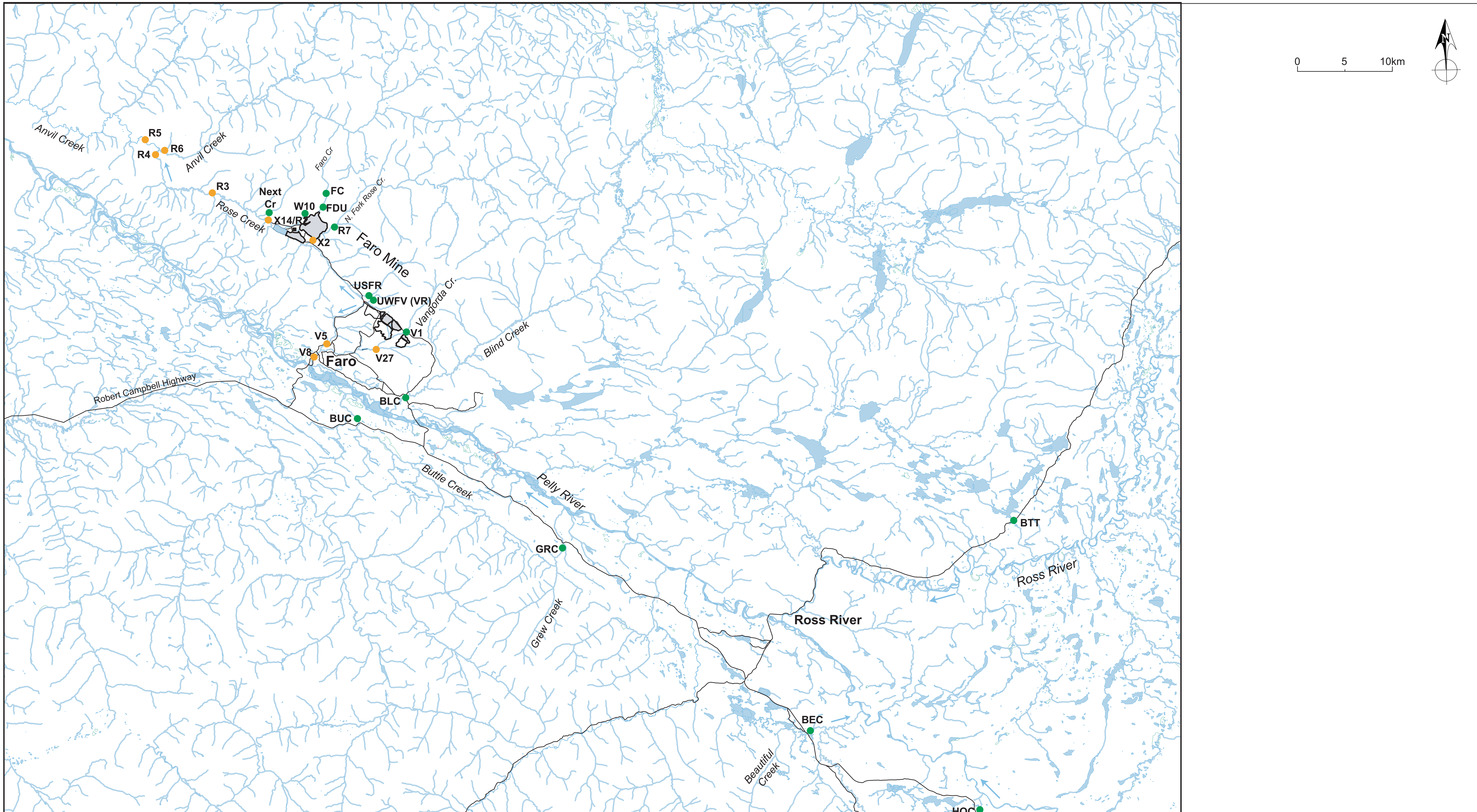
The sampling described in the sections below (August 25–29, 2007 and August 19-24, 2008) overlapped with water license sampling by LES (August 27–29, 2007 and August 25 and Sept 4, 2008) to allow direct comparison of different sampling methods and sampling designs being considered for future long-term monitoring at Faro Mine complex. Methods employed in the LES study have been described separately (Burns 2007, 2009) and are not repeated herein, except to the extent required to explain data comparisons. Thus, the sections below describe the methods for in-field measurements and sample collection that were in addition to those described by Burns (2007, 2009). Sample station locations discussed in this report are shown in Figures 2.1 (all areas) and 2.2 (areas near mine).

A key factor in the August 2008 program was unusually heavy and persistent rainfall. Low cloud cover prevented (this study) or delayed (artificial substrate survey, Burns 2009) helicopter access to some areas that had been targeted for sampling. Therefore, reconnaissance of potentially suitable reference areas was limited to those that could be accessed by road. High, fast-flowing water also prevented or limited collection of samples in some reference and exposure areas. Access to V1 was also not possible due to the presence of a grizzly bear attending a moose carcass at that location. Specific modifications to the planned sampling design are noted in Table 2.1 and the implications of these changes are discussed, as appropriate, throughout the report.

2.1 Habitat Characterization based on Field Measurements

Potential mine influence on biological communities is typically determined by comparing communities in mine-exposed areas to reference areas. Detection of differences that may be mine-related is enhanced by minimizing the variation attributable to differences in natural habitat factors among areas. Therefore, detailed habitat characterization was undertaken in all study areas to facilitate selection of reference areas for long-term monitoring.

Water velocity was measured near the bottom (to reflect conditions experienced by benthic invertebrate communities) using a Marsh-McBirney Flo-Mate Model 2000 portable velocity meter. Water depth was measured using a metre stick and stream width was measured using a measuring tape. Velocities and depths were taken at approximately 4-10 intervals (depending on stream width) along a transect perpendicular to the flow direction and recorded on field sheets. Mean values were computed from the recorded data.



- reference
- exposed to Faro Mine

Figure 2.1

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Locations of reference and mine-exposed surface water, sediment and biological sampling areas near Faro, Yukon

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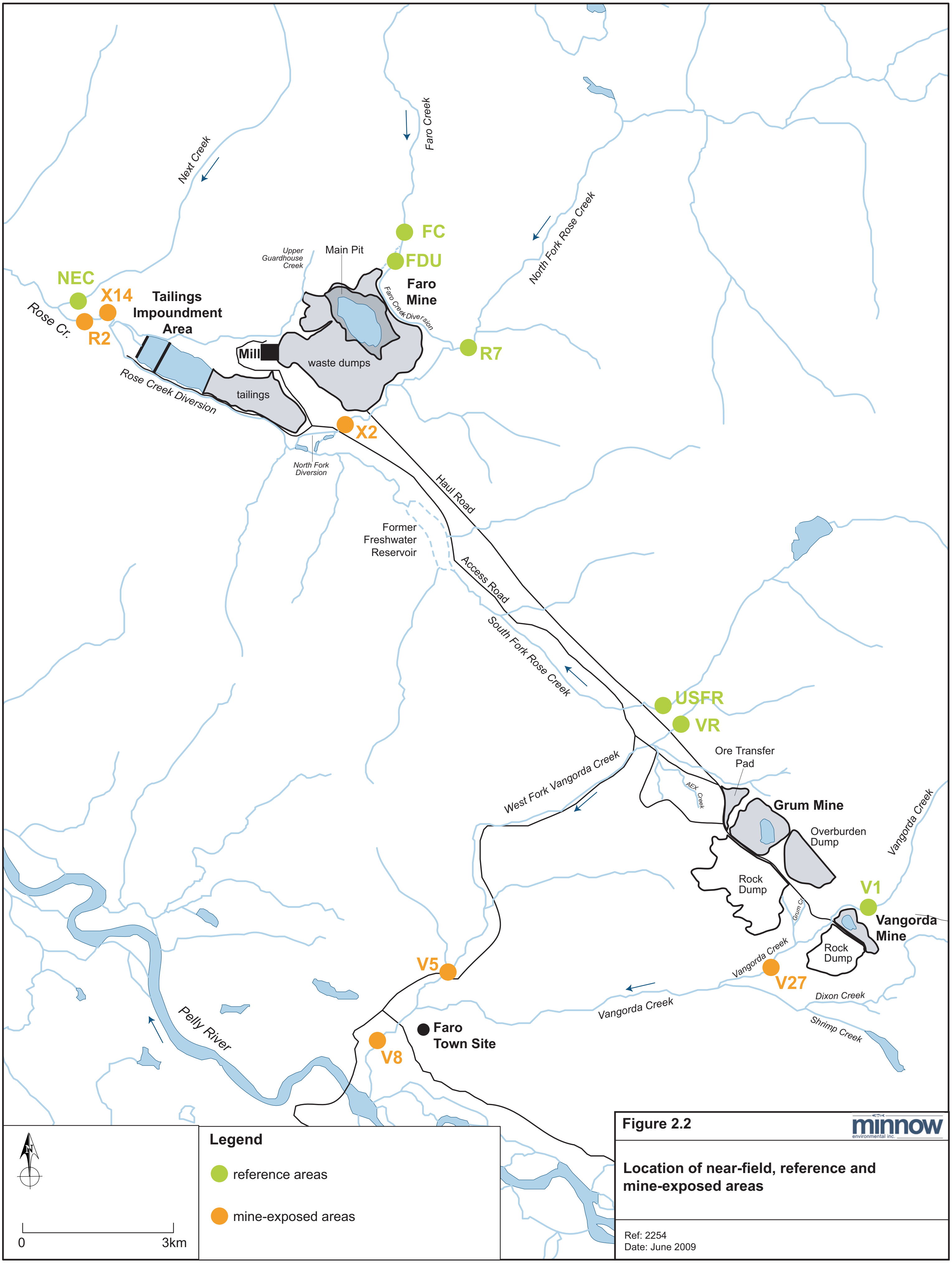

Figure 2.2

Location of near-field, reference and mine-exposed areas

Table 2.1: Sampling Design for Interim Monitoring Program, Faro Mine, 2007-2008

Year	Area Type	Water Body	Area Code	UTM (NAD83)		Water	Sediment		Benthic Invertebrates		
				Easting	Northing	Chemistry	Chemistry	Toxicity	AS (LES)[a]	Hess	Kick
2007	Reference	Upper Vangorda Creek	V1	594460	6903738	1	1	1	5	5	
		Upper West Fork Vangorda Creek	VR (UWFV)	590686	6906911	1				1	
		Upper South Fork Vangorda Creek	USFR	590244	6907387	1				1	
		Next Creek	NEC	579177	6915378	1				1	
	Exposed	Vangorda Creek	V27	591627	6902114	1	3	3	5	5	
		West Fork Vangorda	V5	586201	6902136	1			5	5	
		Lower Vangorda Creek	V8	584832	6900642	1			5	5	
2008	Reference	Upper North Fork Rose Creek	R7	586415	6914362	1	1	1	5	1[b]	2[b]
		Upper Anvil Creek	R6	568200	6921500	1			3	-[c]	-[c]
		Upper Vangorda Creek	V1	594460	6903738					-[d]	-[d]
		Upper West Fork Vangorda Creek	VR (UWFV)	590686	6906911	1				1	1
		Upper South Fork Vangorda Creek	USFR	590244	6907387	1				1	1
		Upper Faro Creek	FC	585356	6916777	1				1	1
		Next Creek	NEC (NXT)	579177	6915378	1				1	1
		Blind Creek	BLC	589480	6896900	1				5[e]	3
		Starr Creek	STC	349168	6851621	1				1	1
		Horton Creek	HOC	656455	6855494	1				1	1
		Beautiful Creek	BEC	638209	6863348	1				1	1
		Grew Creek	GRC	611873	6882292	1				1	1
		Buttle Creek	BUC	589908	6893972	1				1	1
		Unnamed Creek, near Big Trout Tributary	BTT	345565	6886145	1				1	1
	Exposed	North Fork Rose Creek	X2	584072	6912786	1	1	1	5	5	3
		Rose Creek	R2	579133	6914947	1	1	1	5	5	3
		Rose Creek	R3	574000	6917200	1			3		
		Rose Creek	R4	567700	6921300	1			5	-[c]	-[c]
		Anvil Creek	R5	566300	6922700	1			3		

[a] Artificial substrate sampling by Laberge Environmental Services (Burns 2009).

[b] High water and lack of suitable substrate (cobble-gravel) resulted in collection of fewer Hess (1 of 5) and kick (2 of 3) samples than planned.

[c] Samples could not be collected due to extraordinarily heavy rains with low cloud cover (not accessible by helicopter).

[d] Samples could not be collected due to grizzly bear activity around a moose carcass at this location.

[e] Replicated stations were sampled here after it was determined that it would not be possible to sample more than one station at R7 due to high water and limited area with suitable substrate (cobble-gravel).

Gradient was measured using a clinometer. Stream morphology, substrate type, instream cover, overhead canopy, and aquatic vegetation were visually assessed, identified as appropriate, and categorized (i.e., assigned percentage area cover) based on the judgment of experienced field personnel. All habitat information was documented on standardized habitat assessment forms. Sketches of each area were made on field sheets, noting key features and the locations of any samples collected. The locations of all samples were noted using a hand-held global positioning system (GPS). Photographs were taken at each sampling area to further support habitat descriptions (Appendix D).

2.2 Habitat Characterization based on GIS

Habitat characteristics that could be taken from Geographic Information Systems (GIS) were tabulated for 22 areas that had been sampled in 2007 and/or 2008 around the Faro Mine complex. Source and station elevations were taken from the Yukon Digital Elevation Model (DEM) available at Geobase.ca and used to calculate average upstream gradient (elevation difference divided by distance). Stream order (Strahler method) and distance to source were taken from the Yukon Stream Network, also available at Geobase.ca. Drainage density was the total stream distance within the basin divided by basin area. Land cover types were taken from Natural Resources Canada (geogratis.ca) but the information was coarse and dated. Percent area associated with bedrock geology types, logging, and mine claims were taken from Yukon Geomatics (geomaticsyukon.ca).

Watershed boundaries were delineated using ArcMap 9.1 and the extension ArcHydro 9.1 (ESRI 2005), based on a 30-m-resolution digital elevation model and a 1:50,000 stream network. Basin characteristics (area and perimeter) were determined using the X-Tools extension for ArcMap. Based on the extracted boundaries, the intersect function in ArcMap was utilized to associate the environment layers (i.e., streams, geology, and land cover) to the appropriate watershed. Relative areas and lengths were then calculated for each environmental attribute in each watershed. All important characteristics were then summarized in Excel.

2.3 Water Chemistry

Conductivity, pH, dissolved oxygen (DO), and temperature were measured in the field immediately upstream of each benthic invertebrate sampling area (Section 2.4). DO, pH and temperature were measured using a WTW 3301 meter (for conductivity) and YSI 556 MDS (Multi-parameter Display System for DO, pH, and temperature) or a YSI 556 WQA (conductivity, pH, DO, temperature). Meters were calibrated according to manufacturers’ instructions. Probes were placed into the water and allowed to acclimate prior to taking measurements.

Water samples for laboratory analyses were collected directly into appropriate sample bottles supplied by Maxxam Analytics, Burnaby, BC. All water samples were collected immediately upstream of each sampling area and sample bottles were oriented upstream during filling. Sample bottles were rinsed three times with the surface water being sampled prior to final filling. Care was taken to ensure that no headspace was left in the collection bottles, except for samples requiring preservation for which a small headspace was left to accommodate addition of the preservative (also added in the field). All samples were placed in coolers immediately following collection and were later placed in a refrigerator at approximately 4°C until they could be shipped, in coolers with ice packs, to Maxxam Analytics, Burnaby, BC.

Water quality benchmarks were selected to assist in the evaluation of water quality data (Appendix A). CCME (1999) criteria for the protection of aquatic life were selected, where available, otherwise alternative water quality criteria or aquatic toxicity values were selected. Observed concentrations in mine-exposed areas were compared to the applicable benchmarks and to reference area concentrations to identify any parameters present at elevated concentrations. The results were also compared to those reported by LES (Burns 2007) based on samples collected at the same times and locations (e.g., field replicates) and sent to Cantest Ltd., Burnaby, BC.

2.4 Water Toxicity

Two sets of samples (August 2008 and January 2009) were collected from R7, X2, and R2 (the latter area only in January 2009) for analysis of acute lethal toxicity to rainbow trout (Environment Canada 2000), effects on survival and reproduction of the water flea *Ceriodaphnia dubia* (Environment Canada 2007a), and/or effects on the growth of the green alga *Pseudokirchneriella subcapitata* (Environment Canada 2007b). The samples were collected into 20-L collapsible plastic containers, placed in coolers with ice packs, and shipped by courier to the laboratory (Nautilus Environmental, Burnaby, BC). The samples were received and testing was initiated with 3 days of collection except for the sample collected at R7 in August 2008, which was delayed by courier delivery of the sample (i.e., test was initiated 5 days after collection).

2.5 Sediment Chemistry

Sediment samples collected by LES under the site Water License are analyzed after they have been dried and passed through a 0.15 mm sieve. While this standardizes the size fraction of particles analyzed for metal content, the results may not be indicative of whole sediment metal concentrations nor of organism exposure. For example, the fine fraction of sediment may represent a small proportion of the whole sediment sample and may be even less representative of the areas sampled if deposits of fines are small and/or rare (Minnow 2007b). To investigate this issue, sediment samples were collected for analysis of particle size distribution and chemistry in both the whole sediment (rocks larger than 2 mm were removed for metals analyses consistent with standard laboratory practice) and in the <0.15 mm fraction.

Sediment samples were collected at V1 (n=1) and V27 (n=3) in 2007 and from R7 (n=1), X2 (n=1), and R2 (n=1) in 2008 (Figure 2.1). Sediment samples for chemical analyses were collected using a petite ponar grab (15.24 cm x 15.24 cm, 0.023 m^2 total bottom area per grab). Suitable patches of fine substrate (relatively more sand and silt, and less coarse material) were sought within each reach for sampling. Grabs were deemed acceptable if they showed reasonable penetration and had a visibly intact surface layer. Unacceptable grab samples were discarded. The top 5 cm from several acceptable ponar grabs were composited to fulfill sample volume requirements for all the sediment analyses. Sediment was then mixed to ensure homogeneity and excess water was decanted with care taken to minimize loss of fines. A stainless steel spoon was used to separate the sample into three ziplock bags; one for particle size analysis, one for percent moisture and total organic carbon (TOC) analyses, and one for total metals analysis. Details pertaining to the samples (e.g., water depth, substrate characteristics, colour, texture) were recorded on field sheets. Immediately after collection, the sample containers were placed in a cooler on ice, and were later placed in a refrigerator at approximately 4 °C until they could be shipped, in coolers with ice packs, to Maxxam Analytics in Burnaby, BC. Results were reported in units of percent or mg/kg on a dry weight basis.

Federal (CCME 1999) and British Columbia (BCMOE 2006) sediment quality guidelines were used in evaluating sediment chemical concentrations. Observed concentrations in mine-exposed areas were compared to the applicable guidelines and to reference area concentrations to identify parameters and locations having elevated concentrations.

2.6 Sediment Toxicity

Sediment samples were collected for toxicity testing in the same manner as described above. A stainless steel spoon was used to place the remainder of the homogeneous sediment mixture into pails with plastic liners. A minimum volume of 3 L was required for the testing. Immediately after collection, the samples were placed in a cooler on ice, and were later placed in a refrigerator at approximately 4 °C until they could be couriered to the laboratory. Samples were sent to Aquatox Testing and Consulting Inc. in Aberfoyle, ON, in 2007 and to Nautilus Environmental in Burnaby, BC, in 2008. The samples were tested for potential effects on survival and growth of *Hyallela azteca* over a 14-day exposure period (Environment Canada 1997).

2.7 Benthic Invertebrate Community Assessment

Previous benthic invertebrate community sampling at the Faro Mine complex has chiefly involved artificial substrates (rock baskets) deployed for a 5- to 6-week period (Burns 1991-2007). While there are advantages to the use of artificial substrates, sampling of resident benthic communities may be less prone to sampling bias and spatial and temporal variability (Minnow 2007b) and could save costs as it requires only one trip to sampling areas. Therefore, it was recommended that parallel benthic community surveys be conducted in both the Vangorda (2007) and Rose Creek (2008) drainages using both approaches to determine which one will be most cost-effective for long-term monitoring at the Faro Mine complex (Minnow 2007b). This study compared the relative effectiveness artificial substrates, Hess samples and kick samples for benthic community characterization.

In addition, this study evaluated two sampling designs that could serve as the basis for long-term monitoring at the Faro Mine complex: 1) a traditional control-impact (CI) approach in which mine-exposed areas were compared to a reference area based on replicate stations within areas (3 or 5 stations per area), and 2) a Reference Condition Approach (RCA) which involves comparison of each mine-exposed area to numerous reference areas (single stations within each area). The CI design relies on comparison of an effluent-exposed area to (usually) a single reference area that has not been exposed to effluent but is otherwise similar to the exposed area (Green 1979; Hurlbert 1984). The RCA design involves statistically comparing benthic community characteristics of an exposure area to those of a broader set of reference areas to better account for the natural variability that exists among areas (Hughes et al. 1986, Wright et al. 2000, Bailey et al. 2004; Bowman and Somers 2005, 2006). An underlying assumption of both approaches is that habitats of the exposure area and the selected reference areas are similar, so that reference-exposure differences can be more confidently ascribed to effluent influence; however, prior to this study, the degree of habitat similarity between reference and exposure area(s) has rarely or never been formally tested.

In 2007 and 2008, samples of resident benthic invertebrates were collected using a Hess sampler. In 2008, samples were also collected using a kick net. Hess as well as kick and sweep sampling data were compared to data from the artificial substrate sampling by Burns (2007, 2009). The number of samples collected per area are shown in Table 2.1. Conditions of substrate, water depth, water velocity, sampler penetration depth, and sampling time were controlled to the extent possible to optimize comparability among sample stations. In areas where artificial substrates (AS) were deployed by LES (Burns 2007), Hess and kick and sweep samples were taken as close as could be achieved while still ensuring comparable habitat/substrate characteristics among stations.

The planned sampling design included sample collection at replicate stations from V1 (2007) and R7 (2008) since these areas have been used for reference sampling in past artificial substrate surveys conducted under the site Water License. However, as noted in Section 2.1, it was only possible to sample one station by Hess and two stations by kick and sweep sampling at R7 in 2008. Replicate stations were sampled instead at Blind Creek. Also, samples could not be collected at V1 (grizzly bear attending a moose carcass) nor R4 (low clouds and torrential rain) in 2008.

2.7.1 Hess Sampling

Samples were collected using a 0.1 m^2 Hess sampler fitted with a 243 um mesh collection net. One sample was collected at each station and was a composite of three-sub-samples in order to ensure that each sample was representative of average conditions at the station (0.3 m^2 per sample). Each sub-sample was collected by carefully inserting the base of the Hess sampler into the substrate to a depth of approximately 10 cm (2007) or 5-8 cm (2008) after which gravel and cobble contained within the sampler was carefully washed while allowing the current to carry dislodged organisms into the collection net. After the area within the sampler was completely washed, any organisms adhering to the mesh, other than that of the collection net, were rinsed into the collection net. The sampler was then moved to the next sub-sampling location and the procedure repeated. After collection of the third sub-sample, all organisms were rinsed to the end of the collection net. The sample was then rinsed into a labelled 1- or 2-litre, wide-mouth plastic jar. Internal labels were also used to further ensure correct identification of each sample. Samples were preserved to a level of 10% buffered formalin in ambient water within six hours of collection.

2.7.2 Kick and Sweep Sampling

A kick-and-sweep technique (referred to as kick sampling throughout the remainder of the report) was also used to collect benthic invertebrate community samples. In this technique, the sampler disturbed the substrate with her feet upstream of a D-net (243 um mesh) that was placed on the streambed. The sampler started adjacent to the streambank, disturbed the substrate, let the displaced benthic macroinvertebrates and debris flow into the net, moved the net upstream and away from the streambank, and repeated the process for 3 minutes to generate a single sample in each area (Reynoldson et al. 1999). If the sampler reached the other streambank within the 3 minute time period, she continued sampling towards the other streambank until time elapsed. The number of transects and distance (m) were recorded on field sheets. All organisms were rinsed into a labelled 1- or 2-litre, wide-mouth plastic jar. Internal labels were also used to further ensure correct identification of each sample. Samples were preserved to a level of 10% buffered formalin in ambient water within six hours of collection.

2.7.3 Laboratory Analyses

Benthic invertebrate samples were sent to Cordillera Consulting in Summerland, BC, for sorting, enumeration and identification (to lowest practicable level). Although samples collected by LES in 2007 were initially sent to a different laboratory for analysis (data reported by Burns 2007), the samples were sent to and re-analyzed by Cordillera to allow the direct comparison of sampling methods. As a result, data presented herein for artificial substrates differ somewhat from data reported by Burns (2007) for the same samples. All samples were sent directly to Cordillera in 2008.

To ensure size comparability with samples collected by Burns (2007), the samples were re-sieved at the laboratory with a 300-um mesh. Each sample was elutriated to remove sand or gravel. The elutriate was examined for molluscs or trichopteran cases which were removed if found. The remaining organic material was washed through 2 mm and 300 micron sieves. The contents of the two sieves were sorted and identified separately under low power dissecting microscopes. If numbers of invertebrates appeared to be high (> 400) the sample was split by surface area. The fractions were subsampled to achieve a total of more than 300 organisms in the sample. Invertebrates were divided into orders or classes and stored in individual vials in 80% ethanol. Following the sorting process, the invertebrates were identified to the lowest practical level.

There were two samples collected in 2008 (BTT Hess and BTT kick) with a large proportion of filamentous algae which could not be subsampled with the above method because even distribution of the sample was not achievable. In these cases the whole sample was rinsed, pressed to a point where no water was dripping and then weighed. A subsample was removed by weight using scissors. This subsample was sorted and subsequent subsamples were removed until 325 organisms had been removed from the whole. Subsampling numbers and proportions are reported in Appendix D, along with a laboratory quality control report, which showed good average sorting efficiency, precision, and accuracy.

2.7.4 Community Descriptors

Sample codes used in the field by Minnow (in 2007 and 2008) and LES (Burns 2007, 2009) were modified slightly for data analysis to ensure consistency in coding rules and clarity in data management and output. The first 2-4 digits reflected the sampling location, which included area codes previously used in monitoring programs at Faro (V1, USFR, R2, etc.) or, in the case of new reference areas, typically represented a three-digit contraction of the water body name (Next Creek – NEC, Buttle Creek – BUC, etc.). The next digit indicated the sample collection method: A for artificial substrate, H for Hess, and K for kick sampling. For areas in which up to five replicate stations were sampled, a lower case letter "a" to "e" followed, otherwise no lower case letters were used in the sample code. The last digit of the sampling year (7 or 8) was included as the last digit in the sample code to distinguish samples that were collected from areas sampled in both years (i.e., VR, USFR, NEC). As examples, the code for the single Hess samples collected at USFR in 2007 and 2008 were USFRH7 and USFRH8, whereas the first replicate station sampled by artificial substrate at area X2 in 2008 was X2aA (no corresponding sample collected in 2007 so no trailing 7 or 8 digit).

Commonly used benthic invertebrate community metrics (e.g., Environment Canada 2002) were computed for each station. For Hess samples, organism density (individuals/m^2) was calculated based on the known area sampled, whereas AS samples were reported as total abundance per substrate and kick samples were reported as abundance per 3-minute kick sample. The number of taxa (also known as taxon richness), which is a simple and robust expression of benthic community diversity, included all separate taxa identified to the lowest practicable level, excluding any life stages that could not be conclusively identified as separate taxa. For the purposes of data analysis, some invertebrate taxa were combined at a generic taxonomic level in order to incorporate abundance associated with indeterminate species and/or standardize taxonomic levels among stations and years. Comparisons that involved only areas within the Vangorda Creek drainage (2007) were based on a data set to which slightly different re-attributions were applied (Appendix Tables D.4 and D.5), compared to those including samples collected in 2008 (Appendix Tables D.2 and D.3).

Simpson's indices of diversity ("D") and evenness ("E") were computed from custom MS Excel macros and spreadsheets following the formulae presented by Environment Canada (2002). These indices take into account both the relative abundance of taxa, and the number of taxa, with values ranging from 0 (low diversity or evenness) to 1 (high diversity or evenness). In general, relatively high diversity values reflect moderate abundance of a proportionately high number of taxa, and are often associated with good environmental quality. Low diversity values typically reflect communities with a high abundance of only a few taxa, or simply few taxa, and may indicate an impaired benthic community. Simpson's E measures how well (evenly) individuals are distributed among the total number of sampled taxa, with low evenness values indicating that benthic communities are dominated by few taxa, suggestive of an impaired biological community.

The Bray-Curtis Index is commonly calculated for Environmental Effects Monitoring studies at Canadian mine sites (Environment Canada 2002), but was not included in this study because the ordination axis scores used yield analogous but more detailed information (i.e., direction of difference from average community).

The relative abundances (as percentages of total organisms in a sample) of the most common major taxonomic groups were also computed for each station (i.e., Ephemeroptera, Plecoptera, Trichoptera, which are more commonly and collectively referred to as EPT taxa, as well as chironomid midges). These percentages are not independent variables, because as one group increases in percent abundance, other groups must necessarily decrease. Despite this, such metrics are useful in describing the relative composition of benthic communities in different areas and over time.

Benthic invertebrate community structure was also assessed using a multivariate technique known as correspondence analysis (CA; Thioulouse et al. 1997). CA was used to calculate axes, which can be thought of as new variables summarizing the variation in benthic community data. When depicted in two-dimensional plots, taxa that tend to co-occur will have similar CA axis scores and will plot together, while those that rarely co-occur plot farther apart. Similarly, stations exhibiting similar relative abundance of taxa will plot closest to one another, while those with little in common plot farther apart. The greatest variation among either taxa or stations is explained by the first axis, with other axes accounting for progressively less variation. Therefore, this type of multivariate analysis describes not only which stations have distinct benthic communities but also how these benthic communities differ among stations (*i.e.*, which particular taxa differ). CA is influenced by rare species, so those taxa occurring at 10% or fewer stations were eliminated from the analysis. Scores for both stations and taxa were calculated using the ADE-4 package (Thioulouse et al. 1997) and were saved as new summary variables to evaluate the associations of organisms and stations.

Benthic invertebrate community metrics were computed for each station and summarized for each area in cases where multiple stations were sampled within an area (e.g., mean, standard deviation, standard error, minimum, maximum).

2.7.5 Control-Impact (ANOVA) Comparisons

Reference-exposure areas differences were tested using multivariate analysis of variance (MANOVA) and analysis of variance (ANOVA), followed by *a priori* user-defined post-hoc tests. All data were transformed as necessary to satisfy assumptions of normality and homogeneity of variance. Unadjusted t-values for contrast tests were used if assumptions of normality and variance were met. In instances where variances could not be homogenized by transformation, contrast tests not requiring this assumption (i.e., contrast t-tests for unequal variances) were used. Tests of significance were based on $p<0.1$. All statistical tests were conducted using SPSS Version 13 software (SPSS Inc. 2006).

2.7.6 Reference Condition Approach

Reference-exposure area differences were also tested using the Reference Condition Approach (RCA) and Test Site Analysis (TSA). In the RCA, the biological community at an exposure area is compared to the range of communities found at minimally impacted reference areas with comparable habitat characteristics (e.g., Bailey et al. 2004). The TSA method is used to statistically test whether community attributes of an exposure area are within the range found at suitable reference areas (with similar habitat) (Bowman and Somers 2006).

In a RCA approach, habitat characteristics that are minimally influenced by human activities are used to select (match) suitable reference areas as opposed to characteristics that are known or suspected to be anthropogenically influenced (e.g., water chemistry). Habitat characteristics were divided into categories: basin characteristics (e.g., size, elevation, bedrock types, land cover), area characteristics (e.g., flow), and water chemistry (the latter of which was examined but no used directly for matching reference and exposure areas). Principle components analysis (PCA) was used to select the variables within each habitat category (e.g., bedrock types) that were important in distinguishing study areas and Pearson correlations were used to eliminate highly correlated (i.e. $r > 0.6$) variables (Appendix E).

The habitat characteristics that were most strongly correlated to biological community characteristics (i.e., $r > 0.6$) were used in a “nearest neighbour” approach (e.g., Linke et al. 2005) to select appropriate reference areas for each exposure area. Euclidean distances (summarizing habitat characteristics) between each exposure area and each reference area were used to rank the reference areas from best to worst habitat match with each exposure area. A TSA of habitat data was used to help decide the cut-off between suitable and non-suitable reference areas for a given exposure area.

A TSA of biological data was used to assess the condition of the benthic invertebrate community within each exposure area relative to those in the set of reference areas with comparable habitat. The non-central probability value (ncP) indicates the likelihood an exposure area is in (ncP>0.90) or outside of (ncP<0.1) reference condition (values between 0.1 and 0.9 indicate uncertainty with respect to whether area is inside our outside reference). The 90th percentile was used to define reference condition (i.e., typical range for reference areas). If the biological community at an exposure area was within the *range* found at the reference areas (ncP > 0.9) it was deemed unimpaired by mine influences whereas a community different from reference (ncP < 0.1) was deemed impaired. The more traditional central P (cP) indicates the probability the value at an exposure area is different than the *mean* value for reference areas. This cP differs from the P-values in the ANOVAs performed for the Control-Impact design (Section 2.7.5) in that it is based on one mean value for an exposure area rather than replicate stations within each exposure area.

2.8 Fish Surveys

In 2007 only, exploratory backpack electrofishing was opportunistically conducted (i.e., time-permitting) in three areas: Next Creek, Upper South Fork Rose Creek (upstream of the Haul Road) and in Vangorda Creek downstream of V8 (Figure 2.1). Electrofishing was conducted using a Smith-Root POW Type 12A battery powered backpack. No stop nets were used. Sampling effort (electrofisher settings, electrofishing seconds, surface area sampled) and GPS coordinates were recorded on field sheets following each respective pass. Fish were collected under fish Licence No. 07-52 issued by the Department of Fisheries and Oceans, Whitehorse, Yukon. All captured fish were identified and enumerated prior to their release. The main objective of these fish collections was to confirm the reproductive status (gonad size) of slimy sculpin at this time of year (late August, undeveloped). Another reconnaissance-level sculpin survey was conducted in the spring of 2008 and has been reported separately, along with recommendations for approaching assessment of fish health in long-term monitoring (Minnow 2009). No further discussion of fish monitoring has been included in this report.

3.0 WATER QUALITY ASSESSMENT

3.1 In situ Measurements

All surface waters were well oxygenated at the time of sampling (Table 3.1). Water temperatures were in the range of 4 to 10°C at most areas except at two reference creeks sampled in 2008 which were slightly warmer (BEC, BTT 13°C) (Table 3.1). Variability in water temperatures may be at least partially attributable to variation in the time of day that measurements were made. Of the tributaries in the immediate vicinity of the Faro Mine complex, Upper South Fork Rose Creek was slightly warmer in both years (10°C compared to 4-8°C for most other locations in the Rose and Vangorda drainages). Water pH ranged from 6.2 to 8.5, except at Upper West Fork Vangorda Creek (VR) in 2007 and Faro Creek (FC) in 2008 which had lower pH (4.7 and 5.4, respectively).

Elevated conductivity levels were observed, as expected, at mine-exposed areas (Table 3.1), reflecting higher concentrations of other non-specific parameters such as total dissolved solids, and major ions that contribute to them (e.g., calcium, magnesium, sulphate; Tables 3.2 and 3.3). Some reference areas sampled in 2008 showed conductivities that were relatively high (e.g., STC, BEC, HOC, GRC; Table 3.1) with corresponding elevations in sulphate and hardness levels (Table 3.3). There was no evidence of recent anthropogenic disturbance near these areas at the time of the field survey (e.g., no signs posted indicating mining activity upstream nor evidence of routine vehicle access to upstream areas), although there was purportedly some mineral development in the Grew Ceek drainage in the mid-1990s (D. Cornett and B. Slater, pers. comm.). The influence of historical activities on water quality in Grew Creek or other drainages was considered minor (except for slightly elevated selenium levels, metal concentrations were generally comparable to other reference areas; Table 3.3), especially in the context of the current study objectives (i.e., assessing relative, rather than absolute, sensitivity of various benthic invertebrate community assessment methods). However, the extent, if any, to which Grew Creek or other reference areas may be anthropogenically influenced should be determined prior to inclusion of such areas in long-term monitoring programs.

At the Vangorda site, conductivity was highest at V5 and V8 compared to V27, indicating an unknown source of dissolved solids to West Fork Vangorda Creek. Indeed, total dissolved solids as well as alkalinity, hardness and total suspended solids were higher at V5 and V8 than at V27, V1 or VR (Table 3.2), which indicates a disturbance (mine-related or otherwise) downstream of VR.

Table 3.1: Field water quality measurements collected in August 2007 and August 2008, Vangorda Creek, Faro Mine, Yukon.

Area		Station Description	Station ID	Date Measured	pH	DO	DO	Conductivity	Specific Conductance	Temperature	Wetted Width	Bankful Width	Depth	Velocity	Gradient
					pH units	mg/L	%	uS/cm	uS/cm	°C	m	m	m	m/s	%
August 2007	Reference	Upper West Fork Vangorda Creek	VR	Aug. 25	4.73	10.8	84.0	97	158	4.7	2	2	0.10	0.31	5
		Upper South Fork Rose Creek	USFR	Aug. 25	7.08	9.1	81.3	60	84	10.1	0.2	9	0.22	0.37	4.8
		Next Creek	NEC	Aug. 25	7.50	11.4	87.5	136	226	4.2	6	7	0.19	0.25	4
		Upper Vangorda Creek	V1-01	Aug. 28	6.85	12.2	98.8	48	75	6.3	4	8	0.21	0.11	5
			V1-02	Aug. 28	6.52	12.2	99.0	48	74	6.5	5	7	0.14	0.31	8
			V1-03	Aug. 28	6.91	12.1	98.5	49	76	6.5	5	8	0.13	0.42	7
			V1-04	Aug. 29	6.56	12.8	99.1	43	71	4.5	7	10	0.30	0.06	8
			V1-05	Aug. 29	6.37	13.6	105	44	72	4.5	4	7	0.20	0.12	6
	Effluent Exposed	Vangorda Creek	V27-01	Aug. 28	7.54	13.4	105	134	215	5.2	5	6	0.18	0.19	2
			V27-02	Aug. 28	7.81	12.9	102	140	223	5.5	4	8	0.23	0.21	2.5
			V27-03	Aug. 28	7.84	12.7	103	135	214	5.7	4	5	0.19	0.12	3.5
			V27-04	Aug. 28	7.87	12.4 [a]	103	137	213	6.3	5	5	0.24	0.16	3
			V27-05	Aug. 28	8.00	12.3	103	143	214	7.7	5	6	0.23	0.13	3
			V5-01	Aug. 29	8.46	14.5	114	329	534	4.9	3	5	0.12	0.23	3
			V5-02	Aug. 29	8.47	14.1	110	328	532	4.9	3	6	0.13	0.18	3
			V5-03	Aug. 29	8.25	13.5	107	333	532	5.4	4	6	0.20	0.22	3
			V5-04	Aug. 29	8.41	13.4	107	336	531	5.8	4	5	0.16	0.24	4
			V5-05	Aug. 29	8.48	13.1	106	339	529	6.2	4	7	0.11	0.24	3
			V8-01	Aug. 27	8.33	13.2	107	277	432	6.2	6	8	0.26	0.18	5
			V8-02	Aug. 27	8.38	13.3	109	280	432	6.6	5	8	0.24	0.17	5.5
			V8-03	Aug. 27	8.43	13.1	108	285	433	7.1	6	8	0.29	0.09	2.5
			V8-04	Aug. 27	8.46	13.0	109	289	430	7.8	7	10	0.23	0.21	2.5
			V8-05	Aug. 27	8.47	12.9	109	291	430	8.1	3	6	0.27	0.14	4
August 2008	Reference	Upper West Fork Vangorda Creek	VR	Aug. 19	6.29	12.2	97.8	36	59	5.8	2	2	0.15	0.29	3
		Upper South Fork Rose Creek	USFR	Aug. 19	6.22	10.9	95.0	32	45	9.4	9	10	0.19	0.35	7
		Next Creek	NXT	Aug. 20	7.60	12.1	98.6	57	87	6.7	6	8	0.09	0.22	4
		Upper West Fork Rose Creek	R7	Aug. 21	7.62	11.3	88.7	90	146	5.6	7	8	0.10	0.30	3
		Faro Creek Upstream	FC	Aug. 22	5.43	11.9	96.4	29	45	6.3	4	5	0.28	0.40	4
		Blind Creek	BLC	Aug. 22	7.82	11.2	98.5	100	143	9.2	26	30	0.40	0.25	2
		Star Creek [b]	STC	Aug. 23	8.17	12.7	104.5	377	577	6.8	12	13	0.35	0.35	3.5
		Beautiful Creek [b]	BEC	Aug. 23	8.22	11.6	111.7	560	714	13.7	4	4	0.20	0.60	2
		Horton Creek [b]	HOC	Aug. 23	8.23	11.5	97.8	368	538	8.5	12	12	0.20	0.35	3
		Grew Creek	GRC	Aug. 23	8.25	11.4	100.1	468	661	9.7	3	10	0.20	0.50	
		Tributary of Ross River	BTT	Aug. 24	8.08	9.6	91.3	163	210	13.3	5	6	0.15	0.50	4
		Buttle Creek [b]	BUC	Aug. 24	8.20	11.2	99.0	276	394	9.3	4	5	0.15	0.60	2.5
	Exposure	North Fork Rose Creek	X2	Aug. 19	7.18	12.1	95.6	91	146	5.3	6	8	0.38	0.42	3.5
		Rose Creek	R2	Aug. 20	7.86	11.7	99.0	205	302	8.1	11	11	0.47	0.43	2

[a] Dissolved oxygen value is an estimate based on temperature.

[b] Areas were samples downstream of highway crossing because upstream habitat (wetland) did not match exposure area characteristics (erosional).

Table 3.2: Water quality data compared to benchmarks, Faro Mine Complex, August 2007.

Parameter	Units	Benchmark (see Appendix A)	Reference: Upper West Fork Vangorda Creek (VR) (Sample Date: 8/25/2007)	Reference: Upper South Fork Rose Creek (USFR) (Sample Date: 8/25/2007)	Reference: Next Creek (NEC) (Sample Date: 8/26/2007)	Reference: Upper Vangorda Creek (V1) (Sample Date: 8/28/2007)	Mine Exposed (Vangorda Creek): V27 (Sample Date: 8/28/2007)	Mine Exposed (Vangorda Creek): V5 (Sample Date: 8/29/2007)	Mine Exposed (Vangorda Creek): V8 (Sample Date: 8/27/2007)	Mine Exposed (Vangorda Creek): V8Z Field Duplicate (Sample Date: 8/27/2007)
Alkalinity (Total as CaCO3)	mg/L	12.6 [a]	30.6	21.9	47.4	24.4	52.3	206	134	137
Alkalinity (PP as CaCO3)			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	3.3	< 0.5	< 0.5
Ammonia - N	"	0.25	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chloride	"	250	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	2.1	0.8	0.8
Conductivity	uS		75	59	102	71	210	533	396	398
Dissolved solids, total (TDS)	"	500	62	50	78	54	140	354	264	260
Fluoride	"	0.12	0.08	0.07	0.09	0.07	0.08	0.19	0.13	0.13
Hardness	"		35	26.1	49.7	30.8	102	304	214	213
Mercury, total	ug/L	0.026	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nitrate (N)	mg/L	13	< 0.02	< 0.02	< 0.02	< 0.02	0.13	0.03	0.08	0.08
Nitrate plus Nitrite (N)			< 0.02	< 0.02	< 0.02	< 0.02	0.13	0.03	0.08	0.08
Nitrite - N	"	0.06	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Organic carbon, dissolved (DOC)	"		3.1	1.9	2.7	1.4	1.8	3.5	2.6	2.5
Organic carbon, total (TOC)	"		3.3	2.7	3.2	2	2.2	3.5	2.6	2.4
Phosphorus, total	mg/L	0.03	< 0.005	0.005	< 0.005	0.01	< 0.005	0.017	0.012	0.008
Sulphate	"	50	4.2	5.5	2.4	8.9	49.3	75.6	65.9	66.5
Suspended solids, total (TSS)	"	29	< 1	< 1	< 1	< 1	< 1	11	3	12
ICP - Metals Scan										
Aluminum	mg/L	0.1	0.0306	0.0263	0.0172	0.0143	0.0184	0.275	0.101	0.107
Antimony	"	0.020	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00007	0.00015	0.00013	0.00012
Arsenic	"	0.005	0.0001	0.0003	< 0.00001	0.0002	0.0004	0.001	0.0004	0.0005
Barium	"	1	0.0287	0.025	0.0256	0.0257	0.0326	0.078	0.0528	0.0539
Beryllium	"	1.1	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00005	< 0.00005	< 0.00005	< 0.00005
Bismuth		0.260	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Boron	"		< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Cadmium	"	0.00003	0.00001	< 0.00001	0.00001	< 0.00001	0.00005	0.00004	0.00004	0.00004
Calcium	"		10.9	8.82	16.5	10.6	28.3	77.8	52.8	54.9
Chromium	"	0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0008	0.0003	0.0003
Cobalt	"		0.00002	0.00004	< 0.00002	< 0.00002	0.00004	0.00027	0.00014	0.00012
Copper	"	0.002	0.0006	0.0004	0.0006	0.0004	0.0009	0.0014	0.0013	0.0011
Iron	"	0.3	0.031	0.164	0.014	0.027	0.049	0.464	0.177	0.18
Lead	"	0.002	0.00007	0.0001	0.00005	0.00004	0.00052	0.00052	0.00032	0.0003
Total Magnesium (Mg)	"	82	1.94	1.32	2.47	1.45	8.55	28.7	19.7	20
Dissolved Magnesium (Mg)			1.87	1.2	2.32	1.34	8.4	28.2	19.9	20
Total Manganese	"	1.0	0.00106	0.00959	0.00035	0.00076	0.0035	0.0218	0.011	0.011
Molybdenum	"	0.073	0.00014	0.0003	0.00024	0.00023	0.00032	0.00158	0.00081	0.00083
Nickel	"	0.065	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0018	0.0011	0.0011
Potassium	"	53	0.326	0.285	0.522	0.343	0.525	1.15	0.892	0.911
Selenium	"	0.001	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0013	< 0.0005	0.0006
Silver	"	0.0001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Total Sodium (Na)	"	200	1.93	1.92	2.37	2.09	2.54	4.12	3.33	3.48
Dissolved Sodium (Na)			1.73	1.6	2	1.81	2.21	3.78	3.11	3.11
Strontium	"	9.3	0.054	0.0495	0.0661	0.0539	0.104	0.27	0.191	0.203
Thallium	"	0.0008	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Tin	"	0.35	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00006	< 0.00005
Titanium	"	1.83	< 0.0005	0.0008	< 0.0005	< 0.0005	0.0007	0.0083	0.0027	0.0027
Uranium	"	0.005	0.00037	0.00029	0.00029	0.00031	0.00126	0.00405	0.00315	0.00323
Vanadium	"	0.006	< 0.00005	0.00008	0.00006	< 0.00005	< 0.00005	0.00095	0.00033	0.00032
Zinc	"	0.030	0.0021	0.0019	0.0019	0.0027	0.0318	0.0039	0.0091	0.009
Zirconium	"	0.004	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005

[a] Values less than benchmark are considered to be of concern.

(shaded) Indicates sample analytical result was above the selected benchmark.

Table 3.3: Water quality data compared to benchmarks, Faro Mine Complex August 2008 (raw data appears in Appendix B).

				Reference													Mine-Exposed (Rose Creek)	
Parameter	Units	MDL[a]	Water Quality Benchmark[b]	Faro Creek (FC)	Blind Creek (BLC)		Star Creek (STC)	Horton Creek (HOC)	Beautiful Creek (BEC)	Grew Creek (GRC)	Buttle Creek (BUC)	Tributary of Ross River (BTT)	Next Creek (NXT)	Upper South Fork Rose Creek (USFR)	Upper West Fork Vangorda Creek (VR)	Upper West Fork Rose Creek (R7)	Rose Creek (R2)	North Fork Rose Creek (X2)
				Aug. 22	Aug. 22	Aug. 22	Aug. 23	Aug. 23	Aug. 23	Aug. 23	Aug. 24	Aug. 24	Aug. 20	Aug. 19	Aug. 19	Aug. 21	Aug. 20	Aug. 19
Misc. Inorganics & Physical Properties																		
Fluoride (F)	mg/L	0.01	0.12	0.07	0.09	0.09	0.10	0.16	0.12	0.17	0.12	0.11	0.07	0.06	0.06	0.09	0.10	0.09
Weak Acid Dissoc. Cyanide (CN)	mg/L	0.0005	0.005 (free)	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Organic Carbon (C)	mg/L	0.5	-	3.9	5.4	5.4	1.5	3.7	4.1	4.8	9.9	9.2	3.7	3.7	4.2	3.7	4.3	4.6
Alkalinity (Total as CaCO3)	mg/L	0.5	11.1	11	71	71	230	280	210	290	200	97	48	17	25	78	97	76
Alkalinity (PP as CaCO3)	mg/L	0.5	-	<0.5	<0.5	<0.5	4.2	5.6	2.0	6.9	1.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bicarbonate (HCO3)	mg/L	0.5	-	13	87	87	270	330	250	340	240	120	58	20	31	96	120	93
Carbonate (CO3)	mg/L	0.5	-	<0.5	<0.5	<0.5	5.0	6.7	2.4	8.3	2.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hydroxide (OH)	mg/L	0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dissolved Sulphate (SO4)	mg/L	0.5	-	0.9	14	14	130	73	240	140	47	27	2.8	4.4	4.6	6.6	66	9.7
Dissolved Chloride (Cl)	mg/L	0.5	250	<0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.1	0.8	<0.5	<0.5	0.6	<0.5	0.7	<0.5
Total Suspended Solids	mg/L	1	28	5	3	3	<1	<1	2	4	2	<1	<1	<1	<1	<1	<1	5
Total Dissolved Solids	mg/L	10	500	30	100	110	430	360	550	490	270	170	68	50	60	98	240	110
Total Hardness (CaCO3)	mg/L	0.5	-	12.5	78.8	75.9	381	354	478	438	229	114	45.2	21.5	26.6	80.1	166	80.2
Nutrients																		
Ammonia (N)	mg/L	0.01	0.24	0.02	0.04	<0.01	<0.01	<0.01	0.04	0.01	<0.01	0.07	<0.01	<0.01	<0.01	<0.01	0.05	<0.01
Nitrite (N)	mg/L	0.005	0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrate (N)	mg/L	0.02	13	<0.02	0.02	0.04	0.14	0.06	0.22	0.09	0.10	0.07	<0.02	<0.02	<0.02	<0.02	0.04	0.02
Nitrate plus Nitrite (N)	mg/L	0.02	-	<0.02	0.02	0.04	0.14	0.06	0.22	0.09	0.10	0.07	<0.02	<0.02	<0.02	<0.02	0.04	0.02
Total Phosphorus (P)	mg/L	0.005	0.03	0.020	0.007	0.007	<0.005	0.005	0.012	<0.005	0.007	0.007	0.011	0.018	0.013	0.025	0.019	0.017
Total Total Kjeldahl Nitrogen (Calc)	mg/L	0.02											0.06	0.07	0.11	0.07	0.20	0.13
Total Nitrogen (N)	mg/L	0.02											0.06	0.07	0.11	0.07	0.23	0.15
Total Metals by ICPMS																		
Aluminum (Al)	mg/L	0.0002	0.1	0.108	0.0474	0.0390	0.0211	0.0054	0.0101	0.0260	0.0436	0.0093	0.0283	0.0295	0.0337	0.0187	0.0143	0.0246
Antimony (Sb)	mg/L	0.00002	0.02	0.00003	0.00010	0.00010	0.00017	0.00018	0.00025	0.00018	0.00009	0.00006	0.00002	0.00004	0.00003	0.00008	0.00009	0.00008
Arsenic (As)	mg/L	0.00002	0.005	0.00022	0.00079	0.00078	0.00023	0.00056	0.00065	0.00061	0.00038	0.00054	0.00012	0.00030	0.00023	0.00064	0.00047	0.00056
Barium (Ba)	mg/L	0.00002	1.0	0.0162	0.0576	0.0570	0.0935	0.0858	0.0563	0.0812	0.0803	0.0465	0.0253	0.0244	0.0262	0.0477	0.0467	0.0428
Beryllium (Be)	mg/L	0.00001	1.1	0.00003	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	0.00001	0.00002	<0.00001	<0.00001	<0.00001
Bismuth (Bi)	mg/L	0.000005	0.26	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Boron (B)	mg/L	0.05	1.2	<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
Cadmium (Cd)	mg/L	0.000005	0.00003	0.000016	0.000011	0.000014	0.000164	0.000023	0.000019	0.000025	0.000026	0.000007	0.000018	0.000009	0.000013	0.000010	0.000023	0.000018
Calcium (Ca)	mg/L	0.05	116	3.70	22.5	21.6	92.5	81.4	97.0	111	68.1	32.1	14.2	6.81	8.15	23.9	48.7	23.3
Chromium (Cr)	mg/L	0.0001	0.001	0.0003	0.0001	<0.0001	0.0002	0.0001	<0.0001	0.0005	0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt (Co)	mg/L	0.000005	0.004	0.000084	0.000055	0.000053	0.000076	0.000068	0.000057	0.000073	0.000056	0.000017	0.000016	0.000030	0.000023	0.000038	0.000820	0.000085
Copper (Cu)	mg/L	0.00005	0.002	0.00138	0.00077	0.00072	0.00044	0.00051	0.00113	0.00108	0.00228	0.00294	0.00072	0.00058	0.00070	0.00175	0.00089	0.00079
Iron (Fe)	mg/L	0.001	0.3	0.139	0.158	0.133	0.066	0.114	0.055	0.129	0.111	0.021	0.015	0.119	0.021	0.152	0.243	0.153
Lead (Pb)	mg/L	0.000005	0.002	0.000849	0.000072	0.000078	0.000116	0.000053	0.000180	0.000156	0.000292	0.000255	0.000052	0.000108	0.000051	0.000312	0.000311	0.000767
Lithium (Li)	mg/L	0.0005	-	0.0017	0.0018	0.0017	0.0039	0.0043	0.0054	0.0080	0.0038	0.0030	0.0020	0.0008	<0.0005	0.0030	0.0051	0.0030
Magnesium (Mg)	mg/L	0.05	82	0.79	5.51	5.31	36.3	36.6	57.2	38.9	14.2	8.23	2.34	1.10	1.52	5.00	10.9	5.37
Manganese (Mn)	mg/L	0.00005	1	0.00436	0.0155	0.0150	0.00684	0.0181	0.00565	0.0274	0.0152	0.00521	0.00039	0.00728	0.00077	0.0166	0.717	0.0359
Molybdenum (Mo)	mg/L	0.00005	0.073	0.00006	0.00062	0.00064	0.00153	0.00259	0.00163	0.00201	0.00075	0.00107	0.00021	0.00022	0.00011	0.00050	0.00051	0.00044
Nickel (Ni)	mg/L	0.00002	0.065	0.00051	0.00057	0.00054	0.00195	0.00107	0.00358	0.00107	0.00134	0.00041	0.00031	0.00033	0.00020	0.00039	0.00217	0.00075
Potassium (K)	mg/L	0.05	53	0.12	0.75	0.71	0.61	1.19	0.88	1.74	1.89	1.00	0.45	0.23	0.29	0.50	1.16	0.53
Selenium (Se)	mg/L	0.00004	0.001	<0.00004	0.00021	0.00021	0.00578	0.00205	0.00311	0.00493	0.00060	0.00012	0.00011	0.00005	0.00005	0.00024	0.00021	0.00022
Silicon (Si)	mg/L	0.1	-	6.5	4.9	4.9	3.0	4.6	2.2	3.9	4.6	4.4	7.7	4.1	5.7	5.6	4.8	5.8
Silver (Ag)	mg/L	0.000005	0.0001	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Sodium (Na)	mg/L	0.05	200	1.71	2.69	2.61	2.46	4.77	2.67	4.90	4.67	4.84	1.98	1.49	1.52	2.04	3.98	2.03
Strontium (Sr)	mg/L	0.00005	9.3	0.0226	0.0938	0.0939	0.360	0.360	0.480	0.485	0.225	0.123	0.0642	0.0422	0.0458	0.0977	0.184	0.100
Sulphur (S)	mg/L	3	-	<3	5	5	52	30	95	56	17	11	<3	<3	<3	<3	28	4
Thallium (Tl)	mg/L	0.000002	0.0008	0.000004	0.000002	<0.000002	0.000003	<0.000002	0.000003	<0.000002	<0.000002	<0.000002	<0.000002	<0.000002	0.000003	<0.000002	0.000025	0.000004
Tin (Sn)	mg/L	0.00001	0.35	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Titanium (Ti)	mg/L	0.0005	1.83	0.0027	0.0015	0.0011	<0.0005	<0.0005	<0.0005	0.0010	0.0011	0.0006	<0.0005	0.0015	<0.0005	<0.0005	<0.0005	0.0006
Uranium (U)	mg/L	0.000002	0.015	0.000195	0.000611	0.000624	0.00524	0.00528	0.0109	0.00936	0.00276	0.00108	0.000396	0.000388	0.000397	0.000962	0.00134	0.000881
Vanadium (V)	mg/L	0.0002	0.006	0.0003	0.0003	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Zinc (Zn)	mg/L	0.0001	0.03	0.0035	0.0007	0.0008	0.0082	0.0012	0.0021	0.0012	0.0021	0.0009	0.0013	0.0013	0.0007	0.0016	0.0278	0.0360
Zirconium (Zr)	mg/L	0.0001	0.004	0.0001	0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001

[a] Method Detection Limit.

[b] Benchmarks were selected from relevant water quality criteria as described in Appendix A.

Indicates value exceeds selected benchmark, except for alkalinity for which values below the benchmark are shaded.

3.2 Laboratory Chemical Analyses

Concentrations of various analytes measured in water samples were compared to water quality benchmarks, most of which are associated with protection of aquatic life (Appendix A). Concentrations measured in reference samples did not exceed any of the benchmarks in 2007 (Table 3.3), but several reference creek samples collected in 2008 showed elevated concentrations of a few parameters relative to the water quality benchmarks (Table 3.4). As noted previously, there were no known, active anthropogenic disturbances upstream of the sampling areas.

In 2007, benchmarks for cadmium and zinc were only marginally exceeded at V27 and all other substances measured at this station were below levels associated with effects on aquatic life (Table 3.3). At V5 and V8, concentrations of fluoride, sulphate, aluminum, cadmium, iron, and/or selenium slightly exceeded the benchmarks (Table 3.3). Of the two mine-exposed areas sampled in 2008, only the zinc concentration at X2 slightly exceeded the water quality benchmark. Overall, the data indicated good water quality downstream of both the Faro and Vangorda sites during the respective field surveys.

Additional water samples were collected in January 2009 from R7, X2, and R2 at the same time samples were collected for aquatic toxicity tests. Again, concentrations at R7 were below applicable benchmarks (Table 3.4). However, concentrations of cadmium and zinc at X2 and R2 exceeded the benchmark concentrations. Concentrations of total iron and total and dissolved manganese at R2 were also slightly above applicable benchmarks. Substantially elevated zinc concentrations at X2 reflected contaminated groundwater flow from the monitoring area known as the “S-wells” (southeast of the waste rock piles at the Faro site). Contamination from this source is more evident in winter sampling when there is less dilution from surface waters or precipitation (which are frozen).

3.3 Laboratory Toxicity Tests

The sample collected at X2 in August 2008 impaired reproduction of the water flea *Ceriodaphnia dubia* at sample concentrations greater than 23% (diluted with clean laboratory water), but no effects were observed on the growth of the alga *Pseudokerchneriella subcapitata* nor on the survival of rainbow trout (Table 3.5). The sample collected at X2 in January 2009 was more toxic to *P. subcapitata* but caused similar toxicity to *C. dubia* compared to the August sample from the same location (Table 3.5). The sample collected at R2 in January 2009 was also toxic, but less so than the X2 sample based effects occurring at higher sample concentrations (59% and 63% for *P.*

Table 3.4: Water quality data compared to benchmarks, Faro Mine Complex, January 2009.

				Reference		Mine-Exposed			
Parameter	Units	MDL	Water Quality Benchmark[b]	Upper West Fork Rose Creek (R-7)		North Fork Rose Creek (X-2)		Rose Creek (R-2)	
Misc. Inorganics & Physical Properties				**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**
Fluoride (F)	mg/L	0.01	0.12	0.14	-	0.15	-	0.14	-
Weak Acid Dissoc. Cyanide (CN)	mg/L	0.0005	0.005 (free)	<0.0005	-	0.0005	-	0.0005	-
Dissolved Organic Carbon (C)	mg/L	0.5	-	<0.5	-	<0.5	-	<0.5	-
Alkalinity (Total as CaCO3)	mg/L	0.5	11.1	130	-	130	-	180	-
Alkalinity (PP as CaCO3)	mg/L	0.5	-	<0.5	-	<0.5	-	<0.5	-
Bicarbonate (HCO3)	mg/L	0.5	-	160	-	160	-	210	-
Carbonate (CO3)	mg/L	0.5	-	<0.5	-	<0.5	-	<0.5	-
Hydroxide (OH)	mg/L	0.5	-	<0.5	-	<0.5	-	<0.5	-
Dissolved Sulphate (SO4)	mg/L	0.5	-	-	11	-	46	-	180
Dissolved Chloride (Cl)	mg/L	0.5	250	-	0.6	-	<0.5	-	0.6
Total Dissolved Solids	mg/L	10	500	170	-	250	-	470	-
Total Hardness (CaCO3)	mg/L	0.5	-	119	-	166	-	321	-
Dissolved Hardness (CaCO3)	mg/L	0.5		-	133	-	173	-	368
Nutrients									
Ammonia (N)	mg/L	0.005	0.24	<0.005		0.011		0.095	
Nitrite (N)	mg/L	0.005	0.06	0.005		0.005		0.005	
Nitrate (N)	mg/L	0.02	13	0.24		0.35		0.29	
Nitrate plus Nitrite (N)	mg/L	0.02	-	0.24		0.36		0.29	
Total Phosphorus (P)	mg/L	0.002	0.03	0.006		0.003		0.003	
Total Total Kjeldahl Nitrogen (Calc)	mg/L	0.02		0.03		<0.02		0.08	
Total Nitrogen (N)	mg/L	0.02		0.27		0.34		0.37	
Metals by ICPMS				**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**
Aluminum (Al)	mg/L	0.0002	0.1	0.0059	0.0030	0.0090	0.0092	0.0177	0.0017
Antimony (Sb)	mg/L	0.00002	0.02	0.00007	0.00010	0.00009	0.00008	0.00008	0.00008
Arsenic (As)	mg/L	0.00002	0.005	0.00050	0.00038	0.00049	0.00027	0.00048	0.00029
Barium (Ba)	mg/L	0.00002	1.0	0.0748	0.0771	0.0797	0.0759	0.0699	0.0729
Beryllium (Be)	mg/L	0.00001	1.1	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Bismuth (Bi)	mg/L	0.000005	0.26	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Boron (B)	mg/L	0.05	1.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium (Cd)	mg/L	0.000005	0.00003	0.000008	0.000012	0.000045	0.000042	0.000066	0.000057
Calcium (Ca)	mg/L	0.05	116	35.9	40.6	45.5	48.2	94.5	109
Chromium (Cr)	mg/L	0.0001	0.001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt (Co)	mg/L	0.000005	0.004	0.000022	0.000025	0.000311	0.000291	0.00176	0.00184
Copper (Cu)	mg/L	0.00005	0.002	0.00025	0.00101	0.00045	0.00092	0.00045	0.00108
Iron (Fe)	mg/L	0.001	0.3	0.090	0.036	0.209	0.076	0.403	0.119
Lead (Pb)	mg/L	0.000005	0.002	0.000026	0.000078	0.000420	0.000147	0.000326	0.000046
Lithium (Li)	mg/L	0.0005	-	0.0076	0.0078	0.0089	0.0088	0.0078	0.0082
Magnesium (Mg)	mg/L	0.05	82	7.22	7.76	12.8	12.9	20.7	23.2
Manganese (Mn)	mg/L	0.00005	1	0.0171	0.0162	0.232	0.224	2.47	2.62
Molybdenum (Mo)	mg/L	0.00005	0.073	0.00085	0.00089	0.00084	0.00084	0.00073	0.00080
Nickel (Ni)	mg/L	0.00002	0.065	0.00019	0.00038	0.00222	0.00224	0.00468	0.00480
Potassium (K)	mg/L	0.05	53	0.80	0.96	1.04	1.11	1.80	2.12
Selenium (Se)	mg/L	0.00004	0.001	0.00059	0.00052	0.00064	0.00053	0.00056	0.00050
Silicon (Si)	mg/L	0.1	-	7.2	5.3	8.0	5.0	7.8	5.4
Silver (Ag)	mg/L	0.000005	0.0001	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Sodium (Na)	mg/L	0.05	200	2.65	2.88	3.37	3.43	7.60	8.40
Strontium (Sr)	mg/L	0.00005	9.3	0.159	0.163	0.196	0.194	0.311	0.335
Sulphur (S)	mg/L	3	-	3	4	16	17	72	77
Thallium (Tl)	mg/L	0.000002	0.0008	<0.000002	<0.000002	0.000003	0.000003	0.000007	0.000007
Tin (Sn)	mg/L	0.00001	0.35	<0.00001	<0.00001	<0.00001	0.00002	<0.00001	0.00008
Titanium (Ti)	mg/L	0.0005	1.83	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Uranium (U)	mg/L	0.000002	0.015	0.00241	0.00249	0.00280	0.00280	0.00325	0.00346
Vanadium (V)	mg/L	0.0002	0.006	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Zinc (Zn)	mg/L	0.0001	0.03	0.0005	0.0021	0.229	0.223	0.0919	0.0927
Zirconium (Zr)	mg/L	0.0001	0.004	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

[a] Method Detection Limit.

[b] Benchmarks were selected from relevant water quality criteria as described in Appendix A.

Indicates value exceeds selected benchmark, except for alkalinity for which values below the benchmark are shaded.

Table 3.5: Aquatic toxicity test results for water samples collected at R7, X2, and R2.

Date	Station	IC25[a] (% sample volume		LC50[b] (% sample volume)
		Pseudokirchneriella subcapitata 3-d growth	*Ceriodaphnia dubia* 7-d survival and reproduction	Rainbow trout 96-h survival
Aug. 2008	R7 (reference)	>95	-[c]	>100[d]
	X2 (exposure)	>95	23 (19-35)	>100
Jan. 2009	R7 (reference)	>95	>100	>100
	X2 (exposure)	15 (14-17)	27 (16-33)	>100
	R2 (exposure)	59 (-[e])	63 (51-73)	>100

[a] Concentration causing 25% inhibition relative to control organisms

[b] Concentration causing mortality to 50% of exposed organisms

[c] Reproduction was slightly impaired in some sample dilutions but lack of dose response suggest a factor other than contaminant effects (e.g., possibly bacteria naturally present in the water)

[d] 30% mortality. At least 50% mortality is required to produce an LC50 estimate. Marginal toxicity may have been associated with the same factor that affected *C. dubia*

[e] Confidence interval could not be calculated

subcapitata and *C. dubia*, respectively). Greater toxicity in the January samples from X2 and R2 was likely associated with elevated metal levels, particularly zinc (Table 3.4 compared to 3.3). Marginal toxicity to C. dubia and trout in the sample collected from reference area R7 was likely associated with a factor other than contaminants (see footnotes Table 3.5).

4.0 SEDIMENT QUALITY ASSESSMENT

4.1 Chemistry

The sediment samples collected in 2007 and 2008 were largely comprised of sand and gravel (Table 4.1), typical of fast-flowing, upper perennial creek habitats (Cowardin et al. 1979). Combined silt and clay fractions represented <5% of the whole sediment samples, except in the case of X2, where silt and clay represented 25% and 6.5%, respectively. Total organic carbon (TOC) content was also low (<4%) in all samples (Table 4.1).

Metal concentrations at reference areas V1 and R7 did not exceed applicable sediment quality guidelines in either the whole sediment (<2 mm) or the fine fraction (<0.15 mm; Table 3.1). Arsenic, lead, manganese, and zinc were elevated in samples collected at mine-exposed areas, when compared to both benchmarks and concentrations measured at the reference areas. Except at X2, where the sediment sample contained more fines, metal concentrations were typically about three times higher in the fine fraction than whole sediment, as would be expected in coarse sediments (Horowitz 1991). Thus, a large proportion of the metals present was associated with fine sediment particles, which represented a small proportion of the total sediment composition.

4.2 Toxicity

Tests were conducted to determine if elevated sediment metal concentrations were associated with toxicity to aquatic biota. No effects on either the survival or growth of *Hyallela azteca* were observed after 14-day laboratory exposure period to the sediments collected from mine-exposed areas (Table 4.2), despite elevated levels of some metals (Table 4.1; Appendix B). However, there was a reduction in survival among *Hyallela* exposed to reference sediment collected at R7. The toxicity tests met all quality control criteria (Appendix B), and none of the chemical constituents measured at R7 were particularly elevated (Table 4.1), so the cause of the mortality in R7 sediment is unknown (perhaps the same non-contaminant factor that caused marginal effects to biota in the water sample collected at R7 – see Table 3.5).

Table 4.1: Summary sediment quality in Vangorda and Rose Creeks, Faro Mine Complex, August 2007 and 2008.

Parameter	Units	MDL[a]	Sediment Quality Guidelines						2007								2008					
			Canadian[b]		British Columbia[c]		Ontario[f]		V1 (reference)		V27-A		V27-B		V27-C		R7 (reference)		R2		X2	
									Aug. 28		Aug. 28		Aug. 28		Aug. 28		Aug. 21		Aug. 20		Aug. 21	
			ISQG[d]	PEL[e]	ISQG[d]	PEL[e]	LEL[g]	SEL[h]	whole[i]	<0.15mm	whole[i]	<0.15mm	whole[i]	<0.15mm	whole[i]	<0.15mm	whole[i]	< 0.15 mm	whole[i]	< 0.15 mm	whole[i]	< 0.15 mm
Gravel (> 2 mm)	%	0.1							82		48		41		29		0.2		32		<0.1	
Sand (0.0625 - 2 mm)	%	0.1							17		51		58		70		97		67		69	
Silt (0.0039 - 0.0625 mm)	%	0.1							0.1		0.3		0.4		0.4		1.9		0.4		24	
Clay (<0.0039)	%	0.1							1.0		0.9		1.2		1.1		1.2		0.6		6.5	
Available (KCl) Ammonia (N)	mg/kg	0.5															13		4.6		18	
Nitrite (N)	mg/kg	0.5							<0.5		<0.5		<0.5		<0.5							
Nitrate plus Nitrite (N)	mg/kg	2							<2		<2		<2		<2							
Total Kjeldahl Nitrogen (TKN)	mg/kg	3					550	4,800	0.9		0.7		0.8		0.8		150		36		1,500	
Available (KCl) Orthophosphate (P)	mg/kg	50							4.9		3.6		2.8		3.2		<50		<50		<50	
Total Organic Carbon (TOC)	%	0.2					1	10	0.13		3.7		0.3		0.24		0.25		0.2		1.2	
Soluble (2:1) pH	pH Units	0.01															6.96		7.64		7.52	
Total Metals by ICPMS																						
Aluminum (Al)	mg/kg	100							8,020	16,100	8,180	14,800	8,700	14,300	9,630	13,200	9,180	10,400	8,150	18,000	13,600	13,400
Antimony (Sb)	mg/kg	0.1							0.2	0.3	0.7	2	0.5	2.2	0.8	2	0.6	0.6	0.8	2.0	1.3	1.3
Arsenic (As)	mg/kg	0.2	5.9	17	5.9	17	6	33	6.9	16.2	19.9	48.7	16.8	46	24.7	39.8	10.1	8.6	9.0	20.2	20.7	21.6
Barium (Ba)	mg/kg	0.1							64.3	130	73.5	338	88	265	116	209	125	192	107	404	211	258
Beryllium (Be)	mg/kg	0.1							0.3	0.6	0.2	0.5	0.2	0.5	0.3	0.5	0.2	0.4	0.2	0.8	0.7	0.7
Bismuth (Bi)	mg/kg	0.1							0.2	0.7	0.1	0.3	0.2	0.3	0.2	0.3	0.2	0.2	0.1	0.4	0.8	0.8
Boron (B)	mg/kg	5							<5	<5	<5	<5	<5	<5	<5	<5						
Cadmium (Cd)	mg/kg	0.05	0.6	3.5	0.6	3.5	0.6	10	0.35	0.52	0.82	2.47	0.92	2.35	1.05	2.26	0.17	0.23	0.24	0.86	0.85	0.97
Chromium (Cr)	mg/kg	1	37.3	90	37.3	90	26	110	14	26	25	48	22	43	24	42	17	19	20	53	32	31
Cobalt (Co)	mg/kg	0.3							7.4	17.2	11.2	24.1	11.8	23.4	13.6	23.5	7.1	8.0	10.9	29.4	15.4	14.6
Copper (Cu)	mg/kg	0.5	35.7	197	35.7	197	16	110	14.7	28.4	21.7	57.9	21.2	55.2	25.1	52.1	9.0	13.0	15.2	45.0	36.5	36.9
Iron (Fe)	mg/kg	100			21,200	43,766	20,000	40,000	18,500	34,100	19,200	35,600	20,600	36,900	23,000	32,700	22,100	22,400	19,200	43,400	34,600	32,000
Lead (Pb)	mg/kg	0.1	35.0	91.3	35	91	31	250	10.2	25.2	146	352	123	362	152	313	16.6	12.7	42.8	134	273	286
Magnesium (Mg)	mg/kg	100															3,790	3,690	4,810	10,300	5,970	5,500
Manganese (Mn)	mg/kg	0.2					460	1,100	378	736	830	2,320	941	2,290	1,070	2,290	393	576	2,200	9,620	1,340	1,600
Mercury (Hg)	mg/kg	0.05			0.170	0.486	0.2	2	<0.05	<0.05	0.11	0.27	0.19	0.24	0.09	0.22	<0.05	<0.05	<0.05	0.07	0.20	0.21
Molybdenum (Mo)	mg/kg	0.1							0.4	0.8	0.7	1.9	0.9	1.8	1.2	1.9	0.8	0.8	1.0	2.7	1.2	1.3
Nickel (Ni)	mg/kg	0.8			16	75	16	75	16.2	32.7	28.1	55.6	26.8	54.7	30.3	52.5	16.0	17.9	23.7	63.5	36.3	36.9
Phosphorus (P)	mg/kg	10					600	2,000									549	741	556	793	774	827
Potassium (K)	mg/kg	100															1040	1360	740	1640	1750	1660
Selenium (Se)	mg/kg	0.5			2				<0.5	0.6	0.6	1.3	0.6	1.1	0.6	1.2	<0.5	0.5	0.5	<0.5	0.8	<0.5
Silver (Ag)	mg/kg	0.05							0.09	0.14	0.16	0.68	0.3	0.63	0.29	0.73	0.07	0.10	0.09	0.28	0.56	0.66
Sodium (Na)	mg/kg	100															101	148	106	329	183	200
Strontium (Sr)	mg/kg	0.1							15.5	21	39.9	58	40.7	48.7	40.3	47.3	20.4	29.2	25.2	57.8	31.9	34.6
Thallium (Tl)	mg/kg	0.05							<0.05	0.06	0.19	0.29	0.13	0.32	0.16	0.29	0.09	0.15	0.11	0.34	0.31	0.27
Tin (Sn)	mg/kg	0.1							0.3	0.5	0.3	0.4	0.2	0.4	0.3	0.3	0.5	0.7	0.3	3.8	1.0	1.0
Titanium (Ti)	mg/kg	1							116	247	95	176	104	174	133	151	302	396	149	361	442	390
Uranium (U)	mg/kg	0.05							1.59	3.71	0.89	1.93	0.85	1.99	1.04	1.87						
Vanadium (V)	mg/kg	2							14	25	17	31	18	25	18	24	21	24	18	39	35	34
Zinc (Zn)	mg/kg	1	123	315	123	315	120	820	53	108	290	709	338	806	385	733	57	63	175	546	456	491
Zirconium (Zr)	mg/kg	0.5															0.9	0.9	0.9	2.0	1.1	1.0

[a] MDL = Method Detection Limit.
[b] CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 plus updates, Winnipeg, MB.)
[c] BCMOE (British Columbia Ministry of Environment). 2006. A compendium of Working Water Quality Guidelines for British Columbia. Updated August 2006.)
[d] Interim sediment quality guideline
[e] Probable effect level
[f] OMOE (Ontario Ministry of Environment). 1993. Guidelines For The Protection and Management Of Aquatic Sediment Quality In Ontario. August 1993, Reprinted October, 1996. MOE (1993).
[g] Lowest effect level.
[h] Severe effect level.
[i] Samples for metal analysis were pre-screened to 2 mm to remove large particles that could bias sample results.

Shading indicates selected benchmark and measured values exceeding benchmark.

Table 4.2: Results of 14-d survival and growth tests using *Hyallela azteca* for sediment samples collected at Faro Mine

Sample	Sample Date	Mean Survival (%)	Mean Dry Weight (mg)
Lab Control	Aug-07	100	0.297
V1	Aug-07	100	0.41
V27-A	Aug-07	100	0.357
V27-B	Aug-07	100	0.307
V27-C	Aug-07	100	0.275
Lab Control	Aug-08	88	0.203
R7	Aug-08	50*	0.164
X2	Aug-08	90	0.186
R2	Aug-08	86	0.236

*sample differed from lab control results

5.0 BENTHIC INVERTEBRATE COMMUNITY

The main objective of benthic invertebrate community sampling in 2007 (Vangorda Creek drainage and reference areas) and 2008 (Rose Creek drainage and reference areas) was to compare relative sensitivities of various sampling methods (artificial substrates, Hess, and kick sampling) and sampling designs (control-impact versus RCA) in order to recommend an approach for long-term monitoring. The effect of sampling three versus five stations per area within a control-impact design was also evaluated. In addition, the assessment included evaluation of reference areas to identify those most suitable for comparison to mine-exposed areas based on similarity in habitat characteristics.

5.1 Preliminary Data Assessment

Correspondence Analysis (CA) of all areas and years (using mean values in cases where more than one station was sampled per area) showed overlap of the community characteristics (as described by CA Axes 1-3) reflected by each sampling method (Figure 5.1). There was also considerable overlap of community characteristics in reference and mine-exposed areas (Figure 5.2). Most notable was the separation of BEC and BTT from the other sampling areas on CA1 and CA2 based on both Hess and kick sampling (Figures 5.1 and 5.2; no AS were taken at these areas). There was also some separation of NEC-Hess (2008) (positive direction) and Vangorda areas V27, V5, and V8 –artificial substrates (negative direction) on CA3 (Figures 5.1 and 5.2). Areas sampled both years (USFR, VR, NEC) showed somewhat different CA scores between years, but not in a consistent direction (i.e., no consistent change in community composition between years for these areas; Figures 5.1 and 5.2).

5.2 Control-Impact Design

5.2.1 Comparison of Sampling Methods

Comparison of Hess versus artificial substrate sampling within the Vangorda Creek drainage (2007) involved statistical comparison of each mine-exposed area to a reference area on main stem Vangorda Creek upstream of mine influence (V1) based on various benthic community descriptors (metrics) and five stations per area. The comparison showed that Hess sampling was much more sensitive in detecting reference-exposure differences than artificial substrates (total significant p values across metrics), even though within-area coefficients of variation were not always lower for Hess (Table 5.1).

Comparison of Hess versus kick sampling was based on benthic communities in mine-exposed areas within the Rose Creek drainage relative to a reference area on Blind Creek

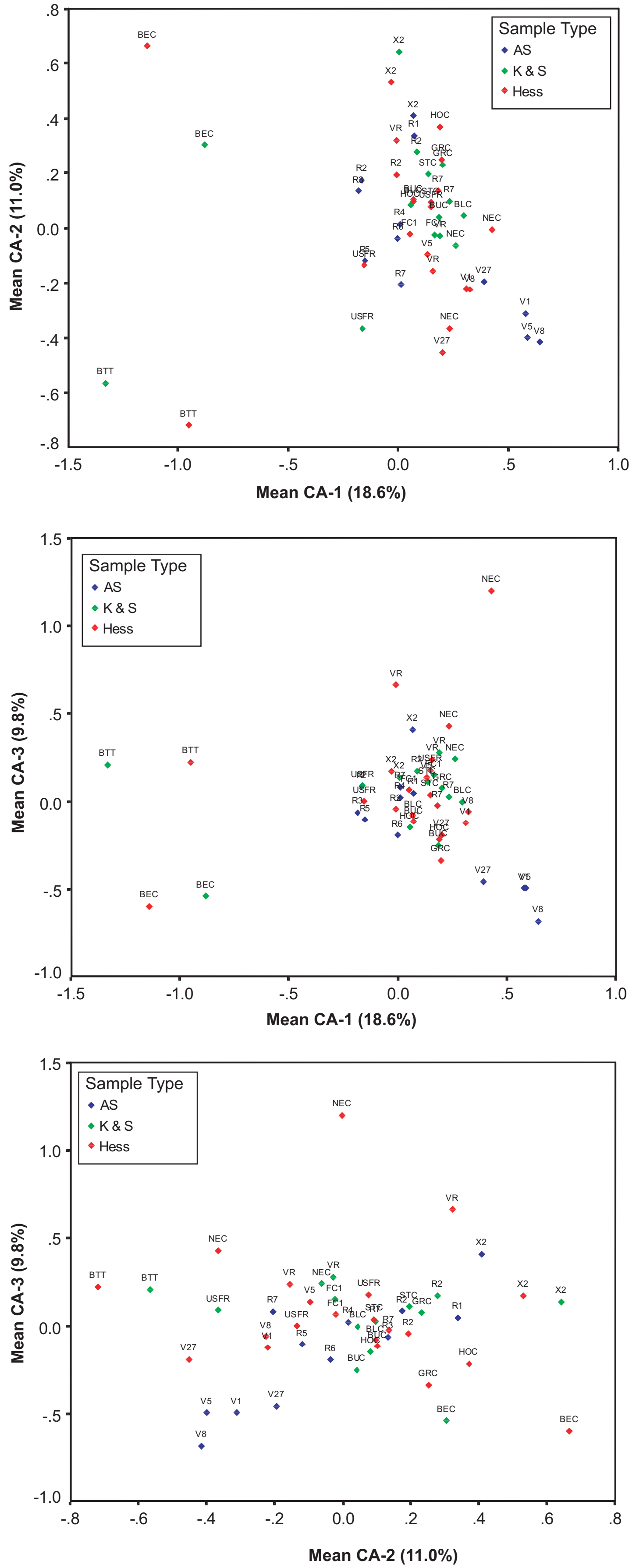

Figure 5.1: Correspondence analysis of benthic community data for artificial substrate, kick and Hess samples collected in 2008. Area means are shown for areas in which replicate stations were sampled.

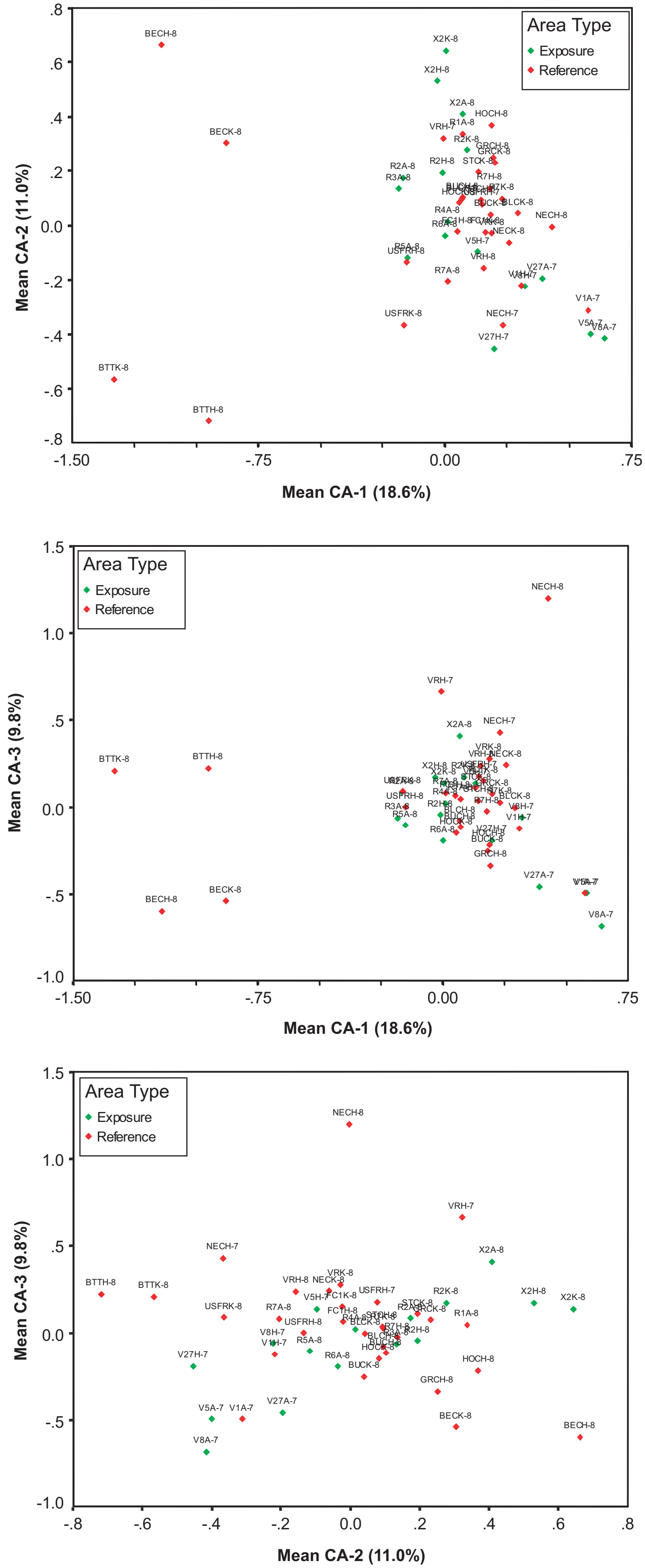

Figure 5.2: Correspondence analysis of benthic community data for exposure versus reference areas (2008) all sample methods combined. Area means are shown for areas in which replicate stations were sampled.

Table 5.1: Coefficients of variation (CV %) and p-values for reference-exposure contrasts based on benthic community metrics for replicate (5) Hess samples versus artificial substrates collected in each area of Vangorda Creek 2007.

		Hess		Artificial Substrates	
Metric	**Station**	**CV[a]**	**p value[b]**	**CV[a]**	**p value[b]**
Density (for Hess) or Sample Abundance (for AS)	V1	32		101	
	V27	29	0.047	88	0.512
	V5	35	0.001	55	0.037
	V8	40	0.987	67	0.160
	Mean	**34**		**78**	
Number of Taxa	V1	22		19	
	V27	25	0.107	16	0.162
	V5	2.4	0.035	6.6	0.343
	V8	15	0.191	21	0.222
	Mean	**16**		**16**	
Simpson's E	V1	29		20	
	V27	19	0.465	26	0.576
	V5	24	0.752	15	0.831
	V8	43	0.002	39	0.790
	Mean	**29**		**25**	
B-C Dist. to V1 median	V1	32		58	
	V27	12	0.000	24	0.186
	V5	8.2	0.000	21	0.032
	V8	8.9	0.000	19	0.134
	Mean	**15**		**30**	
Simpson's D	V1	3.7		3.0	
	V27	3.1	0.342	3.4	0.719
	V5	4.5	0.044	2.2	0.447
	V8	25	0.049	3.1	0.726
	Mean	**9**		**2.9**	
EPT (% of total community abundance)	V1	14		17	
	V27	3.7	0.022	15	0.063
	V5	31	0.008	19	0.553
	V8	37	0.000	19	0.537
	Mean	**21**		**18**	
Chironomids (% of total community abundance)	V1	28		38	
	V27	40	0.000	84	0.022
	V5	29	0.419	47	0.488
	V8	20	0.000	36	0.706
	Mean	**29**		**51**	
CA Axis 1	V1	467		164	
	V27	18	0.000	46	0.658
	V5	17	0.000	40	0.001
	V8	75	0.018	3697	0.107
	Mean	**144**		**987**	
CA Axis 2	V1	31		174	
	V27	83	0.094	478	0.890
	V5	200	0.000	794	0.455
	V8	63	0.002	192	0.160
	Mean	**94**		**410**	
CA Axis 3	V1	78		302	
	V27	98	0.001	215	0.808
	V5	99	0.001	61	0.226
	V8	105	0.196	48	0.003
	Mean	**95**		**156**	
Overall CV	**Mean**	**49**		**177**	
Total Significant Differences (p<0.1)			**22**		**6**

Area was signficantly different from reference, p<0.1

[a] CV - coefficient of variation (%) = (standard deviation/area mean)*100

[b] p value for exposure area comparisons to V1

(2008 samples, three stations per area). The two methods showed comparable sensitivity in detecting reference-exposure differences, but based on different community descriptors (Table 5.2); Hess was more sensitive in detecting differences based on metrics typically used in Environmental Effects Monitoring (EEM) studies for the Metal Mining industry (density/abundance, number of taxa, Simpson's Evenness), whereas kick sampling was superior in detecting differences based on Simpson's Diversity, and percentages of EPT (Ephemeroptera, Plecoptera, Trichoptera) and chironomid taxa.

5.2.2 Number of Stations per Area

Generally, as the number of stations per area is increased, a smaller magnitude of difference can be detected among areas, making it easier to detect mine-related effects. However, the increase in sensitivity (benefit) must be weighed against the additional effort and expense (cost) of collecting and analyzing additional samples. This issue was examined by comparing statistical results generated using the first three stations sampled from each exposure area compared to those based on five stations per area.

The effect of sampling three versus five stations per area was evaluated based on Hess and artificial substrate samples collected in 2007 (Vangorda Creek) and 2008 (Rose Creek). For both sampling methods, a greater number of reference-exposure differences were detectable based on five compared to three stations per area, except in the case of artificial substrates sampled in 2007, when relatively few reference-exposure differences were detected regardless of whether three or five stations were sampled per area (Tables 5.3 and 5.4). However, in both years, reliance on only three stations per area would have detected as many differences as five stations per area if only density, number of taxa and Simpson's Evenness (e.g., metrics typically considered in EEM studies) were considered. Therefore, while the data show that sampling five stations per area would be somewhat superior for identifying and characterizing reference-exposure differences, three stations per area may be sufficient to detect key changes in benthic communities over time in long-term monitoring if Hess sampling is used.

5.3 Reference Condition Approach

5.3.1 Habitat Comparisons

Principle components and correlation analyses of the various habitat variables indicated that basin area, drainage density, station elevation, source elevation, average stream gradient, bedrock geology (sedimentary, volcanic, plutonic), coniferous cover (area), water velocity, and wetted width explained most of the variability in habitat characteristics among all the reference and mine-exposed areas (Appendix E.1).

Table 5.2: Coefficients of variation (CV %) and p-values for reference-exposure contrasts based on benthic community metrics for replicate (3) Hess samples versus kick samples, Rose Creek drainage, 2008.

		Hess		Kick	
Metric	**Station**	**CV[a]**	**p value[b]**	**CV[a]**	**p value[b]**
Density (for Hess) or Total Sample Abundance (for kick)	BLC	52		55	
	X2	35	0.076	55	0.140
	R2	26	0.373	23	0.693
	Mean	**37**		**44**	
Number of Taxa	BLC	11		24	
	X2	8.8	0.224	20	0.424
	R2	5.0	0.059	8.8	0.529
	Mean	**8**		**18**	
Simpson's E	BLC	87		32	
	X2	8.2	0.987	19	0.556
	R2	30	0.061	18	0.088
	Mean	**42**		**23**	
Simpson's D	BLC	40		5.6	
	X2	4.9	0.358	10	0.979
	R2	5.5	0.159	2.7	0.095
	Mean	**17**		**6**	
EPT (%of total community abundance)	BLC	85		26	
	X2	70	0.276	84	0.022
	R2	29	0.221	11	0.258
	Mean	**61**		**40**	
Chironomids (% of total community abundance)	BLC	46		41	
	X2	15	0.580	19	0.046
	R2	35	0.176	30	0.137
	Mean	**32**		**30**	
CA Axis 1	BLC	21		7.3	
	X2	25	0.000	43	0.000
	R2	53	0.001	210	0.007
	Mean	**33**		**87**	
CA Axis 2	BLC	37		197	
	X2	44	0.490	211	0.736
	R2	50	0.001	24	0.137
	Mean	**44**		**144**	
CA Axis 3	BLC	2148		511	
	X2	1815	0.895	456	0.878
	R2	333	0.998	143	0.364
	Mean	**1432**		**370**	
Overall CV		**190**		**85**	
Total Significant Differences (p<0.1)			**6**		**6**

Area was signficantly different from reference, p<0.1

[a] CV - coefficient of variation (%) = (standard deviation/area mean)*100

[b] p value for exposure area comparisons to Blind Creek

Table 5.3: The effect of three versus five stations per area on within area coefficients of variation (CV %), and p-values for reference-exposure contrasts, for various benthic community metrics (2007, Vangorda Creek drainage).

Metric	Station	Hess				Artificial Substrates			
		3 Stations/Area		5 Stations/Area		3 Stations/Area		5 Stations/Area	
		CV[a]	p-value[b]	CV[a]	p-value[b]	CV[a]	p-value[b]	CV[a]	p-value[b]
Density (for Hess) or Sample Abundance (for AS)	V1	44		32		96		101	
	V27	43	0.397	29	0.047	84	0.238	88	0.512
	V5	49	0.069	35	0.001	29	0.002	55	0.037
	V8	20	0.752	40	0.987	61	0.273	67	0.160
Number of Taxa	V1	16		22		28		19	
	V27	25	0.385	25	0.107	12	0.170	16	0.162
	V5	2.6	0.037	2.4	0.035	8.9	0.445	6.6	0.343
	V8	14	0.084	15	0.191	29	0.344	21	0.222
Simpson's E	V1	32		29		21		20	
	V27	20	0.673	19	0.465	33	0.319	26	0.576
	V5	25	0.532	24	0.752	9.5	0.469	15	0.831
	V8	40	0.009	43	0.002	57	0.728	39	0.790
Simpson's D	V1	5.4		3.7		3.4		3.0	
	V27	1.8	0.667	3.1	0.342	4.0	0.961	3.4	0.719
	V5	4.9	0.342	4.5	0.044	2.5	0.696	2.2	0.447
	V8	22	0.100	25	0.049	3.5	0.882	3.1	0.726
EPT (%)	V1	16		14		17		17	
	V27	5	0.192	3.7	0.022	9.1	0.073	15	0.063
	V5	43	0.054	31	0.008	20	0.112	19	0.553
	V8	23	0.003	37	0.000	19	0.367	19	0.537
Chironomids (%)	V1	39		28		37		38	
	V27	58	0.012	40	0.000	139	0.059	84	0.022
	V5	37	0.263	29	0.419	37	0.433	47	0.488
	V8	13	0.003	20	0.000	41	0.452	36	0.706
Total Significant Differences (p<0.1)			**8**		**11**		**3**		**3**

Area was signficantly different from reference, p<0.1

[a] CV - coefficient of variation (%) = (standard deviation/area mean)*100

[b] exposure areas V27, V5, V8 compared to V1

Table 5.4: The effect of three versus five stations per area on within area coefficients of variation (CV %), and p-values for reference-exposure contrasts, for various benthic community metrics (2008, Rose Creek drainage). P-values for Hess sampling cannot be directly compared to those for artificial substrate sampling because the two methods involved use different reference areas.

Metric	Station	Hess[b]				Artificial Substrates[c]			
		3 Stations/Area		5 Stations/Area		3 Stations/Area		5 Stations/Area	
		CV[a]	p-value[b]	CV[a]	p-value[b]	CV[a]	p-value[c]	CV[a]	p-value[c]
Density (for Hess) or Sample Abundance (for AS)	BLC	52		40					
	R7					77		64	
	X2	35	0.076	46	0.163	50	0.643	80	0.525
	R2	26	0.373	27	0.089	48	0.186	83	0.041
	Mean	37		37		58		76	
Number of Taxa	BLC	11		8.0					
	R7					5.3		3.7	
	X2	8.8	0.224	22	1.000	10	0.063	23	0.231
	R2	5.0	0.059	6.3	0.133	14	0.341	17	0.194
	Mean	8.3		12		10		15	
Simpson's E	BLC	87		76					
	R7					15		18	
	X2	8.2	0.987	24	0.391	27	0.637	34	0.982
	R2	30	0.061	34	0.002	11	0.126	13	0.038
	Mean	42		45		17		21	
Simpson's D	BLC	40		30					
	R7					4.8		5.4	
	X2	4.9	0.358	6.0	0.017	14	0.332	11	0.292
	R2	5.5	0.159	5.9	0.001	0.4	0.144	0.8	0.019
	Mean	17		14		6.5		5.7	
EPT (%)	BLC	85		68					
	R7					33		26	
	X2	70	0.276	61	0.085	62	0.039	53	0.000
	R2	29	0.221	27	0.146	7.4	0.125	34	0.070
	Mean	61		52		34		38	
Chironomids (%)	BLC	46		32					
	R7					46		32	
	X2	15	0.580	16	0.622	7.7	0.009	5.6	0.000
	R2	35	0.176	28	0.068	21	0.180	26	0.306
	Mean	32		25		25		21	
Overall Mean CV		**33**		**31**		**25**		**29**	
Total Significant Differences (p<0.1)			**3**		**6**		**3**		**6**

(shaded) Area was signficantly different from reference, p<0.1

[a] CV - coefficient of variation (%) = (standard deviation/area mean)*100

[b] exposure areas X2 and R2 compared to BLC

[c] exposure areas X2 and R2 compared to R7

Water quality variables can be influenced by mine activities and thus cannot be included in the habitat characteristics selected for matching reference and mine-exposed areas. However, water quality data were evaluated to identify variables that most strongly differed among areas and to determine if these correlated with the other (non anthropogenically influenced) abiotic factors (paragraph above) considered in habitat matching (Appendix Section E.1.3). Conductivity and water hardness were water quality variables that differed considerably among reference areas (Table 3.1). Correlation analysis of water quality variables showed that conductivity (and specific conductance) correlated with all the other non-metal inorganic parameters, except TSS (Table 5.5a). Furthermore, calcium correlated with many of the metals found at detectable levels in some streams (Table 5.5b). Hardness, and its component calcium, as well as conductivity/specific conductance all correlated with each other and with station elevation, and area covered by plutonic geology and conifers (Table 5.5c), suggesting that inclusion of any of these three latter variables in subsequent stages of habitat analysis would incorporate some of the variation in water quality among areas (i.e., any direct influence of water quality on benthic communities was at least partly taken into account by other variables included in the analysis).

Correlation analysis was performed to determine the habitat characteristics (i.e., of the 11 habitat variables listed in the first paragraph of this section) most strongly associated with the biological community descriptors (CA1, CA2, CA3, abundance, richness, %EPT, % chironomids, diversity, and evenness) (Appendix E.2). For both the Hess and kick sampling methods, biological community descriptors were highly correlated (i.e., $r > 0.6$) with percent volcanic bedrock and coniferous forest cover in the basin, as well as water velocity measured at the time of sample collection. Average stream gradient was also highly correlated with CA3 for Hess samples but gradient was not used in further analyses because it was also highly correlated with basin coniferous cover. There were not enough reference areas sampled with artificial substrates to perform meaningful correlation analyses for this sample type.

Reference areas were ranked from best to worst habitat match with each exposure area using the Euclidean distances of volcanic bedrock, coniferous cover, and water velocity (Appendix E3). A Euclidean distance of less than or equal to 2.1 was used as the cutoff between suitable and non-suitable reference areas and was based on the examination of P values, graphs of rank versus distance, and previous knowledge of the areas (Appendix E.3). The results showed which areas were suitable reference for exposure areas in upper and lower Rose Creek and Vangorda Creek (Table 5.6). For example, exposure

Table 5.5: Correlations between a) non-metal inorganic parameters, b) aqueous metal concentrations and c) other habitat variables.
Shade indicates correlation coefficients ≥ 0.6.

a)

	Fluoride	Alkalinity (Total as CaCO3)	Alkalinity (PP as CaCO3)	Sulphate	Chloride	Suspended solids, total (TSS)	Dissolved solids, total (TDS)	Hardness	Conductivity	Specific Conductance
Fluoride	1.00									
Alkalinity (Total as CaCO3)	0.87	1.00								
Alkalinity (PP as CaCO3)	0.76	0.89	1.00							
Sulphate	0.58	0.77	0.61	1.00						
Chloride	0.87	0.71	0.59	0.52	1.00					
Suspended solids, total (TSS)	0.57	0.28	0.25	0.14	0.73	1.00				
Dissolved solids, total (TDS)	0.78	0.93	0.78	0.94	0.68	0.25	1.00			
Hardness	0.80	0.95	0.82	0.93	0.67	0.25	1.00	1.00		
Conductivity	0.80	0.92	0.76	0.94	0.67	0.23	0.99	0.99	1.00	
Specific Conductance	0.83	0.94	0.78	0.90	0.70	0.27	0.98	0.98	0.99	1.00

b)

	Aluminum	Antimony	Arsenic	Barium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Molybdenum	Nickel	Potassium	Selenium	Sodium	Strontium	Titanium	Uranium	Zinc
Aluminum	1.00																				
Antimony	0.11	1.00																			
Arsenic	0.44	0.58	1.00																		
Barium	0.18	0.79	0.57	1.00																	
Cadmium	0.08	0.40	-0.05	0.54	1.00																
Calcium	0.14	0.92	0.50	0.89	0.49	1.00															
Chromium	0.83	0.28	0.38	0.30	0.17	0.37	1.00														
Cobalt	0.19	0.13	0.25	0.15	0.07	0.20	0.13	1.00													
Copper	0.18	0.03	0.36	0.21	-0.16	0.16	0.06	0.00	1.00												
Iron	0.79	0.27	0.69	0.36	0.04	0.28	0.66	0.55	0.12	1.00											
Lead	0.43	-0.05	0.28	-0.06	0.02	-0.05	0.29	0.21	0.35	0.43	1.00										
Total Manganese	-0.10	0.02	0.09	0.03	-0.02	0.09	-0.12	0.95	-0.04	0.32	0.09	1.00									
Molybdenum	0.11	0.87	0.56	0.86	0.34	0.89	0.32	0.06	0.13	0.26	-0.12	-0.05	1.00								
Nickel	0.14	0.81	0.40	0.55	0.37	0.75	0.16	0.45	0.05	0.30	0.06	0.35	0.56	1.00							
Potassium	0.12	0.58	0.50	0.78	0.08	0.77	0.26	0.30	0.47	0.31	-0.02	0.23	0.67	0.46	1.00						
Selenium	-0.07	0.76	0.16	0.70	0.69	0.82	0.29	-0.05	-0.16	-0.01	-0.20	-0.10	0.72	0.55	0.39	1.00					
Total Sodium (Na)	0.14	0.52	0.51	0.72	0.06	0.70	0.29	0.32	0.53	0.31	0.00	0.24	0.72	0.35	0.92	0.32	1.00				
Strontium	0.04	0.95	0.47	0.82	0.41	0.98	0.30	0.14	0.09	0.19	-0.10	0.05	0.90	0.77	0.70	0.84	0.62	1.00			
Titanium	0.99	0.17	0.51	0.23	0.07	0.19	0.84	0.20	0.19	0.82	0.40	-0.08	0.19	0.17	0.17	-0.04	0.21	0.10	1.00		
Uranium	0.03	0.93	0.44	0.69	0.31	0.92	0.30	0.03	0.07	0.12	-0.09	-0.06	0.83	0.76	0.59	0.81	0.49	0.97	0.09	1.00	
Zinc	-0.09	-0.03	0.09	-0.06	0.19	-0.03	-0.10	0.46	-0.12	0.16	0.57	0.46	-0.17	0.12	-0.02	-0.12	-0.04	-0.07	-0.09	-0.13	1.00

Table 5.5: Correlations between a) non-mtal inorganic parameters, b) aqueous metal concentrations and c) other habitat variables.

c)

	Basin Area	Drainage Density	Station Elevation	Source Elevation	Avegerage Stream Gradient	Sedimentary	Volcanic	Plutonic	Coniferous	Velocity	Wetted Width	Hardness	Calcium	Conductivity	Specific Conductance
Basin Area	1.00														
Drainage Density	-0.38	1.00													
Station Elevation	-0.50	0.41	1.00												
Source Elevation	0.18	0.11	0.39	1.00											
Avegerage Stream Gradient	-0.28	0.41	0.27	0.24	1.00										
Sedimentary	0.37	-0.12	-0.46	0.19	0.26	1.00									
Volcanic	0.00	-0.29	-0.34	-0.33	-0.24	0.09	1.00								
Plutonic	-0.39	0.38	0.89	0.51	0.21	-0.49	-0.27	1.00							
Coniferous	0.29	-0.17	-0.58	-0.50	-0.51	0.13	0.02	-0.68	1.00						
Velocity	0.08	-0.17	-0.23	-0.21	-0.41	-0.01	0.25	-0.22	0.56	1.00					
Wetted Width	0.83	-0.33	-0.27	-0.04	-0.26	0.10	-0.12	-0.28	0.23	-0.19	1.00				
Hardness	0.06	-0.31	-0.69	-0.52	-0.21	0.37	0.28	-0.88	0.69	0.43	-0.07	1.00			
Calcium	0.09	-0.31	-0.73	-0.52	-0.19	0.36	0.25	-0.88	0.71	0.43	-0.06	0.99	1.00		
Conductivity	0.02	-0.30	-0.69	-0.51	-0.13	0.42	0.31	-0.87	0.63	0.45	-0.13	0.99	0.96	1.00	
Specific Conductance	0.01	-0.28	-0.71	-0.52	-0.09	0.40	0.28	-0.88	0.62	0.37	-0.12	0.98	0.97	0.99	1.00

Table 5.6: Ranking of reference areas in terms of habitat similarity to exposure areas at Faro Mine.

Reference Area	Reference Station Ranks Relative to Exposure Areas										
	Vangorda Creek				Upper Rose Creek			Lower Rose Creek			
	V27	V5	V8	Best overall matches for group	X2	R2	Best overall matches for group	R3	R4	R5	Best overall matches for group
BEC										8	
BLC	5	1	3	√	10	9	√	5	4	4	√
BTT										9	
BUC					6	2	√	10	10		
FC	7				2	3	√	8	8		
GRC			7		8	5	√	7	6	6	√
HOC	9	2	1	√	9	8	√	4	2	2	√
NEC	1	3	6	√	4	4	√	2	5	7	√
R6		7	2					11	11	1	√
R7	3	4	4	√	1	1	√	1	1	3	√
STC	8	5	5	√	7	6	√	3	3	5	√
USFR	6				3	7	√	9	9		
V1	4							12			
VR	2	6	8	√	5	10	√	6	7	10	√

Numbers indicate degree of habitat match with an exposure area (where 1 is the best match, 2 second best match etc.), for areas with Euclidean distance (habitat variables) relative to exposure area of ≤ 2.1.

√ Appropriate reference site for exposure sites in the area (reference areas within a Euclidean distance of 2.1 of all exposure areas in the group).

areas X2 and R2 in upper Rose Creek had similar bedrock, coniferous cover, and velocity to reference areas BLC, BUC, FC, GRC, HOC, NEC, R7, STC, USFR, and VR. Six to ten reference areas were found to be good matches for each group of exposure areas shown in Table 5.6. This is slightly less than the minimum of 20 reference areas previously recommended for reference-exposure comparisons in RCA (Bowman and Somers 2005). However, in this study, particular care was taken in the field to sample only reference areas that were comparable to exposure areas based on habitat characteristics seen/measured in the field, such as size, gradient, and substrate. Reference area habitat matches were further improved by formal tests involving the habitat variables most strongly related to reference benthic invertebrate community variability (volcanic bedrock, coniferous cover and stream velocity). The resulting data sets (6-10 reference areas in each comparison) seem robust in terms of detecting deviations from central and non-central reference condition (see Section 5.3.2). Nevertheless, it may be appropriate to seek additional reference areas for future studies (e.g., minimum of 20 suitable reference areas in each exposure area comparison), if this number can be found with reasonable accessibility (e.g, by road or short helicopter ride).

5.3.2 Comparison of Sampling Methods

Comparisons were made between the biological community attributes at exposure areas X2 and R2 relative to the 10 most suitable reference areas using both the Hess and kick sampling methods.

For Hess samples collected at exposure area X2, benthic community characteristics of CA3 score, density, % EPT, % chironomids, and evenness were significantly different than the *average* for reference areas and, except for evenness, were potentially (but not conclusively) outside the reference *range* for the same metrics (Table 5.7; Figure 5.3). Further downstream at R2, only diversity and evenness were significantly (i.e., $cP < 0.1$) greater than the average for reference area and all community metrics except evenness were within the reference range ($ncP > 0.9$).

For the kick sampling method, all metrics at exposure area X2 were different than the reference average and also significantly (% chironomids) or potentially (all other metrics) outside of the range for reference areas (Table 5.8; Figure 5.3). Downstream at R2, CA1, CA2, CA3, number of taxa, and diversity were significantly different than the reference area average, but still within the reference area range (Table 5.8).

Table 5.7: Benthic community characteristics of Rose Creek exposure areas (X2, R2) relative to reference areas having similar habitat characteristics based on Hess sampling. Results are presented for traditional central (cP) t-tests and non-central (ncP) t-tests (Test Site Analysis).

Hess 2008		CA1	CA2	CA3	Density (#/m^2)	# of Taxa	% EPT	% Chironomids	Simpson's Diversity	Simpson's Evenness
Reference										
BLCH-8		-0.21	0.30	-0.29	6068	24.2	24.7	65.9	0.56	0.12
BUCH-8		0.20	0.33	-0.58	1957	32.0	76.8	12.8	0.91	0.34
FC1H-8		-0.20	-0.47	0.19	6360	19.0	25.2	56.8	0.80	0.27
GRCH-8		-0.25	0.43	0.07	510	17.0	26.8	63.4	0.78	0.27
HOCH-8		-0.20	0.55	0.18	2147	23.0	51.9	39.0	0.88	0.38
NECH-8		1.62	0.01	0.13	4536	20.0	26.3	20.6	0.72	0.18
VRH-8		0.34	-0.39	0.11	7807	21.0	28.2	57.0	0.78	0.21
R7H-8		-0.27	-0.17	0.29	8120	19.0	7.6	82.8	0.41	0.09
STCH-8		-0.29	-0.01	0.15	7240	26.0	49.4	35.2	0.85	0.26
USFRH-8		-0.15	-0.55	-0.52	1743	21.0	46.3	16.3	0.84	0.29
Mean		**0.06**	**0.00**	**-0.03**	**4649**	**22.2**	**36.3**	**45.0**	**0.75**	**0.24**
SD		**0.59**	**0.39**	**0.32**	**2844**	**4.4**	**19.7**	**23.8**	**0.15**	**0.09**
Exposure										
X2H-8	value	-0.01	0.05	0.34	9656	24.2	10.3	70.9	0.75	0.18
	t	-0.35	0.39	3.63	5.57	1.44	-4.18	3.45	-0.09	-2.29
	cP	0.73	0.71	0.01	0.00	0.18	0.00	0.01	0.93	0.05
	ncP	1.00	1.00	0.78	0.30	1.00	0.64	0.82	1.00	0.98
R2H-8	value	-0.12	0.07	0.12	3663	20.8	40.2	43.1	0.85	0.36
	t	-0.94	0.51	1.43	-1.10	-1.03	0.63	-0.25	2.05	4.21
	cP	0.37	0.62	0.19	0.30	0.33	0.54	0.81	0.07	0.00
	ncP	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.63

cP - probability metric value at exposure area is the same as the mean for reference areas.
ncP - probability metric value at exposure area is inside the range of reference values
Different from exposure mean ($cP < 0.1$) or range ($ncP < 0.1$).
Uncertain with respect to being similar to or different from reference ($0.1 > p < 0.9$).
Similar to reference mean ($cP > 0.9$) or within reference range ($ncP < 0.9$).

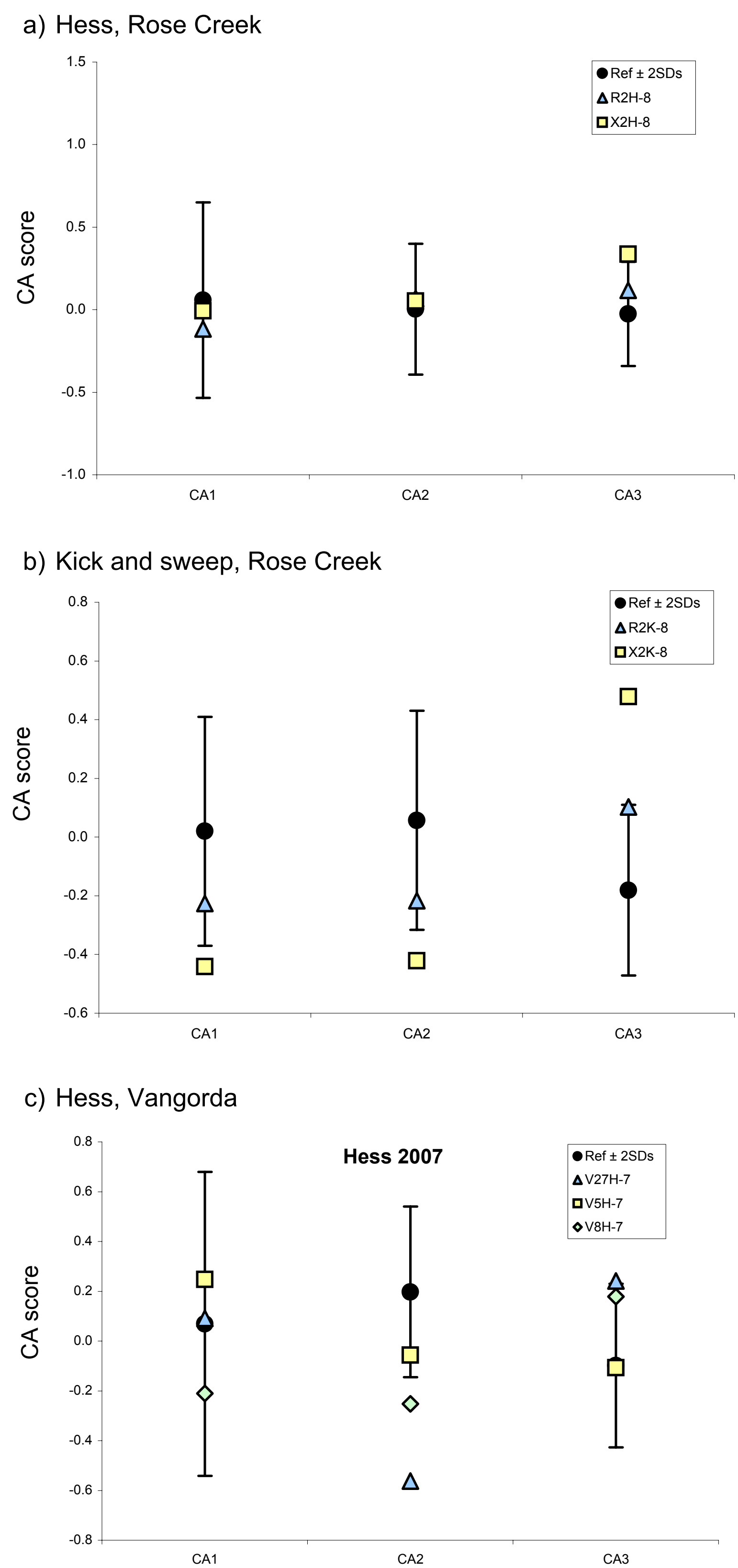

Figure 5.3: Graphical depiction of area CA scores shown for a) Hess samples collected at X2 and R2 in 2008 (Table 5.7), b) Kick samples collected at X2 and R2 in 2008 (Table 5.8) and Hess samples collected at Vangorda areas in 2007 (Table 5.9) relative to reference samples collected in 2007 and 2008 from areas with similar habitats to exposure areas.

Table 5.8: Benthic community characteristics of Rose Creek exposure areas (X2, R2) relative to reference areas having similar habitat characteristics based on kick and sweep samples. Results are presented for traditional central (cP) t-tests and non-central (ncP) t-tests (Test Site Analysis).

K&S 2008		CA1	CA2	CA3	Abundance (3-minute sample)	# of Taxa	% EPT	% Chironomids	Simpson's Diversity	Simpson's Evenness
Reference										
BLCK-8		-0.13	0.24	-0.13	600	21.3	54.8	38.9	0.78	0.23
BUCK-8		0.38	-0.02	-0.05	1865	21.0	85.5	11.3	0.83	0.27
FC1K-8		-0.21	0.71	-0.04	610	19.0	42.6	37.4	0.86	0.37
GRCK-8		-0.19	-0.25	-0.49	63	14.0	58.7	27.0	0.88	0.58
HOCK-8		0.04	-0.20	-0.46	102	16.0	70.6	15.7	0.83	0.37
NECK-8		-0.14	0.41	-0.06	1187	21.0	76.9	18.6	0.83	0.28
R7K-8		-0.16	0.22	0.14	1236	23.5	41.9	39.8	0.87	0.33
STCK-8		-0.30	0.10	-0.25	90	15.0	22.2	43.3	0.86	0.47
USFRK-8		0.98	-0.07	0.21	1969	26.0	74.5	16.6	0.80	0.19
VRK-8		-0.07	-0.57	-0.67	502	20.0	62.4	11.8	0.87	0.37
Mean		**0.02**	**0.06**	**-0.18**	**822**	**19.7**	**59.0**	**26.0**	**0.84**	**0.35**
SD		**0.39**	**0.36**	**0.28**	**710**	**3.8**	**19.3**	**12.7**	**0.03**	**0.12**
Exposure										
X2K-8	value	**-0.44**	**-0.42**	**0.48**	**2192**	**24.3**	**20.8**	**63.7**	**0.78**	**0.20**
	t	-3.78	-4.17	7.33	6.10	3.88	-6.27	9.38	-5.87	-3.99
	cP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	ncP	0.87	0.80	0.17	0.34	0.85	0.31	0.04	0.39	0.83
R2K-8	value	**-0.23**	**-0.22**	**0.10**	**511**	**23.7**	**68.8**	**21.9**	**0.87**	**0.33**
	t	-2.02	-2.38	3.15	-1.39	3.33	1.60	-1.03	3.08	-0.44
	cP	0.07	0.04	0.01	0.20	0.01	0.14	0.33	0.01	0.67
	ncP	1.00	0.99	0.96	1.00	0.94	1.00	1.00	0.96	1.00

cP - probability metric value at exposure area is the same as the mean for reference areas.
ncP - probability metric value at exposure area is inside the range of reference values

(orange)	Different from exposure mean (cP < 0.1) or range (ncP < 0.1).
(yellow)	Uncertain with respect to being similar to or different from reference (0.1 > p < 0.9).
(green)	Similar to reference mean (cP > 0.9) or within reference range (ncP < 0.9).

The collective results suggest that the kick sampling method was slightly more sensitive in detecting differences between the exposure and reference areas than the Hess sampling method within the RCA sampling design.

For the Vangorda Creek drainage, only Hess sample data were available for evaluation using RCA (Table 5.9; Figure 5.3). Several benthic community characteristics (CA2, CA3, density, %EPT, % chironomids) differed from average reference conditions at V27 but were not conclusively outside the range of reference either, suggesting relatively minor differences in invertebrate communities. Benthic communities at V5 and V8 showed fewer significant differences from average reference conditions and, except for CA2 at V8, were within the range of reference for all community metrics.

Comparisons of individual reference areas with average reference condition (Appendix Table F.16 - F.18) further supported the conclusion that differences between reference and mine-exposed areas were small relative to natural variability. As with mine-exposed areas, metric values for individual reference areas were often significantly different from average but were not conclusively outside the range of reference areas (except CA1 at NEXH-8).

5.4 Comparison of Sampling Designs

A modified control-impact design was compared to RCA in terms of relative sensitivity to detect reference-exposure area differences. A typical control-impact design compares mean condition in an exposure area to mean condition in a reference area based on replicate stations sampled within each area (using ANOVA). While this approach takes within-area (among station) variability into account, it does not usually involve multiple reference areas so as to take among-reference-area variability into account (i.e., exposure areas can differ from the selected reference area used in the comparison, but may not be outside the range of variability exhibited among a larger suite of reference areas). To allow for more direct comparison to RCA results, ANOVA and pre-planned reference-exposure contrasts were performed that involved the same set of reference area data used in RCA. This was similar to the central t-test used in RCA, except that within-exposure area variability was taken into account by ANOVA (i.e., all exposure stations included), but not in RCA (which used only the mean exposure area value for each metric).

For the Hess sampling method, central tests (which are based on comparisons of means) of control-impact versus RCA designs detected the same number of significant reference-exposure differences, although not always for the same benthic community metrics (cP

Table 5.9: Benthic community characteristics of Vangorda Creek exposure areas (V27, V5, V8) relative to reference areas having similar habitat characteristics based on Hess sampling. Results are presented for traditional central (cP) t-tests and non-central (ncP) t-tests (Test Site Analysis).

Hess 2007		CA1	CA2	CA3	Density (#/m^2)	# of Taxa	% EPT	% Chironomids	Simpson's Diversity	Simpson's Evenness
Reference										
BLCH-8		-0.17	0.24	0.40	6068	24.2	24.7	65.9	0.565	0.123
HOCH-8		-0.32	0.37	0.02	2147	23.0	51.9	39.0	0.884	0.376
NECH-7		-0.03	-0.52	-0.59	1607	21.0	73.1	20.7	0.844	0.305
R7H-8		-0.22	0.39	-0.30	7807	21.0	28.2	57.0	0.777	0.214
STCH-8		-0.18	0.34	-0.15	8120	19.0	7.6	82.8	0.414	0.090
VRH-7		1.34	0.38	0.03	2057	17.0	9.8	84.9	0.614	0.152
Mean		**0.07**	**0.20**	**-0.10**	**4634**	**20.9**	**32.5**	**58.4**	**0.68**	**0.21**
SD		**0.63**	**0.35**	**0.34**	**3042**	**2.6**	**25.5**	**25.1**	**0.18**	**0.11**
Exposure										
V27H-7	value	0.09	-0.56	0.24	8518	20.8	79.1	6.2	0.83	0.29
	t	0.08	-4.79	2.26	3	-0.1	4.1	-4.6	1.81	1.67
	cP	0.94	0.00	0.07	0.04	0.96	0.01	0.01	0.13	0.16
	ncP	1.00	0.39	0.94	0.84	1.00	0.55	0.42	0.98	0.98
V5H-7	value	0.25	-0.06	-0.11	1324	22.4	45.4	38.7	0.86	0.33
	t	0.64	-1.60	-0.06	-2	1.3	1.1	-1.8	2.16	2.42
	cP	0.55	0.17	0.96	0.06	0.25	0.31	0.14	0.08	0.06
	ncP	1.00	0.99	1.00	0.91	0.99	1.00	0.98	0.95	0.91
V8H-7	value	-0.21	-0.25	0.18	5968	19.0	30.2	60.8	0.63	0.16
	t	-1.00	-2.83	1.84	1	-1.6	-0.2	0.2	-0.69	-1.03
	cP	0.37	0.04	0.13	0.37	0.17	0.85	0.84	0.52	0.35
	ncP	1.00	0.84	0.98	1.00	0.99	1.00	1.00	1.00	1.00

cP - probability metric value at exposure area is the same as the mean for reference areas.
ncP - probability metric value at exposure area is inside the range of reference values

(orange) Different from exposure mean (cP < 0.1) or range (ncP < 0.1).
(yellow) Uncertain with respect to being similar to or different from reference (0.1 > p < 0.9).
(green) Similar to reference mean (cP > 0.9) or within reference range (ncP < 0.9).

values in Table 5.10). However, for kick sample data, more significant differences were detected by central tests within RCA than the modified control-impact design. This might suggest that within-area variability for kick sampling was sufficiently large that fewer differences could be detected by ANOVA than RCA, when compared to Hess sample results. However, comparison of coefficients of variations for both methods suggested less, rather than more within-area variability for kick compared to Hess samples (Table 5.2). It is more likely that fewer differences were detected in the kick sample modified ANOVA than RCA because only three stations were sampled in the exposure area. Hess contrasts were based on five stations per area (giving comparable results to RCA). Previous comparisons based on Hess and artificial substrate samples showed more reference-exposure area differences could be detected with five than three stations per area. Therefore, it seems likely that the modified ANOVA may have shown similar sensitivity to RCA for kick samples had five stations been sampled in the exposure area.

Irrespective of the study design used in future, sampling more reference areas is recommended. Increasing the number of reference areas improves characterization of natural variability and thus increases statistical power to detect ecologically meaningful differences and decreases false detections of differences that are not mine related. Once an adequate number of reference areas have been sampled, 10-20% of the areas should be re-sampled during each survey. The use of GIS data for habitat matching in advance of field collections will reduce field costs and strengthen the understanding of any mine-related (or non-mine related) effects on the receiving environment.

Although the Hess versus kick sampling and control-impact (CI) versus RCA study designs produced similar results overall, there were important differences that should be considered if the results of this study are applied to other mine sites subject to Environmental Effects Monitoring (EEM) requirements under the federal *Fisheries Act*. Significant reference-exposure differences were found for each sampling-study design combination but not always based on the same metrics: Hess-CI (density, number of taxa, evenness), kick-CI (evenness), Hess-RCA (density, eveness), and kick-RCA (density, number of taxa, eveness). While not surprising from an ecological assessment perspective, this has regulatory implications in that sampling-design selection may determine if a mine is classified as having an “effect” on benthic invertebrates, as defined in EEM and also the magnitude of such effect. Also, while area differences may be observed using central tests, they may not be indicative of conditions outside the range of natural regional variability.

Table 5.10: Reference-exposure comparisons using different statistical methods (ANOVA and contrasts versus RCA) and different sampling methods (Hess versus kick sampling) and the same set of reference areas (BLC, HOC, NEC, R7, STC, VR). Shade indicates benthic community metrics that are different from reference (p<0.1) in each comparison.

Metric	Exposure Area	Hess			Kick		
		Comparisons to Reference Mean		Comparisons to Reference Range	Comparisons to Reference Mean		Comparisons to Reference Range
		Modified Control-Impact [a]	RCA		Modified Control-Impact [a]	RCA	
		Area contrasts based on t-statistic (cP)[a]	Central t-test (cP)[b]	Non central t-test (ncP)	Area contrasts based on t-statistic (cP)[a]	Central t-test (cP)[b]	Non central t-test (ncP)
Density (for Hess) or Total Sample Abundance (for kick)	X2	0.06	0.00	0.30	0.18	0.00	0.34
	R2	0.34	0.30	1.00	0.21	0.20	1.00
Number of Taxa	X2	0.40	0.18	1.00	0.09	0.00	0.85
	R2	0.54	0.33	1.00	0.13	0.01	0.94
Simpson's E	X2	0.21	0.05	0.98	0.05	0.00	0.83
	R2	0.03	0.00	0.63	0.81	0.67	1.00
Simpson's D	X2	0.95	0.93	1.00	0.05	0.00	0.39
	R2	0.14	0.07	0.99	0.29	0.01	0.96
EPT (%of total community abundance)	X2	0.01	0.00	0.64	0.01	0.00	0.31
	R2	0.65	0.54	1.00	0.42	0.14	1.00
Chironomids (% of total community abundance)	X2	0.01	0.01	0.82	0.00	0.00	0.04
	R2	0.84	0.81	1.00	0.61	0.33	1.00
CA Axis 1	X2	0.00	0.73	1.00	0.00	0.00	0.87
	R2	0.00	0.37	1.00	0.02	0.07	1.00
CA Axis 2	X2	0.00	0.71	1.00	0.57	0.00	0.80
	R2	0.99	0.62	1.00	0.90	0.04	0.99
CA Axis 3	X2	0.99	0.01	0.78	0.12	0.00	0.17
	R2	0.44	0.19	1.00	0.48	0.01	0.96
Total Significant Differences (p<0.1)		**7**	**7**	**0**	**7**	**14**	**1**

[a] Incorporates all stations within exposure areas and compares to same suite of reference areas used in RCA. Five stations per area in the case of Hess samples. Three stations per area in the case of kick samples.

[b] Uses only mean exposure area values and thus differs from control-impact by ignoring within exposure-area variability.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions can be drawn from the sampling programs conducted at the Faro Mine complex in August 2007, August 2008 and January 2009:

1. Analyses of water samples collected in August of 2007 and 2008 showed relatively good water quality at mine-exposed areas compared to water quality benchmarks based on the protection of aquatic life. However, elevated metal levels and increased aquatic toxicity were observed in the Rose Creek drainage in January 2009 compared to August 2008, indicating potential for groundwater contaminant sources to affect biota during periods of limited surface water dilution.

2. Sediment metal concentrations tended to be about three times higher in the fine sediment fraction (<0.15mm) compared to whole sediment, indicating that a large proportion of metals present were associated with fine sediment particles. However, fine sediments represented a small proportion of the whole sediment sample in most areas. Sediments collected from V27, X2 and R2 which contained elevated concentrations of arsenic, lead, manganese, and zinc were not toxic to the amphipod *Hyallela azteca* in 14-day laboratory tests measuring surivival and growth. Inclusion of sediment analyses in long-term monitoring is of questionable value, unless triggered by substantial increases in metal and/or suspended solids loadings from the mine.

3. Benthic community assessments based on artificial substrates were less sensitive than Hess or kick sample collection for detecting differences in mine-exposed benthic communities relative to those in reference areas.

4. Within a traditional control-impact design (ANOVA and pre-planned reference-exposure contrasts), Hess and kick sampling detected the same number of reference-exposure differences, but based on different benthic community metrics.

5. Within the RCA sampling design, the kick sampling method was slightly more sensitive for detecting differences between the exposure and reference areas than the Hess sampling method.

6. The RCA sampling design was just as sensitive as or more sensitive than a modified control-impact (ANOVA) design that used the same suite of reference areas for detecting reference-exposure differences. The advantage of using

an RCA sampling design is that differences between the exposure and reference areas can be evaluated relative to regional reference variability. In addition, RCA sampling requires collection of fewer samples per area and fewer overall samples than a traditional control-impact design, even though it necessitates sample collection from more reference areas. Overall, RCA represents the most cost-effective approach for long-term monitoring at Faro. Further improvement in reference area sample sizes and overall cost-efficiency may be achievable if monitoring of suitable reference areas could be shared with other programs in the Yukon (e.g., other closed or operating mines, the Placer Mining Monitoring Program).

7. A modified Control-Impact design involving ANOVA and reference exposure contrasts based on a multiple-reference-area data set (a single station per area) and 5 stations per exposure area may yield comparable results to RCA (single sample in all reference and exposure areas). This deviates from conventional ANOVAs because reference-exposure contrasts would combine the within-area variability of exposure areas and the among-area variability of reference areas. This approach would ensure that exposure area data are more representative (multiple stations rather than relying on a single station as in RCA). Assuming that among-reference-area variability exceeds within-reference-area variability, single stations within each reference area would be adequate to capture the full range of within and among area variability provided a sufficient number of reference areas are sampled (e.g., at least 20). This would increase the overall number of samples (because of more stations in each exposure area), but allow for implementation of statistics that may be more familiar to the scientists who are likely to be responsible for long-term monitoring.

8. Inclusion of 6-10 reference areas having habitats comparable to the exposure areas was sufficient to detect significant reference-exposure differences in central tests. Statistical power for non-central tests would be improved if additional reference areas could be found near the Faro Mine complex with similar habitat characteristics to exposure areas (e.g, to ensure 20 reference areas per exposure area group). Candidate areas could be selected in advance of the next field program based on GIS characteristics that were strongly related to benthic community characteristics (e.g., percent volcanic bedrock geology and percent coniferous cover).

9. All reference areas that may be included in future monitoring should be investigated to ensure they are not affected by current or historical anthropogenic influences.

7.0 REFERENCES

Bailey RC, Norris RH, Reynoldson TB. 2004. Bioassessment of freshwater ecosystems using the reference condition approach. Kluwer Academic Publishers, Boston.

BCMOE (British Columbia Ministry of Environment). 2006. A Compendium of Working Water Quality Guidelines for British Columbia. Updated August 2006.

Bowman, M.F. and K.M. Somers. 2005. Considerations when using the reference condition approach for bioassessment of freshwater ecosystems. Water Quality Research Journal of Canada 40(3): 347-360.

Bowman, M.F. and K.M. Somers. 2006. Evaluating a novel Test Site Analysis (TSA) bioassessment approach. Journal of the North American Benthological Society 25(3): 712-727.

Burns, B.E. 1991a. Biological Monitoring Program at Rose and Anvil Creeks, Y.T. 1990. Laberge Environmental Services. Prepared for Curragh Resources Inc.

Burns, B.E. 1991b. Biological Monitoring Program at Vangorda Creek, Faro, Y.T. 1991. Laberge Environmental Services. Prepared for Curragh Resources Inc.

Burns, B.E. 1993. Biological Monitoring Program at Vangorda Creek, Faro, Y.T. 1993. Laberge Environmental Services. Prepared for KPMG Environmental Services.

Burns, B.E. 1994. Biological Monitoring Program at Rose and Anvil Creek, Faro, Y.T. 1994. Laberge Environmental Services. Prepared for KPMG Environmental Services Inc, Toronto, Ontario.

Burns, B.E. 1996. Biological Monitoring Program at Vangorda Creek, Faro, Y.T. 1995. Laberge Environmental Services. Prepared for Anvil Range Mining Corporation.

Burns, B.E. 1997. Biological Monitoring Program at Rose and Anvil Creek, Faro, Y.T. 1996. Laberge Environmental Services. Prepared for Anvil Range Mining Corporation.

Burns, B.E. 1998. Biological Monitoring Program at Vangorda Creek, Faro, Y.T. 1997. Laberge Environmental Services. Prepared for Anvil Range Mining Corporation.

Burns, B.E. 1999. Biological Monitoring Program at Rose and Anvil Creek, Faro, Y.T. 1998. Laberge Environmental Services. Prepared for Deloitte & Touche Inc.

Burns, B.E. 2000. Biological Monitoring Program at Vangorda Creek, Faro, Y.T. 1999. Laberge Environmental Services. Prepared for Deloitte & Touche Inc.

Burns, B.E. 2001. Biological Monitoring Program at Rose and Anvil Creek, Faro, Y.T. 2000. Laberge Environmental Services. Prepared for Deloitte & Touche Inc.

Burns, B.E. 2002a. Biological Monitoring Program at Vangorda Creek, Faro, Y.T. 2001. Laberge Environmental Services. Prepared for Deloitte & Touche Inc.

Burns, B.E. 2002b. Biological Monitoring Program at Rose and Anvil Creek, Faro, Y.T. 2002. Laberge Environmental Services. Prepared for Deloitte & Touche Inc.

Burns, B.E. 2003. Biological Monitoring Program at Vangorda Creek, Faro, Y.T. 2003. Laberge Environmental Services. Prepared for Deloitte & Touche Inc.

Burns, B.E. 2004. Biological Monitoring Program at Rose and Anvil Creek, Faro, Y.T. 2004. Laberge Environmental Services. Prepared for Deloitte & Touche Inc. December 2004.

Burns, B.E. 2005 Biological Monitoring Program at Vangorda Creek, Faro, Y.T. 2005. Laberge Environmental Services. Prepared for Deloitte & Touche Inc. November 2005.

Burns, B.E. 2006. Biological Monitoring Program at Rose and Anvil Creek, Faro, Y.T. 2006. Laberge Environmental Services. Prepared for Deloitte & Touche Inc.

Burns, B.E. 2007. Biological and Sediment Monitoring Program at Vangorda Creek, Faro, Y.T. 2007. Laberge Environmental Services. Submitted to Deloitte and Touche Inc. December 2007.

Burns, B.E. 2009. Biological and Sediment Monitoring Program at Rose and Anvil Creeks, Faro, Y.T. 2008. Laberge Environmental Services. Submitted to Deloitte and Touche Inc. January 2009.

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg

Cowardin, L. M., V. Carter, F. C. Golet and E. T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service, U.S. Dept. of the Interior, Washington, D.C. FWS/OBS-79/31.

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

Environment Canada. 2000. Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout. Environmental Protection Series.

Report EPS 1/RM/13, Second Edition, December 2000, including May 2007 amendments.

Environment Canada. 2002. Metal Mining Guidance Document for Aquatic Environmental Effects Monitoring. Environmental Protection Series Report EEM/2002/1. June 2002.

Environment Canada. 2007a. Biological Test Method: Test of Reproduction and Survival using the Cladoceran *Ceriodaphnia dubia*. Environmental Protection Series Report EPS 1/RM/21. Second Edition, February 2007.

Environment Canada. 2007b. Biological Test Method: Growth Inhibition Test Using Freshwater Alga. Environmental Protection Series, Report EPS 1/RM/25, Second Edition, March 2007.

ESRI (Environmental Systems Research Institute). 2005. ArcGIS, version 9.1. Redlands, USA.

Green, R.H. 1979. Sampling Design and Statistical Methods for Environmental Biologists. Wiley, New York.

Horowitz, A.J. 1991. A Primer On Sediment-Trace Element Chemistry. Second Edition. Lewis Publishers, Inc., Chelsea, Michigan, USA.

Hughes RM, Larsen DP, Omernik JE. 1986. Regional reference sites: a method for assessing stream potentials. Environ. Manage. 10:629-635.

Hurlbert, S.H. 1984. Pseudoreplication and the design of ecological field experiments. Ecol. Monog. 54:187-211.

Linke, S., Norris, R.H.,Faith, D.P., and Stockwell, D. 2005. ANNA: A new prediction method for bioassessment programs. Freshwater Biology 50(1): 147-158

Minnow Environmental Inc. 2007a. Ecological Impact Assessment, Faro Mine, Yukon. Prepared for Faro Mine Closure Office, Whitehorse, Yukon. May 2007.

Minnow Environmental Inc. 2007b. Aquatic Ecosystem Monitoring Program, Faro Mine Yukon. Prepared for Assessment and Abandoned Mines Branch, Government of Yukon, Whitehorse, Yukon. December 2007.

Minnow Environmental Inc. 2009. Faro Mine Slimy Sculpin Survey, May 2008 (Draft). Report Prepared for Assessment and Abandoned Mines Branch, Government of Yukon, Whitehorse, Yukon Territory. January 2009

Reynoldson, T.B., C. Logan, T. Pascoe and S.P. Thompson. 1999. CABIN (Canadian Aquatic Biomonitoring Network) Invertebrate Biomonitoring Field and Laboratory Manual. NWRI Report No. 99-211. http://cabin.cciw.ca/Main/cabin_online_resources.asp

SPSS version 13 (2006). SPSS Inc. 233 S. Wacker Drive, 11th floor Chicago, Illinois, U.S.A.

SRK Consulting Engineers and Scientists. 2004. Water Quality Estimates for Anvil Range Waste Rock (Draft). Prepared for Deloitte and Touche Inc. November 2004.

SRK Consulting Engineers and Scientists. 2005. Project Memorandum: Faro Tailings Source Term Calculations. From John Chapman. Dated June 14, 2005.

Thioulouse J., Chessel D., Dolédec S., & Olivier J.M. (1997) ADE-4: a multivariate analysis and graphical display software. Statistics and Computing 7: 75-83.

Wright JF, Sutcliffe DW, Furse MT (ed.). 2000. Assessing the biological quality of fresh water: RIVPACS and other techniques. Freshwater Biological Association, Cumbria, UK.

APPENDIX A

Water Quality Benchmarks

Appendix A: Selection of Benchmarks for Water Quality Evaluation

In all cases where a Canadian water quality guideline (CWQG) exists for a parameter, such a guideline was selected as the benchmark for evaluation of water quality at Faro (Tables A.1 and A.2). In the absence of a CWQG, the most conservative provincial water quality criterion from British Columbia, Saskatchewan, or Ontario was selected, if such value(s) existed. An exception was the uranium guideline from Saskatchewan which is based on more recent information than the Ontario water quality objective for uranium. In the absence of either a Canadian or provincial criterion, a Canadian drinking water quality guideline was selected. For parameters for which no water quality criteria have been developed, alternative benchmarks (provided by Senes) were identified that represent a low- or no- observed effect concentration reported in the scientific literature for a sensitive aquatic species.

Some water quality criteria vary on the basis of water hardness (aluminum, beryllium cadmium, copper, lead, manganese, nickel). In such cases, the criterion corresponding to a hardness of 100 mg/L as $CaCO_3$ was selected. Although some reference and negligibly-influenced surface waters in the vicinity of Faro mine have lower mean water hardness than 100 mg/L, the receiving waters in which elevated metal levels are sometimes found (and are therefore of potential concern) also have elevated water hardness. For example, mean water hardness concentrations at mine-influenced stations such as X2, X14, R2-R11, V27, and V8 are all >100 mg/L (Minnow 2007). Although hardness values at these stations are occasionally lower, such cases tend to be associated with periods of high precipitation or snowmelt when metal levels also tend to be diluted. A hardness value of 100 mg/L can be considered conservative since water hardness concentrations of up to 793 mg/L (X-14, Minnow 2007) have been observed in mine-affected areas.

In the case of total alkalinity and total suspended solids, the available water quality criteria are expressed as a change relative to background concentrations (Table A.2). In these cases, background values reported in this study were used for deriving the water quality benchmarks.

The CWQG for ammonia is expressed on the basis of un-ionized ammonia, which comprises an increasing fraction of the total ammonia present in water as either water pH or temperature increases (or both). Because the temperature and pH of surface waters near Faro rarely rise above 15°C or 8.5, respectively, it is conservative to use as the benchmark the total ammonia concentration corresponding to an un-ionized concentration of 0.019 mg/L (the CWQG) under such conditions (Table A.2).

Although separate CWQGs exist for the two main valence states of chromium, speciation of chromium in water samples is not readily available from commercial laboratories and the lower value of 0.001 mg/L (for hexavalent chromium) is generally applied for data screening purposes.

Except for alkalinity and pH, concentrations of potential concern are those that are higher than the selected benchmark. In the case of alkalinity and pH, it is values below the benchmark that are of greatest interest at an acid-generating site like Faro.

Table A.1: Water quality criteria relative to Maxxam DLs (August 2008).

Measurements	Units	Water quality criteria: Canadian water quality guideline (for protection of FW aquatic life)[a]	Water quality criteria: British Columbia (freshwater)[b]	Water quality criteria: Saskatchewan[c]	Water quality criteria: Ontario Provincial Water Quality Objective[d]	Water quality criteria: Canadian Drinking Water Quality Guideline[a]	Alternative Aquatic Effects-Based Benchmarks[e]
Total metals							
Aluminum	mg/L	0.005 - 0.100[g]	0.05	0.005 - 0.100[g]	0.015 - 0.075[h]	0.1	
Antimony	mg/L				0.02[h]	0.006	0.15[i]
Arsenic	mg/L	0.005	0.005	0.005	0.005[h]	0.005 proposed	
Barium	mg/L					1.0	5.8[j]
Beryllium	mg/L				0.011 - 1.1[k]		0.0038[l]
Bismuth	mg/L						0.26[m]
Boron	mg/L		1.2		0.2[h]	5.000	
Cadmium	mg/L	0.000017 or more depending on hardness[B]		0.000017 or more depending on hardness[B]	0.0001 - 0.0005[h]	0.005	
Calcium	mg/L						116[j]
Chromium	mg/L	0.001 (hexavalent), 0.0089 (trivalent)		0.001 (hexavalent), 0.0089 (trivalent)	0.001 (hexavalent), 0.0089 (trivalent)	0.05	
Cobalt	mg/L		0.004		0.0009		
Copper	mg/L	0.002-0.004[n]	0.002-0.008[o]	0.002-0.004[n]	0.001-0.005[h]	1.0[p]	
Iron	mg/L	0.3		0.3	0.300	0.3[p]	
Lead	mg/L	0.001 - 0.007[q]	0.005-0.011[o]	0.001 - 0.007[q]	0.001 - 0.005[h]	0.010	
Lithium	mg/L						
Magnesium	mg/L						82[j]
Manganese	mg/L		0.7 - 1.9[o]			0.05[k]	
Mercury	ug/L	0.026[r] (0.004)[s]	0.004 - 0.02[s]	0.026[r]	0.2 (filtered)	1.0	
Molybdenum	mg/L	0.073	1		0.04[h]		
Nickel	mg/L	0.025 - 0.150[t]		0.025 - 0.150[t]	0.025		
Potassium	mg/L						53[j]
Selenium	mg/L	0.001	0.002	0.001	0.100	0.01	
Silicon	mg/L						
Silver	mg/L	0.0001	0.00005/0.0015[u]	0.0001	0.0001		
Sodium	mg/L					200[p]	680[s]
Strontium	mg/L						9.3[v]
Sulphur	mg/L						
Tellurium	mg/L						
Thallium	mg/L	0.0008			0.0003[h]		
Thorium	mg/L						
Tin	mg/L						0.35[j]
Titanium	mg/L						1.83[w]
Uranium	mg/L			0.015	0.005[h]	0.02	0.011[x]
Vanadium	mg/L				0.006[h]		0.024[y]
Zinc	mg/L	0.030	0.0075-0.090[o]	0.030	0.02[h]	5.0	
Zirconium	mg/L				0.004		548[z]
Non-metals							
Alkalinity - phenolphthalein	mg/L as $CaCO_3$						
Alkalinity - Total	mg/L as $CaCO_3$				no decreases more than 25% of natural concentration[f]		
Ammonia - total	mg/L	0.24[A]	1.9[A]		0.25[A]		
Bicarbonate	mg/L						
Carbonate	mg/L						
Chloride - dissolved	mg/L					250[p]	
Colour	CU						
Conductivity - laboratory	μS/cm						
Conductivity - in situ	μS/cm						
Cyanide - weak acid dissociable	mg/L	0.005 (free)	0.01		0.005 (free)	0.2	
Dissolved oxygen - in situ	mg/L	6.5 - 9.5[D,E]	5 - 11[E]		5 - 8[D,E]		
Dissolved oxygen - in situ	%				54 - 63[D,E]		
Dissolved organic carbon	mg/L						
Fluoride	mg/L	0.120				1.5	
Hardness - dissolved	mg/L as $CaCO_3$						
Hardness - Total	mg/L as $CaCO_3$						
Hydroxide	mg/L						
Nitrate	mg/L	13	40		narrative	10	
Nitrite	mg/L	0.06	0.02-0.2[C]		0.06	3.2	
Nitrate plus nitrite	mg/L						
pH - Laboratory	pH units	6.5-9.0	6.5 - 9.0		6.5-8.5	6.5-8.5	
pH - in situ	pH units	6.5-9.0	6.5 - 9.0		6.5-8.5	6.5-8.5	
Phosphorus - nutrient analysis	mg/L		0.005-0.015 (lakes)		0.03 for rivers[h]		
Sulphate	mg/L		50			500[p]	
Temperature - in situ	˚C						
Total organic carbon	mg/L						
Total dissolved solids - lab.	mg/L					500[p]	
Total suspended solids	mg/L	no more than 5 mg/L above background[f]	< 25 mg/L above background in 24 hours				
Turbidity	NTU		2				

[a] CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg

[b] BCMOE (British Columbia Ministry of Environment). 2006. British Columbia Approved Water Quality Guidelines (Criteria), 2006 Edition. Updated August 2006. For parameters with both maximum and 30-day average values, the 30-d average is shown.

[c] Saskatchewan Environment. 2006. Surface Water Quality Objectives. Interim Edition. EPB356. July 2006. 9pp.

[d] OMOE (Ontario Ministry of Environment and Energy). 1994. Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of the Environment and Energy (Ontario), July 1994

[e] toxicity reference value for most sensitive aquatic receptor (aquatic plants, phytoplankton, benthic invertebrates, zooplankton, fish). From Senes Consultants Limited, Richmond Hill, Ontario.

[f] computed from data presented in this report and shown in Table B.2

[g] 0.005 mg/L at pH<6.5, Ca<4 mg/L and DOC<2 mg/L; 0.1 mg/L at pH ≥ 6.5; [Ca^{2+}] ≥ 4 mg/L; DOC ≥ 2 mg/L

[h] interim objective

[i] for phytoplankton; U.S. EPA (United States Environmental Protection Agency). 1978. In-depth Studies on Health and Environmental Impacts of Selected Water Pollutants. Contract No. 68-0104646, U.S. EPA, Duluth, MN.

[j] for zooplankton; Biesinger, K.E. and G.M. Christensen. 1982. Effects of Varioue Metals on Survival, Growth, Reproduction, and Metabolism of *Daphnia magna*. *J. Fish. Res. Bd. Canada.* 29:1691-1700.

[k] 0.011 for hardness <75 mg/L and 1.1 for hardness >75 mg/L.

[l] for zooplankton; Kimball, G. n.d. The Effects of Lesser Known Metals and One Organic to Fathead minnows [*Pimephales promelas*] and *Daphnia magna*. U.S. Environmental Protection Agency, Duluth, MN.

[m] Khangarot, B.S. 1991. Toxicity of Metals to a Freshwater Tubificid Worm, Tubifex tubifex (Muller) Bull.Environ.Contam.Toxicol. 46:906-912

[n] 0.002 at [$CaCO_3$] = 0-120 mg/L, 0.003 at [$CaCO_3$] = 120-180 mg/L, 0.004 at [$CaCO_3$] > 180 mg/L

[o] for hardnesses ranging between 25 and 300 mg/L, respectively

[p] Canadian drinking water quality guideline, aesthetic objective (CCME 1999).

[q] 0.001 at [$CaCO_3$] = 0-60 mg/L, 0.002 at [$CaCO^3$] = 60-120 mg/L, 0.004 at [$CaCO_3$] = 120-180 mg/L, 0.007 at [$CaCO_3$] > 180 mg/L

[r] Inorganic mercury

[s] Organic mercury

[t] 0.025 at [$CaCO_3$] = 0-60 mg/L, 0.065 at [$CaCO^3$] = 60-120 mg/L, 0.110 at [$CaCO_3$] = 120-180 mg/L, 0.150 at [$CaCO_3$] > 180 mg/L

[u] hardnesses of ≤100 mg/L and >100 mg/L, respectively

[v] for fish; Dwyer, F.J., S.A. Burch, C.G. Ingersoll, and J.B. Hunn 1992 Toxicity of Trace Element and Salinity Mixtures to Striped Bass (Morone saxatilis) and Daphnia magna. Environ.Toxicol.Chem. 11(4):513-520

[w] for fish; Birge, W.J., J.A. Black, A.G. Westerman, and J.E. Hudson. 1979. In: C. Gale (Ed.) EPA-600/9-80-022, Oil Shale Symposium: Sampling, Analysis and Quality Assurance, March 1979, U.S. EPA, Cincinnati, OH: 519-534 (US NTIS PB80-221435).

[x] for phytoplankton and zooplankton; Franklin, N.M., J.L.Stauber, S.J. Markich, and R.P. Lim. 2000. pH-dependent Toxicity of Copper and Uranium to a Tropical Freshwater Algae (*Chlorella sp* .). *Aquatic Toxicology*. 48:275-289.

[y] for benthic invertebrates; Fargasova, A. 1997. Sensitivity of *Chironomus plumosus* Larvae to V^{5+}, Mo^{6+}, Mn^{2+}, Ni^{2+}, Cu^{2+}, and Cu^{+} Metal Ions and their Combinations. *Bull. Environ. Contam. Toxicol.* 59(1):956-962.

[z] Cushman, R.M, S.G. Hildebrand, R.H. Strand, and R.M. Anderson. 1977. The Toxicity of 35 Trace Elements in Coal to Freshwater Biota: A Data Base with Automated Retrieval Capabilities. ORNL/TM-5793. Oak Ridge National Laboratory.

[A] based on conservative assumption of pH 8.5 and temperature of 15C to achieve un-ionized ammonia of <0.02 mg/L

[B] CWQG for cadmium = $10^{\{0.86[\log(\text{hardness})] - 3.2\}}$ in ug/L

[C] Depends on chloride concentration

[D] for cold water streams

[E] lower end of range is applicable for protecting early life-stages

Table A.2: Selected benchmarks for evaluation of water quality at Faro Mine, Yukon.

Measurements	Units	Selected water quality benchmarks[a]
Total metals		
Aluminum	mg/L	0.1
Antimony	mg/L	0.02
Arsenic	mg/L	0.005
Barium	mg/L	1.0
Beryllium	mg/L	1.1
Bismuth	mg/L	0.26
Boron	mg/L	1.2
Cadmium	mg/L	0.00003
Calcium	mg/L	116
Chromium	mg/L	0.001
Cobalt	mg/L	0.004
Copper	mg/L	0.002
Iron	mg/L	0.3
Lead	mg/L	0.002
Lithium	mg/L	
Magnesium	mg/L	82
Manganese	mg/L	1
Mercury	mg/L	0.000026
Molybdenum	mg/L	0.073
Nickel	mg/L	0.065
Potassium	mg/L	53
Selenium	mg/L	0.001
Silicon	mg/L	
Silver	mg/L	0.0001
Sodium	mg/L	200
Strontium	mg/L	9.3
Sulphur	mg/L	
Tellurium	mg/L	
Thallium	mg/L	0.0008
Thorium	mg/L	
Tin	mg/L	0.35
Titanium	mg/L	1.83
Uranium	mg/L	0.015
Vanadium	mg/L	0.006
Zinc	mg/L	0.030
Zirconium	mg/L	0.004
Non-metals		
Alkalinity - phenolphthalein	mg/L as $CaCO_3$	
Alkalinity - Total	mg/L as $CaCO_3$	11.1[b]
Ammonia - total	mg/L	0.24
Bicarbonate	mg/L	
Carbonate	mg/L	
Chloride - dissolved	mg/L	250
Colour	CU	
Conductivity - laboratory	µS/cm	
Conductivity - in situ	µS/cm	
Cyanide - weak acid dissociable	mg/L	0.005 (free)
Dissolved oxygen - in situ	mg/L	6.5 (minimum)
Dissolved oxygen - in situ	%	
Dissolved organic carbon	mg/L	
Fluoride	mg/L	0.12
Hardness - dissolved	mg/L as $CaCO_3$	
Hardness - Total	mg/L as $CaCO_3$	
Hydroxide	mg/L	
Nitrate	mg/L	13
Nitrite	mg/L	0.06
Nitrate plus nitrite	mg/L	
pH - Laboratory	pH units	6.5-9.0
pH - in situ	pH units	6.5-9.0
Phosphorus - nutrient analysis	mg/L	0.03
Sulphate	mg/L	50
Temperature - in situ	˚C	
Total organic carbon	mg/L	
Total dissolved solids - lab.	mg/L	500
Total suspended solids	mg/L	8[c]
Turbidity	NTU	2

[a] Benchmarks were selected from relevant water quality criteria as shown in Appendix Table B.1.
[b] Represents a 25% decrease below lower background benchmark of 14.8 mg/L reported in this study.
[c] Based on an increase of 5 mg/L above upper background benchmark of 3 mg/L reported in this study.

APPENDIX B

Water and Sediment Quality Data (Chemistry, Toxicity)

Chemistry

Driven by service and Science
www.maxxamanalytics.com

Your P.O. #: BC07-066-FC
Your Project #: 2212
Your C.O.C. #: F82587, F82588

Attention: Patti Orr
Minnow Environmental Inc.
6800 Kitimat Road
Mississauga, ON
CANADA L5N 5M1

Report Date: 2007/09/13

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: A740575
Received: 2007/08/31, 14:20

Sample Matrix: Soil
Samples Received: 8

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by ICPMS (total)	8	2007/09/10	2007/09/10	BRN SOP-00203	Based on EPA 200.8
Moisture	4	N/A	2007/09/11	BRN SOP-00321 R3.0	Ont MOE -E 3139
Ammonia-N (Available) ◊	4	2007/09/10	2007/09/10	BRN SOP-00239	Carter, SSMA 4.2
Nitrate+Nitrite (N) (Available)	4	N/A	2007/09/10	BRN SOP-000233 R1.0	Based on Carter- 4.2
Nitrite (N) (Available) (soil)	4	2007/09/10	2007/09/10	BRN SOP-00233 R1.0	Carter,SSMA 4.2
Available Phosphate	4	2007/09/07	2007/09/07	BRN SOP-00235 R3.0	Carter, SSMA 4.2
Sublet (Inorganics) ◊	4	N/A	2007/09/11		
TOC Soil Subcontract ◊	4	2007/09/12	2007/09/12		

Sample Matrix: Water
Samples Received: 8

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	8	2007/09/04	2007/09/04	BRN SOP-00264 R2.0	Based on SM2320B
Chloride by Automated Colourimetry	8	N/A	2007/09/11	BRN-SOP 00234 R1.0	Based on EPA 325.2
Carbon (DOC)	8	N/A	2007/09/04	BRN SOP-00224 R3.0	Based on SM-5310C
Conductance - water	8	N/A	2007/09/04	BRN SOP-00264 R2.0	Based on SM-2510B
Fluoride	8	N/A	2007/09/04	BRN SOP-00225 R1.0	Based SM - 4500 F C
Hardness (calculated as CaCO3)	8	N/A	2007/09/11		
Mercury (Total)	8	2007/09/07	2007/09/10	BRN SOP-00205	Based on EPA 245.1
Elements by ICP-AES (dissolved)	8	2007/09/10	2007/09/10	BRN SOP-00201 R1.0	Based on EPA 6010B
Elements by ICPMS (total) ◊	8	N/A	2007/09/12	BRN SOP-00204	Based on EPA 200.8
Elements by ICP-AES (total)	8	N/A	2007/09/10	BRN SOP-00201 R1.0	Based on EPA 6010B
Ammonia (N)	8	N/A	2007/09/12	BRN SOP-00231 R3.0	Based on SM-4500MH3G
Nitrate + Nitrite (N)	8	N/A	2007/09/04	ING233 Rev.4.4	Based on EPA 353.2
Nitrite (N) by CFA	8	N/A	2007/09/04	BRN SOP-00233 R1.0	EPA 353.2
Nitrogen - Nitrate (as N)	8	N/A	2007/09/05		
Sulphate by Automated Colourimetry	8	N/A	2007/09/11	BRN-SOP 00243 R1.0	Based on EPA 375.4
Total Dissolved Solids (Filt. Residue)	8	N/A	2007/09/07	ING443 Rev.5.1	APHA 2540C
Carbon (Total Organic)	8	N/A	2007/09/04	BRN SOP-00224 R3.0	Based on SM-5310C
Total Phosphorus	8	N/A	2007/09/12	BRN SOP-00236 R4.0	SM 4500
Total Suspended Solids	8	N/A	2007/09/12	BRN SOP-00277 R2.0	Based on SM-2540 D

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Bedford(From Burnaby)
(2) SCC/CAEAL

Encryption Key

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

ELAINE COUSINS, CS Manager
Email: elaine.cousins@maxxamanalytics.com
Phone# (604) 444-4808 Ext:276

==
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.   SCC and CAEAL have approved this reporting process and electronic report format.

Maxxam Job #: A740575
Report Date: 2007/09/13

Minnow Environmental Inc.
Client Project #: 2212
Site Reference:
Your P.O. #: BC07-066-FC
Sampler Initials: KC

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		G74778	G74779	G74780	G74781		
Sampling Date		2007/08/28	2007/08/28	2007/08/28	2007/08/28		
COC Number		F82588	F82588	F82588	F82588		
	Units	**V27-A (D/S 01)**	**V27-B (03)**	**V27-C (04)**	**V1**	**RDL**	**QC Batch**
CONVENTIONALS							
Nitrite (N)	mg/kg	<0.5	<0.5	<0.5	<0.5	0.5	1836722
Parameter							
Subcontract Parameter	N/A	ATTACHED	ATTACHED	ATTACHED	ATTACHED	N/A	1843048
Nutrients							
Available (KCl) Ammonia (N)	mg/kg	0.7	0.8	0.8	0.9	0.5	1836723
Nitrate plus Nitrite (N)	ug/g	<2	<2	<2	<2	2	1836720
Available (KCl) Orthophosphate (P)	ug/g	3.6	2.8	3.2	4.9	0.5	1834384
Physical Properties							
Moisture	%	7.2	16.7	20.9	15.7	0.3	1836531

RDL = Reportable Detection Limit

Maxxam Job #: A740575
Report Date: 2007/09/13

Minnow Environmental Inc.
Client Project #: 2212
Site Reference:
Your P.O. #: BC07-066-FC
Sampler Initials: KC

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		G74778	G74779	G74780	G74781		
Sampling Date		2007/08/28	2007/08/28	2007/08/28	2007/08/28		
COC Number		F82588	F82588	F82588	F82588		
	Units	**V27-A (D/S 01)**	**V27-B (03)**	**V27-C (04)**	**V1**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total Aluminum (Al)	mg/kg	8180	8700	9630	8020	100	1837797
Total Antimony (Sb)	mg/kg	0.7	0.5	0.8	0.2	0.1	1837797
Total Arsenic (As)	mg/kg	19.9	16.8	24.7	6.9	0.2	1837797
Total Barium (Ba)	mg/kg	73.5	88.0	116	64.3	0.1	1837797
Total Beryllium (Be)	mg/kg	0.2	0.2	0.3	0.3	0.1	1837797
Total Bismuth (Bi)	mg/kg	0.1	0.2	0.2	0.2	0.1	1837797
Total Boron (B)	mg/kg	<5	<5	<5	<5	5	1837797
Total Cadmium (Cd)	mg/kg	0.82	0.92	1.05	0.35	0.05	1837797
Total Chromium (Cr)	mg/kg	25	22	24	14	1	1837797
Total Cobalt (Co)	mg/kg	11.2	11.8	13.6	7.4	0.3	1837797
Total Copper (Cu)	mg/kg	21.7	21.2	25.1	14.7	0.5	1837797
Total Iron (Fe)	mg/kg	19200	20600	23000	18500	100	1837797
Total Lead (Pb)	mg/kg	146	123	152	10.2	0.1	1837797
Total Manganese (Mn)	mg/kg	830	941	1070	378	0.2	1837797
Total Mercury (Hg)	mg/kg	0.11	0.19	0.09	<0.05	0.05	1837797
Total Molybdenum (Mo)	mg/kg	0.7	0.9	1.2	0.4	0.1	1837797
Total Nickel (Ni)	mg/kg	28.1	26.8	30.3	16.2	0.8	1837797
Total Selenium (Se)	mg/kg	0.6	0.6	0.6	<0.5	0.5	1837797
Total Silver (Ag)	mg/kg	0.16	0.30	0.29	0.09	0.05	1837797
Total Strontium (Sr)	mg/kg	39.9	40.7	40.3	15.5	0.1	1837797
Total Thallium (Tl)	mg/kg	0.19	0.13	0.16	<0.05	0.05	1837797
Total Tin (Sn)	mg/kg	0.3	0.2	0.3	0.3	0.1	1837797
Total Titanium (Ti)	mg/kg	95	104	133	116	1	1837797
Total Uranium (U)	mg/kg	0.89	0.85	1.04	1.59	0.05	1837797
Total Vanadium (V)	mg/kg	17	18	18	14	2	1837797
Total Zinc (Zn)	mg/kg	290	338	385	53	1	1837797

RDL = Reportable Detection Limit

Maxxam Job #: A740575
Report Date: 2007/09/13

Minnow Environmental Inc.
Client Project #: 2212
Site Reference:
Your P.O. #: BC07-066-FC
Sampler Initials: KC

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		G81718	G81721	G81726	G81727		
Sampling Date		2007/08/28	2007/08/28	2007/08/28	2007/08/28		
COC Number		F82588	F82588	F82588	F82588		
	Units	**V27-A (D/S 01) 0.15MM**	**V27-B (03) 0.15MM**	**V27-C (04) 0.15MM**	**V1 0.15MM**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total Aluminum (Al)	mg/kg	14800	14300	13200	16100	100	1837797
Total Antimony (Sb)	mg/kg	2.0	2.2	2.0	0.3	0.1	1837797
Total Arsenic (As)	mg/kg	48.7	46.0	39.8	16.2	0.2	1837797
Total Barium (Ba)	mg/kg	338	265	209	130	0.1	1837797
Total Beryllium (Be)	mg/kg	0.5	0.5	0.5	0.6	0.1	1837797
Total Bismuth (Bi)	mg/kg	0.3	0.3	0.3	0.7	0.1	1837797
Total Boron (B)	mg/kg	<5	<5	<5	<5	5	1837797
Total Cadmium (Cd)	mg/kg	2.47	2.35	2.26	0.52	0.05	1837797
Total Chromium (Cr)	mg/kg	48	43	42	26	1	1837797
Total Cobalt (Co)	mg/kg	24.1	23.4	23.5	17.2	0.3	1837797
Total Copper (Cu)	mg/kg	57.9	55.2	52.1	28.4	0.5	1837797
Total Iron (Fe)	mg/kg	35600	36900	32700	34100	100	1837797
Total Lead (Pb)	mg/kg	352	362	313	25.2	0.1	1837797
Total Manganese (Mn)	mg/kg	2320	2290	2290	736	0.2	1837797
Total Mercury (Hg)	mg/kg	0.27	0.24	0.22	<0.05	0.05	1837797
Total Molybdenum (Mo)	mg/kg	1.9	1.8	1.9	0.8	0.1	1837797
Total Nickel (Ni)	mg/kg	55.6	54.7	52.5	32.7	0.8	1837797
Total Selenium (Se)	mg/kg	1.3	1.1	1.2	0.6	0.5	1837797
Total Silver (Ag)	mg/kg	0.68	0.63	0.73	0.14	0.05	1837797
Total Strontium (Sr)	mg/kg	58.0	48.7	47.3	21.0	0.1	1837797
Total Thallium (Tl)	mg/kg	0.29	0.32	0.29	0.06	0.05	1837797
Total Tin (Sn)	mg/kg	0.4	0.4	0.3	0.5	0.1	1837797
Total Titanium (Ti)	mg/kg	176	174	151	247	1	1837797
Total Uranium (U)	mg/kg	1.93	1.99	1.87	3.71	0.05	1837797
Total Vanadium (V)	mg/kg	31	25	24	25	2	1837797
Total Zinc (Zn)	mg/kg	709	806	733	108	1	1837797

RDL = Reportable Detection Limit

Maxxam Job #: A740575
Report Date: 2007/09/13

Minnow Environmental Inc.
Client Project #: 2212
Site Reference:
Your P.O. #: BC07-066-FC
Sampler Initials: KC

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		G74770	G74771	G74772		
Sampling Date		2007/08/25 10:30	2007/08/25 13:30	2007/08/26 08:30		
COC Number		F82587	F82587	F82587		
	Units	**REF1**	**REF2**	**NEXC1**	**RDL**	**QC Batch**
Misc. Inorganics						
Fluoride (F)	mg/L	0.08	0.07	0.09	0.01	1825983
ANIONS						
Nitrite (N)	mg/L	<0.005	<0.005	<0.005	0.005	1826419
Calculated Parameters						
Nitrate (N)	mg/L	<0.02	<0.02	<0.02	0.02	1825502
Misc. Inorganics						
Dissolved Hardness (CaCO3)	mg/L	35.0	26.1	49.7	0.5	1827341
Dissolved Organic Carbon (C)	mg/L	3.1	1.9	2.7	0.5	1826869
Alkalinity (Total as CaCO3)	mg/L	30.6	21.9	47.4	0.5	1826117
Total Organic Carbon (C)	mg/L	3.3	2.7	3.2	0.5	1826798
Alkalinity (PP as CaCO3)	mg/L	<0.5	<0.5	<0.5	0.5	1826117
Anions						
Dissolved Sulphate (SO4)	mg/L	4.2	5.5	2.4	0.5	1838888
Dissolved Chloride (Cl)	mg/L	<0.5	<0.5	<0.5	0.5	1838884
Nutrients						
Ammonia (N)	mg/L	<0.005	<0.005	<0.005	0.005	1841342
Nitrate plus Nitrite (N)	mg/L	<0.02	<0.02	<0.02	0.02	1826416
Total Phosphorus (P)	mg/L	<0.005	<0.005	<0.005	0.005	1838312
Physical Properties						
Conductivity	uS/cm	75	59	102	1	1826116
Physical Properties						
Total Suspended Solids	mg/L	<1	1	<1	1	1838408
Total Dissolved Solids	mg/L	62	50	78	10	1835207

RDL = Reportable Detection Limit

Maxxam Job #: A740575
Report Date: 2007/09/13

Minnow Environmental Inc.
Client Project #: 2212
Site Reference:
Your P.O. #: BC07-066-FC
Sampler Initials: KC

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		G74773	G74774	G74775	G74776		
Sampling Date		2007/08/27 09:30	2007/08/29	2007/08/28	2007/08/28		
COC Number		F82587	F82587	F82587	F82587		
	Units	**V8**	**V5**	**V27**	**V1**	**RDL**	**QC Batch**
Misc. Inorganics							
Fluoride (F)	mg/L	0.13	0.19	0.08	0.07	0.01	1825983
ANIONS							
Nitrite (N)	mg/L	<0.005	<0.005	<0.005	<0.005	0.005	1826419
Calculated Parameters							
Nitrate (N)	mg/L	0.08	0.03	0.13	<0.02	0.02	1825502
Misc. Inorganics							
Dissolved Hardness (CaCO3)	mg/L	214	304	102	30.8	0.5	1827341
Dissolved Organic Carbon (C)	mg/L	2.6	3.5	1.8	1.4	0.5	1826869
Alkalinity (Total as CaCO3)	mg/L	134	206	52.3	24.4	0.5	1826117
Total Organic Carbon (C)	mg/L	2.6	3.5	2.2	2.0	0.5	1826798
Alkalinity (PP as CaCO3)	mg/L	<0.5	3.3	<0.5	<0.5	0.5	1826117
Anions							
Dissolved Sulphate (SO4)	mg/L	65.9	75.6	49.3	8.9	0.5	1838888
Dissolved Chloride (Cl)	mg/L	0.8	2.1	<0.5	<0.5	0.5	1838884
Nutrients							
Ammonia (N)	mg/L	<0.005	<0.005	<0.005	<0.005	0.005	1841342
Nitrate plus Nitrite (N)	mg/L	0.08	0.03	0.13	<0.02	0.02	1826416
Total Phosphorus (P)	mg/L	0.012	0.017	<0.005	0.010	0.005	1838312
Physical Properties							
Conductivity	uS/cm	396	533	210	71	1	1826116
Physical Properties							
Total Suspended Solids	mg/L	3	11	<1	<1	1	1838408
Total Dissolved Solids	mg/L	264	354	140	54	10	1835207

RDL = Reportable Detection Limit

Maxxam Job #: A740575
Report Date: 2007/09/13

Minnow Environmental Inc.
Client Project #: 2212
Site Reference:
Your P.O. #: BC07-066-FC
Sampler Initials: KC

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		G74777		
Sampling Date		2007/08/27 09:30		
COC Number		F82587		
	Units	**V8Z**	**RDL**	**QC Batch**
Misc. Inorganics				
Fluoride (F)	mg/L	0.13	0.01	1825983
ANIONS				
Nitrite (N)	mg/L	<0.005	0.005	1826419
Calculated Parameters				
Nitrate (N)	mg/L	0.08	0.02	1825502
Misc. Inorganics				
Dissolved Hardness (CaCO3)	mg/L	213	0.5	1827341
Dissolved Organic Carbon (C)	mg/L	2.5	0.5	1826869
Alkalinity (Total as CaCO3)	mg/L	137	0.5	1826117
Total Organic Carbon (C)	mg/L	2.4	0.5	1826798
Alkalinity (PP as CaCO3)	mg/L	<0.5	0.5	1826117
Anions				
Dissolved Sulphate (SO4)	mg/L	66.5	0.5	1838888
Dissolved Chloride (Cl)	mg/L	0.8	0.5	1838884
Nutrients				
Ammonia (N)	mg/L	<0.005	0.005	1841342
Nitrate plus Nitrite (N)	mg/L	0.08	0.02	1826416
Total Phosphorus (P)	mg/L	0.008	0.005	1838312
Physical Properties				
Conductivity	uS/cm	398	1	1826116
Physical Properties				
Total Suspended Solids	mg/L	12	1	1838408
Total Dissolved Solids	mg/L	260	10	1835207

RDL = Reportable Detection Limit

Maxxam Job #: A740575
Report Date: 2007/09/13

Minnow Environmental Inc.
Client Project #: 2212
Site Reference:
Your P.O. #: BC07-066-FC
Sampler Initials: KC

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		G74770	G74771	G74772		
Sampling Date		2007/08/25 10:30	2007/08/25 13:30	2007/08/26 08:30		
COC Number		F82587	F82587	F82587		
	Units	**REF1**	**REF2**	**NEXC1**	**RDL**	**QC Batch**
Low Level Elements						
Total Mercury (Hg)	ug/L	<0.05	<0.05	<0.05	0.05	1835311
Dissolved Metals by ICP						
Dissolved Magnesium (Mg)	mg/L	1.87	1.20	2.32	0.05	1837760
Dissolved Sodium (Na)	mg/L	1.73	1.60	2.00	0.05	1837760
Total Metals by ICP						
Total Boron (B)	mg/L	<0.008	<0.008	<0.008	0.008	1837752
Total Calcium (Ca)	mg/L	10.9	8.82	16.5	0.05	1837752
Total Iron (Fe)	mg/L	0.031	0.164	0.014	0.005	1837752
Total Magnesium (Mg)	mg/L	1.94	1.32	2.47	0.05	1837752
Total Sodium (Na)	mg/L	1.93	1.92	2.37	0.05	1837752
Total Zirconium (Zr)	mg/L	<0.005	<0.005	<0.005	0.005	1837752
Total Metals by ICPMS						
Total Aluminum (Al)	ug/L	30.6	26.3	17.2	0.2	1837295
Total Antimony (Sb)	ug/L	<0.05	<0.05	<0.05	0.05	1837295
Total Arsenic (As)	ug/L	0.1	0.3	<0.1	0.1	1837295
Total Barium (Ba)	ug/L	28.7	25.0	25.6	0.02	1837295
Total Beryllium (Be)	ug/L	<0.05	<0.05	<0.05	0.05	1837295
Total Bismuth (Bi)	ug/L	<0.05	<0.05	<0.05	0.05	1837295
Total Cadmium (Cd)	ug/L	0.01	<0.01	0.01	0.01	1837295
Total Chromium (Cr)	ug/L	<0.2	<0.2	<0.2	0.2	1837295
Total Cobalt (Co)	ug/L	0.02	0.04	<0.02	0.02	1837295
Total Copper (Cu)	ug/L	0.6	0.4	0.6	0.1	1837295
Total Lead (Pb)	ug/L	0.07	0.10	0.05	0.02	1837295
Total Manganese (Mn)	ug/L	1.06	9.59	0.35	0.02	1837295
Total Molybdenum (Mo)	ug/L	0.14	0.30	0.24	0.02	1837295
Total Nickel (Ni)	ug/L	<0.5	<0.5	<0.5	0.5	1837295
Total Potassium (K)	ug/L	326	285	522	50	1837295
Total Selenium (Se)	ug/L	<0.5	<0.5	<0.5	0.5	1837295
Total Silver (Ag)	ug/L	<0.01	<0.01	<0.01	0.01	1837295
Total Strontium (Sr)	ug/L	54.0	49.5	66.1	0.01	1837295
Total Thallium (Tl)	ug/L	<0.05	<0.05	<0.05	0.05	1837295
Total Tin (Sn)	ug/L	<0.05	<0.05	<0.05	0.05	1837295

RDL = Reportable Detection Limit

Maxxam Job #: A740575
Report Date: 2007/09/13

Minnow Environmental Inc.
Client Project #: 2212
Site Reference:
Your P.O. #: BC07-066-FC
Sampler Initials: KC

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		G74770	G74771	G74772		
Sampling Date		2007/08/25 10:30	2007/08/25 13:30	2007/08/26 08:30		
COC Number		F82587	F82587	F82587		
	Units	**REF1**	**REF2**	**NEXC1**	**RDL**	**QC Batch**
Total Titanium (Ti)	ug/L	<0.5	0.8	<0.5	0.5	1837295
Total Uranium (U)	ug/L	0.37	0.29	0.29	0.01	1837295
Total Vanadium (V)	ug/L	<0.05	0.08	0.06	0.05	1837295
Total Zinc (Zn)	ug/L	2.1	1.9	1.9	0.5	1837295

RDL = Reportable Detection Limit

Maxxam Job #: A740575
Report Date: 2007/09/13

Minnow Environmental Inc.
Client Project #: 2212
Site Reference:
Your P.O. #: BC07-066-FC
Sampler Initials: KC

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		G74773	G74774	G74775	G74776		
Sampling Date		2007/08/27 09:30	2007/08/29	2007/08/28	2007/08/28		
COC Number		F82587	F82587	F82587	F82587		
	Units	**V8**	**V5**	**V27**	**V1**	**RDL**	**QC Batch**
Low Level Elements							
Total Mercury (Hg)	ug/L	<0.05	<0.05	<0.05	<0.05	0.05	1835311
Dissolved Metals by ICP							
Dissolved Magnesium (Mg)	mg/L	19.9	28.2	8.40	1.34	0.05	1837760
Dissolved Sodium (Na)	mg/L	3.11	3.78	2.21	1.81	0.05	1837760
Total Metals by ICP							
Total Boron (B)	mg/L	<0.008	<0.008	<0.008	<0.008	0.008	1837752
Total Calcium (Ca)	mg/L	52.8	77.8	28.3	10.6	0.05	1837752
Total Iron (Fe)	mg/L	0.177	0.464	0.049	0.027	0.005	1837752
Total Magnesium (Mg)	mg/L	19.7	28.7	8.55	1.45	0.05	1837752
Total Sodium (Na)	mg/L	3.33	4.12	2.54	2.09	0.05	1837752
Total Zirconium (Zr)	mg/L	<0.005	<0.005	<0.005	<0.005	0.005	1837752
Total Metals by ICPMS							
Total Aluminum (Al)	ug/L	101	275	18.4	14.3	0.2	1837295
Total Antimony (Sb)	ug/L	0.13	0.15	0.07	<0.05	0.05	1837295
Total Arsenic (As)	ug/L	0.4	1.0	0.4	0.2	0.1	1837295
Total Barium (Ba)	ug/L	52.8	78.0	32.6	25.7	0.02	1837295
Total Beryllium (Be)	ug/L	<0.05	<0.05	0.05	<0.05	0.05	1837295
Total Bismuth (Bi)	ug/L	<0.05	<0.05	<0.05	<0.05	0.05	1837295
Total Cadmium (Cd)	ug/L	0.04	0.04	0.05	<0.01	0.01	1837295
Total Chromium (Cr)	ug/L	0.3	0.8	<0.2	<0.2	0.2	1837295
Total Cobalt (Co)	ug/L	0.14	0.27	0.04	<0.02	0.02	1837295
Total Copper (Cu)	ug/L	1.3	1.4	0.9	0.4	0.1	1837295
Total Lead (Pb)	ug/L	0.32	0.52	0.52	0.04	0.02	1837295
Total Manganese (Mn)	ug/L	11.0	21.8	3.50	0.76	0.02	1837295
Total Molybdenum (Mo)	ug/L	0.81	1.58	0.32	0.23	0.02	1837295
Total Nickel (Ni)	ug/L	1.1	1.8	<0.5	<0.5	0.5	1837295
Total Potassium (K)	ug/L	892	1150	525	343	50	1837295
Total Selenium (Se)	ug/L	<0.5	1.3	<0.5	<0.5	0.5	1837295
Total Silver (Ag)	ug/L	<0.01	<0.01	<0.01	<0.01	0.01	1837295
Total Strontium (Sr)	ug/L	191	270	104	53.9	0.01	1837295
Total Thallium (Tl)	ug/L	<0.05	<0.05	<0.05	<0.05	0.05	1837295
Total Tin (Sn)	ug/L	0.06	<0.05	<0.05	<0.05	0.05	1837295

RDL = Reportable Detection Limit

Maxxam Job #: A740575
Report Date: 2007/09/13

Minnow Environmental Inc.
Client Project #: 2212
Site Reference:
Your P.O. #: BC07-066-FC
Sampler Initials: KC

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		G74773	G74774	G74775	G74776		
Sampling Date		2007/08/27 09:30	2007/08/29	2007/08/28	2007/08/28		
COC Number		F82587	F82587	F82587	F82587		
	Units	**V8**	**V5**	**V27**	**V1**	**RDL**	**QC Batch**
Total Titanium (Ti)	ug/L	2.7	8.3	0.7	<0.5	0.5	1837295
Total Uranium (U)	ug/L	3.15	4.05	1.26	0.31	0.01	1837295
Total Vanadium (V)	ug/L	0.33	0.95	<0.05	<0.05	0.05	1837295
Total Zinc (Zn)	ug/L	9.1	3.9	31.8	2.7	0.5	1837295

RDL = Reportable Detection Limit

Maxxam Job #: A740575
Report Date: 2007/09/13

Minnow Environmental Inc.
Client Project #: 2212
Site Reference:
Your P.O. #: BC07-066-FC
Sampler Initials: KC

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		G74777		
Sampling Date		2007/08/27 09:30		
COC Number		F82587		
	Units	**V8Z**	**RDL**	**QC Batch**
Low Level Elements				
Total Mercury (Hg)	ug/L	<0.05	0.05	1835311
Dissolved Metals by ICP				
Dissolved Magnesium (Mg)	mg/L	20.0	0.05	1837760
Dissolved Sodium (Na)	mg/L	3.11	0.05	1837760
Total Metals by ICP				
Total Boron (B)	mg/L	<0.008	0.008	1837752
Total Calcium (Ca)	mg/L	54.9	0.05	1837752
Total Iron (Fe)	mg/L	0.180	0.005	1837752
Total Magnesium (Mg)	mg/L	20.0	0.05	1837752
Total Sodium (Na)	mg/L	3.48	0.05	1837752
Total Zirconium (Zr)	mg/L	<0.005	0.005	1837752
Total Metals by ICPMS				
Total Aluminum (Al)	ug/L	107	0.2	1837295
Total Antimony (Sb)	ug/L	0.12	0.05	1837295
Total Arsenic (As)	ug/L	0.5	0.1	1837295
Total Barium (Ba)	ug/L	53.9	0.02	1837295
Total Beryllium (Be)	ug/L	<0.05	0.05	1837295
Total Bismuth (Bi)	ug/L	<0.05	0.05	1837295
Total Cadmium (Cd)	ug/L	0.04	0.01	1837295
Total Chromium (Cr)	ug/L	0.3	0.2	1837295
Total Cobalt (Co)	ug/L	0.12	0.02	1837295
Total Copper (Cu)	ug/L	1.1	0.1	1837295
Total Lead (Pb)	ug/L	0.30	0.02	1837295
Total Manganese (Mn)	ug/L	11.0	0.02	1837295
Total Molybdenum (Mo)	ug/L	0.83	0.02	1837295
Total Nickel (Ni)	ug/L	1.1	0.5	1837295
Total Potassium (K)	ug/L	911	50	1837295
Total Selenium (Se)	ug/L	0.6	0.5	1837295
Total Silver (Ag)	ug/L	<0.01	0.01	1837295
Total Strontium (Sr)	ug/L	203	0.01	1837295
Total Thallium (Tl)	ug/L	<0.05	0.05	1837295
Total Tin (Sn)	ug/L	<0.05	0.05	1837295

RDL = Reportable Detection Limit

Maxxam Job #: A740575
Report Date: 2007/09/13

Minnow Environmental Inc.
Client Project #: 2212
Site Reference:
Your P.O. #: BC07-066-FC
Sampler Initials: KC

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		G74777		
Sampling Date		2007/08/27 09:30		
COC Number		F82587		
	Units	**V8Z**	**RDL**	**QC Batch**
Total Titanium (Ti)	ug/L	2.7	0.5	1837295
Total Uranium (U)	ug/L	3.23	0.01	1837295
Total Vanadium (V)	ug/L	0.32	0.05	1837295
Total Zinc (Zn)	ug/L	9.0	0.5	1837295

RDL = Reportable Detection Limit

Maxxam Job #: A740575
Report Date: 2007/09/13

Minnow Environmental Inc.
Client Project #: 2212
Site Reference:
Your P.O. #: BC07-066-FC
Sampler Initials: KC

General Comments

Sample G81718-01: Metals were analyzed on the fraction passed through 0.15 mm sieve.

Sample G81721-01: Metals were analyzed on the fraction passed through 0.15 mm sieve.

Sample G81726-01: Metals were analyzed on the fraction passed through 0.15 mm sieve.

Sample G81727-01: Metals were analyzed on the fraction passed through 0.15 mm sieve.

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL) Comments

Sample G81718-01 Elements by ICPMS (total): 0.15mm sieve sample.

Sample G81721-01 Elements by ICPMS (total): 0.15mm sieve sample.

Sample G81726-01 Elements by ICPMS (total): 0.15mm sieve sample.

Sample G81727-01 Elements by ICPMS (total): 0.15mm sieve sample.

Results relate only to the items tested.

Minnow Environmental Inc.
Attention: Patti Orr
Client Project #: 2212
P.O. #: BC07-066-FC
Site Reference:

Quality Assurance Report

Maxxam Job Number: VA740575

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1825983 WAY	MATRIX SPIKE	Fluoride (F)	2007/09/04		82	%	80 - 120
	SPIKE	Fluoride (F)	2007/09/04		105	%	80 - 120
	BLANK	Fluoride (F)	2007/09/04	<0.01		mg/L	
	RPD	Fluoride (F)	2007/09/04	2.8		%	25
1826116 CK	SPIKE	Conductivity	2007/09/04		101	%	80 - 120
	BLANK	Conductivity	2007/09/04	<1		uS/cm	
	RPD	Conductivity	2007/09/04	0.5		%	25
1826117 CK	MATRIX SPIKE	Alkalinity (Total as CaCO3)	2007/09/04		94	%	80 - 120
	SPIKE	Alkalinity (Total as CaCO3)	2007/09/04		94	%	80 - 120
	BLANK	Alkalinity (Total as CaCO3)	2007/09/04	<0.5		mg/L	
		Alkalinity (PP as CaCO3)	2007/09/04	<0.5		mg/L	
	RPD	Alkalinity (Total as CaCO3)	2007/09/04	0.5		%	25
		Alkalinity (PP as CaCO3)	2007/09/04	NC		%	25
1826416 BB3	MATRIX SPIKE	Nitrate plus Nitrite (N)	2007/09/04		99	%	80 - 120
	SPIKE	Nitrate plus Nitrite (N)	2007/09/04		103	%	80 - 120
	BLANK	Nitrate plus Nitrite (N)	2007/09/04	<0.02		mg/L	
	RPD [G74774-01]	Nitrate plus Nitrite (N)	2007/09/04	NC		%	25
1826419 BB3	MATRIX SPIKE	Nitrite (N)	2007/09/04		102	%	80 - 120
	SPIKE	Nitrite (N)	2007/09/04		103	%	80 - 120
	BLANK	Nitrite (N)	2007/09/04	<0.005		mg/L	
	RPD [G74774-01]	Nitrite (N)	2007/09/04	NC		%	25
1826798 MX	MATRIX SPIKE	Total Organic Carbon (C)	2007/09/04		105	%	80 - 120
	SPIKE	Total Organic Carbon (C)	2007/09/04		105	%	80 - 120
	BLANK	Total Organic Carbon (C)	2007/09/04	<0.5		mg/L	
	RPD	Total Organic Carbon (C)	2007/09/04	NC		%	20
1826869 MX	MATRIX SPIKE	Dissolved Organic Carbon (C)	2007/09/04		102	%	80 - 120
	SPIKE	Dissolved Organic Carbon (C)	2007/09/04		106	%	80 - 120
	BLANK	Dissolved Organic Carbon (C)	2007/09/04	<0.5		mg/L	
	RPD	Dissolved Organic Carbon (C)	2007/09/04	1.3		%	20
1834384 TS1	MATRIX SPIKE [G74780-01]	Available (KCl) Orthophosphate (P)	2007/09/07		90	%	75 - 125
	SPIKE	Available (KCl) Orthophosphate (P)	2007/09/07		109	%	75 - 125
	BLANK	Available (KCl) Orthophosphate (P)	2007/09/07	<5		ug/g	
	RPD [G74780-01]	Available (KCl) Orthophosphate (P)	2007/09/07	8.5		%	25
1835207 FS1	MATRIX SPIKE	Total Dissolved Solids	2007/09/07		96	%	80 - 120
	SPIKE	Total Dissolved Solids	2007/09/07		104	%	80 - 120
	BLANK	Total Dissolved Solids	2007/09/07	<10		mg/L	
	RPD	Total Dissolved Solids	2007/09/07	1.4		%	25
1835311 JT3	MATRIX SPIKE [G74770-01]	Total Mercury (Hg)	2007/09/10		120	%	70 - 130
	QC STANDARD	Total Mercury (Hg)	2007/09/10		112	%	80 - 120
	SPIKE	Total Mercury (Hg)	2007/09/10		88	%	80 - 120
	BLANK	Total Mercury (Hg)	2007/09/10	<0.05		ug/L	
	RPD [G74770-01]	Total Mercury (Hg)	2007/09/10	NC		%	25
1836531 CW3	BLANK	Moisture	2007/09/11	<0.3		%	
	RPD	Moisture	2007/09/11	3.3		%	20
1836720 BB3	MATRIX SPIKE	Nitrate plus Nitrite (N)	2007/09/10		84	%	70 - 130
	SPIKE	Nitrate plus Nitrite (N)	2007/09/10		81	%	70 - 130
	BLANK	Nitrate plus Nitrite (N)	2007/09/10	<2		ug/g	
	RPD	Nitrate plus Nitrite (N)	2007/09/10	NC		%	35
1836722 BB3	MATRIX SPIKE	Nitrite (N)	2007/09/10		83	%	80 - 120
	SPIKE	Nitrite (N)	2007/09/10		91	%	80 - 120
	BLANK	Nitrite (N)	2007/09/10	<0.5		mg/kg	
	RPD	Nitrite (N)	2007/09/10	NC		%	25
1836723 NN	MATRIX SPIKE [G74780-01]	Available (KCl) Ammonia (N)	2007/09/10		88	%	80 - 120

Minnow Environmental Inc.
Attention: Patti Orr
Client Project #: 2212
P.O. #: BC07-066-FC
Site Reference:

Quality Assurance Report (Continued)

Maxxam Job Number: VA740575

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1836723 NN	SPIKE	Available (KCl) Ammonia (N)	2007/09/10		92	%	80 - 120
	BLANK	Available (KCl) Ammonia (N)	2007/09/10	<0.5		mg/kg	
	RPD [G74780-01]	Available (KCl) Ammonia (N)	2007/09/10	NC		%	25
1837295 AA1	MATRIX SPIKE						
	[G74770-01]	Total Arsenic (As)	2007/09/12		107	%	75 - 125
		Total Cadmium (Cd)	2007/09/12		110	%	75 - 125
		Total Chromium (Cr)	2007/09/12		110	%	75 - 125
		Total Cobalt (Co)	2007/09/12		113	%	75 - 125
		Total Copper (Cu)	2007/09/12		116	%	75 - 125
		Total Lead (Pb)	2007/09/12		117	%	75 - 125
		Total Selenium (Se)	2007/09/12		110	%	75 - 125
		Total Thallium (Tl)	2007/09/12		116	%	75 - 125
		Total Zinc (Zn)	2007/09/12		115	%	75 - 125
	SPIKE	Total Arsenic (As)	2007/09/12		103	%	75 - 125
		Total Cadmium (Cd)	2007/09/12		100	%	75 - 125
		Total Chromium (Cr)	2007/09/12		107	%	75 - 125
		Total Cobalt (Co)	2007/09/12		110	%	75 - 125
		Total Copper (Cu)	2007/09/12		114	%	75 - 125
		Total Lead (Pb)	2007/09/12		112	%	75 - 125
		Total Selenium (Se)	2007/09/12		108	%	75 - 125
		Total Thallium (Tl)	2007/09/12		109	%	75 - 125
		Total Zinc (Zn)	2007/09/12		109	%	75 - 125
	BLANK	Total Aluminum (Al)	2007/09/12	0.3, RDL=0.2		ug/L	
		Total Antimony (Sb)	2007/09/12	<0.05		ug/L	
		Total Arsenic (As)	2007/09/12	<0.1		ug/L	
		Total Barium (Ba)	2007/09/12	<0.02		ug/L	
		Total Beryllium (Be)	2007/09/12	0.07, RDL=0.05		ug/L	
		Total Bismuth (Bi)	2007/09/12	<0.05		ug/L	
		Total Cadmium (Cd)	2007/09/12	<0.01		ug/L	
		Total Chromium (Cr)	2007/09/12	<0.2		ug/L	
		Total Cobalt (Co)	2007/09/12	<0.02		ug/L	
		Total Copper (Cu)	2007/09/12	<0.1		ug/L	
		Total Lead (Pb)	2007/09/12	<0.02		ug/L	
		Total Manganese (Mn)	2007/09/12	<0.02		ug/L	
		Total Molybdenum (Mo)	2007/09/12	<0.02		ug/L	
		Total Nickel (Ni)	2007/09/12	<0.5		ug/L	
		Total Potassium (K)	2007/09/12	<50		ug/L	
		Total Selenium (Se)	2007/09/12	<0.5		ug/L	
		Total Silver (Ag)	2007/09/12	<0.01		ug/L	
		Total Strontium (Sr)	2007/09/12	<0.01		ug/L	
		Total Thallium (Tl)	2007/09/12	<0.05		ug/L	
		Total Tin (Sn)	2007/09/12	<0.05		ug/L	
		Total Titanium (Ti)	2007/09/12	<0.5		ug/L	
		Total Uranium (U)	2007/09/12	<0.01		ug/L	
		Total Vanadium (V)	2007/09/12	<0.05		ug/L	
		Total Zinc (Zn)	2007/09/12	<0.5		ug/L	
	RPD [G74770-01]	Total Aluminum (Al)	2007/09/12	1.1		%	25
		Total Antimony (Sb)	2007/09/12	NC		%	25
		Total Arsenic (As)	2007/09/12	NC		%	25
		Total Barium (Ba)	2007/09/12	2.8		%	25
		Total Beryllium (Be)	2007/09/12	NC		%	25
		Total Bismuth (Bi)	2007/09/12	NC		%	25
		Total Cadmium (Cd)	2007/09/12	NC		%	25
		Total Chromium (Cr)	2007/09/12	NC		%	25
		Total Cobalt (Co)	2007/09/12	NC		%	25

Minnow Environmental Inc.
Attention: Patti Orr
Client Project #: 2212
P.O. #: BC07-066-FC
Site Reference:

Quality Assurance Report (Continued)

Maxxam Job Number: VA740575

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1837295 AA1	RPD [G74770-01]	Total Copper (Cu)	2007/09/12	6.0		%	25
		Total Lead (Pb)	2007/09/12	NC		%	25
		Total Manganese (Mn)	2007/09/12	1.6		%	25
		Total Molybdenum (Mo)	2007/09/12	7.4		%	25
		Total Nickel (Ni)	2007/09/12	NC		%	25
		Total Potassium (K)	2007/09/12	3.8		%	25
		Total Selenium (Se)	2007/09/12	NC		%	25
		Total Silver (Ag)	2007/09/12	NC		%	25
		Total Strontium (Sr)	2007/09/12	0.2		%	25
		Total Thallium (Tl)	2007/09/12	NC		%	25
		Total Tin (Sn)	2007/09/12	NC		%	25
		Total Titanium (Ti)	2007/09/12	NC		%	25
		Total Uranium (U)	2007/09/12	8.1		%	25
		Total Vanadium (V)	2007/09/12	NC		%	25
		Total Zinc (Zn)	2007/09/12	NC		%	25
1837752 GS2	BLANK	Total Boron (B)	2007/09/10	<0.008		mg/L	
		Total Calcium (Ca)	2007/09/10	<0.05		mg/L	
		Total Iron (Fe)	2007/09/10	<0.005		mg/L	
		Total Magnesium (Mg)	2007/09/10	<0.05		mg/L	
		Total Sodium (Na)	2007/09/10	<0.05		mg/L	
		Total Zirconium (Zr)	2007/09/10	<0.005		mg/L	
	RPD [G74770-01]	Total Boron (B)	2007/09/10	NC		%	25
		Total Calcium (Ca)	2007/09/10	3.1		%	25
		Total Iron (Fe)	2007/09/10	12.3		%	25
		Total Magnesium (Mg)	2007/09/10	0.9		%	25
		Total Sodium (Na)	2007/09/10	2.2		%	25
		Total Zirconium (Zr)	2007/09/10	NC		%	25
1837760 GS2	BLANK	Dissolved Magnesium (Mg)	2007/09/10	<0.05		mg/L	
		Dissolved Sodium (Na)	2007/09/10	<0.05		mg/L	
	RPD	Dissolved Magnesium (Mg)	2007/09/10	0.6		%	25
1837797 DJ	MATRIX SPIKE	Total Arsenic (As)	2007/09/10		113	%	75 - 125
		Total Cadmium (Cd)	2007/09/10		111	%	75 - 125
		Total Chromium (Cr)	2007/09/10		104	%	75 - 125
		Total Cobalt (Co)	2007/09/10		110	%	75 - 125
		Total Copper (Cu)	2007/09/10		113	%	75 - 125
		Total Lead (Pb)	2007/09/10		111	%	75 - 125
		Total Mercury (Hg)	2007/09/10		109	%	75 - 125
		Total Selenium (Se)	2007/09/10		112	%	75 - 125
		Total Thallium (Tl)	2007/09/10		121	%	75 - 125
		Total Zinc (Zn)	2007/09/10		111	%	75 - 125
	SPIKE	Total Arsenic (As)	2007/09/10		112	%	75 - 125
		Total Cadmium (Cd)	2007/09/10		106	%	75 - 125
		Total Chromium (Cr)	2007/09/10		107	%	75 - 125
		Total Cobalt (Co)	2007/09/10		106	%	75 - 125
		Total Copper (Cu)	2007/09/10		112	%	75 - 125
		Total Lead (Pb)	2007/09/10		113	%	75 - 125
		Total Mercury (Hg)	2007/09/10		109	%	75 - 125
		Total Selenium (Se)	2007/09/10		110	%	75 - 125
		Total Thallium (Tl)	2007/09/10		117	%	75 - 125
		Total Zinc (Zn)	2007/09/10		113	%	75 - 125
	BLANK	Total Aluminum (Al)	2007/09/10	<100		mg/kg	
		Total Antimony (Sb)	2007/09/10	<0.1		mg/kg	
		Total Arsenic (As)	2007/09/10	<0.2		mg/kg	
		Total Barium (Ba)	2007/09/10	<0.1		mg/kg	
		Total Beryllium (Be)	2007/09/10	<0.1		mg/kg	

Minnow Environmental Inc.
Attention: Patti Orr
Client Project #: 2212
P.O. #: BC07-066-FC
Site Reference:

Quality Assurance Report (Continued)

Maxxam Job Number: VA740575

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1837797 DJ	BLANK	Total Bismuth (Bi)	2007/09/10	<0.1		mg/kg	
		Total Boron (B)	2007/09/10	<5		mg/kg	
		Total Cadmium (Cd)	2007/09/10	<0.05		mg/kg	
		Total Chromium (Cr)	2007/09/10	<1		mg/kg	
		Total Cobalt (Co)	2007/09/10	<0.3		mg/kg	
		Total Copper (Cu)	2007/09/10	<0.5		mg/kg	
		Total Iron (Fe)	2007/09/10	<100		mg/kg	
		Total Lead (Pb)	2007/09/10	<0.1		mg/kg	
		Total Manganese (Mn)	2007/09/10	<0.2		mg/kg	
		Total Mercury (Hg)	2007/09/10	<0.05		mg/kg	
		Total Molybdenum (Mo)	2007/09/10	<0.1		mg/kg	
		Total Nickel (Ni)	2007/09/10	<0.8		mg/kg	
		Total Selenium (Se)	2007/09/10	<0.5		mg/kg	
		Total Silver (Ag)	2007/09/10	<0.05		mg/kg	
		Total Strontium (Sr)	2007/09/10	<0.1		mg/kg	
		Total Thallium (Tl)	2007/09/10	<0.05		mg/kg	
		Total Tin (Sn)	2007/09/10	<0.1		mg/kg	
		Total Titanium (Ti)	2007/09/10	<1		mg/kg	
		Total Uranium (U)	2007/09/10	<0.05		mg/kg	
		Total Vanadium (V)	2007/09/10	<2		mg/kg	
		Total Zinc (Zn)	2007/09/10	<1		mg/kg	
	RPD	Total Aluminum (Al)	2007/09/10	2.1		%	35
		Total Antimony (Sb)	2007/09/10	3.7		%	35
		Total Arsenic (As)	2007/09/10	1.2		%	35
		Total Barium (Ba)	2007/09/10	1.3		%	35
		Total Beryllium (Be)	2007/09/10	NC		%	35
		Total Bismuth (Bi)	2007/09/10	NC		%	35
		Total Cadmium (Cd)	2007/09/10	NC		%	35
		Total Chromium (Cr)	2007/09/10	1.1		%	35
		Total Cobalt (Co)	2007/09/10	5.3		%	35
		Total Copper (Cu)	2007/09/10	3.8		%	35
		Total Iron (Fe)	2007/09/10	0.6		%	35
		Total Lead (Pb)	2007/09/10	3.4		%	35
		Total Manganese (Mn)	2007/09/10	0.9		%	35
		Total Mercury (Hg)	2007/09/10	NC		%	35
		Total Molybdenum (Mo)	2007/09/10	4.1		%	35
		Total Nickel (Ni)	2007/09/10	5.7		%	35
		Total Selenium (Se)	2007/09/10	NC		%	35
		Total Silver (Ag)	2007/09/10	NC		%	35
		Total Strontium (Sr)	2007/09/10	0.5		%	35
		Total Thallium (Tl)	2007/09/10	NC		%	35
		Total Tin (Sn)	2007/09/10	NC		%	35
		Total Titanium (Ti)	2007/09/10	4.5		%	35
		Total Vanadium (V)	2007/09/10	1.9		%	35
		Total Zinc (Zn)	2007/09/10	3.2		%	35
1838312 MX	SPIKE	Total Phosphorus (P)	2007/09/12		89	%	80 - 120
	BLANK	Total Phosphorus (P)	2007/09/12	<0.005		mg/L	
	RPD [G74771-01]	Total Phosphorus (P)	2007/09/12	NC		%	25
1838408 FS1	SPIKE	Total Suspended Solids	2007/09/12		102	%	N/A
	BLANK	Total Suspended Solids	2007/09/12	<1		mg/L	
1838884 NN	MATRIX SPIKE	Dissolved Chloride (Cl)	2007/09/11		105	%	80 - 120
	SPIKE	Dissolved Chloride (Cl)	2007/09/11		105	%	80 - 120
	BLANK	Dissolved Chloride (Cl)	2007/09/11	<0.5		mg/L	
	RPD [G74772-01]	Dissolved Chloride (Cl)	2007/09/11	NC		%	20
1838888 NN	MATRIX SPIKE	Dissolved Sulphate (SO4)	2007/09/11		98	%	75 - 125

Minnow Environmental Inc.
Attention: Patti Orr
Client Project #: 2212
P.O. #: BC07-066-FC
Site Reference:

Quality Assurance Report (Continued)

Maxxam Job Number: VA740575

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1838888 NN	SPIKE	Dissolved Sulphate (SO4)	2007/09/11		102	%	80 - 120
	BLANK	Dissolved Sulphate (SO4)	2007/09/11	<0.5		mg/L	
	RPD [G74772-01]	Dissolved Sulphate (SO4)	2007/09/11	NC		%	20
1841342 NN	MATRIX SPIKE	Ammonia (N)	2007/09/12		96	%	80 - 120
	SPIKE	Ammonia (N)	2007/09/12		94	%	80 - 120
	BLANK	Ammonia (N)	2007/09/12	<0.005		mg/L	
	RPD [G74770-01]	Ammonia (N)		TBA		%	25

N/A = Not Applicable
TBA = Result to follow
NC = Non-calculable
RPD = Relative Percent Difference

- A740575

Maxxam Analytics Inc

8577 Commerce Court
Burnaby, BC V5A 4N5
www.maxxamanalytics.com

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CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

PAGE 1 OF 2

ANALYSIS REQUEST F 82587

COMPANY NAME: MINNOW ENVIRONMENTAL

PH. #: 905-567-8771
E-mail: PORR@minnow-environmental.com
FAX #: 905-567-6805

COMPANY ADDRESS: 6800 KITIMAT RD UNIT 13 MISSISSAUGA, ON

CLIENT PROJECT ID: (#) 2212

NOTE 2 COOLERS

SAMPLER NAME (PRINT): KIM CONNORS

PROJECT MANAGER: PATTI ORR

LAB - USE ONLY

	FIELD SAMPLE ID	MAXXAM LAB # (Lab Use Only)	MATRIX: GROUND WATER	MATRIX: SURFACE WATER	MATRIX: SOIL	MATRIX: OTHER	# CONTAINERS	SAMPLING: DATE DD/MM/YY	SAMPLING: TIME	SAMPLING: HEADSPACE VAPOUR	Alkalinity	Ammonia-N	Chloride	Fluoride	Sulphate	nitrate-N	nitrite-N	TOC	DOC	TDS	TSS	hardness	total phosphorus	total metals	★CHECK MDL SHEETS★	CONDUCTIVITY
1	Ref 1			✓			6	25/08/07	10:30		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
2	Ref 2			✓			6	25/08/07	13:30		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
3	NexC1			✓			6	26/08/07	08:30		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
4	V8			✓			6	27/08/07	09:30		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
5	V5			✓			6	29/08/07			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
6	V27			✓			6	28/08/07			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
7	V1			✓			6	28/08/07			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
8	V8Z			✓			6	29/08/07	09:30		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
9																										
10																										
11																										
12																										

TAT (Turnaround Time)

<5 DAY TAT MUST HAVE PRIOR APPROVAL

*some exceptions apply please contact lab

- STANDARD 5 BUSINESS DAYS ☑
- RUSH 3 BUSINESS DAYS ☐
- RUSH 2 BUSINESS DAYS ☐
- URGENT 1 BUSINESS DAY ☐

OTHER BUSINESS DAYS ____

P.O. NUMBER / QUOTE NUMBER: BC07-066-FC

SPECIAL DETECTION LIMITS / CONTAMINANT TYPE: NOTE MDL SHEETS ATTACHED

☐ CCME
☐ CSR
☐ ALBERTA TIER 1
☐ OTHER

LAB USE ONLY

ARRIVAL TEMPERATURE °C: 2,2,3

DUE DATE:

LOG IN CHECK:

ACCOUNTING CONTACT:

SPECIAL REPORTING OR BILLING INSTRUCTIONS: Att. Elaine Cousins

JARS USED:

RELINQUISHED BY SAMPLER: Kim Connors	DATE: DD/MM/YY Aug 30/07	TIME: 14:25	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY	TIME:	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY	TIME: 14:20	RECEIVED BY LABORATORY: A.M

CUSTODY RECORD

COCFORM - BC - 06/06

ORIGINAL - MAXXAM   YELLOW - MAXXAM   PINK - CLIENT

Maxxam Analytics Inc

8577 Commerce Court
Burnaby, BC V5A 4N5
www.maxxamanalytics.com

Phone: (604) 444-4808
Fax: (604) 444-4511
Toll Free: 1-800-440-4808

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

PAGE 2 OF 2

F 82588

COMPANY NAME: MINNOW ENVIRONMENTAL

PH. #: 905-567-8771
E-mail: PORR@MINNOW-ENVIRONMENTAL.COM
FAX #: 905-567-6805

COMPANY ADDRESS: 6800 KITIMAT RD UNIT 13 MISSISSAUGA, ON

CLIENT PROJECT ID: (#) 2212.

NOTE 2 COOLERS

SAMPLER NAME (PRINT): KIM CONNORS.

PROJECT MANAGER: PATTI ORR.

ANALYSIS REQUEST — LAB USE ONLY

★ REFER TO QUOTE FOR SPECIAL INSTRUCTIONS ★

	FIELD SAMPLE ID	MAXXAM LAB # (Lab Use Only)	GROUND WATER	SURFACE WATER	SOIL / SEDIMENT	OTHER	# CONTAINERS	DATE DD/MM/YY	TIME	HEADSPACE VAPOUR	PARTICLE SIZE	TOC	TKN	TOTAL PHOSPHORUS	TOTAL MERCURY	TOTAL METALS BULK & BREAKDOWN
1	V27-A (d/s 01)				✓		2	28/08/07			✓	✓	✓	✓	✓	✓
2	V27-B (03)				✓		2	28/08/07			✓	✓	✓	✓	✓	✓
3	V27-C (04)				✓		2	28/08/07			✓	✓	✓	✓	✓	✓
4	V1				✓		2	28/08/07			✓	✓	✓	✓	✓	✓
5																
6																
7																
8																
9																
10																
11																
12																

TAT (Turnaround Time)

<5 DAY TAT MUST HAVE PRIOR APPROVAL

some exceptions apply please contact lab

STANDARD 5 BUSINESS DAYS ☑
RUSH 3 BUSINESS DAYS ☐
RUSH 2 BUSINESS DAYS ☐
URGENT 1 BUSINESS DAY ☐
OTHER BUSINESS DAYS ____

CUSTODY RECORD

P.O. NUMBER / QUOTE NUMBER: BC07-066-FC

SPECIAL DETECTION LIMITS / CONTAMINANT TYPE: SEE ATTACHED MDL'S REFER TO SPECIAL INSTRUCTIONS

☐ CCME
☐ CSR
☐ ALBERTA TIER 1
☐ OTHER

LAB USE ONLY — ARRIVAL TEMPERATURE °C: 2, 2, 3 — DUE DATE: — LOG IN CHECK:

ACCOUNTING CONTACT:

SPECIAL REPORTING OR BILLING INSTRUCTIONS: Attn. Elaine Cousins

JARS USED:

RELINQUISHED BY SAMPLER: Kim Connors — DATE: DD/MM/YY Aug 30/07 — TIME: 14:25 — RECEIVED BY:

RELINQUISHED BY: — DATE: DD/MM/YY — TIME: — RECEIVED BY:

RELINQUISHED BY: — DATE: DD/MM/YY 31/8/07 — TIME: 14:20 — RECEIVED BY LABORATORY: A.M

COCFORM - BC - 06/06

ORIGINAL - MAXXAM YELLOW - MAXXAM PINK - CLIENT

Your Project #: A740575
Your C.O.C. #: N/A

Attention: Elaine Cousins
Maxxam Analytics Inc
Burnaby to Bedford
8577 Commerce Crt
Burnaby, BC
V5A 4N5

Report Date: 2007/09/10

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: A795627
Received: 2007/09/05, 14:15

Sample Matrix: Soil
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Total Organic Carbon in Soil	4	N/A	2007/09/07	ATL SOP 00044 R2	LECO 203-601-224

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

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

MARIE (MCNAIR) MUISE, Project Manager
Email: marie.muise.reports@maxxamanalytics.com
Phone# (902) 420-0203

==
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. SCC and CAEAL have approved this reporting process and electronic report format.

Total cover pages: 1

Maxxam Job #: A795627
Report Date: 2007/09/10

Maxxam Analytics Inc
Client Project #: A740575
Project name:
Sampler Initials:

RESULTS OF ANALYSES OF SOIL

Maxxam ID		U46414	U46415	U46416		
Sampling Date		2007/08/28	2007/08/28	2007/08/28		
COC Number		N/A	N/A	N/A		
	Units	**G74778-01R\V27-A(D/S 01)**	**G74779-01R\V27-B(03)**	**G74780-01R\V27-C(04)**	**RDL**	**QC Batch**
Organic Carbon (TOC)	g/kg	3.7	3.0	2.4	0.2	1354494

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		U46417		
Sampling Date		2007/08/28		
COC Number		N/A		
	Units	**G74781-01R\V1**	**RDL**	**QC Batch**
Organic Carbon (TOC)	g/kg	1.3	0.2	1354494

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel:902-420-0203 Toll-free:800-565-7227 Fax:902-420-8612 www.maxxamanalytics.com

Maxxam Job #: A795627
Report Date: 2007/09/10

Maxxam Analytics Inc
Client Project #: A740575
Project name:
Sampler Initials:

GENERAL COMMENTS

Results relate only to the items tested.

200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel:902-420-0203 Toll-free:800-565-7227 Fax:902-420-8612 www.maxxamanalytics.com

Maxxam Analytics Inc
Attention: Elaine Cousins
Client Project #: A740575
P.O. #:
Project name:

Quality Assurance Report

Maxxam Job Number: DA795627

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1354494	BBD	QC STANDARD	Organic Carbon (TOC)	2007/09/07		97	%	75 - 125
		Method Blank	Organic Carbon (TOC)	2007/09/07	ND, RDL=0.2		g/kg	
		RPD	Organic Carbon (TOC)	2007/09/07	2.8		%	35

ND = Not detected
RPD = Relative Percent Difference
QC Standard = Quality Control Standard

200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel:902-420-0203 Toll-free:800-565-7227 Fax:902-420-8612 www.maxxamanalytics.com

Your Project #: A740575
Your C.O.C. #: N/A

Attention: Elaine Cousins
Maxxam Analytics Inc
Burnaby to Bedford
8577 Commerce Crt
Burnaby, BC
V5A 4N5

Report Date: 2007/09/11

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: A795621
Received: 2007/09/05, 14:15

Sample Matrix: Soil
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Particle size in solids (pipette&sieve)	4	N/A	2007/09/07	ATL SOP 00012 R2	based on MSAMS-1978

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

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

MARIE (MCNAIR) MUISE, Project Manager
Email: marie.muise.reports@maxxamanalytics.com
Phone# (902) 420-0203

==
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. SCC and CAEAL have approved this reporting process and electronic report format.

Total cover pages: 1

Maxxam Job #: A795621
Report Date: 2007/09/11

Maxxam Analytics Inc
Client Project #: A740575
Project name:
Sampler Initials:

RESULTS OF ANALYSES OF SOIL

Maxxam ID		U46394	U46404	U46405		
Sampling Date		2007/08/28	2007/08/28	2007/08/28		
COC Number		N/A	N/A	N/A		
	Units	**G74778-01R\V27-A(D/S 01)**	**G74779-01R\V27-B(03)**	**G74780-01R\V27-C(04)**	**RDL**	**QC Batch**
< -4 Phi	%	100	100	100	0.1	1353856
< -3 Phi	%	100	100	100	0.1	1353856
< -2 Phi	%	100	100	100	0.1	1353856
< -1 Phi	%	52	59	71	0.1	1353856
< 0 Phi	%	19	34	35	0.1	1353856
< +1 Phi	%	5.2	9.8	13	0.1	1353856
< +2 Phi	%	2.0	2.9	3.8	0.1	1353856
< +3 Phi	%	1.3	1.8	1.9	0.1	1353856
< +4 Phi	%	1.2	1.6	1.5	0.1	1353856
< +5 Phi	%	1.1	1.3	1.4	0.1	1353856
< +6 Phi	%	1.0	1.5	1.1	0.1	1353856
< +7 Phi	%	0.9	1.3	1.2	0.1	1353856
< +8 Phi	%	0.9	1.2	1.1	0.1	1353856
< +9 Phi	%	0.8	1.2	1.0	0.1	1353856
Gravel	%	48	41	29	0.1	1353856
Sand	%	51	58	70	0.1	1353856
Silt	%	0.3	0.4	0.4	0.1	1353856
Clay	%	0.9	1.2	1.1	0.1	1353856

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: A795621
Report Date: 2007/09/11

Maxxam Analytics Inc
Client Project #: A740575
Project name:
Sampler Initials:

RESULTS OF ANALYSES OF SOIL

Maxxam ID		U46406		
Sampling Date		2007/08/28		
COC Number		N/A		
	Units	**G74781-01R\V1**	**RDL**	**QC Batch**
< -4 Phi	%	100	0.1	1353856
< -3 Phi	%	100	0.1	1353856
< -2 Phi	%	100	0.1	1353856
< -1 Phi	%	18	0.1	1353856
< 0 Phi	%	3.5	0.1	1353856
< +1 Phi	%	1.4	0.1	1353856
< +2 Phi	%	1.2	0.1	1353856
< +3 Phi	%	1.2	0.1	1353856
< +4 Phi	%	1.2	0.1	1353856
< +5 Phi	%	1.2	0.1	1353856
< +6 Phi	%	1.2	0.1	1353856
< +7 Phi	%	1.1	0.1	1353856
< +8 Phi	%	1.0	0.1	1353856
< +9 Phi	%	1.1	0.1	1353856
Gravel	%	82	0.1	1353856
Sand	%	17	0.1	1353856
Silt	%	0.1	0.1	1353856
Clay	%	1.0	0.1	1353856

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel:902-420-0203 Toll-free:800-565-7227 Fax:902-420-8612 www.maxxamanalytics.com

Maxxam Job #: A795621
Report Date: 2007/09/11

Maxxam Analytics Inc
Client Project #: A740575
Project name:
Sampler Initials:

GENERAL COMMENTS

Results relate only to the items tested.

200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel:902-420-0203 Toll-free:800-565-7227 Fax:902-420-8612 www.maxxamanalytics.com

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Your Project #: MINNOW #2254
Your C.O.C. #: F110454

Attention: Patti Orr
MINNOW ENVIRONMENTAL
2 Lamb Street
Georgetown, ON
CANADA L7G 3M9

Report Date: 2008/09/10

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: A844730
Received: 2008/08/29, 11:40

Sample Matrix: Water
Samples Received: 10

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	8	2008/09/02	2008/09/02	BRN SOP-00264 R2.0	Based on SM2320B
Alkalinity - Water	2	2008/09/02	2008/09/03	BRN SOP-00264 R2.0	Based on SM2320B
Chloride by Automated Colourimetry	10	N/A	2008/08/30	BRN-SOP 00234 R1.0	Based on EPA 325.2
Cyanide WAD (weak acid dissociable)	10	N/A	2008/09/08	BRN SOP-00227 R1.0	Based on SM-4500CN I
Carbon (DOC)	4	N/A	2008/09/04	BRN SOP-00224 R3.0	Based on SM-5310C
Carbon (DOC)	6	N/A	2008/09/05	BRN SOP-00224 R3.0	Based on SM-5310C
Fluoride - Mining Clients	10	N/A	2008/09/04	BRN SOP-00225 R1.0	Based SM - 4500 F C
Hardness Total (calculated as CaCO3)	6	N/A	2008/09/08		
Hardness Total (calculated as CaCO3)	4	N/A	2008/09/09		
Elements by ICPMS Low Level (total) (1)	6	2008/09/04	2008/09/06	BRN SOP-00206	Based on EPA 200.8
Elements by ICPMS Low Level (total) (1)	4	2008/09/08	2008/09/09	BRN SOP-00206	Based on EPA 200.8
Na, K, Ca, Mg, S by CRC ICPMS (total)	6	2008/09/04	2008/09/06	BRN SOP-00206	Based on EPA 200.8
Na, K, Ca, Mg, S by CRC ICPMS (total)	4	2008/09/08	2008/09/09	BRN SOP-00206	Based on EPA 200.8
Ammonia-N	10	N/A	2008/09/02	BRN SOP-00232 R3.0	SM-4500 NH3 G
Nitrate + Nitrite (N)	10	N/A	2008/09/03	ING233 Rev.4.4	Based on EPA 353.2
Nitrite (N) by CFA	10	N/A	2008/09/03	BRN SOP-00233 R1.0	EPA 353.2
Nitrogen - Nitrate (as N)	10	N/A	2008/09/03		
Sulphate by Automated Colourimetry	10	N/A	2008/08/30	BRN-SOP 00243 R1.0	Based on EPA 375.4
Total Dissolved Solids (Filt. Residue)	10	N/A	2008/09/04	ING443 Rev.5.1	APHA 2540C
Total Phosphorus	10	N/A	2008/09/03	BRN SOP-00236 R4.0	SM 4500
Total Suspended Solids	6	N/A	2008/09/02	BRN SOP-00277 R2.0	Based on SM-2540 D
Total Suspended Solids	4	N/A	2008/09/03	BRN SOP-00277 R2.0	Based on SM-2540 D

* Results relate only to the items tested.

(1) SCC/CAEAL

../2

Maxxam Job #: A844730
Report Date: 2008/09/10

MINNOW ENVIRONMENTAL
Client Project #: MINNOW #2254

Sampler Initials: CR

Encryption Key

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

ELAINE COUSINS, CS Manager
Email: elaine.cousins@maxxamanalytics.com
Phone# (604) 444-4808 Ext:276

==

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. SCC and CAEAL have approved this reporting process and electronic report format.

For Service Group specific validation please refer to the Validation Signature Page

Total cover pages: 2

Maxxam Job #: A844730
Report Date: 2008/09/10

MINNOW ENVIRONMENTAL
Client Project #: MINNOW #2254

Sampler Initials: CR

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		L36318	L36319	L36320		L36321		L36322		
Sampling Date		2008/08/22	2008/08/22	2008/08/22		2008/08/23		2008/08/23		
COC#		F110454	F110454	F110454		F110454		F110454		
	Units	**FC**	**BLC**	**BLC-Z**	**RDL**	**STC**	**QC Batch**	**HOC**	**RDL**	**QC Batch**
Misc. Inorganics										
Fluoride (F)	mg/L	0.07	0.09	0.09	0.01	0.10	2551942	0.16	0.01	2551942
ANIONS										
Nitrite (N)	mg/L	<0.005	<0.005	<0.005	0.005	<0.005	2544608	<0.005	0.005	2544608
Calculated Parameters										
Nitrate (N)	mg/L	<0.02	0.02	0.04	0.02	0.14	2540323	0.06	0.02	2540323
Misc. Inorganics										
Weak Acid Dissoc. Cyanide (CN)	mg/L	<0.0005	<0.0005	<0.0005	0.0005	<0.0005	2559239	<0.0005	0.0005	2559239
Dissolved Organic Carbon (C)	mg/L	3.9	5.4	5.4	0.5	1.5	2548819	3.7	0.5	2551411
Alkalinity (Total as CaCO3)	mg/L	11	71	71	0.5	230	2546249	280	0.5	2546249
Alkalinity (PP as CaCO3)	mg/L	<0.5	<0.5	<0.5	0.5	4.2	2546249	5.6	0.5	2546249
Bicarbonate (HCO3)	mg/L	13	87	87	0.5	270	2546249	330	0.5	2546249
Carbonate (CO3)	mg/L	<0.5	<0.5	<0.5	0.5	5.0	2546249	6.7	0.5	2546249
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5	0.5	<0.5	2546249	<0.5	0.5	2546249
Anions										
Dissolved Sulphate (SO4)	mg/L	0.9	14	14	0.5	130	2543065	73	5	2543065
Dissolved Chloride (Cl)	mg/L	<0.5	0.6	0.7	0.5	0.8	2543062	0.9	0.5	2543062
Nutrients										
Ammonia (N)	mg/L	0.02	0.04	<0.01	0.01	<0.01	2545502	<0.01	0.01	2545502
Nitrate plus Nitrite (N)	mg/L	<0.02	0.02	0.04	0.02	0.14	2544601	0.06	0.02	2544601
Total Phosphorus (P)	mg/L	0.020	0.007	0.007	0.005	<0.005	2543927	0.005	0.005	2543927
Physical Properties										
Total Suspended Solids	mg/L	5	3	3	1	<1	2544471	<1	1	2544471
Total Dissolved Solids	mg/L	30	100	110	10	430	2551507	360	10	2551507

RDL = Reportable Detection Limit

Maxxam Job #: A844730
Report Date: 2008/09/10

MINNOW ENVIRONMENTAL
Client Project #: MINNOW #2254

Sampler Initials: CR

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		L36323		L36324		L36325	L36326	L36327		
Sampling Date		2008/08/23		2008/08/23		2008/08/24	2008/08/24	2008/08/24		
COC#		F110454		F110454		F110454	F110454	F110454		
	Units	**BEC**	**QC Batch**	**GRC**	**RDL**	**BUC**	**BUCZ**	**BTT**	**RDL**	**QC Batch**
Misc. Inorganics										
Fluoride (F)	mg/L	0.12	2551942	0.17	0.01	0.12	0.12	0.11	0.01	2551942
ANIONS										
Nitrite (N)	mg/L	<0.005	2544608	<0.005	0.005	<0.005	<0.005	<0.005	0.005	2544608
Calculated Parameters										
Nitrate (N)	mg/L	0.22	2540323	0.09	0.02	0.10	0.09	0.07	0.02	2540323
Misc. Inorganics										
Weak Acid Dissoc. Cyanide (CN)	mg/L	<0.0005	2559239	<0.0005	0.0005	<0.0005	<0.0005	<0.0005	0.0005	2559239
Dissolved Organic Carbon (C)	mg/L	4.1	2551411	4.8	0.5	9.9	8.9	9.2	0.5	2551411
Alkalinity (Total as CaCO3)	mg/L	210	2546249	290	0.5	200	200	97	0.5	2546249
Alkalinity (PP as CaCO3)	mg/L	2.0	2546249	6.9	0.5	1.8	<0.5	<0.5	0.5	2546249
Bicarbonate (HCO3)	mg/L	250	2546249	340	0.5	240	240	120	0.5	2546249
Carbonate (CO3)	mg/L	2.4	2546249	8.3	0.5	2.1	<0.5	<0.5	0.5	2546249
Hydroxide (OH)	mg/L	<0.5	2546249	<0.5	0.5	<0.5	<0.5	<0.5	0.5	2546249
Anions										
Dissolved Sulphate (SO4)	mg/L	240	2543065	140	5	47	46	27	0.5	2543065
Dissolved Chloride (Cl)	mg/L	1.0	2543062	1.2	0.5	1.1	0.8	0.8	0.5	2543062
Nutrients										
Ammonia (N)	mg/L	0.04	2545502	0.01	0.01	<0.01	0.05	0.07	0.01	2545502
Nitrate plus Nitrite (N)	mg/L	0.22	2544601	0.09	0.02	0.10	0.09	0.07	0.02	2544601
Total Phosphorus (P)	mg/L	0.012	2543927	<0.005	0.005	0.007	0.006	0.007	0.005	2543927
Physical Properties										
Total Suspended Solids	mg/L	2	2544471	4	1	2	2	<1	1	2546746
Total Dissolved Solids	mg/L	550	2551507	490	10	270	280	170	10	2551507

RDL = Reportable Detection Limit

Maxxam Job #: A844730
Report Date: 2008/09/10

MINNOW ENVIRONMENTAL
Client Project #: MINNOW #2254

Sampler Initials: CR

LOW LEVEL TOTAL METALS - WATER (WATER)

Maxxam ID		L36318	L36319	L36320	L36321	L36322		
Sampling Date		2008/08/22	2008/08/22	2008/08/22	2008/08/23	2008/08/23		
COC#		F110454	F110454	F110454	F110454	F110454		
	Units	**FC**	**BLC**	**BLC-Z**	**STC**	**HOC**	**RDL**	**QC Batch**
Calculated Parameters								
Total Hardness (CaCO3)	mg/L	12.5	78.8	75.9	381	354	0.5	2540801
Total Metals by ICPMS								
Total Aluminum (Al)	mg/L	0.108	0.0474	0.0390	0.0211	0.0054	0.0002	2550131
Total Antimony (Sb)	mg/L	0.00003	0.00010	0.00010	0.00017	0.00018	0.00002	2550131
Total Arsenic (As)	mg/L	0.00022	0.00079	0.00078	0.00023	0.00056	0.00002	2550131
Total Barium (Ba)	mg/L	0.0162	0.0576	0.0570	0.0935	0.0858	0.00002	2550131
Total Beryllium (Be)	mg/L	0.00003	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	2550131
Total Bismuth (Bi)	mg/L	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000005	2550131
Total Boron (B)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	2550131
Total Cadmium (Cd)	mg/L	0.000016	0.000011	0.000014	0.000164	0.000023	0.000005	2550131
Total Chromium (Cr)	mg/L	0.0003	0.0001	<0.0001	0.0002	0.0001	0.0001	2550131
Total Cobalt (Co)	mg/L	0.000084	0.000055	0.000053	0.000076	0.000068	0.000005	2550131
Total Copper (Cu)	mg/L	0.00138	0.00077	0.00072	0.00044	0.00051	0.00005	2550131
Total Iron (Fe)	mg/L	0.139	0.158	0.133	0.066	0.114	0.001	2550131
Total Lead (Pb)	mg/L	0.000849	0.000072	0.000078	0.000116	0.000053	0.000005	2550131
Total Lithium (Li)	mg/L	0.0017	0.0018	0.0017	0.0039	0.0043	0.0005	2550131
Total Manganese (Mn)	mg/L	0.00436	0.0155	0.0150	0.00684	0.0181	0.00005	2550131
Total Molybdenum (Mo)	mg/L	0.00006	0.00062	0.00064	0.00153	0.00259	0.00005	2550131
Total Nickel (Ni)	mg/L	0.00051	0.00057	0.00054	0.00195	0.00107	0.00002	2550131
Total Selenium (Se)	mg/L	<0.00004	0.00021	0.00021	0.00578	0.00205	0.00004	2550131
Total Silicon (Si)	mg/L	6.5	4.9	4.9	3.0	4.6	0.1	2550131
Total Silver (Ag)	mg/L	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000005	2550131
Total Strontium (Sr)	mg/L	0.0226	0.0938	0.0939	0.360	0.360	0.00005	2550131
Total Thallium (Tl)	mg/L	0.000004	0.000002	<0.000002	0.000003	<0.000002	0.000002	2550131
Total Tin (Sn)	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	2550131
Total Titanium (Ti)	mg/L	0.0027	0.0015	0.0011	<0.0005	<0.0005	0.0005	2550131
Total Uranium (U)	mg/L	0.000195	0.000611	0.000624	0.00524	0.00528	0.000002	2550131
Total Vanadium (V)	mg/L	0.0003	0.0003	<0.0002	<0.0002	<0.0002	0.0002	2550131
Total Zinc (Zn)	mg/L	0.0035	0.0007	0.0008	0.0082	0.0012	0.0001	2550131
Total Zirconium (Zr)	mg/L	0.0001	0.0001	0.0001	<0.0001	<0.0001	0.0001	2550131
Total Calcium (Ca)	mg/L	3.70	22.5	21.6	92.5	81.4	0.05	2556124
Total Magnesium (Mg)	mg/L	0.79	5.51	5.31	36.3	36.6	0.05	2556124
Total Potassium (K)	mg/L	0.12	0.75	0.71	0.61	1.19	0.05	2556124
Total Sodium (Na)	mg/L	1.71	2.69	2.61	2.46	4.77	0.05	2556124
Total Sulphur (S)	mg/L	<3	5	5	52	30	3	2556124

RDL = Reportable Detection Limit

Maxxam Job #: A844730
Report Date: 2008/09/10

MINNOW ENVIRONMENTAL
Client Project #: MINNOW #2254

Sampler Initials: CR

LOW LEVEL TOTAL METALS - WATER (WATER)

Maxxam ID		L36323		L36324	L36325	L36326	L36327		
Sampling Date		2008/08/23		2008/08/23	2008/08/24	2008/08/24	2008/08/24		
COC#		F110454		F110454	F110454	F110454	F110454		
	Units	**BEC**	**QC Batch**	**GRC**	**BUC**	**BUCZ**	**BTT**	**RDL**	**QC Batch**
Calculated Parameters									
Total Hardness (CaCO3)	mg/L	478	2540801	438	229	233	114	0.5	2540801
Total Metals by ICPMS									
Total Aluminum (Al)	mg/L	0.0101	2550131	0.0260	0.0436	0.0370	0.0093	0.0002	2557567
Total Antimony (Sb)	mg/L	0.00025	2550131	0.00018	0.00009	0.00009	0.00006	0.00002	2557567
Total Arsenic (As)	mg/L	0.00065	2550131	0.00061	0.00038	0.00039	0.00054	0.00002	2557567
Total Barium (Ba)	mg/L	0.0563	2550131	0.0812	0.0803	0.0850	0.0465	0.00002	2557567
Total Beryllium (Be)	mg/L	<0.00001	2550131	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	2557567
Total Bismuth (Bi)	mg/L	<0.000005	2550131	<0.000005	<0.000005	<0.000005	<0.000005	0.000005	2557567
Total Boron (B)	mg/L	<0.05	2550131	<0.05	<0.05	<0.05	<0.05	0.05	2557567
Total Cadmium (Cd)	mg/L	0.000019	2550131	0.000025	0.000026	0.000022	0.000007	0.000005	2557567
Total Chromium (Cr)	mg/L	<0.0001	2550131	0.0005	0.0001	0.0001	<0.0001	0.0001	2557567
Total Cobalt (Co)	mg/L	0.000057	2550131	0.000073	0.000056	0.000055	0.000017	0.000005	2557567
Total Copper (Cu)	mg/L	0.00113	2550131	0.00108	0.00228	0.00126	0.00294	0.00005	2557567
Total Iron (Fe)	mg/L	0.055	2550131	0.129	0.111	0.099	0.021	0.001	2557567
Total Lead (Pb)	mg/L	0.000180	2550131	0.000156	0.000292	0.000170	0.000255	0.000005	2557567
Total Lithium (Li)	mg/L	0.0054	2550131	0.0080	0.0038	0.0039	0.0030	0.0005	2557567
Total Manganese (Mn)	mg/L	0.00565	2550131	0.0274	0.0152	0.0149	0.00521	0.00005	2557567
Total Molybdenum (Mo)	mg/L	0.00163	2550131	0.00201	0.00075	0.00078	0.00107	0.00005	2557567
Total Nickel (Ni)	mg/L	0.00358	2550131	0.00107	0.00134	0.00084	0.00041	0.00002	2557567
Total Selenium (Se)	mg/L	0.00311	2550131	0.00493	0.00060	0.00059	0.00012	0.00004	2557567
Total Silicon (Si)	mg/L	2.2	2550131	3.9	4.6	4.6	4.4	0.1	2557567
Total Silver (Ag)	mg/L	<0.000005	2550131	<0.000005	<0.000005	<0.000005	<0.000005	0.000005	2557567
Total Strontium (Sr)	mg/L	0.480	2550131	0.485	0.225	0.235	0.123	0.00005	2557567
Total Thallium (Tl)	mg/L	0.000003	2550131	<0.000002	0.000002	<0.000002	<0.000002	0.000002	2557567
Total Tin (Sn)	mg/L	<0.00001	2550131	<0.00001	0.00001	<0.00001	<0.00001	0.00001	2557567
Total Titanium (Ti)	mg/L	<0.0005	2550131	0.0010	0.0011	0.0011	0.0006	0.0005	2557567
Total Uranium (U)	mg/L	0.0109	2550131	0.00936	0.00276	0.00286	0.00108	0.000002	2557567
Total Vanadium (V)	mg/L	<0.0002	2550131	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	2557567
Total Zinc (Zn)	mg/L	0.0021	2550131	0.0012	0.0021	0.0017	0.0009	0.0001	2557567
Total Zirconium (Zr)	mg/L	<0.0001	2550131	<0.0001	<0.0001	<0.0001	0.0002	0.0001	2557567
Total Calcium (Ca)	mg/L	97.0	2556124	111	68.1	69.9	32.1	0.05	2559448
Total Magnesium (Mg)	mg/L	57.2	2556124	38.9	14.2	14.3	8.23	0.05	2559448
Total Potassium (K)	mg/L	0.88	2556124	1.74	1.89	1.93	1.00	0.05	2559448
Total Sodium (Na)	mg/L	2.67	2556124	4.90	4.67	4.53	4.84	0.05	2559448
Total Sulphur (S)	mg/L	95	2556124	56	17	17	11	3	2559448

RDL = Reportable Detection Limit

Maxxam Job #: A844730
Report Date: 2008/09/10

MINNOW ENVIRONMENTAL
Client Project #: MINNOW #2254

Sampler Initials: CR

QUALITY ASSURANCE REPORT

			Matrix Spike		Spike		Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2543062	Dissolved Chloride (Cl)	2008/08/30	98	80 - 120	97	80 - 120	<0.5	mg/L	NC	20
2543065	Dissolved Sulphate (SO4)	2008/08/30	98	75 - 125	97	80 - 120	<0.5	mg/L	0.5	20
2543927	Total Phosphorus (P)	2008/09/03	94	80 - 120	108	80 - 120	<0.005	mg/L	NC	25
2544471	Total Suspended Solids	2008/09/02			99	N/A	<1	mg/L		
2544601	Nitrate plus Nitrite (N)	2008/09/03	100	80 - 120	103	80 - 120	<0.02	mg/L	0.9	25
2544608	Nitrite (N)	2008/09/03	103	80 - 120	103	80 - 120	<0.005	mg/L	NC	25
2545502	Ammonia (N)	2008/09/02	98	80 - 120	96	80 - 120	<0.01	mg/L	2.3	25
2546249	Alkalinity (Total as CaCO3)	2008/09/02	NC	80 - 120	94	80 - 120	<0.5	mg/L	0.2	25
2546249	Alkalinity (PP as CaCO3)	2008/09/02					<0.5	mg/L	NC	25
2546249	Bicarbonate (HCO3)	2008/09/02					<0.5	mg/L	0.2	25
2546249	Carbonate (CO3)	2008/09/02					<0.5	mg/L	NC	25
2546249	Hydroxide (OH)	2008/09/02					<0.5	mg/L	NC	25
2546746	Total Suspended Solids	2008/09/03			99	N/A	<1	mg/L		
2548819	Dissolved Organic Carbon (C)	2008/09/04	98	80 - 120	103	80 - 120	<0.5	mg/L	NC	20
2550131	Total Arsenic (As)	2008/09/06	NC	75 - 125	98	75 - 125	<0.00002	mg/L	2.5	25
2550131	Total Beryllium (Be)	2008/09/06	98	75 - 125	101	75 - 125	<0.00001	mg/L	7.5	25
2550131	Total Cadmium (Cd)	2008/09/06	99	75 - 125	97	75 - 125	<0.000005	mg/L	0.7	25
2550131	Total Chromium (Cr)	2008/09/06	99	75 - 125	99	75 - 125	<0.0001	mg/L	5.9	25
2550131	Total Cobalt (Co)	2008/09/06	NC	75 - 125	99	75 - 125	<0.000005	mg/L	2.1	25
2550131	Total Copper (Cu)	2008/09/06	NC	75 - 125	102	75 - 125	<0.00005	mg/L	2.4	25
2550131	Total Lead (Pb)	2008/09/06	89	75 - 125	99	75 - 125	<0.000005	mg/L	1.2	25
2550131	Total Lithium (Li)	2008/09/06	97	75 - 125	99	75 - 125	<0.0005	mg/L	NC	25
2550131	Total Nickel (Ni)	2008/09/06	NC	75 - 125	99	75 - 125	<0.00002	mg/L	2.4	25
2550131	Total Selenium (Se)	2008/09/06	100	75 - 125	97	75 - 125	<0.00004	mg/L	12.6	25
2550131	Total Uranium (U)	2008/09/06	95	75 - 125	98	75 - 125	<0.000002	mg/L	0.4	25
2550131	Total Vanadium (V)	2008/09/06	NC	75 - 125	96	75 - 125	<0.0002	mg/L	2.7	25
2550131	Total Zinc (Zn)	2008/09/06	NC	75 - 125	107	75 - 125	<0.0001	mg/L	1	25
2550131	Total Aluminum (Al)	2008/09/06					0.0002, RDL=0.0002	mg/L	2.3	25
2550131	Total Antimony (Sb)	2008/09/06					<0.00002	mg/L	NC	25
2550131	Total Barium (Ba)	2008/09/06					<0.00002	mg/L	0.4	25
2550131	Total Bismuth (Bi)	2008/09/06					<0.000005	mg/L	4.3	25
2550131	Total Boron (B)	2008/09/06					<0.05	mg/L	NC	25
2550131	Total Iron (Fe)	2008/09/06					<0.001	mg/L	8.7	25
2550131	Total Manganese (Mn)	2008/09/06					<0.00005	mg/L	1.8	25
2550131	Total Molybdenum (Mo)	2008/09/06					<0.00005	mg/L	0.1	25
2550131	Total Silicon (Si)	2008/09/06					<0.1	mg/L	7.4	25
2550131	Total Silver (Ag)	2008/09/06					<0.000005	mg/L	2.3	25
2550131	Total Strontium (Sr)	2008/09/06					<0.00005	mg/L	0.1	25
2550131	Total Thallium (Tl)	2008/09/06					<0.000002	mg/L	6.9	25
2550131	Total Tin (Sn)	2008/09/06					<0.00001	mg/L	2.1	25

Maxxam Job #: A844730
Report Date: 2008/09/10

MINNOW ENVIRONMENTAL
Client Project #: MINNOW #2254

Sampler Initials: CR

QUALITY ASSURANCE REPORT

			Matrix Spike		Spike		Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2550131	Total Titanium (Ti)	2008/09/06					<0.0005	mg/L	4.6	25
2550131	Total Zirconium (Zr)	2008/09/06					<0.0001	mg/L	0.9	25
2551411	Dissolved Organic Carbon (C)	2008/09/05	100	80 - 120	104	80 - 120	<0.5	mg/L	NC	20
2551507	Total Dissolved Solids	2008/09/04	NC	80 - 120	110	80 - 120	<10	mg/L	0.7	25
2551942	Fluoride (F)	2008/09/04	96	80 - 120	94	80 - 120	<0.01	mg/L	0	25
2556124	Total Calcium (Ca)	2008/09/06					<0.05	mg/L	2.4	25
2556124	Total Magnesium (Mg)	2008/09/06					<0.05	mg/L	1.7	25
2556124	Total Potassium (K)	2008/09/06					<0.05	mg/L	1.7	25
2556124	Total Sodium (Na)	2008/09/06					<0.05	mg/L	1.5	25
2556124	Total Sulphur (S)	2008/09/06					<3	mg/L	NC	25
2557567	Total Arsenic (As)	2008/09/09	109	75 - 125	98	75 - 125	<0.00002	mg/L	1.6	25
2557567	Total Beryllium (Be)	2008/09/09	95	75 - 125	100	75 - 125	<0.00001	mg/L	NC	25
2557567	Total Cadmium (Cd)	2008/09/09	100	75 - 125	98	75 - 125	<0.000005	mg/L	NC	25
2557567	Total Chromium (Cr)	2008/09/09	104	75 - 125	100	75 - 125	<0.0001	mg/L	NC	25
2557567	Total Cobalt (Co)	2008/09/09	100	75 - 125	101	75 - 125	<0.000005	mg/L	2.7	25
2557567	Total Copper (Cu)	2008/09/09	96	75 - 125	105	75 - 125	<0.00005	mg/L	9.7	25
2557567	Total Lead (Pb)	2008/09/09	91	75 - 125	104	75 - 125	<0.000005	mg/L	0.1	25
2557567	Total Lithium (Li)	2008/09/09	NC	75 - 125	98	75 - 125	<0.0005	mg/L	0.8	25
2557567	Total Nickel (Ni)	2008/09/09	97	75 - 125	103	75 - 125	<0.00002	mg/L	12.2	25
2557567	Total Selenium (Se)	2008/09/09	115	75 - 125	100	75 - 125	<0.00004	mg/L	0.5	25
2557567	Total Uranium (U)	2008/09/09	NC	75 - 125	101	75 - 125	<0.000002	mg/L	2.2	25
2557567	Total Vanadium (V)	2008/09/09	107	75 - 125	97	75 - 125	<0.0002	mg/L	NC	25
2557567	Total Zinc (Zn)	2008/09/09	100	75 - 125	102	75 - 125	<0.0001	mg/L	8.0	25
2557567	Total Aluminum (Al)	2008/09/09					<0.0002	mg/L	5.0	25
2557567	Total Antimony (Sb)	2008/09/09					<0.00002	mg/L	0.7	25
2557567	Total Barium (Ba)	2008/09/09					<0.00002	mg/L	2.3	25
2557567	Total Bismuth (Bi)	2008/09/09					<0.000005	mg/L	NC	25
2557567	Total Boron (B)	2008/09/09					<0.05	mg/L	NC	25
2557567	Total Iron (Fe)	2008/09/09					<0.001	mg/L	1.2	25
2557567	Total Manganese (Mn)	2008/09/09					<0.00005	mg/L	2.1	25
2557567	Total Molybdenum (Mo)	2008/09/09					<0.00005	mg/L	2.3	25
2557567	Total Silicon (Si)	2008/09/09					<0.1	mg/L	0.8	25
2557567	Total Silver (Ag)	2008/09/09					<0.000005	mg/L	NC	25
2557567	Total Strontium (Sr)	2008/09/09					<0.00005	mg/L	2.2	25
2557567	Total Thallium (Tl)	2008/09/09					<0.000002	mg/L	NC	25
2557567	Total Tin (Sn)	2008/09/09					<0.00001	mg/L	NC	25
2557567	Total Titanium (Ti)	2008/09/09					<0.0005	mg/L	NC	25
2557567	Total Zirconium (Zr)	2008/09/09					<0.0001	mg/L	NC	25
2559239	Weak Acid Dissoc. Cyanide (CN)	2008/09/08	101	80 - 120	105	80 - 120	<0.0005	mg/L	NC	20
2559448	Total Calcium (Ca)	2008/09/09					<0.05	mg/L	0.7	25

Maxxam Job #: A844730
Report Date: 2008/09/10

MINNOW ENVIRONMENTAL
Client Project #: MINNOW #2254

Sampler Initials: CR

QUALITY ASSURANCE REPORT

			Matrix Spike		Spike		Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2559448	Total Magnesium (Mg)	2008/09/09					<0.05	mg/L	2.3	25
2559448	Total Potassium (K)	2008/09/09					<0.05	mg/L	1.1	25
2559448	Total Sodium (Na)	2008/09/09					<0.05	mg/L	2.5	25
2559448	Total Sulphur (S)	2008/09/09					<3	mg/L	0.3	25

N/A = Not Applicable
NC = Non-calculable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference

Validation Signature Page

Maxxam Job #: A844730

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

ELAINE COUSINS, CS Manager

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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. SCC and CAEAL have approved this reporting process and electronic report format.

Maxxam Analytics Inc

8577 Commerce Court
Burnaby, BC V5A 4N5
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Toll Free: 1-800-440-4808

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

PAGE ____ OF ____

A844730

ANALYSIS REQUEST F 110454

COMPANY NAME: Minnow Environmental

PH. #: 905 873-3371 x 23
E-mail: porr@minnow-environmental.com
FAX #: 905 873-6370

COMPANY ADDRESS: 2 Lamb St Georgetown, ON L7G 3M9

CLIENT PROJECT ID: (#) Minnow # 2254 Maxxam Quote B08-065-FC

SAMPLER NAME (PRINT): CR. MB

PROJECT MANAGER: Patti Orr

	FIELD SAMPLE ID	MAXXAM LAB # (Lab Use Only)	MATRIX: GROUND WATER	SURFACE WATER	SOIL	OTHER	# CONTAINERS	SAMPLING: DATE DD/MM/YY	TIME	HEADSPACE VAPOUR	DOC (Filtered)	Cyanide	Genchem. Alk, Cl, F, TDS, SO4	Metals LL Dissolved (Filtered)	Metals LL Total	NH4, NO2, NO3, NH3	Total Phosphorus	TSS
1	FC			X			8	Aug22	10		✓	✓	✓	✓	✓	✓	✓	✓
2	BLC			X					3pm		✓	✓	✓	✓	✓	✓	✓	✓
3	BLC-Z			X					3pm		✓	✓	✓	✓	✓	✓	✓	✓
4	STC			X				Aug23	11am		✓	✓	✓	✓	✓	✓	✓	✓
5	HOC			X					12pm		✓	✓	✓	✓	✓	✓	✓	✓
6	BEC			X					3pm		✓	✓	✓	✓	✓	✓	✓	✓
7	GRC			X					4pm		✓	✓	✓	✓	✓	✓	✓	✓
8	BUC			X				Aug24	3pm		✓	✓	✓	✓	✓	✓	✓	✓
9	BUCZ			X					3pm		✓	✓	✓	✓	✓	✓	✓	✓
10	BTT			X					11am		✓	✓	✓	✓	✓	✓	✓	✓
11																		
12																		

TAT (Turnaround Time)

<5 DAY TAT MUST HAVE PRIOR APPROVAL

*some exceptions apply please contact lab

- STANDARD 5 BUSINESS DAYS ☐
- RUSH 3 BUSINESS DAYS ☐
- RUSH 2 BUSINESS DAYS ☐
- URGENT 1 BUSINESS DAY ☐

OTHER BUSINESS DAYS ____

CUSTODY RECORD

P.O. NUMBER / QUOTE NUMBER: Minnow # 2254 Maxxam Quote B08-065-FC

SPECIAL DETECTION LIMITS / CONTAMINANT TYPE: * MDL > CCME

- ☒ CCME
- ☐ CSR
- ☐ ALBERTA TIER 1
- ☐ OTHER

LAB USE ONLY — ARRIVAL TEMPERATURE °C: 9, 9, 9 / 9, 10, 10 | DUE DATE: | LOG IN CHECK:

ACCOUNTING CONTACT: Patti Orr

SPECIAL REPORTING OR BILLING INSTRUCTIONS: * Samples in 2 Coolers

JARS USED:

RELINQUISHED BY SAMPLER: C. Russel	DATE: DD/MM/YY	TIME:	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY	TIME:	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY 29/08/07	TIME: 11:40	RECEIVED BY LABORATORY: A. M

COCFORM - BC - 06/06

ORIGINAL - MAXXAM YELLOW - MAXXAM PINK - CLIENT

Your Project #: 2254
Your C.O.C. #: F110464

Attention: Patti Orr
MINNOW ENVIRONMENTAL
2 Lamb Street
Georgetown, ON
CANADA L7G 3M9

Report Date: 2008/09/11
This report supersedes all previous reports with the same Maxxam job number

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: A843579
Received: 2008/08/25, 09:40

Sample Matrix: Soil
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by ICPMS (total)	3	2008/08/29	2008/08/29	BRN SOP-00203	Based on EPA 200.8
Elements by ICPMS (total)	3	2008/09/02	2008/08/29	BRN SOP-00203	Based on EPA 200.8
Ammonia-N (Available) (1)	3	2008/08/29	2008/08/29	BRN SOP-00239	Carter, SSMA 4.2
pH (2:1 DI Water Extract) (1)	3	2008/08/27	2008/08/28	BRN SOP-00266 R1.0	Carter, SSMA 16.2
Available Phosphate	3	2008/08/28	2008/08/29	BRN SOP-00235 R3.0	Carter, SSMA 4.2
Sublet (Inorganics)	3	N/A	2008/09/11		
Total Kjeldahl Nitrogen - Soil (1, 3)	3	2008/08/29	2008/08/29	CAL SOP-00072	SM - 4500N
TOC Soil Subcontract (2)	3	2008/09/03	2008/09/03		

Sample Matrix: Water
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	6	2008/08/27	2008/08/28	BRN SOP-00264 R2.0	Based on SM2320B
Chloride by Automated Colourimetry	6	N/A	2008/08/30	BRN-SOP 00234 R1.0	Based on EPA 325.2
Cyanide WAD (weak acid dissociable)	6	N/A	2008/08/28	BRN SOP-00227 R1.0	Based on SM-4500CN I
Carbon (DOC)	6	N/A	2008/08/29	BRN SOP-00224 R3.0	Based on SM-5310C
Fluoride - Mining Clients	6	N/A	2008/08/28	BRN SOP-00225 R1.0	Based SM - 4500 F C
Hardness Total (calculated as CaCO3)	6	N/A	2008/09/02		
Hardness (calculated as CaCO3)	6	N/A	2008/08/30		
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	6	N/A	2008/08/29	BRN SOP-00206	Based on EPA 200.8
Elements by ICPMS Low Level (dissolved) (1)	6	N/A	2008/08/29	BRN SOP-00206	Based on EPA 200.8
Elements by ICPMS Low Level (total) (1)	6	2008/08/28	2008/08/30	BRN SOP-00206	Based on EPA 200.8
Na, K, Ca, Mg, S by CRC ICPMS (total)	6	2008/08/28	2008/08/30	BRN SOP-00206	Based on EPA 200.8
Nitrogen (Total)	6	2008/08/28	2008/08/28	BRN SOP-00242 R2.0	Based on SM-4500N C
Ammonia-N	6	N/A	2008/08/28	BRN SOP-00232 R3.0	SM-4500 NH3 G
Nitrate + Nitrite (N)	6	N/A	2008/08/27	ING233 Rev.4.4	Based on EPA 353.2
Nitrite (N) by CFA	6	N/A	2008/08/27	BRN SOP-00233 R1.0	EPA 353.2
Nitrogen - Nitrate (as N)	6	N/A	2008/08/28		
Filter and HNO3 Preserve for Metals	6	N/A	2008/08/29	BRN WI-00006 R1.0	Based on EPA 200.2
Sulphate by Automated Colourimetry	6	N/A	2008/08/30	BRN-SOP 00243 R1.0	Based on EPA 375.4
Total Dissolved Solids (Filt. Residue)	6	N/A	2008/08/28	ING443 Rev.5.1	APHA 2540C
TKN (Calc. TN, N/N) total	6	N/A	2008/08/29		
Total Phosphorus	6	N/A	2008/08/28	BRN SOP-00236 R4.0	SM 4500
Total Suspended Solids	6	N/A	2008/08/28	BRN SOP-00277 R2.0	Based on SM-2540 D

* Results relate only to the items tested.

(1) This test was performed by Maxxam Calgary
(2) This test was performed by Maxxam Bedford(From Burnaby)
(3) SCC/CAEAL

Encryption Key

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

ELAINE COUSINS, CS Manager
Email: elaine.cousins@maxxamanalytics.com
Phone# (604) 444-4808 Ext:276

==
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. SCC and CAEAL have approved this reporting process and electronic report format.

For Service Group specific validation please refer to the Validation Signature Page

Total cover pages: 1

Maxxam Job #: A843579
Report Date: 2008/09/11

MINNOW ENVIRONMENTAL
Client Project #: 2254

Sampler Initials: CR

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		L30811			L30813		L30815		
Sampling Date		2008/08/20			2008/08/21		2008/08/21		
COC#		F110464			F110464		F110464		
	Units	**R2 BULK SCREEN (<2.00 MM)**	**RDL**	**QC Batch**	**X2 BULK SCREEN (<2.00 MM)**	**RDL**	**R7 BULK SCREEN (<2.00 MM)**	**RDL**	**QC Batch**
Misc. Inorganics									
Total Kjeldahl Nitrogen	mg/kg	36	3	2541840	1500	30	150	3	2541840
Parameter									
Subcontract Parameter	N/A	ATTACHED	N/A	2548580	ATTACHED	N/A	ATTACHED	N/A	2569693
Nutrients									
Available (KCl) Ammonia (N)	mg/kg	4.6	0.5	2540729	18	0.5	13	0.5	2540729
Available (KCl) Orthophosphate (P)	ug/g	<50	50	2538422	<50	50	<50	50	2538422

N/A = Not Applicable
RDL = Reportable Detection Limit

Maxxam Analytics Inc

MINNOW ENVIRONMENTAL
Client Project #: 2254

Maxxam Job #: A843579
Report Date: 2008/09/11

Sampler Initials: CR

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		L30810		L30812	L30814	L30816	L30817	L30818		
Sampling Date		2008/08/20		2008/08/19	2008/08/21	2008/08/20	2008/08/19	2008/08/19		
COC#		F110464		F110464	F110464	F110464	F110464	F110464		
	Units	**R2**	**RDL**	**X2**	**R7**	**NXT**	**USFR**	**VR**	**RDL**	**QC Batch**
Misc. Inorganics										
Fluoride (F)	mg/L	0.10	0.01	0.09	0.09	0.07	0.06	0.06	0.01	2537900
Preparation										
Filter and HNO3 Preservation	N/A	FIELD	N/A	FIELD	FIELD	FIELD	FIELD	FIELD	N/A	ONSITE
ANIONS										
Nitrite (N)	mg/L	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	2535291
Calculated Parameters										
Nitrate (N)	mg/L	0.04	0.02	0.02	<0.02	<0.02	<0.02	<0.02	0.02	2535234
Misc. Inorganics										
Weak Acid Dissoc. Cyanide (CN)	mg/L	<0.0005	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	2538675
Dissolved Organic Carbon (C)	mg/L	4.3	0.5	4.6	3.7	3.7	3.7	4.2	0.5	2537548
Alkalinity (Total as CaCO3)	mg/L	97	0.5	76	78	48	17	25	0.5	2534959
Alkalinity (PP as CaCO3)	mg/L	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	2534959
Bicarbonate (HCO3)	mg/L	120	0.5	93	96	58	20	31	0.5	2534959
Carbonate (CO3)	mg/L	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	2534959
Hydroxide (OH)	mg/L	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	2534959
Anions										
Dissolved Sulphate (SO4)	mg/L	66	5	9.7	6.6	2.8	4.4	4.6	0.5	2543065
Dissolved Chloride (Cl)	mg/L	0.7	0.5	<0.5	<0.5	<0.5	<0.5	0.6	0.5	2543062
Nutrients										
Ammonia (N)	mg/L	0.05	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	2537503
Total Total Kjeldahl Nitrogen (Calc)	mg/L	0.20	0.02	0.13	0.07	0.06	0.07	0.11	0.02	2534464
Nitrate plus Nitrite (N)	mg/L	0.04	0.02	0.02	<0.02	<0.02	<0.02	<0.02	0.02	2535290
Total Nitrogen (N)	mg/L	0.23	0.02	0.15	0.07	0.06	0.07	0.11	0.02	2539768
Total Phosphorus (P)	mg/L	0.019	0.005	0.017	0.025	0.011	0.018	0.013	0.005	2534791
Physical Properties										
Total Suspended Solids	mg/L	<1	1	5	<1	<1	<1	<1	1	2537716
Total Dissolved Solids	mg/L	240	10	110	98	68	50	60	10	2538051

N/A = Not Applicable
RDL = Reportable Detection Limit

Maxxam Job #: A843579
Report Date: 2008/09/11

MINNOW ENVIRONMENTAL
Client Project #: 2254

Sampler Initials: CR

CSR/CCME METALS - SOIL (SOIL)

Maxxam ID		L30811	L30813	L30815	L39109	L39110	L39111		
Sampling Date		2008/08/20	2008/08/21	2008/08/21	2008/08/19	2008/08/19	2008/08/19		
COC#		F110464	F110464	F110464	F110464	F110464	F110464		
	Units	**R2 BULK SCREEN (<2.00 MM)**	**X2 BULK SCREEN (<2.00 MM)**	**R7 BULK SCREEN (<2.00 MM)**	**R2 FINE SCREEN (<0.15MM)**	**X2 FINE SCREEN (<0.15MM)**	**R7 FINE SCREEN (<0.15MM)**	**RDL**	**QC Batch**
Misc. Inorganics									
Soluble (2:1) pH	pH Units	7.64	7.52	6.96				0.01	2536478
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	8150	13600	9180	18000	13400	10400	100	2540042
Total Antimony (Sb)	mg/kg	0.8	1.3	0.6	2.0	1.3	0.6	0.1	2540042
Total Arsenic (As)	mg/kg	9.0	20.7	10.1	20.2	21.6	8.6	0.2	2540042
Total Barium (Ba)	mg/kg	107	211	125	404	258	192	0.1	2540042
Total Beryllium (Be)	mg/kg	0.2	0.7	0.2	0.8	0.7	0.4	0.1	2540042
Total Bismuth (Bi)	mg/kg	0.1	0.8	0.2	0.4	0.8	0.2	0.1	2540042
Total Cadmium (Cd)	mg/kg	0.24	0.85	0.17	0.86	0.97	0.23	0.05	2540042
Total Chromium (Cr)	mg/kg	20	32	17	53	31	19	1	2540042
Total Cobalt (Co)	mg/kg	10.9	15.4	7.1	29.4	14.6	8.0	0.3	2540042
Total Copper (Cu)	mg/kg	15.2	36.5	9.0	45.0	36.9	13.0	0.5	2540042
Total Iron (Fe)	mg/kg	19200	34600	22100	43400	32000	22400	100	2540042
Total Lead (Pb)	mg/kg	42.8	273	16.6	134	286	12.7	0.1	2540042
Total Magnesium (Mg)	mg/kg	4810	5970	3790	10300	5500	3690	100	2540042
Total Manganese (Mn)	mg/kg	2200	1340	393	9620	1600	576	0.2	2540042
Total Mercury (Hg)	mg/kg	<0.05	0.20	<0.05	0.07	0.21	<0.05	0.05	2540042
Total Molybdenum (Mo)	mg/kg	1.0	1.2	0.8	2.7	1.3	0.8	0.1	2540042
Total Nickel (Ni)	mg/kg	23.7	36.3	16.0	63.5	36.9	17.9	0.8	2540042
Total Phosphorus (P)	mg/kg	556	774	549	793	827	741	10	2540042
Total Potassium (K)	mg/kg	740	1750	1040	1640	1660	1360	100	2540042
Total Selenium (Se)	mg/kg	0.5	0.8	<0.5	<0.5	<0.5	0.5	0.5	2540042
Total Silver (Ag)	mg/kg	0.09	0.56	0.07	0.28	0.66	0.10	0.05	2540042
Total Sodium (Na)	mg/kg	106	183	101	329	200	148	100	2540042
Total Strontium (Sr)	mg/kg	25.2	31.9	20.4	57.8	34.6	29.2	0.1	2540042
Total Thallium (Tl)	mg/kg	0.11	0.31	0.09	0.34	0.27	0.15	0.05	2540042
Total Tin (Sn)	mg/kg	0.3	1.0	0.5	3.8	1.0	0.7	0.1	2540042
Total Titanium (Ti)	mg/kg	149	442	302	361	390	396	1	2540042
Total Vanadium (V)	mg/kg	18	35	21	39	34	24	2	2540042
Total Zinc (Zn)	mg/kg	175	456	57	546	491	63	1	2540042
Total Zirconium (Zr)	mg/kg	0.9	1.1	0.9	2.0	1.0	0.9	0.5	2540042

RDL = Reportable Detection Limit

Maxxam Job #: A843579
Report Date: 2008/09/11

MINNOW ENVIRONMENTAL
Client Project #: 2254

Sampler Initials: CR

LOW LEVEL DISSOLVED METALS - WATER (WATER)

Maxxam ID		L30810	L30812	L30814	L30816	L30817	L30818		
Sampling Date		2008/08/20	2008/08/19	2008/08/21	2008/08/20	2008/08/19	2008/08/19		
COC#		F110464	F110464	F110464	F110464	F110464	F110464		
	Units	**R2**	**X2**	**R7**	**NXT**	**USFR**	**VR**	**RDL**	**QC Batch**
Misc. Inorganics									
Dissolved Hardness (CaCO3)	mg/L	166	80.0	81.0	46.4	21.3	26.3	0.5	2534171
Dissolved Metals by ICPMS									
Dissolved Aluminum (Al)	mg/L	0.0148	0.0126	0.0172	0.0225	0.0208	0.0288	0.0002	2539539
Dissolved Antimony (Sb)	mg/L	0.00011 (1)	0.00007	0.00008	0.00003	0.00004	0.00003	0.00002	2539539
Dissolved Arsenic (As)	mg/L	0.00046	0.00051	0.00062	0.00013	0.00028	0.00023	0.00002	2539539
Dissolved Barium (Ba)	mg/L	0.0502	0.0424	0.0470	0.0263	0.0242	0.0257	0.00002	2539539
Dissolved Beryllium (Be)	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	0.00002	0.00003	0.00001	2539539
Dissolved Bismuth (Bi)	mg/L	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000005	2539539
Dissolved Boron (B)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	2539539
Dissolved Cadmium (Cd)	mg/L	0.000040 (1)	0.000016	0.000013	0.000016	0.000007	0.000013	0.000005	2539539
Dissolved Chromium (Cr)	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	2539539
Dissolved Cobalt (Co)	mg/L	0.000770	0.000059	0.000049 (1)	0.000017	0.000020	0.000020	0.000005	2539539
Dissolved Copper (Cu)	mg/L	0.00109 (1)	0.00078	0.00075	0.00070	0.00052	0.00073	0.00005	2539539
Dissolved Iron (Fe)	mg/L	0.183	0.102	0.119	0.010	0.085	0.019	0.001	2539539
Dissolved Lead (Pb)	mg/L	0.000638 (1)	0.000332	0.000873 (1)	0.000120 (1)	0.000161 (1)	0.000106 (1)	0.000005	2539539
Dissolved Lithium (Li)	mg/L	0.0053	0.0029	0.0028	0.0019	0.0008	<0.0005	0.0005	2539539
Dissolved Manganese (Mn)	mg/L	0.699	0.0307	0.0163	0.00034	0.00326	0.00064	0.00005	2539539
Dissolved Molybdenum (Mo)	mg/L	0.00056	0.00044	0.00049	0.00021	0.00022	0.00011	0.00005	2539539
Dissolved Nickel (Ni)	mg/L	0.00209	0.00071	0.00036	0.00025	0.00028	0.00028 (1)	0.00002	2539539
Dissolved Selenium (Se)	mg/L	0.00026 (1)	0.00023	0.00025	0.00009	0.00006	0.00005	0.00004	2539539
Dissolved Silicon (Si)	mg/L	4.5	4.9	4.6	5.9	3.6	4.9	0.1	2539539
Dissolved Silver (Ag)	mg/L	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000005	2539539
Dissolved Strontium (Sr)	mg/L	0.193	0.0992	0.0973	0.0634	0.0421	0.0440	0.00005	2539539
Dissolved Thallium (Tl)	mg/L	0.000027	0.000004	0.000002	0.000003	0.000003	0.000004	0.000002	2539539
Dissolved Tin (Sn)	mg/L	0.00002	<0.00001	<0.00001	<0.00001	0.00002	<0.00001	0.00001	2539539
Dissolved Titanium (Ti)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	2539539
Dissolved Uranium (U)	mg/L	0.00142	0.000873	0.000931	0.000389	0.000364	0.000378	0.000002	2539539
Dissolved Vanadium (V)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	2539539
Dissolved Zinc (Zn)	mg/L	0.0315	0.0345	0.0043 (1)	0.0010	0.0017 (1)	0.0018 (1)	0.0001	2539539
Dissolved Zirconium (Zr)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0002	0.0001	2539539
Dissolved Calcium (Ca)	mg/L	49.3	23.5	24.5	14.7	6.81	8.15	0.05	2540978
Dissolved Magnesium (Mg)	mg/L	10.3	5.16	4.81	2.34	1.04	1.44	0.05	2540978
Dissolved Potassium (K)	mg/L	1.18	0.54	0.51	0.46	0.26	0.29	0.05	2540978
Dissolved Sodium (Na)	mg/L	3.71	1.90	1.88	1.86	1.34	1.41	0.05	2540978

RDL = Reportable Detection Limit
(1) - dissolved > total Metals, reanalyzed & confirmed. Possible trace level of field-filtered contamination on dissolved metal bottle or there is a discrepancy between samples taken.

Maxxam Job #: A843579
Report Date: 2008/09/11

MINNOW ENVIRONMENTAL
Client Project #: 2254

Sampler Initials: CR

LOW LEVEL DISSOLVED METALS - WATER (WATER)

Maxxam ID		L30810	L30812	L30814	L30816	L30817	L30818		
Sampling Date		2008/08/20	2008/08/19	2008/08/21	2008/08/20	2008/08/19	2008/08/19		
COC#		F110464	F110464	F110464	F110464	F110464	F110464		
	Units	**R2**	**X2**	**R7**	**NXT**	**USFR**	**VR**	**RDL**	**QC Batch**
Dissolved Sulphur (S)	mg/L	29	4	<3	<3	<3	<3	3	2540978

RDL = Reportable Detection Limit

MINNOW ENVIRONMENTAL
Client Project #: 2254

Maxxam Job #: A843579
Report Date: 2008/09/11

Sampler Initials: CR

LOW LEVEL TOTAL METALS - WATER (WATER)

Maxxam ID		L30810	L30812	L30814	L30816	L30817	L30818		
Sampling Date		2008/08/20	2008/08/19	2008/08/21	2008/08/20	2008/08/19	2008/08/19		
COC#		F110464	F110464	F110464	F110464	F110464	F110464		
	Units	**R2**	**X2**	**R7**	**NXT**	**USFR**	**VR**	**RDL**	**QC Batch**
Calculated Parameters									
Total Hardness (CaCO3)	mg/L	166	80.2	80.1	45.2	21.5	26.6	0.5	2534459
Total Metals by ICPMS									
Total Aluminum (Al)	mg/L	0.0143	0.0246	0.0187	0.0283	0.0295	0.0337	0.0002	2539686
Total Antimony (Sb)	mg/L	0.00009	0.00008	0.00008	0.00002	0.00004	0.00003	0.00002	2539686
Total Arsenic (As)	mg/L	0.00047	0.00056	0.00064	0.00012	0.00030	0.00023	0.00002	2539686
Total Barium (Ba)	mg/L	0.0467	0.0428	0.0477	0.0253	0.0244	0.0262	0.00002	2539686
Total Beryllium (Be)	mg/L	<0.00001	<0.00001	<0.00001	0.00001	0.00001	0.00002	0.00001	2539686
Total Bismuth (Bi)	mg/L	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000005	2539686
Total Boron (B)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	2539686
Total Cadmium (Cd)	mg/L	0.000023	0.000018	0.000010	0.000018	0.000009	0.000013	0.000005	2539686
Total Chromium (Cr)	mg/L	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	0.0001	2539686
Total Cobalt (Co)	mg/L	0.000820	0.000085	0.000038	0.000016	0.000030	0.000023	0.000005	2539686
Total Copper (Cu)	mg/L	0.00089	0.00079	0.00175	0.00072	0.00058	0.00070	0.00005	2539686
Total Iron (Fe)	mg/L	0.243	0.153	0.152	0.015	0.119	0.021	0.001	2539686
Total Lead (Pb)	mg/L	0.000311	0.000767	0.000312	0.000052	0.000108	0.000051	0.000005	2539686
Total Lithium (Li)	mg/L	0.0051	0.0030	0.0030	0.0020	0.0008	<0.0005	0.0005	2539686
Total Manganese (Mn)	mg/L	0.717	0.0359	0.0166	0.00039	0.00728	0.00077	0.00005	2539686
Total Molybdenum (Mo)	mg/L	0.00051	0.00044	0.00050	0.00021	0.00022	0.00011	0.00005	2539686
Total Nickel (Ni)	mg/L	0.00217	0.00075	0.00039	0.00031	0.00033	0.00020	0.00002	2539686
Total Selenium (Se)	mg/L	0.00021	0.00022	0.00024	0.00011	0.00005	0.00005	0.00004	2539686
Total Silicon (Si)	mg/L	4.8	5.8	5.6	7.7	4.1	5.7	0.1	2539686
Total Silver (Ag)	mg/L	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000005	2539686
Total Strontium (Sr)	mg/L	0.184	0.100	0.0977	0.0642	0.0422	0.0458	0.00005	2539686
Total Thallium (Tl)	mg/L	0.000025	0.000004	<0.000002	<0.000002	<0.000002	0.000003	0.000002	2539686
Total Tin (Sn)	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	2539686
Total Titanium (Ti)	mg/L	<0.0005	0.0006	<0.0005	<0.0005	0.0015	<0.0005	0.0005	2539686
Total Uranium (U)	mg/L	0.00134	0.000881	0.000962	0.000396	0.000388	0.000397	0.000002	2539686
Total Vanadium (V)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	2539686
Total Zinc (Zn)	mg/L	0.0278	0.0360	0.0016	0.0013	0.0013	0.0007	0.0001	2539686
Total Zirconium (Zr)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	0.0001	2539686
Total Calcium (Ca)	mg/L	48.7	23.3	23.9	14.2	6.81	8.15	0.05	2543331
Total Magnesium (Mg)	mg/L	10.9	5.37	5.00	2.34	1.10	1.52	0.05	2543331
Total Potassium (K)	mg/L	1.16	0.53	0.50	0.45	0.23	0.29	0.05	2543331
Total Sodium (Na)	mg/L	3.98	2.03	2.04	1.98	1.49	1.52	0.05	2543331
Total Sulphur (S)	mg/L	28	4	<3	<3	<3	<3	3	2543331

RDL = Reportable Detection Limit

Maxxam Job #: A843579
Report Date: 2008/09/11

MINNOW ENVIRONMENTAL
Client Project #: 2254

Sampler Initials: CR

QUALITY ASSURANCE REPORT

			Matrix Spike		Spike		Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2534791	Total Phosphorus (P)	2008/08/28	88	80 - 120	118	80 - 120	<0.005	mg/L	1.9	25		
2534959	Alkalinity (Total as CaCO3)	2008/08/28	NC	80 - 120	92	80 - 120	<0.5	mg/L	2.4	25		
2534959	Alkalinity (PP as CaCO3)	2008/08/28					<0.5	mg/L	NC	25		
2534959	Bicarbonate (HCO3)	2008/08/28					<0.5	mg/L	2.4	25		
2534959	Carbonate (CO3)	2008/08/28					<0.5	mg/L	NC	25		
2534959	Hydroxide (OH)	2008/08/28					<0.5	mg/L	NC	25		
2535290	Nitrate plus Nitrite (N)	2008/08/27	99	80 - 120	101	80 - 120	<0.02	mg/L	NC	25		
2535291	Nitrite (N)	2008/08/27	100	80 - 120	102	80 - 120	<0.005	mg/L	NC	25		
2536478	Soluble (2:1) pH	2008/08/28			100	N/A			0.3	20		
2537503	Ammonia (N)	2008/08/28	85	80 - 120	103	80 - 120	<0.01	mg/L	4.9	25		
2537548	Dissolved Organic Carbon (C)	2008/08/29	103	80 - 120	118	80 - 120	<0.5	mg/L	0.8	20		
2537716	Total Suspended Solids	2008/08/28			95	N/A	<1	mg/L				
2537900	Fluoride (F)	2008/08/28	98	80 - 120	98	80 - 120	<0.01	mg/L	0	25		
2538051	Total Dissolved Solids	2008/08/28	96	80 - 120	118	80 - 120	<10	mg/L	1.7	25		
2538422	Available (KCl) Orthophosphate (P)	2008/08/29	98	75 - 125	102	75 - 125	<0.5	ug/g	NC	25		
2538675	Weak Acid Dissoc. Cyanide (CN)	2008/08/27			93	80 - 120	<0.0005	mg/L	NC	20		
2539539	Dissolved Arsenic (As)	2008/08/29	99	75 - 125	97	75 - 125	<0.00002	mg/L	2.5	25		
2539539	Dissolved Beryllium (Be)	2008/08/29	104	75 - 125	102	75 - 125	<0.00001	mg/L	NC	25		
2539539	Dissolved Cadmium (Cd)	2008/08/29	102	75 - 125	98	75 - 125	<0.000005	mg/L	10.4	25		
2539539	Dissolved Chromium (Cr)	2008/08/29	99	75 - 125	99	75 - 125	<0.0001	mg/L	NC	25		
2539539	Dissolved Cobalt (Co)	2008/08/29	94	75 - 125	96	75 - 125	<0.000005	mg/L	3.6	25		
2539539	Dissolved Copper (Cu)	2008/08/29	95	75 - 125	103	75 - 125	<0.00005	mg/L	9.7	25		
2539539	Dissolved Lead (Pb)	2008/08/29	98	75 - 125	105	75 - 125	0.000007, RDL=0.000005	mg/L	0.03	25		
2539539	Dissolved Lithium (Li)	2008/08/29	NC	75 - 125	107	75 - 125	<0.0005	mg/L	0.09	25		
2539539	Dissolved Nickel (Ni)	2008/08/29	96	75 - 125	102	75 - 125	<0.00002	mg/L	4.8	25		
2539539	Dissolved Selenium (Se)	2008/08/29	107	75 - 125	104	75 - 125	<0.00004	mg/L	4.3	25		
2539539	Dissolved Uranium (U)	2008/08/29	101	75 - 125	105	75 - 125	<0.000002	mg/L	2.8	25		
2539539	Dissolved Vanadium (V)	2008/08/29	99	75 - 125	96	75 - 125	<0.0002	mg/L	NC	25		
2539539	Dissolved Zinc (Zn)	2008/08/29	NC	75 - 125	108	75 - 125	<0.0001	mg/L	4.1	25		
2539539	Dissolved Aluminum (Al)	2008/08/29					<0.0002	mg/L	11.0	25		
2539539	Dissolved Antimony (Sb)	2008/08/29					<0.00002	mg/L	2.8	25		
2539539	Dissolved Barium (Ba)	2008/08/29					<0.00002	mg/L	4.0	25		
2539539	Dissolved Bismuth (Bi)	2008/08/29					<0.000005	mg/L	NC	25		
2539539	Dissolved Boron (B)	2008/08/29					<0.05	mg/L	NC	25		
2539539	Dissolved Iron (Fe)	2008/08/29					<0.001	mg/L	1.4	25		
2539539	Dissolved Manganese (Mn)	2008/08/29					<0.00005	mg/L	4.6	25		
2539539	Dissolved Molybdenum (Mo)	2008/08/29					<0.00005	mg/L	4.9	25		
2539539	Dissolved Silicon (Si)	2008/08/29					<0.1	mg/L	0.1	25		
2539539	Dissolved Silver (Ag)	2008/08/29					<0.000005	mg/L	NC	25		
2539539	Dissolved Strontium (Sr)	2008/08/29					<0.00005	mg/L	3.7	25		

Maxxam Analytics Inc

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Maxxam Job #: A843579
Report Date: 2008/09/11

MINNOW ENVIRONMENTAL
Client Project #: 2254

Sampler Initials: CR

QUALITY ASSURANCE REPORT

			Matrix Spike		Spike		Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2539539	Dissolved Thallium (Tl)	2008/08/29					<0.000002	mg/L	7.2	25		
2539539	Dissolved Tin (Sn)	2008/08/29					<0.00001	mg/L	NC	25		
2539539	Dissolved Titanium (Ti)	2008/08/29					<0.0005	mg/L	NC	25		
2539539	Dissolved Zirconium (Zr)	2008/08/29					<0.0001	mg/L	NC	25		
2539686	Total Arsenic (As)	2008/08/30	100	75 - 125	93	75 - 125	<0.00002	mg/L	5.9	25		
2539686	Total Beryllium (Be)	2008/08/30	103	75 - 125	98	75 - 125	<0.00001	mg/L	NC	25		
2539686	Total Cadmium (Cd)	2008/08/30	101	75 - 125	97	75 - 125	<0.000005	mg/L	NC	25		
2539686	Total Chromium (Cr)	2008/08/30	102	75 - 125	94	75 - 125	<0.0001	mg/L	NC	25		
2539686	Total Cobalt (Co)	2008/08/30	100	75 - 125	95	75 - 125	<0.000005	mg/L	4.6	25		
2539686	Total Copper (Cu)	2008/08/30	99	75 - 125	99	75 - 125	<0.00005	mg/L	8.2	25		
2539686	Total Lead (Pb)	2008/08/30	100	75 - 125	102	75 - 125	<0.000005	mg/L	23.7	25		
2539686	Total Lithium (Li)	2008/08/30	106	75 - 125	99	75 - 125	<0.0005	mg/L	NC	25		
2539686	Total Nickel (Ni)	2008/08/30	100	75 - 125	95	75 - 125	<0.00002	mg/L	6.0	25		
2539686	Total Selenium (Se)	2008/08/30	100	75 - 125	95	75 - 125	<0.00004	mg/L	NC	25		
2539686	Total Uranium (U)	2008/08/30	106	75 - 125	102	75 - 125	0.000002, RDL=0.000002	mg/L	9.1	25		
2539686	Total Vanadium (V)	2008/08/30	102	75 - 125	92	75 - 125	<0.0002	mg/L	NC	25		
2539686	Total Zinc (Zn)	2008/08/30	100	75 - 125	102	75 - 125	<0.0001	mg/L	2.8	25		
2539686	Total Aluminum (Al)	2008/08/30					<0.0002	mg/L	0.5	25		
2539686	Total Antimony (Sb)	2008/08/30					<0.00002	mg/L	NC	25		
2539686	Total Barium (Ba)	2008/08/30					<0.00002	mg/L	1	25		
2539686	Total Bismuth (Bi)	2008/08/30					<0.000005	mg/L	NC	25		
2539686	Total Boron (B)	2008/08/30					<0.05	mg/L	NC	25		
2539686	Total Iron (Fe)	2008/08/30					<0.001	mg/L	9.1	25		
2539686	Total Manganese (Mn)	2008/08/30					<0.00005	mg/L	3.5	25		
2539686	Total Molybdenum (Mo)	2008/08/30					<0.00005	mg/L	NC	25		
2539686	Total Silicon (Si)	2008/08/30					<0.1	mg/L	11.3	25		
2539686	Total Silver (Ag)	2008/08/30					<0.000005	mg/L	NC	25		
2539686	Total Strontium (Sr)	2008/08/30					<0.00005	mg/L	0.8	25		
2539686	Total Thallium (Tl)	2008/08/30					<0.000002	mg/L	NC	25		
2539686	Total Tin (Sn)	2008/08/30					<0.00001	mg/L	NC	25		
2539686	Total Titanium (Ti)	2008/08/30					<0.0005	mg/L	NC	25		
2539686	Total Zirconium (Zr)	2008/08/30					<0.0001	mg/L				
2539768	Total Nitrogen (N)	2008/08/28	80	80 - 120	95	80 - 120	<0.02	mg/L	2.6	25		
2540042	Total Arsenic (As)	2008/08/29	NC	75 - 125	109	75 - 125	<0.2	mg/kg	3.8	35	97	75 - 125
2540042	Total Beryllium (Be)	2008/08/29	103	75 - 125	104	75 - 125	<0.1	mg/kg	NC	35		
2540042	Total Cadmium (Cd)	2008/08/29	101	75 - 125	104	75 - 125	<0.05	mg/kg	1.5	35	94	75 - 125
2540042	Total Chromium (Cr)	2008/08/29	100	75 - 125	102	75 - 125	<1	mg/kg	0.8	35	92	75 - 125
2540042	Total Cobalt (Co)	2008/08/29	98	75 - 125	109	75 - 125	<0.3	mg/kg	1.6	35	101	75 - 125
2540042	Total Copper (Cu)	2008/08/29	NC	75 - 125	108	75 - 125	<0.5	mg/kg	0.05	35	95	75 - 125
2540042	Total Lead (Pb)	2008/08/29	NC	75 - 125	106	75 - 125	<0.1	mg/kg	1.1	35	99	75 - 125

MINNOW ENVIRONMENTAL
Client Project #: 2254

Maxxam Job #: A843579
Report Date: 2008/09/11

Sampler Initials: CR

QUALITY ASSURANCE REPORT

			Matrix Spike		Spike		Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
2540042	Total Mercury (Hg)	2008/08/29	NC	75 - 125	107	75 - 125	<0.05	mg/kg	NC	35		
2540042	Total Nickel (Ni)	2008/08/29	98	75 - 125	105	75 - 125	<0.8	mg/kg	0.7	35	102	75 - 125
2540042	Total Selenium (Se)	2008/08/29	104	75 - 125	110	75 - 125	<0.5	mg/kg	NC	35		
2540042	Total Vanadium (V)	2008/08/29	101	75 - 125	104	75 - 125	<2	mg/kg	1.1	35	95	75 - 125
2540042	Total Zinc (Zn)	2008/08/29	NC	75 - 125	112	75 - 125	<1	mg/kg	0.5	35	92	75 - 125
2540042	Total Aluminum (Al)	2008/08/29					<100	mg/kg	0.09	35	93	75 - 125
2540042	Total Antimony (Sb)	2008/08/29					<0.1	mg/kg	1.7	35	106	75 - 125
2540042	Total Barium (Ba)	2008/08/29					<0.1	mg/kg	1.8	35	104	75 - 125
2540042	Total Bismuth (Bi)	2008/08/29					<0.1	mg/kg	0.4	35	91	75 - 125
2540042	Total Iron (Fe)	2008/08/29					<100	mg/kg	0.9	35	97	75 - 125
2540042	Total Magnesium (Mg)	2008/08/29					<100	mg/kg	0.6	35	94	75 - 125
2540042	Total Manganese (Mn)	2008/08/29					<0.2	mg/kg	0.1	35	98	75 - 125
2540042	Total Molybdenum (Mo)	2008/08/29					<0.1	mg/kg	0.9	35	99	75 - 125
2540042	Total Phosphorus (P)	2008/08/29					<10	mg/kg	1.3	35	99	75 - 125
2540042	Total Silver (Ag)	2008/08/29					<0.05	mg/kg	5.4	35	92	75 - 125
2540042	Total Strontium (Sr)	2008/08/29					<0.1	mg/kg	0.3	35	96	75 - 125
2540042	Total Thallium (Tl)	2008/08/29					<0.05	mg/kg	NC	35	83	75 - 125
2540042	Total Titanium (Ti)	2008/08/29					<1	mg/kg	2.0	35	96	75 - 125
2540042	Total Potassium (K)	2008/08/29					<100	mg/kg	2.1	35		
2540042	Total Sodium (Na)	2008/08/29					<100	mg/kg	NC	35		
2540042	Total Tin (Sn)	2008/08/29					<0.1	mg/kg	3.2	35		
2540042	Total Zirconium (Zr)	2008/08/29					<0.5	mg/kg	NC	35		
2540729	Available (KCl) Ammonia (N)	2008/08/29	90	80 - 120	97	80 - 120	<0.5	mg/kg	1.6	25		
2540978	Dissolved Calcium (Ca)	2008/08/29					<0.05	mg/L	3.6	25		
2540978	Dissolved Magnesium (Mg)	2008/08/29					<0.05	mg/L	2.1	25		
2540978	Dissolved Potassium (K)	2008/08/29					<0.05	mg/L	3.4	25		
2540978	Dissolved Sodium (Na)	2008/08/29					<0.05	mg/L	2.5	25		
2540978	Dissolved Sulphur (S)	2008/08/29					<3	mg/L	4.0	25		
2541840	Total Kjeldahl Nitrogen	2008/08/29	NC	75 - 125			<3	mg/kg	12.6	35	112	60 - 121
2543062	Dissolved Chloride (Cl)	2008/08/30	98	80 - 120	97	80 - 120	<0.5	mg/L	NC	20		
2543065	Dissolved Sulphate (SO4)	2008/08/30	98	75 - 125	97	80 - 120	<0.5	mg/L	0.5	20		
2543331	Total Calcium (Ca)	2008/08/30					<0.05	mg/L	3.4	25		
2543331	Total Magnesium (Mg)	2008/08/30					<0.05	mg/L	4.0	25		
2543331	Total Potassium (K)	2008/08/30					<0.05	mg/L	3.5	25		
2543331	Total Sodium (Na)	2008/08/30					<0.05	mg/L	4.1	25		
2543331	Total Sulphur (S)	2008/08/30					<3	mg/L	NC	25		

Maxxam Job #: A843579
Report Date: 2008/09/11

MINNOW ENVIRONMENTAL
Client Project #: 2254

Sampler Initials: CR

QUALITY ASSURANCE REPORT

QC Batch	Parameter	Date	Calibration Check % Recovery	Calibration Check QC Limits
2541840	Total Kjeldahl Nitrogen	2008/08/29	114	87 - 120

N/A = Not Applicable
NC = Non-calculable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference

Validation Signature Page

Maxxam Job #: A843579

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

ELAINE COUSINS, CS Manager

DAVE HUANG, BBY Scientific Specialist

LILI ZHOU, Senior analyst, Inorganic department.

==

Maxxam Analytics Inc

8577 Commerce Court
Burnaby, BC V5A 4N5
www.maxxamanalytics.com

A843579

Phone: (604) 444-4808
Fax: (604) 444-4511
Toll Free: 1-800-440-4808

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

PAGE ___ OF ___

ANALYSIS REQUEST F 110464

COMPANY NAME: MINNOW ENVIRONMENTAL	PH. #: 905-873-3371 E-mail: porr@minnow-environmental.com FAX #: 905-873-3370
COMPANY ADDRESS: 2 LAMB ST GEORGETOWN, ON L7G 3M9	CLIENT PROJECT ID: (#) 2254 MAXXAM REFERENCE/QUOTE # B08-065-FC
SAMPLER NAME (PRINT): CR, TH, MB	PROJECT MANAGER: PATTI ORR.

#	FIELD SAMPLE ID	MAXXAM LAB # (Lab Use Only)	MATRIX: GROUND WATER	MATRIX: SURFACE WATER	MATRIX: SOIL	MATRIX: OTHER	# CONTAINERS	SAMPLING: DATE DD/MM/YY	SAMPLING: TIME	HEADSPACE VAPOUR	DOC (filtered)	CYANIDE	GENERAL CHEM ALK, Cl, F, TDS, SO4	METALS LL DISSOLVED	METALS LL TOTAL	NH4/NO3/NO2/TKN	PHOSPHORUS TOTAL	SOLIDS TSS		~~[illegible]~~	TOC, GRAIN SIZE	TKN	TOTAL PHOSPHORUS	AMMONIA	METALS, CCME PACKAGE	↳ BULK SCREENING	↳ FINE SCREENING		
1	R2			✓			8	20/08/08			✓	✓	✓	✓	✓	✓	✓	✓											
2	R2				✓		3	20/08/08													✓	✓	✓	✓		✓	✓		
3	X2			✓			8	19/08/08			✓	✓	✓	✓	✓	✓	✓	✓											
4	X2				✓		3	21/08/08													✓	✓	✓	✓		✓	✓		
5	R7			✓			8	21/08/08			✓	✓	✓	✓	✓	✓	✓	✓											
6	R7				✓		3	21/08/08													✓	✓	✓	✓		✓	✓		
7	NXT			✓			8	20/08/08			✓	✓	✓	✓	✓	✓	✓	✓											
8	USFR			✓			8	19/08/08			✓	✓	✓	✓	✓	✓	✓	✓											
9	VR			✓				19/08/08			✓	✓	✓	✓	✓	✓	✓	✓											
10																													
11																													
12																													

TAT (Turnaround Time)

<5 DAY TAT MUST HAVE PRIOR APPROVAL

*some exceptions apply please contact lab

- STANDARD 5 BUSINESS DAYS ☐
- RUSH 3 BUSINESS DAYS ☐
- RUSH 2 BUSINESS DAYS ☐
- URGENT 1 BUSINESS DAY ☐

OTHER BUSINESS DAYS ______

P.O. NUMBER / QUOTE NUMBER: project # 2254 quote # B08-065-FC

SPECIAL DETECTION LIMITS / CONTAMINANT TYPE: * Water MDL > CCME

- ☒ CCME
- ☐ CSR
- ☐ ALBERTA TIER 1
- ☐ OTHER

ARRIVAL TEMPERATURE °C: 5,5,5

DUE DATE:

LOG IN CHECK:

ACCOUNTING CONTACT: Patti Orr

SPECIAL REPORTING OR BILLING INSTRUCTIONS:

JARS USED:

RELINQUISHED BY SAMPLER: C Russel	DATE: DD/MM/YY Aug 21/08	TIME: 530pm	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY	TIME:	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY 25/08/08	TIME: 9:40	RECEIVED BY LABORATORY: A.M

CUSTODY RECORD

COCFORM - BC - 06/06

ORIGINAL - MAXXAM YELLOW - MAXXAM PINK - CLIENT

Your Project #: A843579
Your C.O.C. #: N/A

Attention: Elaine Cousins
Maxxam Analytics Inc
Burnaby to Bedford
8577 Commerce Crt
Burnaby, BC
V5A 4N5

Report Date: 2008/08/29

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: A896662
Received: 2008/08/28, 12:42

Sample Matrix: Soil
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Total Organic Carbon in Soil	3	N/A	2008/08/29	ATL SOP 00044 R2	LECO 203-601-224

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

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

HEATHER WEST, Bedford
Email: heather.west.reports@maxxamanalytics.com
Phone# (902) 420-0203

===
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. SCC and CAEAL have approved this reporting process and electronic report format.

Total cover pages: 1

Maxxam Analytics Inc
Client Project #: A843579

Maxxam Job #: A896662
Report Date: 2008/08/29

RESULTS OF ANALYSES OF SOIL

Maxxam ID		AI0637	AI0637		AI0638		
Sampling Date		2008/08/20	2008/08/20		2008/08/21		
COC Number		N/A	N/A		N/A		
Registration #							
	Units	**L30811-01R\R2**	**L30811-01R\R2 Lab-Dup**	**RDL**	**L30813-01R\X2**	**RDL**	**QC Batch**
Organic Carbon (TOC)	g/kg	2.0	2.0	0.2	12	1	1599689

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		AI0639		
Sampling Date		2008/08/21		
COC Number		N/A		
Registration #				
	Units	**L30815-01R\R7**	**RDL**	**QC Batch**
Organic Carbon (TOC)	g/kg	2.5	0.2	1599689

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Analytics Inc
Maxxam Job #: A896662
Client Project #: A843579
Report Date: 2008/08/29

GENERAL COMMENTS

Results relate only to the items tested.

200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel:902-420-0203 Toll-free:800-565-7227 Fax:902-420-8612 www.maxxamanalytics.com

Maxxam Analytics Inc
Attention: Elaine Cousins
Client Project #: A843579
P.O. #:
Project name:

Quality Assurance Report

Maxxam Job Number: DA896662

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1599689	CAC	QC STANDARD	Organic Carbon (TOC)	2008/08/29		97	%	75 - 125
		Method Blank	Organic Carbon (TOC)	2008/08/29	ND, RDL=0.2		g/kg	
		RPD [AI0637-01]	Organic Carbon (TOC)	2008/08/29	0.05		%	35

ND = Not detected
RPD = Relative Percent Difference
QC Standard = Quality Control Standard

200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel:902-420-0203 Toll-free:800-565-7227 Fax:902-420-8612 www.maxxamanalytics.com

Your Project #: A843579
Your C.O.C. #: N/A

Attention: Elaine Cousins
Maxxam Analytics Inc
Burnaby to Bedford
8577 Commerce Crt
Burnaby, BC
V5A 4N5

Report Date: 2008/09/11

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: A896674
Received: 2008/08/28, 12:42

Sample Matrix: Soil
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Particle size in solids (pipette&sieve)	3	N/A	2008/09/08	ATL SOP 00012 R2	based on MSAMS-1978

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

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

HEATHER WEST, Bedford
Email: heather.west.reports@maxxamanalytics.com
Phone# (902) 420-0203

==
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Total cover pages: 1

Maxxam Job #: A896674
Report Date: 2008/09/11

Maxxam Analytics Inc
Client Project #: A843579

RESULTS OF ANALYSES OF SOIL

Maxxam ID		AI0693	AI0694	AI0695		
Sampling Date						
COC Number		N/A	N/A	N/A		
Registration #						
	Units	**L30811-01R\R2**	**L30813-01R\X2**	**L30815-01R\R7**	**RDL**	**QC Batch**
< -4 Phi (16 mm)	%	100	100	100	0.1	1606454
< -3 Phi (8 mm)	%	100	100	100	0.1	1606454
< -2 Phi (4 mm)	%	100	100	100	0.1	1606454
< -1 Phi (2 mm)	%	68	100	100	0.1	1606454
< 0 Phi (1 mm)	%	42	93	96	0.1	1606454
< +1 Phi (0.5 mm)	%	12	82	70	0.1	1606454
< +2 Phi (0.25 mm)	%	2.1	61	30	0.1	1606454
< +3 Phi (0.12 mm)	%	1.1	43	8.4	0.1	1606454
< +4 Phi (0.062 mm)	%	1.0	31	3.1	0.1	1606454
< +5 Phi (0.031 mm)	%	0.9	25	2.3	0.1	1606454
< +6 Phi (0.016 mm)	%	0.8	17	1.8	0.1	1606454
< +7 Phi (0.0078 mm)	%	0.7	8.3	1.4	0.1	1606454
< +8 Phi (0.0039 mm)	%	0.6	6.5	1.2	0.1	1606454
< +9 Phi (0.0020 mm)	%	0.6	4.3	1.0	0.1	1606454
Gravel	%	32	ND	0.2	0.1	1606454
Sand	%	67	69	97	0.1	1606454
Silt	%	0.4	24	1.9	0.1	1606454
Clay	%	0.6	6.5	1.2	0.1	1606454

ND = Not detected
N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel:902-420-0203 Toll-free:800-565-7227 Fax:902-420-8612 www.maxxamanalytics.com

GENERAL COMMENTS

Results relate only to the items tested.

200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel:902-420-0203 Toll-free:800-565-7227 Fax:902-420-8612 www.maxxamanalytics.com

Maxxam Analytics Inc
Attention: Elaine Cousins
Client Project #: A843579
P.O. #:
Project name:

Quality Assurance Report

Maxxam Job Number: DA896674

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
1606454	SBK	RPD	< -4 Phi (16 mm)	2008/09/08	0		%	25
			< -3 Phi (8 mm)	2008/09/08	0		%	25
			< -2 Phi (4 mm)	2008/09/08	0		%	25
			< -1 Phi (2 mm)	2008/09/08	1.9		%	25
			< 0 Phi (1 mm)	2008/09/08	0.1		%	25
			< +1 Phi (0.5 mm)	2008/09/08	2.4		%	25
			< +2 Phi (0.25 mm)	2008/09/08	3.7		%	25
			< +3 Phi (0.12 mm)	2008/09/08	5.1		%	25
			< +4 Phi (0.062 mm)	2008/09/08	6.1		%	25
			< +5 Phi (0.031 mm)	2008/09/08	5.4		%	25
			< +6 Phi (0.016 mm)	2008/09/08	9.1		%	25
			< +7 Phi (0.0078 mm)	2008/09/08	21.5		%	25
			< +8 Phi (0.0039 mm)	2008/09/08	4.5		%	25
			< +9 Phi (0.0020 mm)	2008/09/08	10.8		%	25
			Gravel	2008/09/08	NC (1)		%	25
			Sand	2008/09/08	47.7 (1)		%	25
			Silt	2008/09/08	7.6		%	25
			Clay	2008/09/08	4.5		%	25

NC = Non-calculable
RPD = Relative Percent Difference
(1) Duplicate %RPD acceptable. Values agree within 10%.

Your Project #: #2254 BIOASSAY SAMPLING FARO M
Your C.O.C. #: F117513

Attention: Patti Orr
MINNOW ENVIRONMENTAL
2 Lamb Street
Georgetown, ON
CANADA L7G 3M9

Report Date: 2009/02/18
This report supersedes all previous reports with the same Maxxam job number

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: A902175
Received: 2009/01/19, 10:10

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	3	2009/01/19	2009/01/19	BRN SOP-00264 R4.0	Based on SM2320B
Chloride by Automated Colourimetry	2	N/A	2009/01/19	BRN-SOP 00234 R3.0	Based on EPA 325.2
Chloride by Automated Colourimetry	1	N/A	2009/02/13	BRN-SOP 00234 R3.0	Based on EPA 325.2
Cyanide WAD (weak acid dissociable)	3	N/A	2009/01/20	BRN SOP-00227 R3.0	Based on SM-4500CN I
Carbon (DOC)	3	N/A	2009/01/21	BRN SOP-00224 R4.0	Based on M 860-87T
Fluoride - Mining Clients	3	N/A	2009/01/20	BRN SOP-00225 R1.0	Based SM - 4500 F C
Hardness Total (calculated as CaCO3)	3	N/A	2009/01/22		
Hardness (calculated as CaCO3)	3	N/A	2009/01/22		
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	2	N/A	2009/01/21	BRN SOP-00206 R7.0	Based on EPA 200.8
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	1	N/A	2009/01/22	BRN SOP-00206 R7.0	Based on EPA 200.8
Elements by ICPMS Low Level (dissolved) (1)	1	N/A	2009/01/21	BRN SOP-00206 R7.0	Based on EPA 200.8
Elements by ICPMS Low Level (dissolved) (1)	2	N/A	2009/01/22	BRN SOP-00206 R7.0	Based on EPA 200.8
Elements by ICPMS Low Level (total) (1)	3	2009/01/21	2009/01/22	BRN SOP-00206 R7.0	Based on EPA 200.8
Na, K, Ca, Mg, S by CRC ICPMS (total)	3	2009/01/21	2009/01/22	BRN SOP-00206 R7.0	Based on EPA 200.8
Nitrogen (Total)	3	2009/01/20	2009/01/20	BRN SOP-00242 R3.0	Based on SM-4500N C
Ammonia (N)	2	N/A	2009/01/19	BRN SOP-00232 R4.0	Based on USEPA 350.1
Ammonia (N)	1	N/A	2009/01/24	BRN SOP-00232 R4.0	Based on USEPA 350.1
Nitrate + Nitrite (N)	3	N/A	2009/01/19	ING233 Rev.4.4	Based on EPA 353.2
Nitrite (N) by CFA	3	N/A	2009/01/19	BRN SOP-00233 R1.0	EPA 353.2
Nitrogen - Nitrate (as N)	3	N/A	2009/01/19		
Filter and HNO3 Preserve for Metals	3	N/A	2009/01/19	BRN WI-00006 R1.0	Based on EPA 200.2
Sulphate by Automated Colourimetry	2	N/A	2009/01/19	BRN-SOP 00243 R1.0	Based on EPA 375.4
Sulphate by Automated Colourimetry	1	N/A	2009/02/13	BRN-SOP 00243 R1.0	Based on EPA 375.4
Total Dissolved Solids (Filt. Residue)	3	N/A	2009/01/21	BRN SOP 00276 R4.0	SM 2540C
TKN (Calc. TN, N/N) total	3	N/A	2009/01/21		
Total Phosphorus	3	N/A	2009/01/19	BRN SOP-00236 R4.0	SM 4500

* Results relate only to the items tested.

(1) SCC/CAEAL

../2

MINNOW ENVIRONMENTAL
Maxxam Job #: A902175
Client Project #: #2254 BIOASSAY SAMPLING FARO M
Report Date: 2009/02/18

Sampler Initials: LE

Encryption Key

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

ELAINE COUSINS, BBY CS Manager
Email: elaine.cousins@maxxamanalytics.com
Phone# (604) 444-4808 Ext:276

===
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For Service Group specific validation please refer to the Validation Signature Page

Total cover pages: 2

Maxxam Job #: A902175
Report Date: 2009/02/18

MINNOW ENVIRONMENTAL
Client Project #: #2254 BIOASSAY SAMPLING FARO M

Sampler Initials: LE

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		N39681			N39682			N39683		
Sampling Date		2009/01/15 10:00			2009/01/15 14:00			2009/01/15 15:30		
COC#		F117513			F117513			F117513		
	Units	**R-7**	**RDL**	**QC Batch**	**R-2**	**RDL**	**QC Batch**	**X-2**	**RDL**	**QC Batch**
Misc. Inorganics										
Fluoride (F)	mg/L	0.14	0.01	2865421	0.14	0.01	2865421	0.15	0.01	2865421
Preparation										
Filter and HNO3 Preservation	N/A	FIELD	N/A	ONSITE	FIELD	N/A	ONSITE	FIELD	N/A	ONSITE
ANIONS										
Nitrite (N)	mg/L	0.005	0.005	2862835	0.005	0.005	2862835	0.005	0.005	2862835
Calculated Parameters										
Nitrate (N)	mg/L	0.24	0.02	2863318	0.29	0.02	2863318	0.35	0.02	2863318
Misc. Inorganics										
Weak Acid Dissoc. Cyanide (CN)	mg/L	<0.0005	0.0005	2866045	0.0005	0.0005	2866045	0.0005	0.0005	2866045
Dissolved Organic Carbon (C)	mg/L	<0.5	0.5	2869492	<0.5	0.5	2869492	<0.5	0.5	2869492
Alkalinity (Total as CaCO3)	mg/L	130	0.5	2864452	180	0.5	2864452	130	0.5	2864452
Alkalinity (PP as CaCO3)	mg/L	<0.5	0.5	2864452	<0.5	0.5	2864452	<0.5	0.5	2864452
Bicarbonate (HCO3)	mg/L	160	0.5	2864452	210	0.5	2864452	160	0.5	2864452
Carbonate (CO3)	mg/L	<0.5	0.5	2864452	<0.5	0.5	2864452	<0.5	0.5	2864452
Hydroxide (OH)	mg/L	<0.5	0.5	2864452	<0.5	0.5	2864452	<0.5	0.5	2864452
Anions										
Dissolved Sulphate (SO4)	mg/L	11	0.5	2863778	180	5	2863778	46	0.5	2923108
Dissolved Chloride (Cl)	mg/L	0.6	0.5	2863780	0.6	0.5	2863780	<0.5	0.5	2923039
Nutrients										
Total Total Kjeldahl Nitrogen (Calc)	mg/L	0.03	0.02	2862857	0.08	0.02	2862857	<0.02	0.02	2862857
Ammonia (N)	mg/L	<0.005	0.005	2863781	0.095	0.005	2877065	0.011	0.005	2863781
Nitrate plus Nitrite (N)	mg/L	0.24	0.02	2862833	0.29	0.02	2862833	0.36	0.02	2862833
Total Nitrogen (N)	mg/L	0.27	0.02	2866860	0.37	0.02	2866860	0.34	0.02	2866860
Total Phosphorus (P)	mg/L	0.006	0.002	2860479	0.003	0.002	2860479	0.003	0.002	2860479
Physical Properties										
Total Dissolved Solids	mg/L	170	10	2865011	470	10	2865011	250	10	2865011

N/A = Not Applicable
RDL = Reportable Detection Limit

Maxxam Job #: A902175
Report Date: 2009/02/18

MINNOW ENVIRONMENTAL
Client Project #: #2254 BIOASSAY SAMPLING FARO M

Sampler Initials: LE

LOW LEVEL DISSOLVED METALS - WATER (WATER)

Maxxam ID		N39681	N39682	N39683		
Sampling Date		2009/01/15 10:00	2009/01/15 14:00	2009/01/15 15:30		
COC#		F117513	F117513	F117513		
	Units	**R-7**	**R-2**	**X-2**	**RDL**	**QC Batch**
Misc. Inorganics						
Dissolved Hardness (CaCO3)	mg/L	133	368	173	0.5	2862674
Dissolved Metals by ICPMS						
Dissolved Aluminum (Al)	mg/L	0.0030	0.0017	0.0092	0.0002	2868196
Dissolved Antimony (Sb)	mg/L	0.00010	0.00008	0.00008	0.00002	2868196
Dissolved Arsenic (As)	mg/L	0.00038	0.00029	0.00027	0.00002	2868196
Dissolved Barium (Ba)	mg/L	0.0771	0.0729	0.0759	0.00002	2868196
Dissolved Beryllium (Be)	mg/L	<0.00001	<0.00001	<0.00001	0.00001	2868196
Dissolved Bismuth (Bi)	mg/L	<0.000005	<0.000005	<0.000005	0.000005	2868196
Dissolved Boron (B)	mg/L	<0.05	<0.05	<0.05	0.05	2868196
Dissolved Cadmium (Cd)	mg/L	0.000012	0.000057	0.000042	0.000005	2868196
Dissolved Chromium (Cr)	mg/L	0.0001	<0.0001	<0.0001	0.0001	2868196
Dissolved Cobalt (Co)	mg/L	0.000025	0.00184	0.000291	0.000005	2868196
Dissolved Copper (Cu)	mg/L	0.00101(1)	0.00108(1)	0.00092	0.00005	2868196
Dissolved Iron (Fe)	mg/L	0.036	0.119	0.076	0.001	2868196
Dissolved Lead (Pb)	mg/L	0.000078(1)	0.000046	0.000147	0.000005	2868196
Dissolved Lithium (Li)	mg/L	0.0078	0.0082	0.0088	0.0005	2868196
Dissolved Manganese (Mn)	mg/L	0.0162	2.62	0.224	0.00005	2868196
Dissolved Molybdenum (Mo)	mg/L	0.00089	0.00080	0.00084	0.00005	2868196
Dissolved Nickel (Ni)	mg/L	0.00038(1)	0.00480	0.00224	0.00002	2868196
Dissolved Selenium (Se)	mg/L	0.00052	0.00050	0.00053	0.00004	2868196
Dissolved Silicon (Si)	mg/L	5.3	5.4	5.0	0.1	2868196
Dissolved Silver (Ag)	mg/L	<0.000005	<0.000005	<0.000005	0.000005	2868196
Dissolved Strontium (Sr)	mg/L	0.163	0.335	0.194	0.00005	2868196
Dissolved Thallium (Tl)	mg/L	<0.000002	0.000007	0.000003	0.000002	2868196
Dissolved Tin (Sn)	mg/L	<0.00001	0.00008(1)	0.00002	0.00001	2868196
Dissolved Titanium (Ti)	mg/L	<0.0005	<0.0005	<0.0005	0.0005	2868196
Dissolved Uranium (U)	mg/L	0.00249	0.00346	0.00280	0.000002	2868196
Dissolved Vanadium (V)	mg/L	<0.0002	<0.0002	<0.0002	0.0002	2868196
Dissolved Zinc (Zn)	mg/L	0.0021(1)	0.0927	0.223	0.0001	2868196
Dissolved Zirconium (Zr)	mg/L	<0.0001	<0.0001	<0.0001	0.0001	2868196
Dissolved Calcium (Ca)	mg/L	40.6	109	48.2	0.05	2871548
Dissolved Magnesium (Mg)	mg/L	7.76	23.2	12.9	0.05	2871548
Dissolved Potassium (K)	mg/L	0.96	2.12	1.11	0.05	2871548
Dissolved Sodium (Na)	mg/L	2.88	8.40	3.43	0.05	2871548

RDL = Reportable Detection Limit
(1) - dissolved > total, reanalyzed & confirmed. Possible trace level of field-filtered contamination on dissolved metal bottle or there is a discrepancy between samples taken.

MINNOW ENVIRONMENTAL
Client Project #: #2254 BIOASSAY SAMPLING FARO M

Maxxam Job #: A902175
Report Date: 2009/02/18

Sampler Initials: LE

LOW LEVEL DISSOLVED METALS - WATER (WATER)

Maxxam ID		N39681	N39682	N39683		
Sampling Date		2009/01/15 10:00	2009/01/15 14:00	2009/01/15 15:30		
COC#		F117513	F117513	F117513		
	Units	**R-7**	**R-2**	**X-2**	**RDL**	**QC Batch**
Dissolved Sulphur (S)	mg/L	4	77	17	3	2871548

RDL = Reportable Detection Limit

MINNOW ENVIRONMENTAL
Client Project #: #2254 BIOASSAY SAMPLING FARO M

Maxxam Job #: A902175
Report Date: 2009/02/18

Sampler Initials: LE

LOW LEVEL TOTAL METALS - WATER (WATER)

Maxxam ID		N39681	N39682	N39683		
Sampling Date		2009/01/15 10:00	2009/01/15 14:00	2009/01/15 15:30		
COC#		F117513	F117513	F117513		
	Units	**R-7**	**R-2**	**X-2**	**RDL**	**QC Batch**
Calculated Parameters						
Total Hardness (CaCO3)	mg/L	119	321	166	0.5	2862759
Total Metals by ICPMS						
Total Aluminum (Al)	mg/L	0.0059	0.0177	0.0090	0.0002	2868251
Total Antimony (Sb)	mg/L	0.00007	0.00008	0.00009	0.00002	2868251
Total Arsenic (As)	mg/L	0.00050	0.00048	0.00049	0.00002	2868251
Total Barium (Ba)	mg/L	0.0748	0.0699	0.0797	0.00002	2868251
Total Beryllium (Be)	mg/L	<0.00001	<0.00001	<0.00001	0.00001	2868251
Total Bismuth (Bi)	mg/L	<0.000005	<0.000005	<0.000005	0.000005	2868251
Total Boron (B)	mg/L	<0.05	<0.05	<0.05	0.05	2868251
Total Cadmium (Cd)	mg/L	0.000008	0.000066	0.000045	0.000005	2868251
Total Chromium (Cr)	mg/L	<0.0001	<0.0001	<0.0001	0.0001	2868251
Total Cobalt (Co)	mg/L	0.000022	0.00176	0.000311	0.000005	2868251
Total Copper (Cu)	mg/L	0.00025	0.00045	0.00045	0.00005	2868251
Total Iron (Fe)	mg/L	0.090	0.403	0.209	0.001	2868251
Total Lead (Pb)	mg/L	0.000026	0.000326	0.000420	0.000005	2868251
Total Lithium (Li)	mg/L	0.0076	0.0078	0.0089	0.0005	2868251
Total Manganese (Mn)	mg/L	0.0171	2.47	0.232	0.00005	2868251
Total Molybdenum (Mo)	mg/L	0.00085	0.00073	0.00084	0.00005	2868251
Total Nickel (Ni)	mg/L	0.00019	0.00468	0.00222	0.00002	2868251
Total Selenium (Se)	mg/L	0.00059	0.00056	0.00064	0.00004	2868251
Total Silicon (Si)	mg/L	7.2	7.8	8.0	0.1	2868251
Total Silver (Ag)	mg/L	<0.000005	<0.000005	<0.000005	0.000005	2868251
Total Strontium (Sr)	mg/L	0.159	0.311	0.196	0.00005	2868251
Total Thallium (Tl)	mg/L	<0.000002	0.000007	0.000003	0.000002	2868251
Total Tin (Sn)	mg/L	<0.00001	<0.00001	<0.00001	0.00001	2868251
Total Titanium (Ti)	mg/L	<0.0005	<0.0005	<0.0005	0.0005	2868251
Total Uranium (U)	mg/L	0.00241	0.00325	0.00280	0.000002	2868251
Total Vanadium (V)	mg/L	<0.0002	<0.0002	<0.0002	0.0002	2868251
Total Zinc (Zn)	mg/L	0.0005	0.0919	0.229	0.0001	2868251
Total Zirconium (Zr)	mg/L	<0.0001	<0.0001	<0.0001	0.0001	2868251
Total Calcium (Ca)	mg/L	35.9	94.5	45.5	0.05	2871551
Total Magnesium (Mg)	mg/L	7.22	20.7	12.8	0.05	2871551
Total Potassium (K)	mg/L	0.80	1.80	1.04	0.05	2871551
Total Sodium (Na)	mg/L	2.65	7.60	3.37	0.05	2871551
Total Sulphur (S)	mg/L	3	72	16	3	2871551

RDL = Reportable Detection Limit

Maxxam Job #: A902175
Report Date: 2009/02/18

MINNOW ENVIRONMENTAL
Client Project #: #2254 BIOASSAY SAMPLING FARO M

Sampler Initials: LE

QUALITY ASSURANCE REPORT

			Matrix Spike		Spike		Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2860479	Total Phosphorus (P)	2009/01/19	100	80 - 120	82	80 - 120	0.002, RDL=0.002	mg/L	NC	25
2862833	Nitrate plus Nitrite (N)	2009/01/19	99	80 - 120	98	80 - 120	<0.02	mg/L	NC(1)	25
2862835	Nitrite (N)	2009/01/19	100	80 - 120	98	80 - 120	<0.005	mg/L	NC(1)	25
2863778	Dissolved Sulphate (SO4)	2009/01/19	NC	75 - 125	95	80 - 120	<0.5	mg/L	0.4	20
2863780	Dissolved Chloride (Cl)	2009/01/19	104	80 - 120	99	80 - 120	<0.5	mg/L	NC	20
2863781	Ammonia (N)	2009/01/19	115	80 - 120	106	80 - 120	<0.005	mg/L	NC	25
2864452	Alkalinity (Total as CaCO3)	2009/01/19	NC	80 - 120	98	80 - 120	<0.5	mg/L	1	25
2864452	Alkalinity (PP as CaCO3)	2009/01/19					<0.5	mg/L	NC	25
2864452	Bicarbonate (HCO3)	2009/01/19					<0.5	mg/L	1.0	25
2864452	Carbonate (CO3)	2009/01/19					<0.5	mg/L	NC	25
2864452	Hydroxide (OH)	2009/01/19					<0.5	mg/L	NC	25
2865011	Total Dissolved Solids	2009/01/21	NC	80 - 120	110	80 - 120	<10	mg/L	4.8	25
2865421	Fluoride (F)	2009/01/20	108	80 - 120	97	80 - 120	<0.01	mg/L	1.4	25
2866045	Weak Acid Dissoc. Cyanide (CN)	2009/01/20	111	80 - 120	112	80 - 120	<0.0005	mg/L	NC	20
2866860	Total Nitrogen (N)	2009/01/20	108	80 - 120	102	80 - 120	<0.02	mg/L	1.3	25
2868196	Dissolved Arsenic (As)	2009/01/21	100	75 - 125	95	75 - 125	<0.00002	mg/L	1.5	25
2868196	Dissolved Beryllium (Be)	2009/01/21	103	75 - 125	98	75 - 125	<0.00001	mg/L	NC	25
2868196	Dissolved Cadmium (Cd)	2009/01/21	101	75 - 125	97	75 - 125	<0.000005	mg/L	NC	25
2868196	Dissolved Chromium (Cr)	2009/01/21	96	75 - 125	96	75 - 125	<0.0001	mg/L	NC	25
2868196	Dissolved Cobalt (Co)	2009/01/21	93	75 - 125	96	75 - 125	<0.000005	mg/L	NC	25
2868196	Dissolved Copper (Cu)	2009/01/21	93	75 - 125	99	75 - 125	<0.00005	mg/L	8.8	25
2868196	Dissolved Lead (Pb)	2009/01/21	97	75 - 125	102	75 - 125	<0.000005	mg/L	0.3	25
2868196	Dissolved Lithium (Li)	2009/01/21	NC	75 - 125	100	75 - 125	<0.0005	mg/L	0.3	25
2868196	Dissolved Nickel (Ni)	2009/01/21	97	75 - 125	98	75 - 125	<0.00002	mg/L	5.4	25
2868196	Dissolved Selenium (Se)	2009/01/21	109	75 - 125	98	75 - 125	<0.00004	mg/L	5.4	25
2868196	Dissolved Uranium (U)	2009/01/21	103	75 - 125	102	75 - 125	<0.000002	mg/L	0.7	25
2868196	Dissolved Vanadium (V)	2009/01/21	97	75 - 125	95	75 - 125	<0.0002	mg/L	NC	25
2868196	Dissolved Zinc (Zn)	2009/01/21	102	75 - 125	96	75 - 125	<0.0001	mg/L	6.2	25
2868196	Dissolved Aluminum (Al)	2009/01/21					<0.0002	mg/L	5.4	25
2868196	Dissolved Antimony (Sb)	2009/01/21					<0.00002	mg/L	NC	25
2868196	Dissolved Barium (Ba)	2009/01/21					<0.00002	mg/L	2.3	25
2868196	Dissolved Bismuth (Bi)	2009/01/21					<0.000005	mg/L	NC	25
2868196	Dissolved Boron (B)	2009/01/21					<0.05	mg/L	NC	25
2868196	Dissolved Iron (Fe)	2009/01/21					<0.001	mg/L	7.7	25
2868196	Dissolved Manganese (Mn)	2009/01/21					<0.00005	mg/L	0.06	25
2868196	Dissolved Molybdenum (Mo)	2009/01/21					<0.00005	mg/L	1.2	25
2868196	Dissolved Silicon (Si)	2009/01/21					<0.1	mg/L	6.9	25
2868196	Dissolved Silver (Ag)	2009/01/21					<0.000005	mg/L	NC	25
2868196	Dissolved Strontium (Sr)	2009/01/21					<0.00005	mg/L	1.2	25
2868196	Dissolved Thallium (Tl)	2009/01/21					<0.000002	mg/L	NC	25

Maxxam Job #: A902175
Report Date: 2009/02/18

MINNOW ENVIRONMENTAL
Client Project #: #2254 BIOASSAY SAMPLING FARO M

Sampler Initials: LE

QUALITY ASSURANCE REPORT

			Matrix Spike		Spike		Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2868196	Dissolved Tin (Sn)	2009/01/21					<0.00001	mg/L	NC	25
2868196	Dissolved Titanium (Ti)	2009/01/21					<0.0005	mg/L	NC	25
2868196	Dissolved Zirconium (Zr)	2009/01/21					<0.0001	mg/L	NC	25
2868251	Total Arsenic (As)	2009/01/22	104	75 - 125	92	75 - 125	<0.00002	mg/L	4.3	25
2868251	Total Beryllium (Be)	2009/01/22	97	75 - 125	97	75 - 125	<0.00001	mg/L	NC	25
2868251	Total Cadmium (Cd)	2009/01/22	101	75 - 125	93	75 - 125	<0.000005	mg/L	3.8	25
2868251	Total Chromium (Cr)	2009/01/22	99	75 - 125	93	75 - 125	<0.0001	mg/L	NC	25
2868251	Total Cobalt (Co)	2009/01/22	94	75 - 125	93	75 - 125	<0.000005	mg/L	1.2	25
2868251	Total Copper (Cu)	2009/01/22	91	75 - 125	96	75 - 125	<0.00005	mg/L	1	25
2868251	Total Lead (Pb)	2009/01/22	90	75 - 125	100	75 - 125	<0.000005	mg/L	2.0	25
2868251	Total Lithium (Li)	2009/01/22	NC	75 - 125	99	75 - 125	<0.0005	mg/L	1.1	25
2868251	Total Nickel (Ni)	2009/01/22	92	75 - 125	95	75 - 125	<0.00002	mg/L	0.2	25
2868251	Total Selenium (Se)	2009/01/22	112	75 - 125	99	75 - 125	<0.00004	mg/L	2.2	25
2868251	Total Uranium (U)	2009/01/22	99	75 - 125	99	75 - 125	<0.000002	mg/L	3.5	25
2868251	Total Vanadium (V)	2009/01/22	101	75 - 125	93	75 - 125	<0.0002	mg/L	NC	25
2868251	Total Zinc (Zn)	2009/01/22	NC	75 - 125	93	75 - 125	<0.0001	mg/L	1.3	25
2868251	Total Aluminum (Al)	2009/01/22					<0.0002	mg/L	2.8	25
2868251	Total Antimony (Sb)	2009/01/22					<0.00002	mg/L	NC	25
2868251	Total Barium (Ba)	2009/01/22					<0.00002	mg/L	3.3	25
2868251	Total Bismuth (Bi)	2009/01/22					<0.000005	mg/L	NC	25
2868251	Total Boron (B)	2009/01/22					<0.05	mg/L	NC	25
2868251	Total Iron (Fe)	2009/01/22					<0.001	mg/L	5.6	25
2868251	Total Manganese (Mn)	2009/01/22					<0.00005	mg/L	2.1	25
2868251	Total Molybdenum (Mo)	2009/01/22					<0.00005	mg/L	5.2	25
2868251	Total Silicon (Si)	2009/01/22					<0.1	mg/L	2.0	25
2868251	Total Silver (Ag)	2009/01/22					<0.000005	mg/L	NC	25
2868251	Total Strontium (Sr)	2009/01/22					<0.00005	mg/L	0.7	25
2868251	Total Thallium (Tl)	2009/01/22					<0.000002	mg/L	NC	25
2868251	Total Tin (Sn)	2009/01/22					<0.00001	mg/L	NC	25
2868251	Total Titanium (Ti)	2009/01/22					<0.0005	mg/L	NC	25
2868251	Total Zirconium (Zr)	2009/01/22					<0.0001	mg/L	NC	25
2869492	Dissolved Organic Carbon (C)	2009/01/21	107	80 - 120	106	80 - 120	<0.5	mg/L	4.1	20
2871548	Dissolved Calcium (Ca)	2009/01/21					<0.05	mg/L	1.6	25
2871548	Dissolved Magnesium (Mg)	2009/01/21					<0.05	mg/L	1.2	25
2871548	Dissolved Potassium (K)	2009/01/21					<0.05	mg/L	2.0	25
2871548	Dissolved Sodium (Na)	2009/01/21					<0.05	mg/L	0.03	25
2871548	Dissolved Sulphur (S)	2009/01/21					<3	mg/L	NC	25
2871551	Total Calcium (Ca)	2009/01/22					<0.05	mg/L	1.2	25
2871551	Total Magnesium (Mg)	2009/01/22					<0.05	mg/L	0.2	25
2871551	Total Potassium (K)	2009/01/22					<0.05	mg/L	0.9	25

Maxxam Job #: A902175
Report Date: 2009/02/18

MINNOW ENVIRONMENTAL
Client Project #: #2254 BIOASSAY SAMPLING FARO M

Sampler Initials: LE

QUALITY ASSURANCE REPORT

			Matrix Spike		Spike		Blank		RPD	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**	**Value (%)**	**QC Limits**
2871551	Total Sodium (Na)	2009/01/22					<0.05	mg/L	0.8	25
2871551	Total Sulphur (S)	2009/01/22					<3	mg/L	1.2	25
2877065	Ammonia (N)	2009/01/24	93	80 - 120	91	80 - 120	<0.005	mg/L	NC	25
2923039	Dissolved Chloride (Cl)	2009/02/13	114	80 - 120	97	80 - 120	<0.5	mg/L	0.1	20
2923108	Dissolved Sulphate (SO4)	2009/02/13			103	80 - 120	<0.5	mg/L	0.4	20

N/A = Not Applicable
NC = Non-calculable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
(1) - RDL raised due to sample matrix interference.

Validation Signature Page

Maxxam Job #: A902175

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

DAVE HUANG, BBY Scientific Specialist

==

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MaxXam Analytics Inc

8577 Commerce Court
Burnaby, BC V5A 4N5
www.maxxamanalytics.com

Phone: (604) 444-4808
Fax: (604) 444-4511
Toll Free: 1-800-440-4808

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST PAGE 1 OF 1

MAXXAM JOB # A902175 ANALYSIS REQUEST F 117513

COMPANY NAME: MINNOW CONSULTING

PH. #: 905 873 3511 ext 23
E-mail: porr@minnow-environmental.com
FAX #: 905 873 6370

COMPANY ADDRESS: minnow Environmental Inc
2 Lamb St.
Georgetown, Ontario
L7G 3M9

CLIENT PROJECT ID: (#) # 2254
BIOASSAY SAMPLING
FARO MINE COMPLEX

SAMPLER NAME (PRINT): LABERGE ENVIRONMENTAL

PROJECT MANAGER: PATTI ORR

LAB USE ONLY

FIELD SAMPLE ID	MAXXAM LAB # (Lab Use Only)	GROUND WATER	SURFACE WATER	SOIL	DRINKING WATER	OTHER	# CONTAINERS	DATE (DD/MM/YY) 2009	TIME	HEADSPACE VAPOUR	BTEX / LH	BTEX / VPH	MTBE	VOC's / VPH	EPH	TEH	PAH	LEPH/HEPH	CCME-PHC (FRACTIONS 1-4 PLUS BTEX)	CCME-PHCS (FRACTIONS 2-4)	CCME BTEX (FRACTION 1 PLUS BTEX)	PHENOLS BY 4AAP	PHENOLS BY GCMS	TOTAL O&G	MINERAL O&G	Dissolved Metals Field Filtered? YES ✓ NO	Field Preserved? YES ✓ NO	Total Metals Field Preserved? YES ✓ NO	NITRATE ✓ NITRITE ✓ AMMONIA ✓	CHLORIDE ✓ FLUORIDE ✓ SULPHATE ✓	TOTAL SUSPENDED SOLIDS (NFR) ✓	CYANIDE SAD WAD ✓	LEACHABLE LEAD (AA) (TCLP)	LEACHABLE BTEX (AA) (TCLP)	NUTRIENTS: Ammonia (N)	TKN, Nitrate + Nitrite	N (TOTAL), P (TOTAL)	Dissolved Organic Carbon	Alkalinity (Total as CaCO3)	Alkalinity (PP as CaCO3)	Bicarbonate (HCO3)	Carbonate (CO3)	Hydroxide (OH)	TOTAL DISSOLVED SOLIDS	HOLD
1 R-7			✓					15/01	10:00																	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
2 R-2			✓					15/01	14:00																	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
3 X-2			✓					15/01	15:30																	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
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11																																													
12																																													

TAT (Turnaround Time)

<5 DAY TAT MUST HAVE PRIOR APPROVAL

*some exceptions apply please contact lab

STANDARD 5 BUSINESS DAYS ☑
RUSH 3 BUSINESS DAYS ☐
RUSH 2 BUSINESS DAYS ☐
URGENT 1 BUSINESS DAY ☐
OTHER BUSINESS DAYS ____

P.O. NUMBER / QUOTE NUMBER:

SPECIAL DETECTION LIMITS / CONTAMINANT TYPE:
Low LEVEL DLs
SEE ATTACHED RESULTS
MAXXAM # A843579

☐ CCME
☐ CSR
☐ ALBERTA TIER 1
☐ OTHER

LAB USE ONLY

ARRIVAL TEMPERATURE °C	DUE DATE:	LOG IN CHECK:
3, 3, 3		

ACCOUNTING CONTACT:

SPECIAL REPORTING OR BILLING INSTRUCTIONS:

JARS USED:

RELINQUISHED BY SAMPLER: STH WITHERS	DATE: DD/MM/YY 16/01/09	TIME: 16:00	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY	TIME:	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY 19/01/09	TIME 10:10	RECEIVED BY LABORATORY: A. M

CUSTODY RECORD

COCFORM BC 06/08

ORIGINAL - MAXXAM YELLOW - MAXXAM

Toxicity

AquaTox Testing & Consulting Inc.
11B Nicholas Beaver Rd.
RR 3
Guelph ON N1H 6H9
Tel: (519) 763-4412 Fax: (519) 763-4419

Hyalella azteca Test Report

Survival and Growth

SAMPLE IDENTIFICATION

Work Order:	211960	Shipped By:	Fed Ex/Rd
Company :	Minnow Environmental Inc. (BMS Corp.)	Date Received :	2007-09-06
Location :	Mississauga ON	Time Received :	14:00
Sampling Method :	Composite	Date Tested :	2007-09-19
Sampled By :	K. Connors	Lab Storage:	4±2 °C
Sample Volume:	1 x 5 L pail		

Test Method : Test for Survival and Growth in Sediment Using the Freshwater Amphipod *Hyalella azteca*. Environment Canada, Conservation and Protection. Ottawa, Ontario. Report EPS 1/RM/33, December, 1997.

SAMPLE SUMMARY

Sample Number	Sample Name	Description	Sample Date	Sample Time	Temp. on Arrival
-	Control	Fine brown organic sediment; no odour.	2006-08-28	11:00	-
19474	V27-A (d/s 01)	Dark brown with rocks, vegetation, mild odour.	2007-08-28	12:00	18.5 °C
19475	V27-B (03)	Dark brown with rocks, no odour.	2007-08-28	12:00	18.5 °C
19476	V27-C (04)	Dark brown with rocks, no odour.	2007-08-28	12:00	18.5 °C
19477	V1	Brown with rocks, no odour.	2007-08-28	15:00	18.5 °C

RESULTS

Survival Data (Treatment Average Survival, %)[1]

Control	V27-A (d/s 01)	V27-B (03)	V27-C (04)	V1
100	100	100	100	100

[1]Based on visual inspection of the data, samples sharing the same line are not significantly different from one another (i.e. they are considered to be homogenous, that is, from the same population) (α =0.05). Data did not meet the assumptions for normality and homogeneity of variance.

Growth Data (Treatment Average Weight, mg)[2]

V27-C (04)	Control	V27-B (03)	V27-A (d/s 01)	V1
0.275	0.297	0.307	0.357	0.410

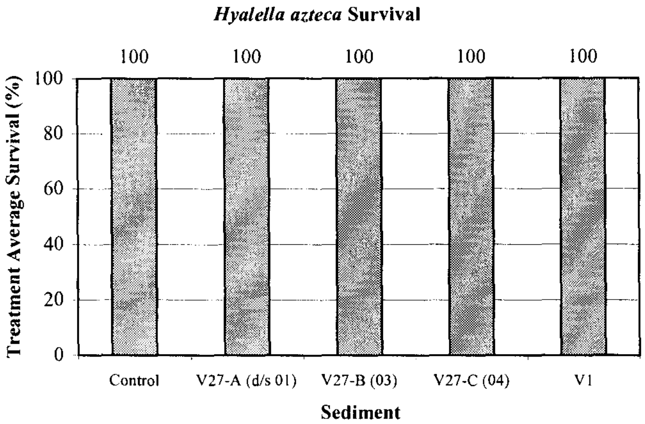
[2] **Tukey Method of Multiple Comparisons (Toxstat 3.5)[a]:** Samples sharing the same line are not significantly different from one another (i.e. they are considered to be homogenous, that is, from the same population) (α =0.05). All data sets met the assumptions for normality and homogeneity of variance.

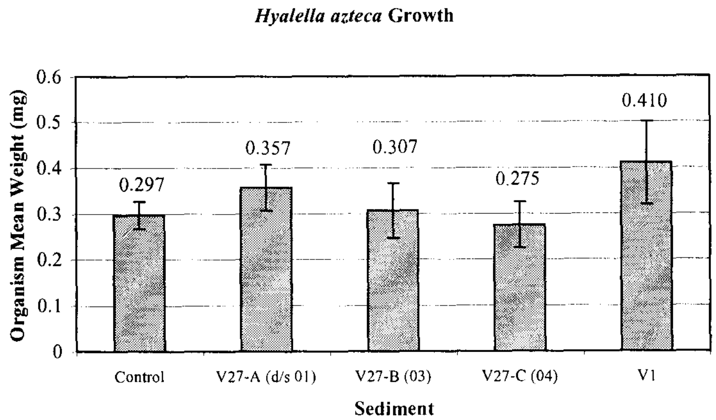
POTASSIUM CHLORIDE REFERENCE TOXICANT DATA

Test Date :	2007-09-07	Historical Mean LC50 :	145 µg/L
Test Duration :	96 hours	Warning Limits (± 2 SD) :	79 - 265
LC50 (95% confidence limits) :	187 µg/L (143 - 244)	Statistical Method :	Probit [b]
Organism Batch :	Ha07-09	Test Conducted By :	KJ/EJ/AS

The reference toxicant test was conducted as a water only test, as specified in the test method.

Work Order : 211960





SEDIMENT CHARACTERISTICS

Sample Number	Sample Name	TOC (mg/kg)	Moisture Content (%)	Particle Size (%) Gravel	Sand	Silt	Clay
–	Control	93000	72.0	0.00	42.00	58.00	<2
19474	V27-A (d/s 01)	3700	7.2	48	51	0.3	0.9
19475	V27-B (03)	3000	16.7	41	58	0.4	1.2
19476	V27-C (04)	2400	20.9	29	70	0.4	1.1
19477	V1	1300	15.7	82	17	0.1	1.0

TEST CONDITIONS

Test Organism:	*Hyalella azteca*	Test Vessel:	300 mL pyrex beaker
Organism Batch :	Ha07-09	Sediment Depth:	Approx. 3.5 cm
Source:	In-house culture	Sediment Volume:	100 mL per replicate
Life Stage on Test Day 0 :	2-9 days old	Overlying Water Volume:	175 mL per replicate
Test Type:	Static	Control/Test Water:	Well water (no chemicals added)
Samples per Treatment [c]:	1	Control Sediment:	Long Point, Lake Erie
Number of Replicates:	5	Test Aeration :	Yes (all replicates)
Organisms per Replicate:	10	Test Aeration Rate :	2-3 bubbles per second
Organisms per Treatment:	50	Photoperiod (light/dark) :	16 h / 8 h
Feed Type:	YCT (Batch 07-05)	Light Intensity :	646 - 692 lux
Feeding Rate (per replicate):	~2.7 mg dry solids daily	Test Method Deviations :	None
Test Duration :	14 days		

[c] as disclosed by the client

COMMENTS

The results reported relate only to the sample tested.
All test validity criteria as specified in the test method cited in this report were met.
No organisms exhibiting unusual appearance, behavior, or undergoing unusual treatment were used in the test.

REFERENCES

[a] West, Inc. and D. Gulley. 1996. Toxstat Release 3.5. Western Ecosystems Technology. Cheyenne, WY, U.S.A.

[b] Stephan, C. E. 1977. Methods for calculating an LC50. P. 65-84 In: P.L. Mayer and J. L. Hamelink (eds.), Aquatic Toxicology and Hazard Evaluation. Amer. Soc. Testing and Materials, Philadelphia PA. ASTM STP 634.

Date: 2007-10-30
yyyy-mm-dd

Approved by: [signature]
Project Manager

Work Order : 211960

Hyalella azteca Survival Data

Sample	Replicate	Number of Survivors (n=10)	Surviving Organisms (%)	Treatment Average Survival (%)	Standard Deviation	CV (%)
Control	A	10	100	100	0.0	0.0
	B	10	100			
	C	10	100			
	D	10	100			
	E	10	100			
19474 V27-A (d/s 01)	A	10	100	100	0.0	0.0
	B	10	100			
	C	10	100			
	D	10	100			
	E	10	100			
19475 V27-B (03)	A	10	100	100	0.0	0.0
	B	10	100			
	C	10	100			
	D	10	100			
	E	10	100			
19476 V27-C (04)	A	10	100	100	0.0	0.0
	B	10	100			
	C	10	100			
	D	10	100			
	E	10	100			
19477 V1	A	10	100	100	0.0	0.0
	B	10	100			
	C	10	100			
	D	10	100			
	E	10	100			

Hyalella azteca Weight Data

Sample	Replicate	Foil Weight (mg)	Dry Weigt of Foil + Organisms (mg)	Number of Organisms Weighed	Mean Dry Weight of Organisms (mg)	Treatment Mean Dry Weight (mg)	Standard Deviation	CV (%)
Control	A	779.18	782.50	10	0.332	0.297	0.03	8.7
	B	766.05	768.75	10	0.270			
	C	770.20	773.26	10	0.306			
	D	766.30	769.03	10	0.273			
	E	783.01	786.07	10	0.306			
19474 V27-A (d/s 01)	A	772.70	775.83	10	0.313	0.357	0.05	14.5
	B	776.30	779.73	10	0.343			
	C	799.58	804.00	10	0.442			
	D	770.42	773.64	10	0.322			
	E	774.17	777.83	10	0.366			
19475 V27-B (03)	A	769.81	773.27	10	0.346	0.307	0.06	20.4
	B	775.14	777.91	10	0.277			
	C	764.58	768.45	10	0.387			
	D	765.16	768.14	10	0.298			
	E	767.44	769.69	10	0.225			
19476 V27-C (04)	A	766.32	768.94	10	0.262	0.275	0.05	18.7
	B	764.93	766.85	10	0.192			
	C	789.05	792.02	10	0.297			
	D	771.49	774.74	10	0.325			
	E	783.93	786.92	10	0.299			
19477 V1	A	783.17	788.23	10	0.506	0.410	0.09	21.8
	B	780.38	784.62	10	0.424			
	C	789.62	793.23	10	0.361			
	D	782.02	784.85	10	0.283			
	E	804.57	809.31	10	0.474			

Data Reviewed By: I
Date: 2007 10-26

Hyalella azteca Sediment Test Data

Work Order :	211960
Sample Number :	**Control**
Species:	*Hyalella azteca*
Organism Batch :	Ha07-09
Sediment pH:	7.3
Pore Water pH:	7.9
Pore Water Ammonia (mg/L) :	10.5
Sample Treatment:	Dry sieved (2 mm)
Time Start:	12:45

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Analyst(s)	Conductivity (µmhos)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Wed	2007-09-19	23.0	Composite	7.8	Y	KJ	509	8.4	260	3.00	0.33
1	Thurs	2007-09-20	24.0	–	–	Y	KJ	–	–	–	–	–
2	Fri	2007-09-21	23.0	A	8.1	Y	KJ	–	–	–	–	–
3	Sat	2007-09-22	24.0	–	–	Y	HR	–	–	–	–	–
4	Sun	2007-09-23	23.0	–	–	Y	HR	–	–	–	–	–
5	Mon	2007-09-24	23.0	B	8.3	Y	EJ	–	–	–	–	–
6	Tues	2007-09-25	23.0	–	–	Y	KJ	–	–	–	–	–
7	Wed	2007-09-26	23.0	C	7.7	Y	KJ	–	–	–	–	–
8	Thurs	2007-09-27	23.0	–	–	Y	KJ	–	–	–	–	–
9	Fri	2007-09-28	23.0	D	7.8	Y	KJ	–	–	–	–	–
10	Sat	2007-09-29	23.0	–	–	Y	JL	–	–	–	–	–
11	Sun	2007-09-30	23.0	–	–	Y	KJ	–	–	–	–	–
12	Mon	2007-10-01	23.0	A	7.6	Y	KJ	–	–	–	–	–
13	Tues	2007-10-02	24.0	–	–	Y	KJ	–	–	–	–	–
14	Wed	2007-10-03	24.0	Composite	7.6	N	KJ	554	8.4	260	0.45	0.05

"–" = not measured

Data Reviewed By: JL
Date: 2007-10-26

Hyalella azteca Sediment Test Data

Work Order : 211960
Sample Number : **19474**
Species: *Hyalella azteca*
Organism Batch : Ha07-09
Sediment pH: 7.1
Pore Water pH: 7.5
Pore Water Ammonia (mg/L) : 0.3
Sample Treatment: Hand homogenized
Time Start: 13:05

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Analyst(s)	Conductivity (µmhos)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Wed	2007-09-19	23.0	Composite	7.9	Y	KJ	453	8.4	230	0.75	0.08
1	Thurs	2007-09-20	24.0	–	–	Y	KJ	–	–	–	–	–
2	Fri	2007-09-21	23.0	A	7.8	Y	KJ	–	–	–	–	–
3	Sat	2007-09-22	24.0	–	–	Y	HR	–	–	–	–	–
4	Sun	2007-09-23	23.0	–	–	Y	HR	–	–	–	–	–
5	Mon	2007-09-24	23.0	B	8.4	Y	EJ	–	–	–	–	–
6	Tues	2007-09-25	23.0	–	–	Y	KJ	–	–	–	–	–
7	Wed	2007-09-26	23.0	C	7.9	Y	KJ	–	–	–	–	–
8	Thurs	2007-09-27	23.0	–	–	Y	KJ	–	–	–	–	–
9	Fri	2007-09-28	23.0	D	7.6	Y	KJ	–	–	–	–	–
10	Sat	2007-09-29	23.0	–	–	Y	JL	–	–	–	–	–
11	Sun	2007-09-30	23.0	–	–	Y	KJ	–	–	–	–	–
12	Mon	2007-10-01	23.0	A	7.8	Y	KJ	–	–	–	–	–
13	Tues	2007-10-02	24.0	–	–	Y	KJ	–	–	–	–	–
14	Wed	2007-10-03	23.0	Composite	7.8	N	KJ	518	7.8	250	0.30	0.01

"–" = not measured

Data Reviewed By: JL
Date: 2007 10 26

Hyalella azteca Sediment Test Data

Work Order :	211960
Sample Number :	**19475**
Species:	*Hyalella azteca*
Organism Batch :	Ha07-09
Sediment pH:	7.4
Pore Water pH:	7.5
Pore Water Ammonia (mg/L) :	0.0
Sample Treatment:	Hand homogenized
Time Start:	13:00

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Analyst(s)	Conductivity (µmhos)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Wed	2007-09-19	23.0	Composite	7.8	Y	KJ	454	8.4	210	0.25	0.03
1	Thurs	2007-09-20	24.0	–	–	Y	KJ	–	–	–	–	–
2	Fri	2007-09-21	23.0	A	8.2	Y	KJ	–	–	–	–	–
3	Sat	2007-09-22	24.0	–	–	Y	HR	–	–	–	–	–
4	Sun	2007-09-23	23.0	–	–	Y	HR	–	–	–	–	–
5	Mon	2007-09-24	23.0	B	8.4	Y	EJ	–	–	–	–	–
6	Tues	2007-09-25	23.0	–	–	Y	KJ	–	–	–	–	–
7	Wed	2007-09-26	23.0	C	8.0	Y	KJ	–	–	–	–	–
8	Thurs	2007-09-27	23.0	–	–	Y	KJ	–	–	–	–	–
9	Fri	2007-09-28	23.0	D	7.4	Y	KJ	–	–	–	–	–
10	Sat	2007-09-29	23.0	–	–	Y	JL	–	–	–	–	–
11	Sun	2007-09-30	23.0	–	–	Y	KJ	–	–	–	–	–
12	Mon	2007-10-01	23.0	A	8.0	Y	KJ	–	–	–	–	–
13	Tues	2007-10-02	24.0	–	–	Y	KJ	–	–	–	–	–
14	Wed	2007-10-03	23.0	Composite	7.6	N	KJ	508	8.3	260	0.40	0.04

"–" = not measured

Data Reviewed By: JL
Date 2007-10-26

Hyalella azteca Sediment Test Data

Work Order :	211960
Sample Number :	**19476**
Species:	*Hyalella azteca*
Organism Batch :	Ha07-09
Sediment pH:	7.1
Pore Water pH:	7.5
Pore Water Ammonia (mg/L) :	0.0
Sample Treatment:	Hand homogenized
Time Start:	12:55

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Analyst(s)	Conductivity (μmhos)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Wed	2007-09-19	23.0	Composite	7.8	Y	KJ	418	8.4	220	0.75	0.08
1	Thurs	2007-09-20	24.0	–	–	Y	KJ	–	–	–	–	–
2	Fri	2007-09-21	23.0	A	8.3	Y	KJ	–	–	–	–	–
3	Sat	2007-09-22	24.0	–	–	Y	HR	–	–	–	–	–
4	Sun	2007-09-23	23.0	–	–	Y	HR	–	–	–	–	–
5	Mon	2007-09-24	23.0	B	8.4	Y	EJ	–	–	–	–	–
6	Tues	2007-09-25	23.0	–	–	Y	KJ	–	–	–	–	–
7	Wed	2007-09-26	23.0	C	7.6	Y	KJ	–	–	–	–	–
8	Thurs	2007-09-27	23.0	–	–	Y	KJ	–	–	–	–	–
9	Fri	2007-09-28	23.0	D	7.7	Y	KJ	–	–	–	–	–
10	Sat	2007-09-29	23.0	–	–	Y	JL	–	–	–	–	–
11	Sun	2007-09-30	23.0	–	–	Y	KJ	–	–	–	–	–
12	Mon	2007-10-01	23.0	A	7.9	Y	KJ	–	–	–	–	–
13	Tues	2007-10-02	24.0	–	–	Y	KJ	–	–	–	–	–
14	Wed	2007-10-03	23.0	Composite	7.6	N	KJ	512	8.3	240	<0.05	0.00

"–" = not measured

Data Reviewed By: JL
Date: 2007-10-26

Hyalella azteca Sediment Test Data

Work Order :	211960
Sample Number :	**19477**
Species:	*Hyalella azteca*
Organism Batch :	Ha07-09
Sediment pH:	7.2
Pore Water pH:	7.1
Pore Water Ammonia (mg/L) :	0.0
Sample Treatment:	Hand homogenized
Time Start:	12:50

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Analyst(s)	Conductivity (µmhos)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Wed	2007-09-19	23.0	Composite	7.8	Y	KJ	446	8.4	210	0.00	0.00
1	Thurs	2007-09-20	24.0	–	–	Y	KJ	–	–	–	–	–
2	Fri	2007-09-21	23.0	A	8.3	Y	KJ	–	–	–	–	–
3	Sat	2007-09-22	24.0	–	–	Y	HR	–	–	–	–	–
4	Sun	2007-09-23	23.0	–	–	Y	HR	–	–	–	–	–
5	Mon	2007-09-24	23.0	B	8.2	Y	EJ	–	–	–	–	–
6	Tues	2007-09-25	23.0	–	–	Y	KJ	–	–	–	–	–
7	Wed	2007-09-26	23.0	C	7.9	Y	KJ	–	–	–	–	–
8	Thurs	2007-09-27	23.0	–	–	Y	KJ	–	–	–	–	–
9	Fri	2007-09-28	23.0	D	4.6	Y	KJ	–	–	–	–	–
10	Sat	2007-09-29	23.0	–	–	Y	JL	–	–	–	–	–
11	Sun	2007-09-30	23.0	–	–	Y	KJ	–	–	–	–	–
12	Mon	2007-10-01	23.0	A	7.5	Y	KJ	–	–	–	–	–
13	Tues	2007-10-02	24.0	–	–	Y	KJ	–	–	–	–	–
14	Wed	2007-10-03	23.0	Composite	7.6	N	KJ	472	8.3	210	1.45	0.13

"–" = not measured

Data Reviewed By: JL
Date: 2007-10-26

Attention: Lesley Novak

CHAIN OF CUSTODY RECORD

Stantec

Stantec Work Order No: 211960

Shipping Address: Stantec Consulting Ltd.
11B Nicholas Beaver Road, RR #3
Guelph, Ontario Canada N1H 6H9

Voice: (519) 763-4412 Fax: (519) 763-4419

P.O. Number: 2212
Field Sampler Name (print): KIM CONNORS
Signature: Kim Connors
Affiliation: Minnow
Sample Storage (prior to shipping): fridge
Custody Relinquished by:
Date/Time Shipped: Sept

Client: Minnow Environmental
6800 KITIMAT RD
UNIT 13, MISSISSAUGA ON
Phone: 905-567-8771
Fax: 905-567-6805
Contact: PATTI ORIZ

Sample Identification					Analyses Requested							Sample Method and Volume		
Date Collected (yyyy-mm-dd)	Time Collected (e.g. 14:30, 24 hr clock)	Sample Name	Stantec Sample Number	Temp. on arrival	Rainbow trout Single Concentration	Daphnia magna Single Concentration	Hyalella azteca 14-d Survival and Growth	Chironomus sp. 10-d Survival and Growth	Selenastrum capricornutum Growth		Other (please specify below)	Grab	Composite	# of Containers and Volume (eg. 2 x 1L, 3 x 10L, etc.)
Aug 28, 07	~12:00	V27-A (ds 01)	19474	8.5			✓						✓	1 x 3L
"	~12:00	V27-B (03)	19475	↓			✓						✓	1 x 3L
"	~12:00	V27-C (04)	19476				✓						✓	1 x 3L
"	~15:00	V1	19477				✓						✓	1 x 3L

shipment complete

For Lab Use Only
Received By: Francoise (Stantec)
Date: 2007-09-06
Time: 1400
Storage Location: walk in cooler
Storage Temp.(°C): 4±2°C

Please list any special requests or instructions:
Cooler 1 of 2

2007-09-06

Toxicity Testing on the sample identified as R-7

Revised Toxicity Test Report

Report date: February 9, 2009

Submitted to:

Minnow Environmental Incorporated
Georgetown, ON

Burnaby Laboratory
8664 Commerce Court
Burnaby, BC
V5A 4N7

TABLE OF CONTENTS

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LIST OF APPENDICES

1.0 INTRODUCTION

Nautilus Environmental (Burnaby, BC) conducted sub-lethal and acute toxicity tests for Minnow Environmental on the sample identified as R-7, collected on August 21, 2008 and delivered to the Nautilus Environmental Laboratory in Burnaby, BC on August 25, 2008. The sample (collected in 20-L collapsible containers) was transported in coolers containing ice packs and stored in the dark at 4° C prior to testing. Toxicity testing was performed on the sample using the following tests:

- *Ceriodaphnia dubia* survival and reproduction
- 72-h *Pseudokirchneriella subcapitata* growth inhibition (formerly identified as *Selenastrum capricornutum*)
- 96-h Rainbow trout *(Oncorhynchus mykiss)* LC50

This report describes the results of these toxicity tests. Copies of raw laboratory data sheets and statistical analysis for each test species are provided in Appendices A to C. The chain of custody form is provided in Appendix D.

2.0 METHODS

Methods for the toxicity tests are summarized in Tables 1 to 3. Testing was conducted according to procedures described by Environment Canada (2000a, 2007a and 2007b).

Statistical analyses for all the tests were performed using CETIS (Tidepool Scientific Software, 2007).

2.1 Quality Assurance/Quality Control (QA/QC)

Nautilus follows a comprehensive QA/QC program to ensure that data generated are of high quality and scientifically defensible. Our QA program is designed to ensure that all tests are performed in accordance with well-established and approved methods (e.g., Environment Canada, US EPA).

To meet these objectives, Nautilus has implemented a number of quality control procedures that include the following:

- Negative controls to ensure that appropriate testing performance criteria are met;
- Positive control to assess the health and sensitivity of the test organisms;
- Use of appropriate species and life stage to meet the study objectives;
- Appropriate number of replicates to allow the proper statistical analyses;
- Calibration and proper maintenance of instruments to ensure accurate measurements;
- Proper documentation and record keeping to allow traceability of performance;
- Adequate supervision and training of staff to ensure that methods are followed;
- Proper handling and storage to ensure sample integrity;
- Procedures in place to address issues that arise during testing so that appropriate corrective actions can be implemented; and
- Rigorous review of data by a registered professional biologist to ensure they are of good quality and scientifically defensible prior to releasing to the client.

Table 1. Summary of test conditions for the *Ceriodaphnia dubia* survival and reproduction test.

Test organism	*Ceriodaphnia dubia*
Test organism source	In-house culture
Test organism age	<24 hr old neonates produced within 12 hr
Test type	Static renewal
Test duration	7 ± 1 day
Test chamber	20 mL test tube
Test solution volume	15 mL
Test concentrations	Seven concentrations, plus laboratory control
Number of replicates	10
Control/dilution water	20% Perrier water (hardness 80-100mg/L $CaCO_3$)
Test solution renewal	Daily
Test temperature	25 ± 1°C
Number of organisms/chamber	1
Feeding	Daily, with 0.1 ml *Pseudokirchneriella subcapitata* and 0.05 mL YCT
Light intensity	100 to 600 lux
Photoperiod	16 hours light/8 hours dark
Aeration	None
Test protocol	Environment Canada (2007a), EPS 1/RM/21
Test endpoints	Survival and reproduction
Test acceptability criteria for criteria for control	≥80% survival; ≥15 young per surviving control; ≥60% of controls producing three or more broods
Reference Toxicant	Sodium chloride

Table 2. Summary of test conditions for the *Pseudokirchneriella subcapitata* growth inhibition test.

Test organism	*Pseudokirchneriella subcapitata*
Test organism source	In-house culture
Test organism age	3 to 7-day old culture in logarithmic growth phase
Test type	Static
Test duration	72 hours
Test chamber	Microplate
Test solution volume	220 µL
Test concentrations	Seven concentrations, plus laboratory control
Number of replicates	4 for treatments; 8 for control
Control/Dilution water	Deionized or distilled water
Test solution renewal	None
Test temperature	24 ± 2°C
Number of organisms/chamber	10,000 cells/mL
Light intensity	3600 to 4400 lux
Photoperiod	Continuous
Aeration	None
Test protocol	Environment Canada (2007b), EPS 1/RM/25
Test endpoint	Algal cell growth inhibition
Test acceptability criteria for control	≥ 16-fold increase in number of algal cells; no trend; and CV ≤ 20%
Reference toxicant	Zinc

Table 3. Summary of test conditions for the 96-h LC50 rainbow trout test.

Test organism	*Oncorhynchus mykiss*
Test organism source	Commercial hatchery
Test organism age	Juveniles
Test type	Static
Test duration	96 hours
Test chamber	18.2 L glass aquarium
Test solution volume	10 L
Test concentrations	Five concentrations, plus laboratory control
Number of replicates	1
Control/Dilution water	Municipal dechlorinated water
Test solution renewal	None
Test temperature	15 ± 1°C
Number of organisms/chamber	Ten
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light/8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test protocol	Environment Canada (2000b), EPS 1/RM/13
Test endpoint	Survival
Test acceptability criterion for control	Survival ≥ 90%
Reference toxicant	Sodium dodecyl sulphate

3.0 RESULTS

Results of the toxicity tests are summarized in Tables 4 to 6. The *C. dubia* test did not show any significant adverse effects on survival; the LC50 for survival was >100%. Reproduction was inhibited in all of the test concentrations, with the exception of the lowest (1.56%) relative to the negative control. However, the dose-response observed in this test was unusual, with a larger adverse effect occurring in the intermediate concentrations than in the full-strength sample. This pattern of effect might be explained by a toxicant that was present at concentrations significantly exceeding its rate of solubility. Alternatively, this type of pattern could be associated with the presence of microorganisms in the sample that adversely affected the test organisms, or by some interaction between the sample and dilution water.

Thus, some or all of the observed effect may be an artifact associated with the test, rather than being related to a true toxicological property of the sample. Despite the reduced reproduction observed in most of the test concentrations, the lack of dose-response and limited overall adverse effect (i.e., none of the concentrations caused more than a 50% reduction in reproduction), tends to suggest that it is unlikely that reduced reproduction was caused by a toxicant. Future tests with samples from this site should be evaluated carefully to establish whether this pattern is repeated. Calculated NOEC, LOEC and IC25 values are reported for this test in Table 4; however, these results should only be considered in the context of the discussion provided above.

The 72-h *P. subcapitata* toxicity test did not show any significant inhibitory effects on growth. All the test concentrations exhibited enhanced growth relative to the negative control. The IC25 and IC50 were both >95.2%, the highest concentration tested.

The LC50 in the 96-h rainbow trout toxicity test was >100%, although 30% mortality was observed in the full-strength sample.

3.1 Quality Assurance/Quality Control

The health history of the test organisms used in the exposures was acceptable and met the requirements of the Environment Canada protocols. The tests met all control acceptability criteria and water quality parameters were within acceptable ranges specified in the respective test protocol.

Results of the reference toxicant test conducted during the testing program are summarized in Table 7. Results of these tests were all within the acceptable ranges of organism performance (mean ± two standard deviations), based on historical results obtained by the laboratory. These comparable results verify the acceptable quality and similar sensitivity of organisms used in this study.

The *C. dubia* and *P. subcapitata* tests were initiated on August 26, 2008, which was five days after sample collection, and longer than the three days recommended in the test protocols. The delay associated with initiation of the tests was caused by transportation time for the samples.

Table 4. Toxicity test results for the *Ceriodaphnia dubia* survival and reproduction test.

Concentration (%v/v)	Survival (%)	Reproduction (No. of Young/Female) (Mean ± SD)
Control	100	16.9 ± 2.2
1.56	100	16.8 ± 1.5
3.12	100	13.3 ± 3.3*
6.25	100	12.7 ± 4.5*
12.5	100	11.2 ± 3.9*
25	100	8.8 ± 3.0*
50	100	9.2 ± 3.9*
100	100	11.7 ± 3.2*
Test endpoint	**Survival (% v/v)**	**Reproduction (% v/v)**
NOEC	100	1.56 – See text
LOEC	>100	3.12 – See text
LC50	>100	--
IC25 (95% CL)	--	6.3 (2.6 – 14.0) – See text
IC50	--	>100

Asterisks (*) indicate treatments that are significantly different from the control.
CL = Confidence Limits.
NOEC = No Observed Effect Concentration.
LOEC = Lowest Observed Effect Concentration.
LC = Lethal Concentration.
IC = Inhibition Concentration.
SD = Standard Deviation.

Table 5. Toxicity test results for the *Pseudokirchneriella subcapitata* growth inhibition test.

Concentration (% v/v)	Cell Density (x 10^4 cells/mL) (Mean ± SD)
Control	22.5 ± 2.9
1.48	21.8 ± 1.7
2.95	23.8 ± 3.0
5.95	25.2 ± 6.6
11.9	28.5 ± 2.6
23.8	31.8 ± 6.2
47.6	62.2 ± 15.5
95.2	69.2 ± 15.6
Test endpoint	**Cell Density (% v/v)**
NOEC	95.2
LOEC	>95.2
IC25	>95.2
IC50	>95.2

NOEC = No Observed Effect Concentration.
LOEC = Lowest Observed Effect Concentration.
IC = Inhibition Concentration.
SD = Standard Deviation.

Table 6. Toxicity test results for the 96-h LC50 juvenile rainbow trout (*O. mykiss*) test.

Concentration (% v/v)	% Survival
Control	100
6.25	100
12.5	100
25.0	100
50.0	100
100.0	70
Test endpoint	**Survival (% v/v)**
LC50	>100

LC = Lethal Concentration.

Table 7. Reference toxicant test results.

Species	Endpoint	Historical range (mean ± 2 SD)	CV(%)	Date Setup
C. dubia	Survival (EC50): 1.8 g/L NaCl	1.5 ± 0.8	27	August 14, 2008
	Reproduction (IC50): 1.2 g/L NaCl	1.1 ± 0.5	21	
P. subcapitata	Growth (IC50): 17.4 µg/L Zn	16.1 ± 13.4	42	August 26, 2008
O.mykiss (juvenile)	Survival (EC50): 5.0 mg/L SDS	5.4 ± 2.0	19	August 8, 2008

REFERENCES

Environment Canada. 2000. Biological test method: reference method for determining acute lethality of effluents to rainbow trout. Environmental Protection Series. Report EPS 1/RM/13, Second Edition, December 2000, including May 2007 amendments. Environment Canada, Method Development and Application Section, Environmental Technology Centre, Ottawa, ON. 23 pp.

Environment Canada. 2007a. Biological test method: test of reproduction and survival using the cladoceran *Ceriodaphnia dubia*. Environmental Protection Series. Report EPS 1/RM/21, Second Edition, February 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON. 74 pp.

Environment Canada. 2007b. Biological test method: growth inhibition test using the freshwater alga. Environmental Protection Series, Report EPS 1/RM/25. Second Edition, March 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON. 53 pp.

Tidepool Scientific Software. 2007. CETIS comprehensive environmental toxicity information system, version 1.5.0D. Tidepool Scientific Software, McKinleyville, CA. 222 pp.

APPENDIX A – *Ceriodaphnia dubia* Toxicity Test Data

Ceriodaphnia dubia Summary Sheet

Client: Minnow Environmental

Work Order No.: 08198

Start Date/Time: Aug. 26/08 @ 1115h

Set up by: ~~MOD~~ DKL

Sample Information:

Sample ID: R7

Sample Date: Aug. 21/08

Date Received: Aug 25/08

Sample Volume: 2 x 20L

Test Organism Information:

Broodstock No.: 081908

Age of young (Day 0): <24-h (w/in 12-h)

Avg No. young in first 3 broods of previous 7 d: 17

Mortality (%) in previous 7 d: 3

Avg. No. of young in previous brood: 8

NaCl Reference Toxicant Results:

Reference Toxicant ID: CD343

Stock Solution ID: 08 NaO2

Date Initiated: Aug. 14/08

7-d LC50 (95% CL): 1.8 (1.6, 2.2) g/L NaCl

7-d IC50 (95% CL): 1.2 (1.1, 1.3) g/L NaCl

7-d LC50 Reference Toxicant Mean ± 2 SD: 1.5 ± 0.8 g/L NaCl CV (%): 27

7-d IC50 Reference Toxicant Mean ± 2 SD: 1.1 ± 0.5 g/L NaCl CV (%): 21

Test Results:

	Survival	Reproduction
NOEC %(v/v)	100	1.56
LOEC %(v/v)	>100	3.12
LC50 %(v/v) (95% CL)	>100	
IC25 %(v/v) (95% CL)		63 (26 - 140)
IC50 %(v/v) (95% CL)		>100

Reviewed by: JRG

Date reviewed: 27/10/08

Chronic Freshwater Toxicity Test
Initial and Final Water Quality Measurements

Client: Minnow
Sample ID: R7
Work Order #: 08198
% (v/v)

Start Date & Time: Aug 26/08 @ 1115h
Stop Date: Sept 1/08 @ 1300h
Test Species: *Ceriodaphnia dubia*

Control Concentration	Day 0 init.	Day 1 old	Day 1 new	Day 2 old	Day 2 new	Day 3 old	Day 3 new	Day 4 old	Day 4 new	Day 5 old	Day 5 new	Day 6 old	Day 6 new	Day 7 final
Temperature (°C)	24.5	25.8	24.7	25.3	25.1	24.5	24.5	25.1	25.2	24.9	24.6	25.2		
DO (mg/L)	8.1	8.2	8.2	7.9	8.3	7.9	8.3	7.8	8.1	7.6	8.1	7.8		
pH	8.1	8.1	8.1	8.1	8.1	8.0	8.3	7.9	8.0	8.1	8.1	7.8		
Cond. (µS/cm)	208	208		205		203		207		206		208		
Initials	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

1.6 Concentration	Day 0 init.	Day 1 old	Day 1 new	Day 2 old	Day 2 new	Day 3 old	Day 3 new	Day 4 old	Day 4 new	Day 5 old	Day 5 new	Day 6 old	Day 6 new	Day 7 final
Temperature (°C)	24.0	25.8	24.7	25.3	25.0	24.5	25.0	25.1	25.2	24.9	24.5	25.2		
DO (mg/L)	8.3	8.1	8.0	7.8	8.2	7.9	8.2	7.7	8.1	7.7	8.1	7.6		
pH	8.0	8.1	8.2	8.1	8.1	8.0	8.2	8.0	8.1	8.0	8.1	7.8		
Cond. (µS/cm)	203	212		206		203		208		209		211		
Initials	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

12.5 Concentration	Day 0 init.	Day 1 old	Day 1 new	Day 2 old	Day 2 new	Day 3 old	Day 3 new	Day 4 old	Day 4 new	Day 5 old	Day 5 new	Day 6 old	Day 6 new	Day 7 final
Temperature (°C)	24.8	25.8	24.5	25.7	24.8	24.5	24.7	25.1	25.2	24.9	24.3	25.2		
DO (mg/L)	8.3	8.0	8.0	7.9	8.2	8.0	8.2	7.6	8.2	7.7	8.1	7.7		
pH	7.8	8.0	8.1	8.0	8.1	8.1	8.2	8.0	8.1	8.3	8.1	7.7		
Cond. (µS/cm)	208	204		201		199		204		204		206		
Initials	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

100 Concentration	Day 0 init.	Day 1 old	Day 1 new	Day 2 old	Day 2 new	Day 3 old	Day 3 new	Day 4 old	Day 4 new	Day 5 old	Day 5 new	Day 6 old	Day 6 new	Day 7 final
Temperature (°C)	25.0	25.8	24.4	25.3	24.2	24.5	24.2	25.1	25.2	24.9	24.1	25.2		
DO (mg/L)	8.2	8.0	7.8	7.8	8.1	8.0	8.1	7.6	8.3	7.8	8.3	7.6		
pH	7.6	7.7	7.9	8.0	7.9	8.1	8.1	8.0	8.0	8.0	8.0	7.6		
Cond. (µS/cm)	166	161		161		162		163		162		164		
Initials	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

	Control	100		
Hardness*	100	74		
Alkalinity*	80	66		

* mg/L as CaCO3

Analysts: DKL, AWD, ECL
Reviewed by: [illegible]
Date reviewed: 29/10/08

Sample Description: light yellow - clear

Comments:

Chronic Freshwater Toxicity Test
C. dubia Reproduction Data

Client: Minnow
Sample ID: R7
Work Order: 08158

Start Date & Time: Aug 26/08 @ 1115hrs
Stop Date & Time: Sept 1/08 @ 1302
Set up by: OKL

%(v/v)

Days	Concentration: Control A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
4	4	6	3	4	6	3	2	4	2	3	CE
5	✓	5	5	5	6	7	5	7	5	6	a
6	9	8	7	7	7	8	9	9	9	9	a
7											
8											
Total	13	19	15	16	19	18	15	20	16	18	a

Days	Concentration: 1.6 A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
4	3	5	2	3	6	4	3	2	5	6	CE
5	7	6	5	5	5	5	6	7	5	✓	a
6	7	7	8	7	8	8	7	9	8	9	a
7											
8											
Total	17	18	15	15	19	17	16	18	18	15	a

Days	Concentration: 3.12 A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
4	2	3	9	4	✓	5	3	5	2	3	CE
5	5	5	✓	4	7	5	✓	X	4	4	a
6	7	7	8	7	6	7	9		8	9	a
7											
8											
Total	14	15	12	15	13	17	12	5	14	16	a

Days	Concentration: 6.25 A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
4	4	6	3	2	5	3	5	6	2	✓	CE
5	6	3	7	5	✓	5	6	4	✓	3	a
6	✓	7	8	7	8	5	5	6	6	✓	a
7											
8											
Total	10	16	18	14	13	13	16	16	8	3	a

Days	Concentration: 12.5 A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
4	✓	4	2	4	2	3	4	3	6	4	CE
5	4	✓	✓	4	4	5	4	X	3	✓	a
6	6	7	5	7	6	6	5		7	7	a
7											
8											
Total	10	11	7	15	12	14	13	3X	16	11	a

Days	Concentration: 25 A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
4	4	3	3	2	4	✓	2	3	3	5	CE
5	6	✓	✓	5	4	4	5	5	X	4	a
6	4	5	5	✓	4	✓	✓	X	~~4~~	✓	a
7											
8											
Total	14	8	8	7	12	4	7	12	7	9	a

Days	Concentration: 50 A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
4	4	3	2	4	5	3	✓	2	✓	✓	CE
5	5	4	4	5	6	5	4	5	6	5	a
6	4	4	✓	4	4	✓	✓	4	✓	✓	a
7											
8											
Total	13	11	6	13	15	8	4	11	6	5	a

Days	Concentration: 100 A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	a
4	2	4	3	5	3	2	✓	4	✓	3	CE
5	✓	7	5	6	6	7	6	7	7	5	a
6	7	7	5	4	4	✓	3	✓	5	✓	a
7											
8											
Total	9	18	13	15	13	9	9	11	12	8	a

Days	Concentration: A	B	C	D	E	F	G	H	I	J	Init
1											
2											
3											
4											
5											
6											
7											
8											
Total											

Notes: X = mortality.

Sample Description:
Comments:

Reviewed by: JRE

Date reviewed: 23/10/08

Client: Morrow Env.

W.O.#: 08198

Hardness and Alkalinity Datasheet

Sample ID	Sample Date	Alkalinity: Sample Volume (mL)	Alkalinity: (mL) 0.02N HCL/H_2SO_4 used to pH 4.5	Alkalinity: (mL) of 0.02N HCL/H_2SO_4 used to pH 4.2	Alkalinity: Total Alkalinity (mg/L$CaCO_3$)		Hardness: Sample Volume (mL)	Hardness: Volume of 0.01M EDTA Used (mL)	Hardness: Total Hardness (mg/L $CaCO_3$)	Technician
87	Sept.16/08	50.0	3.4	3.5	66		~~50.0~~ 50.0 BPL	37	74	BPL

Notes: Ag 25

Reviewed by: JAG

Date Reviewed: 23/10/08

CETIS Analytical Report

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	10-0555-4524	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	11 Sep-08 16:18	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Sample No:	04-0668-3333	**Code:**	406683333	**Client:**	Minnow
Sample Date:	21 Aug-08	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	R7		
Sample Age:	5d 11h	**Station:**			

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X + 1)	Linear	57951	200	Yes	Two-Point Interpolation

Point Estimates

% Effect	Conc-%	95% LCL	95% UCL
5	1.833	0.6084	2.277
10	2.178	1.569	3.167
15	2.565	1.932	6.569
20	2.999	2.234	8.626
25	6.326	2.622	14.03
40	22.04	8.476	N/A
50	> 100	N/A	N/A

Reproduction Summary

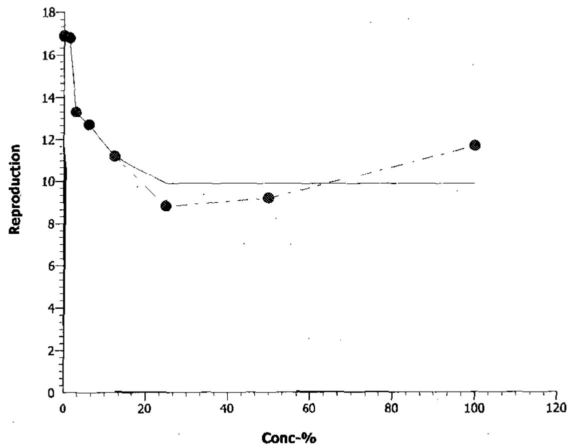
			Calculated Variate						
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Control	10	16.9	13	20	0.4148	2.234	13.22%	0.0%
1.56		10	16.8	15	19	0.274	1.476	8.78%	0.59%
3.12		10	13.3	5	17	0.6193	3.335	25.08%	21.3%
6.25		10	12.7	3	18	0.8444	4.547	35.81%	24.85%
12.5		10	11.2	3	16	0.7208	3.882	34.66%	33.73%
25		10	8.8	4	14	0.5591	3.011	34.22%	47.93%
50		10	9.2	4	15	0.7208	3.882	42.19%	45.56%
100		10	11.7	8	18	0.5875	3.164	27.04%	30.77%

Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	13	19	15	16	19	18	15	20	16	18
1.56		17	18	15	15	19	17	16	18	18	15
3.12		14	15	12	15	13	17	12	5	14	16
6.25		10	16	18	14	13	13	16	16	8	3
12.5		10	11	7	15	12	14	13	3	16	11
25		14	8	8	7	12	4	7	12	7	9
50		13	11	6	13	15	8	4	11	6	5
100		9	18	13	15	13	9	9	11	12	8

Ceriodaphnia 7-d Survival and Reproduction Test					**Nautilus Environmental**
Analysis No: 10-0555-4524		**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed: 11 Sep-08 16:18		**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



CETIS Analytical Report

Report Date: 11 Sep-08 16:22 (p 1 of 2)
Link/Link Code: 08-5585-7190/wo08198

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	15-0701-2805	**Endpoint:**	6d Survival Rate	**CETIS Version:**	CETISv1.5.0
Analyzed:	11 Sep-08 16:13	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes

Sample No:	04-0668-3333	**Code:**	406683333	**Client:**	Minnow
Sample Date:	21 Aug-08	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	R7		
Sample Age:	5d 11h	**Station:**			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	100	>100	#Error	1	N/A

Fisher Exact/Bonferroni-Holm Test

Control	vs	Conc-%	Test Stat	P-Value	Decision(0.05)
Negative Control		1.56	1.0000	1.0000	Non-Significant Effect
		3.12	0.5000	1.0000	Non-Significant Effect
		6.25	1.0000	1.0000	Non-Significant Effect
		12.5	0.5000	1.0000	Non-Significant Effect
		25	1.0000	1.0000	Non-Significant Effect
		50	1.0000	1.0000	Non-Significant Effect
		100	1.0000	1.0000	Non-Significant Effect

Data Summary

Conc-%	Control Type	No-Resp	Resp	Total
0	Negative Contr	10	0	10
1.56		10	0	10
3.12		9	1	10
6.25		10	0	10
12.5		9	1	10
25		10	0	10
50		10	0	10
100		10	0	10

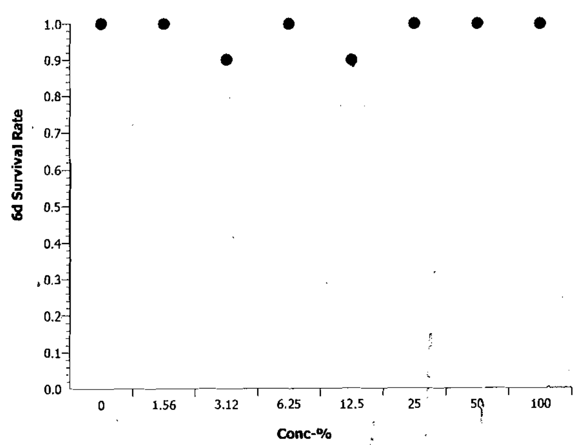
6d Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	1	1	1	1	1	1	1	1	1	1
1.56		1	1	1	1	1	1	1	1	1	1
3.12		1	1	1	1	1	1	1	1	1	0
6.25		1	1	1	1	1	1	1	1	1	1
12.5		1	1	1	1	1	1	1	1	1	0
25		1	1	1	1	1	1	1	1	1	1
50		1	1	1	1	1	1	1	1	1	1
100		1	1	1	1	1	1	1	1	1	1

odaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	15-0701-2805	**Endpoint:**	6d Survival Rate	**CETIS Version:**	CETISv1.5.0
Analyzed:	11 Sep-08 16:13	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes

Graphics



Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Test Run No:	19-5750-5473	**Test Type:**	Reproduction-Survival (7d)	**Dil Water:**	
Start Date:	26 Aug-08 11:15	**Protocol:**	EC/EPS 1/RM/21	**Brine:**	
Ending Date:	01 Sep-08 13:00	**Species:**	Ceriodaphnia dubia		
Duration:	6d 2h	**Source:**			

Sample No:	04-0668-3333	**Code:**	406683333	**Client:**	Minnow
Sample Date:	21 Aug-08	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	R7		
Sample Age:	5d 11h	**Station:**			

Comparison Summary

Analysis No	Endpoint	NOEL	LOEL	TOEL	PMSD	Method
15-0701-2805	6d Survival Rate	100	0	#Error	N/A	Fisher Exact/Bonferroni-Holm Test

Point Estimate Summary

Analysis No	Endpoint	% Effect	Conc-%	95% LCL	95% UCL	Method
18-7227-3257	Reproduction	SNEC	24.54	7.189	41.9	Nonlinear Regression
		10	32.01	14.23	49.78	
		15	48.01	26.67	69.35	
		20	64.02	36.79	91.25	
		25	80.02	45.75	114.3	
		40	128	70.13	185.9	
		50	160	85.62	234.5	
10-0555-4524	Reproduction	5	1.833	0.6084	2.277	Linear Interpolation (ICPIN)
		10	2.178	1.569	3.167	
		15	2.565	1.932	6.569	
		20	2.999	2.234	8.626	
		25	6.326	2.622	14.03	
		40	22.04	8.476	N/A	
		50	> 100	N/A	N/A	

6d Survival Rate Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	1	1	1	1	1	0	0	0.0%	0.0%
1.56		10	1	1	1	1	1	0	0	0.0%	0.0%
3.12		10	0.9	0.7819	1	0	1	0.05774	0.3162	35.14%	10.0%
6.25		10	1	1	1	1	1	0	0	0.0%	0.0%
12.5		10	0.9	0.7819	1	0	1	0.05774	0.3162	35.14%	10.0%
25		10	1	1	1	1	1	0	0	0.0%	0.0%
50		10	1	1	1	1	1	0	0	0.0%	0.0%
100		10	1	1	1	1	1	0	0	0.0%	0.0%

Reproduction Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	16.9	16.07	17.73	13	20	0.4078	2.234	13.22%	0.0%
1.56		10	16.8	16.25	17.35	15	19	0.2694	1.476	8.78%	0.59%
3.12		10	13.3	12.05	14.55	5	17	0.6089	3.335	25.08%	21.3%
6.25		10	12.7	11	14.4	3	18	0.8302	4.547	35.81%	24.85%
12.5		10	11.2	9.751	12.65	3	16	0.7087	3.882	34.66%	33.73%
25		10	8.8	7.676	9.924	4	14	0.5497	3.011	34.22%	47.93%
50		10	9.2	7.751	10.65	4	15	0.7087	3.882	42.19%	45.56%
100		10	11.7	10.52	12.88	8	18	0.5777	3.164	27.04%	30.77%

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

6d Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	1	1	1	1	1	1	1	1	1	1
1.56		1	1	1	1	1	1	1	1	1	1
3.12		1	1	1	1	1	1	1	0	1	1
6.25		1	1	1	1	1	1	1	1	1	1
12.5		1	1	1	1	1	1	1	0	1	1
25		1	1	1	1	1	1	1	1	1	1
50		1	1	1	1	1	1	1	1	1	1
100		1	1	1	1	1	1	1	1	1	1

Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	13	19	15	16	19	18	15	20	16	18
1.56		17	18	15	15	19	17	16	18	18	15
3.12		14	15	12	15	13	17	12	5	14	16
6.25		10	16	18	14	13	13	16	16	8	3
12.5		10	11	7	15	12	14	13	3	16	11
25		14	8	8	7	12	4	7	12	7	9
50		13	11	6	13	15	8	4	11	6	5
100		9	18	13	15	13	9	9	11	12	8

CETIS Analytical Report

Report Date: 09 Oct-08 17:18 (p 1 of 2)
Link/Link Code: 08-5585-7190/wo08198

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	17-5633-4261	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	09 Oct-08 17:16	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Sample No:	04-0668-3333	**Code:**	406683333	**Client:**	Minnow
Sample Date:	21 Aug-08	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	R7		
Sample Age:	5d 11h	**Station:**			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	1.56	3.12	2.206	64.1	21.0%

Dunnett's Multiple Comparison Test

Control vs	Conc-%	Test Stat	Critical	MSD	P-Value	Decision(5%)
Negative Control	1.56	0.06735	2.39	3.543	0.8573	Non-Significant Effect
	3.12*	2.425	2.39	3.543	0.0458	Significant Effect
	6.25*	2.829	2.39	3.543	0.0170	Significant Effect
	12.5*	3.839	2.39	3.543	0.0008	Significant Effect
	25*	5.456	2.39	3.543	0.0000	Significant Effect
	50*	5.186	2.39	3.543	0.0000	Significant Effect
	100*	3.502	2.39	3.543	0.0025	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	653.95	93.42142	7	8.476	0.0000	Significant Effect
Error	793.6	11.02222	72			
Total	1447.55	104.4436	79			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	12.46	18.5	0.0863	Equal Variances
Distribution	Shapiro-Wilk Normality	0.9735		0.0952	Normal Distribution

Reproduction Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	16.9	16.03	17.77	13	20	0.4221	2.234	13.2%	0.0%
1.56		10	16.8	16.23	17.37	15	19	0.2789	1.476	8.78%	0.59%
3.12		10	13.3	12.01	14.59	5	17	0.6303	3.335	25.1%	21.3%
6.25		10	12.7	10.94	14.46	3	18	0.8594	4.547	35.8%	24.9%
12.5		10	11.2	9.695	12.71	3	16	0.7335	3.882	34.7%	33.7%
25		10	8.8	7.632	9.968	4	14	0.569	3.011	34.2%	47.9%
50		10	9.2	7.695	10.71	4	15	0.7335	3.882	42.2%	45.6%
100		10	11.7	10.47	12.93	8	18	0.5979	3.164	27.0%	30.8%

Ceriodaphnia 7-d Survival and Reproduction Test			Nautilus Environmental
Analysis No: 17-5633-4261	**Endpoint:** Reproduction	**CETIS Version:** CETISv1.5.0	
Analyzed: 09 Oct-08 17:16	**Analysis:** Parametric-Control vs Treatments	**Official Results:** Yes	

Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	20	19	19	18	18	16	16	15	15	13
1.56		19	18	18	18	17	17	16	15	15	15
3.12		17	16	15	15	14	14	13	12	12	5
6.25		18	16	16	16	14	13	13	10	8	3
12.5		16	15	14	13	12	11	11	10	7	3
25		14	12	12	9	8	8	7	7	7	4
50		15	13	13	11	11	8	6	6	5	4
100		18	15	13	13	12	11	9	9	9	8

APPENDIX B - *Pseudokirchneriella subcapitata* Toxicity Test Data

Pseudokirchneriella subcapitata Summary Sheet

Client: MINNOW ENVIRONMENTAL
Work Order No.: 08197

Start Date: Aug 26, 2008
Set up by: ART / JLT

Sample Information:

Sample ID: R-7
Sample Date: Aug 21, 2008
Date Received: Aug 25, 2008
Sample Volume: 2X20L

Test Organism Information:

Culture Date: Aug 20, 2008
Age of culture (Day 0): 6 d

Zinc Reference Toxicant Results:

Reference Toxicant ID: SC38
Stock Solution ID: 07Zn01
Date Initiated: Sept 5, 2008

72-h IC~~25~~ 50 (95% CL): 11.0 (7.2 – 17.0) µg/L Zn

~~7-d~~ 72h IC~~25~~ 50 Reference Toxicant Mean ± 2 SD: 16.1 ± 13.4 CV (%): 42

Test Results:

	Algal Growth
NOEC %(v/v)	95.2
LOEC %(v/v)	>95.2
IC25 %(v/v) (95% CL)	>95.2
IC50 %(v/v) (95% CL)	>95.2

Reviewed by: JAG

Date reviewed: 23/10/08

72-h Algal Growth Inhibition Toxicity Test
Water Quality Measurements

Client : Minnow

Setup by: JLT / ~~GEG~~ ART

Sample ID: R-7

Test Date/Time: August 26, 2008 1645h

Work Order No.: 08197

Test Species: *Pseudokirchneriella subcapitata*

Culture Date: August 20/08 Age of Culture: 6 d Culture Health: Good

Culture Count: 1 635 2 682 Average: 658.5 Culture Cell Density (c1): 658.1 × 10⁴

v1 = $\frac{220{,}000 \text{ cells/ml} \times 100 \text{ ml}}{(c1)\ 658.1 \times 10^4 \text{ cells/ml}}$ = ~~33.4 mL~~ 3.3 mL

Time Zero Counts: 1 22 2 21 Average: 21.5

No. of Cells/mL: 21.5×10⁴ Initial Density: # cells/mL ÷ 220 µL x 10 µL = 9,773

Concentration %(v/v)	Water Quality Measurements pH	Temp (°C)				Microplates rotated 2X per day?			
	0 h	0 h	24 h	48 h	72 h	0 h	24 h	48 h	72 h
Control	7.1	22.3	25.2	25.3	24.8	✓	✓ ✓	✓ ✓	✓ ✓
1.48	7.1	22.3	25.2	25.3	24.8	✓	✓ ✓	✓ ✓	✓ ✓
2.95	7.1	22.3	25.2	25.3	24.8	✓	✓ ✓	✓ ✓	✓ ✓
5.9	7.1	22.4	25.2	25.3	24.8	✓	✓ ✓	✓ ✓	✓ ✓
11.9	7.1	22.4	25.2	25.3	24.8	✓	✓ ✓	✓ ✓	✓ ✓
23.8	7.2	22.4	25.2	25.3	24.8	✓	✓ ✓	✓ ✓	✓ ✓
47.6	7.2	22.4	25.2	25.3	24.8	✓	✓ ✓	✓ ✓	✓ ✓
95.2	7.3	22.4	25.2	25.3	24.8	✓	✓ ✓	✓ ✓	✓ ✓
Initials	ART	ART	JLT	JLT	[illegible]	JLT	JLT	JLT	[illegible]

Initial control pH: Well 1: 6.8 Well 2: 6.8

Final control pH: Well 1: 6.8 Well 2: 6.8

Light intensity (lux): 3670 Date measured: August 26, 2008

Sample Description: Clear with slight yellow tinge

Comments:

Reviewed: JAE Date reviewed: 23/10/08

Pseudokirchneriella subcapitata Toxicity Test Data Sheet
72-h Algal Cell Counts

Client: Minnow
Work Order #: 08197
Sample ID: R-7
Start Date/Time: Aug 26, 2008 1645h
Termination Date: Aug 29, 2008 1530h
Test set up by: AT/JLT

Concentration	Rep	Count 1	Count 2	Count 3	Count 4	Comments	Initials
Control	A	24					[illegible]
	B	21					
	C	19					
	D	22					
	E	26					
	F	28					
	G	23					
	H	25					
1.48	A	22					
	B	21					
	C	25					
	D	23					
2.95	A	24					
	B	26					
	C	28					
	D	21					
5.9	A	26					
	B	25					
	C	35					
	D	18	21				
11.9	A	32					
	B	26					
	C	27	31				
	D	31	32				
23.8	A	36					
	B	24					
	C	33					
	D	38					
47.6	A	58					
	B	87	81				
	C	64					
	D	46	49				
95.2	A	74	72				
	B	49	52				
	C	89					
	D	68					

Comments:

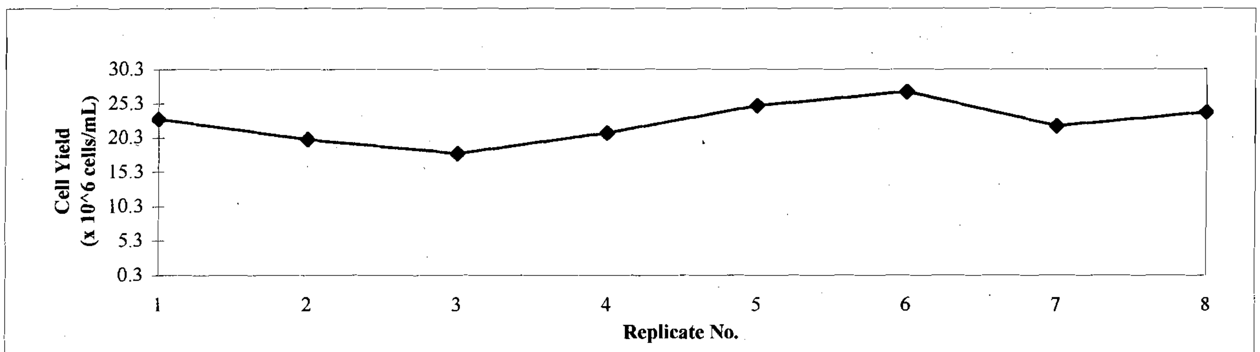
Reviewed by: JLt Date Reviewed: 23/10/08

72-h *Pseudokirchneriella subcapitata* Test - Trend Analysis by Mann-Kendall Test.

Instructions:
1. Enter the project number, work order number and sample ID in the highlighted cells.
2. Enter the negative control cell yield data (X x 10^6 cells/mL) into the highlighted spreadsheet cells.
3. Compare the calculated S value to the table of critical S values at the bottom of the page.
4. If the calculated S value is smaller than the S value in the table, there is no statistically significant trend.

Client: Minnow **Sample ID:** R-7
W.O. No.: 08197 **Test Date:** 26-Aug-08

Rep No.	1	2	3	4	5	6	7	8	Count of + Signs	Count of - Signs
Data Value	23.0	20.0	18.0	21.0	25.0	27.0	22.0	24.0		
(- Rep 1)		-3.000	-5.000	-2.000	2.000	4.000	-1.000	1.000	3	4
(- Rep 2)			-2.000	1.000	5.000	7.000	2.000	4.000	5	1
(- Rep 3)				3.000	7.000	9.000	4.000	6.000	5	0
(- Rep 4)					4.000	6.000	1.000	3.000	4	0
(- Rep 5)						2.000	-3.000	-1.000	1	2
(- Rep 6)							-5.000	-3.000	0	2
(- Rep 7)								2.000	1	0
								Totals	19	9
									S =	10



Critical values of (S) at a probability of p = 0.05, when the number of replicates (n) is 10 or less.

n	4	5	6	7	8	9	10
S	4	6	9	11	14	16	19

If your calculated value for S (for the applicable number of replicates) is equal to or less than the corresponding value for S in the above table, then there is no statistically significant trend present. Refer to Gilbert (1987) for complete table of probabilities for the Mann-Kendall test.

Reference:

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, NY. 320 pp.

JM

***Pseudokirchneriella subcapitata* Algal Counts**

Client:	Minnow	Start Date/Time:	26-Aug-08 @1645h
WO#:	08197	Termination Date:	29-Aug-08 @1300h
Sample ID:	R-7		
		Initial Cell Density:	9772.7273 cell/mL

	215000
	0.22
	0.01
	9772.7273

Concentration ug/L Zn	Rep	Count 1 ($\times 10^4$)	Count 2 ($\times 10^4$)	Count 3 ($\times 10^4$)	Count 4 ($\times 10^4$)	Mean ($\times 10^4$)	Cell Yield ($\times 10^4$) cell/mL		
Control	A	24				24	23.0	mean	22.5
	B	21				21	20.0	SD	2.8784917
	C	19				19	18.0	CV	12.780387
	D	22				22	21.0		
	E	26				26	25.0		
	F	28				28	27.0		
	G	23				23	22.0		
	H	25				25	24.0		
1.48	A	22				22	21.0		
	B	21				21	20.0		
	C	25				25	24.0		
	D	23				23	22.0		
2.95	A	24				24	23.0		
	B	26				26	25.0		
	C	28				28	27.0		
	D	21				21	20.0		
5.9	A	26				26	25.0		
	B	25				25	24.0		
	C	35				35	34.0		
	D	18	21			19.5	18.5		
11.9	A	32				32	31.0		
	B	26				26	25.0		
	C	27	31			29	28.0		
	D	31	32			31.5	30.5		
23.8	A	36				36	35.0		
	B	24				24	23.0		
	C	33				33	32.0		
	D	38				38	37.0		
47.6	A	58				58	57.0		
	B	87	81			84	83.0		
	C	64				64	63.0		
	D	46	49			47.5	46.5		
95.2	A	74	72			73	72.0		
	B	49	52			50.5	49.5		
	C	89				89	88.0		
	D	68				68	67.0		

CETIS Analytical Report

Report Date: 03 Sep-08 17:13 (p 1 of 2)
Link/Link Code: 01-3207-0145/08197

Selenastrum Growth Test — **Nautilus Environmental**

Analysis No:	03-4498-0500	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.5.0
Analyzed:	03 Sep-08 17:13	**Analysis:**	Nonparametric-Multiple Comparison	**Official Results:**	Yes

Sample No:	15-3643-5961	**Code:**	1536435961	**Client:**	Minnow
Sample Date:	21 Aug-08	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	25 Aug-08	**Source:**	R-7		
Sample Age:	5d 0h	**Station:**			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Rank		C > T	Not Run	95.2	> 95.2	#Error	1.05	57.29%

Wilcoxon/Bonferroni Adj Test

Control vs	Conc-%	Test Stat	Critical	Ties	P-Value	Decision(5%)
Negative Control	1.48	23		4	1.0000	Non-Significant Effect
	2.95	30		4	1.0000	Non-Significant Effect
	5.9	30.5		3	1.0000	Non-Significant Effect
	11.9	40.5		1	1.0000	Non-Significant Effect
	23.8	38.5		1	1.0000	Non-Significant Effect
	47.6	42		0	1.0000	Non-Significant Effect
	95.2	42		0	1.0000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	10687.5	1526.786	7	23.52	0.0000	Significant Effect
Error	1817.5	64.91071	28			
Total	12505	1591.697	35			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	27.97	18.48	0.0002	Unequal Variances
Distribution	Shapiro-Wilk Normality	0.878		0.0009	Non-normal Distribution

Cell Density Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	8	22.5	21.38	23.62	18	27	0.544	2.878	12.79%	0.0%
1.48		4	21.75	21.09	22.41	20	24	0.3227	1.708	7.85%	3.33%
2.95		4	23.75	22.59	24.91	20	27	0.5643	2.986	12.57%	-5.56%
5.9		4	25.25	22.69	27.81	18	34	1.248	6.602	26.15%	-12.22%
11.9		4	28.5	27.47	29.53	25	31	0.5	2.646	9.28%	-26.67%
23.8		4	31.75	29.35	34.15	23	37	1.169	6.185	19.48%	-41.11%
47.6		4	62.25	56.23	68.27	46	83	2.933	15.52	24.93%	-176.7%
95.2		4	69.25	63.18	75.32	50	88	2.958	15.65	22.6%	-207.8%

Rank Transformed Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	8	10.44	7.879	13	1.5	20.5	1.247	6.598	63.21%	0.0%
1.48		4	8.25	6.601	9.899	4	14	0.8036	4.252	51.54%	20.96%
2.95		4	13.25	10.41	16.09	4	20.5	1.386	7.331	55.33%	-26.95%
5.9		4	14.75	10.81	18.69	1.5	26	1.922	10.17	68.95%	-41.32%
11.9		4	21.63	20.51	22.74	17.5	24	0.5421	2.869	13.27%	-107.2%
23.8		4	22.75	19.67	25.83	11	28	1.499	7.932	34.87%	-118.0%
47.6		4	31.75	30.78	32.72	29	35	0.4725	2.5	7.87%	-204.2%
95.2		4	33.25	32.28	34.22	30	36	0.4725	2.5	7.52%	-218.6%

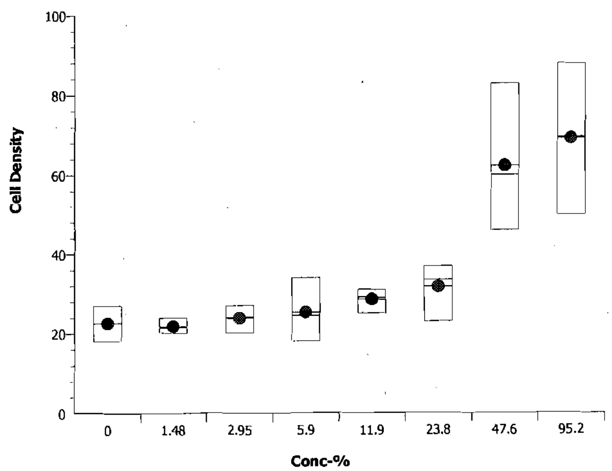
Selenastrum Growth Test	**Nautilus Environmental**

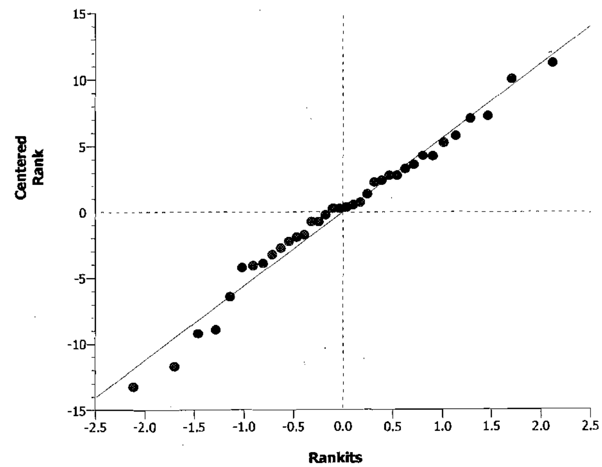
Analysis No:	03-4498-0500	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.5.0
Analyzed:	03 Sep-08 17:13	**Analysis:**	Nonparametric-Multiple Comparison	**Official Results:**	Yes

Cell Density Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Contr	27	25	24	23	22	21	20	18
1.48		24	22	21	20				
2.95		27	25	23	20				
5.9		34	25	24	18				
11.9		31	30	28	25				
23.8		37	35	32	23				
47.6		83	63	57	46				
95.2		88	72	67	50				

Graphics





CETIS Summary Report

Report Date: 03 Sep-08 17:13 (p 1 of 1)
Link/Link Code: 01-3207-0145/08197

Selenastrum Growth Test	Nautilus Environmental

Test Run No:	04-1291-9909	**Test Type:**	Cell Growth	**Dil Water:**	Deionized Water
Start Date:	26 Aug-08	**Protocol:**	EC/EPS 1/RM/25	**Brine:**	
Ending Date:	29 Aug-08	**Species:**	Selenastrum capricornutum		
Duration:	72h	**Source:**	In-House Culture		

Sample No:	15-3643-5961	**Code:**	1536435961	**Client:**	Minnow
Sample Date:	21 Aug-08	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	25 Aug-08	**Source:**	R-7		
Sample Age:	5d 0h	**Station:**			

Comparison Summary

Analysis No	Endpoint	NOEL	LOEL	TOEL	PMSD	Method
03-4498-0500	Cell Density	95.2	>95.2	#Error	57.29%	Wilcoxon/Bonferroni Adj Test

Cell Density Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	8	22.5	21.43	23.57	18	27	0.5255	2.878	12.79%	0.0%
1.48		4	21.75	21.11	22.39	20	24	0.3118	1.708	7.85%	3.33%
2.95		4	23.75	22.63	24.87	20	27	0.5452	2.986	12.57%	-5.56%
5.9		4	25.25	22.78	27.72	18	34	1.205	6.602	26.15%	-12.22%
11.9		4	28.5	27.51	29.49	25	31	0.483	2.646	9.28%	-26.67%
23.8		4	31.75	29.44	34.06	23	37	1.129	6.185	19.48%	-41.11%
47.6		4	62.25	56.45	68.05	46	83	2.834	15.52	24.93%	-176.7%
95.2		4	69.25	63.41	75.09	50	88	2.857	15.65	22.6%	-207.8%

Cell Density Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Contr	23	20	18	21	25	27	22	24
1.48		21	20	24	22				
2.95		23	25	27	20				
5.9		25	24	34	18				
11.9		31	25	28	30				
23.8		35	23	32	37				
47.6		57	83	63	46				
95.2		72	50	88	67				

CETIS Analytical Report

Report Date: 09 Oct-08 17:31 (p 1 of 2)
Link/Link Code: 01-3207-0145/08197

Selenastrum Growth Test — **Nautilus Environmental**

Analysis No:	15-3867-8492	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.5.0
Analyzed:	09 Oct-08 17:31	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Sample No:	15-3643-5961	**Code:**	1536435961	**Client:**	Minnow
Sample Date:	21 Aug-08	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	25 Aug-08	**Source:**	R-7		
Sample Age:	5d 0h	**Station:**			

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X + 1)	Linear	57951	200	Yes	Two-Point Interpolation

Point Estimates

% Effect	Conc-%	95% LCL	95% UCL
5	> 95.2	N/A	N/A
10	> 95.2	N/A	N/A
15	> 95.2	N/A	N/A
20	> 95.2	N/A	N/A
25	> 95.2	N/A	N/A
40	> 95.2	N/A	N/A
50	> 95.2	N/A	N/A

Cell Density Summary

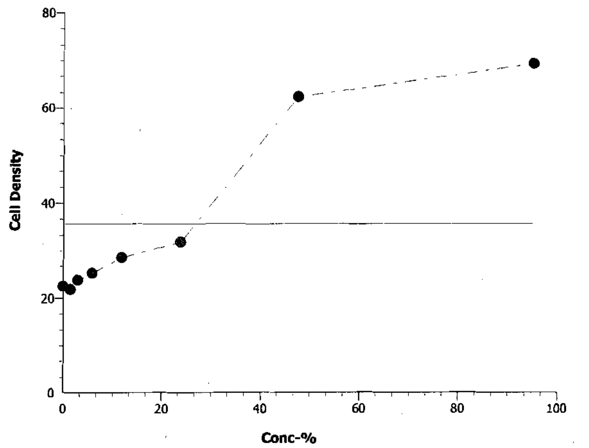
			Calculated Variate						
Conc-%	**Control Type**	**Count**	**Mean**	**Min**	**Max**	**Std Err**	**Std Dev**	**CV%**	**Diff%**
0	Negative Control	8	22.5	18	27	0.5345	2.878	12.8%	0.0%
1.48		4	21.75	20	24	0.3171	1.708	7.85%	3.33%
2.95		4	23.75	20	27	0.5545	2.986	12.6%	-5.56%
5.9		4	25.25	18	34	1.226	6.602	26.1%	-12.2%
11.9		4	28.5	25	31	0.4913	2.646	9.28%	-26.7%
23.8		4	31.75	23	37	1.148	6.185	19.5%	-41.1%
47.6		4	62.25	46	83	2.882	15.52	24.9%	-177.0%
95.2		4	69.25	50	88	2.906	15.65	22.6%	-208.0%

Cell Density Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	23	20	18	21	25	27	22	24
1.48		21	20	24	22				
2.95		23	25	27	20				
5.9		25	24	34	18				
11.9		31	25	28	30				
23.8		35	23	32	37				
47.6		57	83	63	46				
95.2		72	50	88	67				

Selenastrum Growth Test					Nautilus Environmental
Analysis No:	15-3867-8492	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.5.0
Analyzed:	09 Oct-08 17:31	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



APPENDIX C - Rainbow Trout Juvenile Toxicity Test Data

Rainbow Trout Summary Sheet

Client: Minnow Environmental

Start Date/Time: Aug 25/08 @ 1610

Work Order No.: 08199

Test Species: *Oncorhynchus mykiss*

Sample Information:

Sample ID: R7
Sample Date: Aug 21/08
Date Received: Aug 25/08
Sample Volume: 2x20L
Other: –

Dilution Water:

Type: Dechlorinated ~~Tap~~ Municipal Tap Water
Hardness (mg/L $CaCO_3$): 10
Alkalinity (mg/L $CaCO_3$): 9

Test Organism Information:

Batch No.: 072908
Source: Fraser Valley Trout Hatchery
Test Volume/No. Fish: 10/10L
Loading Density: 0.39g/L
Mean Length ± SD (mm): 38 ± 4 — Range: 32 - 44
Mean Weight ± SD (g): 0.39 ± 0.14 — Range: 0.18 - 0.60

SDS Reference Toxicant Results:

Reference Toxicant ID: RT35
Stock Solution ID: 08S03
Date Initiated: Aug 8/08
96-h LC50 (95% CL): 5.0 (4.3 - 5.6)

Reference Toxicant Mean ± 2 SD: 5.4 ± 2.0
Reference Toxicant CV (%): 19.0%

Test Results: The 96hr LC_{50} is > 100% (v/v)

Reviewed by: JCL

Date reviewed: 23/10/08

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: Minnow Environmental
Sample I.D. R7
W.O. # ~~072908~~ 08199
RBT Batch #: 072908
Date Received/Time: Aug 25/08 @ 0945
Date Setup/Time: Aug 25/08 @ 1610
Sample Setup By: [illegible]

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

Number Fish/Volume: 10/10L
7-d % Mortality: 0.01%
Total Pre-aeration Time (mins): 30
Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	14.0		14.0
pH	7.8 ~~[illegible]~~		
D.O. (mg/L)	11.0		11.2
Cond. (µS/cm)	159		159
	1530		

Concentration % (v/v)	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
ctl				10	10	10	10	15.3	15.2	15.2	15.2	15.6	10.1	9.7	9.9	10.2	9.3	7.2	6.9	7.9	7.1	7.7	37	49
6.25				10	10	10	10	15.1	15.2	15.2	15.2	15.4	10.5	9.8	9.9	10.1	9.2	7.2	6.9	7.6	7.2	7.6	45	50
12.5				10	10	10	10	15.0	15.2	15.2	15.2	15.4	10.5	9.9	9.9	10.1	9.2	7.3	7.0	7.5	7.2	7.6	52	58
25				10	10	10	10	14.9	15.2	15.2	15.2	15.1	10.5	10.1	10.0	10.1	9.4	7.3	7.2	7.4	7.3	7.5	66	71
50				10	10	10	10	14.5	15.2	15.2	15.2	15.0	10.6	9.5	9.2	9.9	8.4	7.5	7.2	7.3	7.3	7.4	96	102
100				9	8 ①	7	7	14.0	15.2	15.2	15.2	15.1	11.2	9.6	9.9	10.0	9.3	7.7	7.5	7.2	7.3	7.4	159	166
Initials				[illegible]	[illegible]	JCT	[illegible]	[illegible]	[illegible]	[illegible]	JCT	[illegible]	[illegible]	[illegible]	[illegible]	JCT	[illegible]	[illegible]	[illegible]	[illegible]	JCT	[illegible]	[illegible]	[illegible]

Sample Description/Comments: clear

Fish Description at 96? all remaining fish appear normal

Other Observations: ① one up-side down, gaping

Reviewed by: JAE

Date Reviewed: 23/10/08

APPENDIX D - Chain-of-Custody Form

Nautilus Environmental

Chain of Custody

☐ **CALIFORNIA**
5550 Morehouse Drive • Suite 150
San Diego, California 92121
Phone 858.587.7333
Fax 858.587.3961

☐ **WASHINGTON**
5009 Pacific Highway East • Suite 2
Tacoma, Washington 98424
Phone 253.922.4296
Fax 253.922.5814

☐ **BRITISH COLUMBIA**
8664 Commerce Court
Burnaby British Columbia Canada V5A 4N7
Phone 604.420.8773
Fax 604.357.1361

Date Aug 21/08 Page 1 of 1

Sample Collection by: CR, TH, MB

Report to:
Company MINNOW ENVIRONMENTAL
Address 2 LAMB ST
City GEORGETOWN State ON Zip L7G 3M9
Contact PATTI ORR
Phone/Email 905-873-3371 porr@minnow-environmental.com

Invoice to:
Company SAME AS REPORT
Address
City State Zip
Contact
Phone/Email

ANALYSES REQUIRED

SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	NUMBER OF CONTAINERS	COMMENTS	4-d selenastrum / pseudokerchneriella	7-d ceriodaphnia survival/growth	96-h rainbow trout	14-d hyallela test								RECEIPT TEMPERATURE (°C)
R7	Aug 21 2008		Water	20 L	2		✓	✓	✓									6.6°C
R7	Aug 21 2008		sed	4L	1					✓								
X2	Aug 21 2008		sed	4L	1	Recv'd 0945L Aug 25/08 JT				✓								
R2	Aug 20 2008		sed	4L	1					✓								
							WO # 08197	WO # 08198	WO # 08199	WO # 08200								

PROJECT INFORMATION	
CLIENT	MINNOW
P.O. NO.	2254
SHIPPED VIA:	A-1

SAMPLE RECEIPT	
TOTAL NO. OF CONTAINERS	3
REC'D GOOD CONDITION	✓
MATCHES TEST SCHEDULE	✓

SPECIAL INSTRUCTIONS/COMMENTS:

RELINQUISHED BY (CLIENT)
(Signature) C Russel (Time)
(Printed Name) CYNTHIA RUSSEL (Date) AUG 21/08
(Company) MINNOW

RECEIVED BY (COURIER)
(Signature) (Time)
(Printed Name) (Date)
(Company)

RELINQUISHED BY (COURIER)
(Signature) (Time)
(Printed Name) (Date) 0945 Aug 25/08
(Company) VTZ

RECEIVED BY (LABORATORY)
(Signature) (Time) 0945
(Printed Name) John T (Date) Aug 25/08
Nautilus Environmental Log-in No.

Nautilus Environmental

Toxicity Testing on the sample identified as X-2

Final Toxicity Test Report

Report date: September 17, 2008

Submitted to:

Minnow Environmental Incorporated
Georgetown, ON

Burnaby Laboratory
8664 Commerce Court
Burnaby, BC
V5A 4N7

TABLE OF CONTENTS

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LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

Nautilus Environmental (Burnaby, BC) conducted sub-lethal and acute toxicity tests for Minnow Environmental on the sample identified as X-2, collected on August 19, 2008 and delivered to the Nautilus Environmental Laboratory in Burnaby, BC on August 21, 2008. The sample (collected in 20-L collapsible containers) was transported in coolers containing ice packs and stored in the dark at 4° C prior to testing. Toxicity testing was performed on the sample using the following tests:

- *Ceriodaphnia dubia* survival and reproduction
- 72-h *Pseudokirchneriella subcapitata* growth inhibition (formerly identified as *Selenastrum capricornutum*)
- 96-h Rainbow trout *(Oncorhynchus mykiss)* LC50

This report describes the results of these toxicity tests. Copies of raw laboratory data sheets and statistical analysis for each test species are provided in Appendices A to C. The chain of custody form is provided in Appendix D.

2.0 METHODS

Methods for the toxicity tests are summarized in Tables 1 to 3. Testing was conducted according to procedures described by Environment Canada (2000a, 2007a and 2007b).

Statistical analyses for all the tests were performed using the CETIS program (Tidepool Scientific Software, 2007).

2.1 Quality Assurance/Quality Control (QA/QC)

Nautilus follows a comprehensive QA/QC program to ensure that data generated are of high quality and scientifically defensible. Our QA program is designed to ensure that all tests are performed in accordance with well-established and approved methods (e.g., Environment Canada, US EPA).

To meet these objectives, Nautilus has implemented a number of quality control procedures that include the following:

- Negative controls to ensure that appropriate testing performance criteria are met;
- Positive control to assess the health and sensitivity of the test organisms;
- Use of appropriate species and life stage to meet the study objectives;
- Appropriate number of replicates to allow the proper statistical analyses;
- Calibration and proper maintenance of instruments to ensure accurate measurements;
- Proper documentation and record keeping to allow traceability of performance;
- Adequate supervision and training of staff to ensure that methods are followed;
- Proper handling and storage to ensure sample integrity;
- Procedures in place to address issues that arise during testing so that appropriate corrective actions can be implemented; and
- Rigorous review of data by a registered professional biologist to ensure they are of good quality and scientifically defensible prior to releasing to the client.

Table 1. Summary of test conditions for the *Ceriodaphnia dubia* survival and reproduction test.

Test organism	*Ceriodaphnia dubia*
Test organism source	In-house culture
Test organism age	<24 hr old neonates produced within 12 hr
Test type	Static renewal
Test duration	7 ± 1 day
Test chamber	20 mL test tube
Test solution volume	15 mL
Test concentrations	Seven concentrations, plus laboratory control
Number of replicates	10
Control/dilution water	20% Perrier water (hardness 80-100mg/L $CaCO_3$)
Test solution renewal	Daily
Test temperature	25 ± 1°C
Number of organisms/chamber	1
Feeding	Daily, with 0.1 ml *Pseudokirchneriella subcapitata* and 0.05 mL YCT
Light intensity	100 to 600 lux
Photoperiod	16 hours light/8 hours dark
Aeration	None
Test protocol	Environment Canada (2007a), EPS 1/RM/21
Test endpoints	Survival and reproduction
Test acceptability criteria for criteria for control	≥80% survival; ≥15 young per surviving control; ≥60% of controls producing three or more broods
Reference Toxicant	Sodium chloride

Table 2. Summary of test conditions for the *Pseudokirchneriella subcapitata* growth inhibition test.

Test organism	*Pseudokirchneriella subcapitata*
Test organism source	In-house culture
Test organism age	3 to 7-day old culture in logarithmic growth phase
Test type	Static
Test duration	72 hours
Test chamber	Microplate
Test solution volume	220 µL
Test concentrations	Seven concentrations, plus laboratory control
Number of replicates	4 for treatments; 8 for control
Control/Dilution water	Deionized or distilled water
Test solution renewal	None
Test temperature	24 ± 2°C
Number of organisms/chamber	10,000 cells/mL
Light intensity	3600 to 4400 lux
Photoperiod	Continuous
Aeration	None
Test protocol	Environment Canada (2007b), EPS 1/RM/25
Test endpoint	Algal cell growth inhibition
Test acceptability criteria for control	≥ 16-fold increase in number of algal cells; no trend; and CV ≤ 20%
Reference toxicant	Zinc

Table 3. Summary of test conditions for the 96-h LC50 rainbow trout test.

Test organism	*Oncorhynchus mykiss*
Test organism source	Commercial hatchery
Test organism age	Juveniles
Test type	Static
Test duration	96 hours
Test chamber	18.2 L glass aquarium
Test solution volume	10 L
Test concentrations	Five concentrations, plus laboratory control
Number of replicates	1
Control/Dilution water	Municipal dechlorinated water
Test solution renewal	None
Test temperature	15 ± 1°C
Number of organisms/chamber	Ten
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light/8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test protocol	Environment Canada (2000b), EPS 1/RM/13
Test endpoint	Survival
Test acceptability criterion for control	Survival ≥ 90%
Reference toxicant	Sodium dodecyl sulphate

3.0 RESULTS

Results of the toxicity tests are summarized in Tables 4 to 6. The *C. dubia* test did not show any significant adverse effects on survival, however, reproduction was inhibited in the three highest concentrations (25, 50 and 100%) relative to the negative control. The EC50 for survival was >100%, and the IC25 and IC50 (95% confidence limits) for reproduction were 23.4 (18.9 – 34.7) and >100%, respectively.

The 72-h *P. subcapitata* toxicity test did not show any significant inhibitory effects on growth. All the test concentrations exhibited enhanced growth relative to the negative control. The IC25 and IC50 were both >95.2%, the highest concentration tested.

No significant adverse effects occurred in the 96-h rainbow trout toxicity test. Survival ranged from 90 to 100% in the test concentrations. The 96-h LC50 was >100%.

3.1 Quality Assurance/Quality Control

The health history of the test organisms used in the exposures was acceptable and met the requirements of the Environment Canada protocols. The tests met all control acceptability criteria and water quality parameters were within acceptable ranges specified in the respective test protocol.

Results of the reference toxicant test conducted during the testing program are summarized in Table 7. Results of these tests were all within the acceptable ranges of organism performance (mean ± two standard deviations), based on historical results obtained by the laboratory. These comparable results verify the acceptable quality and similar sensitivity of organisms used in this study.

Table 4. Toxicity test results for the *Ceriodaphnia dubia* survival and reproduction test.

Concentration (%v/v)	Survival (%)	Reproduction (No. of Young/Female) (Mean ± SD)
Control	100	16.2 ± 1.1
1.6	100	16.4 ± 1.4
3.1	100	15.1 ± 1.4
6.25	100	15.1 ± 2.0
12.5	100	15.2 ± 2.1
25	100	11.9 ± 2.3*
50	100	10.5 ± 2.6*
100	100	9.7 ± 2.9*
Test endpoint	**Survival (% v/v)**	**Reproduction (% v/v)**
NOEC	100	100
LOEC	>100	>100
LC50	>100	--
IC25 (95% CL)	--	23.4 (18.9 – 34.7)
IC50	--	>100

Asterisks (*) indicate treatments that are significantly different from the control.
CL = Confidence Limits.
NOEC = No Observed Effect Concentration.
LOEC = Lowest Observed Effect Concentration.
LC = Lethal Concentration.
IC = Inhibition Concentration.
SD = Standard Deviation.

Table 5. **Toxicity test results for the *Pseudokirchneriella subcapitata* growth inhibition test.**

Concentration (% v/v)	Cell Density (x 10^4 cells/mL) (Mean ± SD)
Control	46.2 ± 7.7
1.48	53.8 ± 8.5
2.95	62.5 ± 13.1
5.95	74.2 ± 7.8
11.9	85.8 ± 6.5
23.8	81.0 ± 8.3
47.6	74.2 ± 7.3
95.2	61.5 ± 7.3
Test endpoint	**Cell Density (% v/v)**
NOEC	95.2
LOEC	>95.2
IC25	>95.2
IC50	>95.2

NOEC = No Observed Effect Concentration.
LOEC = Lowest Observed Effect Concentration.
IC = Inhibition Concentration.
SD = Standard Deviation.

Table 6. **Toxicity test results for the 96-h LC50 juvenile rainbow trout (*O. mykiss*) test.**

Concentration (% v/v)	% Survival
Control	100
6.25	100
12.5	90
25.0	90
50.0	100
100.0	100
Test endpoint	**Survival (% v/v)**
LC50	>100

LC = Lethal Concentration.

Table 7. Reference toxicant test results.

Species	Endpoint	Historical range (mean ± 2 SD)	CV(%)	Date Setup
C. dubia	Survival (EC50): 1.8 g/L NaCl	1.5 ± 0.8	27	August 14, 2008
	Reproduction (IC50): 1.2 g/L NaCl	1.1 ± 0.5	21	
P. subcapitata	Growth (IC50): 17.4 µg/L Zn	16.4 ± 13.1	40	August 8, 2008
O.mykiss (juvenile)	Survival (EC50): 5.0 mg/L SDS	5.4 ± 2.0	19	August 8, 2008

REFERENCES

Environment Canada. 2000. Biological test method: reference method for determining acute lethality of effluents to rainbow trout. Environmental Protection Series. Report EPS 1/RM/13, Second Edition, December 2000, including May 2007 amendments. Environment Canada, Method Development and Application Section, Environmental Technology Centre, Ottawa, ON. 23 pp.

Environment Canada. 2007a. Biological test method: test of reproduction and survival using the cladoceran *Ceriodaphnia dubia*. Environmental Protection Series. Report EPS 1/RM/21, Second Edition, February 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON. 74 pp.

Environment Canada. 2007b. Biological test method: growth inhibition test using the freshwater alga. Environmental Protection Series, Report EPS 1/RM/25. Second Edition, March 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON. 53 pp.

Tidepool Scientific Software. 2007. CETIS comprehensive environmental toxicity information system, version 1.5.0D. Tidepool Scientific Software, McKinleyville, CA. 222 pp.

APPENDIX A – *Ceriodaphnia dubia* Toxicity Test Data

Ceriodaphnia dubia Summary Sheet

Client: Minnow Environmental Inc.
Start Date/Time: Aug. 21/08 @ 1645hrs
Work Order No.: 08189
Set up by: AWD

Sample Information:

Sample ID: X-2
Sample Date: Aug 19/08
Date Received: Aug 21/08
Sample Volume: 2×20L

Test Organism Information:

Broodstock No.: 081208
Age of young (Day 0): <24h (w/in 12h)
Avg No. young previous 7 d: 20
Mortality (%) in previous 7 d: 3
Avg. No. of young in previous brood: 10

NaCl Reference Toxicant Results:

Reference Toxicant ID: Cd 33
Stock Solution ID: 08Na02
Date Initiated: Aug 14/08

7-d LC50 (95% CL): 1.8 (1.6 - 2.2) g/L NaCl
7-d IC50 (95% CL): 1.2 (1.1-1.3) g/L NaCl

7-d LC50 Reference Toxicant Mean ± 2 SD: 1.5 ± 0.8 CV (%): 27
7-d IC50 Reference Toxicant Mean ± 2 SD: 1.1 ± 0.5 CV (%): 21

Test Results:

	Survival	Reproduction
NOEC %(v/v)	100	~~100~~ 100
LOEC %(v/v)	>100	~~>100~~ >100
LC50 %(v/v) (95% CL)	>100	
IC25 %(v/v) (95% CL)		23.4 (18.9-34.7)
IC50 %(v/v) (95% CL)		>100

Reviewed by: JAB
Date reviewed: 9 Jan 09

Chronic Freshwater Toxicity Test
C. dubia Reproduction Data

Client: Minnow Environmental Inc.
Sample ID: X2
Work Order: 08189

Start Date & Time: Aug 21/08 @ 1545h
Stop Date & Time: Aug 27/08 @ 1430h
Set up by: DM

% (v/v)

Concentration: Control

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	3	2	3	4	4	2	2	3	2	4	DK
5	7	6	6	5	5	6	6	6	5	4	A
6	6	7	5	8	7	9	9	8	9	9	A
7											
8											
Total	16	15	14	17	16	17	17	17	16	17	A

Concentration: 1.6

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	4	3	5	3	5	✓	4	2	5	3	DK
5	6	5	5	7	6	6	5	6	6	7	A
6	6	7	7	8	6	8	8	7	6	8	A
7											
8											
Total	16	15	17	18	17	14	17	15	17	18	A

Concentration: 3.1

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	3	4	3	3	5	5	4	✓	✓	5	DK
5	6	7	7	8	7	✓	4	6	6	✓	A
6	6	5	5	4	6	8	8	9	8	9	A
7											
8											
Total	15	16	15	15	18	13	16	15	14	14	A

Concentration: 0.78

Days	A	B	C	D	E	F	G	H	I	J	Init
1											
2											
3											
4											
5											
6											
7											
8											
Total											

Concentration: 6.25

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	4	4	4	5	4	5	3	4	3	✓	DK
5	6	5	7	6	6	5	6	5	6	7	A
6	6	7	6	✓	5	7	6	7	7	5	A
7											
8											
Total	16	16	17	~~13~~ 11	15	17	15	16	16	12	A

Concentration: 12.5

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	5	4	5	4	✓	5	4	4	5	3	DK
5	✓	6	5	5	7	6	✓	6	6	5	A
6	8	6	5	6	7	7	7	7	6	8	A
7											
8											
Total	13	16	15	15	14	18	11	17	17	16	A

Concentration: 25

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	3	4	2	3	2	2	3	2	4	3	DK
5	✓	4	4	5	4	6	6	4	7	✓	A
6	5	6	5	4	5	5	4	6	5	6	A
7											
8											
Total	8	14	11	12	11	13	13	12	16	9	A

Concentration: 50

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	2	4	2	5	4	3	3	2	3	5	DK
5	3	✓	4	5	5	3	6	5	4	4	A
6	4	5	3	4	✓	✓	3	4	5	5	A
7											
8											
Total	9	9	9	14	9	6	12	11	12	14	A

Concentration: 100

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	2	4	4	3	3	3	✓	4	✓	2	DK
5	2	3	2	2	4	3	3	2	3	6	A
6	5	6	✓	5	5	✓	5	6	4	6	A
7											
8											
Total	9	13	6	10	12	6	8	12	7	14	A

Notes: X = mortality.

Sample Description: light ~~brown opaque~~ yellow clear
Comments:

Reviewed by: A. Tang

Date reviewed: September 17, 2008

Version 2.0 Issued January 23, 2008

Nautilus Environmental

Chronic Freshwater Toxicity Test
Initial and Final Water Quality Measurements

Client:	Minnow Environmental Inc.	**Start Date & Time:**	Aug 21 /08 1545h
Sample ID:	X2	**Stop Date:**	Aug 27 /08 1430h
Work Order #:	08189	**Test Species:**	Ceriodaphnia dubia

% (v/v) Concentration Control	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	25.0	25.3	25.0	25.6	25.3	25.0	24.7	25.1	24.5	25.2	25.0	25.5		
DO (mg/L)	8.2	7.9	8.0	7.4	8.1	7.6	8.1	7.5	8.1	7.3	8.1	7.1		
pH	8.0	7.8	8.0	7.8	8.1	7.5	8.1	7.8	8.1	7.7	8.1	7.9		
Cond. (µS/cm)	206	205		205		207		207		205		230		
Initials	A	A	A	A	A	A	A	DKL	DKL	A	DKL	A		

1.6 Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	25.0	25.3	25.0	25.6	25.2	25.0	24.8	25.1	24.5	25.2	24.8	25.5		
DO (mg/L)	8.2	7.8	8.1	7.4	8.1	7.6	7.9	7.5	8.1	7.5	8.1	7.2		
pH	7.8	7.7	7.9	7.9	7.9	7.6	8.1	7.9	8.1	7.8	8.2	7.8		
Cond. (µS/cm)	207	206		210		208		205		205		210		
Initials	A	A	A	A	A	A	A	DKL	DKL	A	A	A		

12.5 Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	25.0	25.3	25.0	25.6	25.1	25.0	24.9	25.1	24.5	25.2	24.8	25.5		
DO (mg/L)	8.3	7.9	8.0	7.5	8.0	7.7	7.9	7.5	7.9	7.7	8.0	7.2		
pH	7.9	7.7	7.9	7.8	8.0	7.6	8.1	7.9	8.1	7.7	8.2	7.8		
Cond. (µS/cm)	203	202		204		202		204		201		204		
Initials	A	A	A	A	A	A	A	DKL	DKL	A	DKL	A		

100 Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	24.5	25.3	25.5	25.6	24.8	25.0	25.4	25.1	24.5	25.2	24.7	25.5		
DO (mg/L)	8.3	7.9	8.0	7.2	8.1	7.8	7.8	7.5	7.8	7.7	7.9	7.4		
pH	7.6	7.8	7.7	7.8	7.9	7.6	8.1	7.8	8.0	7.7	8.0	7.8		
Cond. (µS/cm)	170	169		171		172		176		178		180		
Initials	A	A	A	A	A	A	A	DKL	DKL	A	DKL	A		

	Control	100		
Hardness*	100	10		
Alkalinity*	80	220		

* mg/L as CaCO3

Analysts: A, DKL

Reviewed by: [illegible]

Date reviewed: Sept 17/08

Sample Description: light yellow - clear

Comments:

CETIS Analytical Report

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	13-3948-1491	**Endpoint:**	6d Survival Rate	**CETIS Version:**	CETISv1.5.0
Analyzed:	04 Sep-08 13:39	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes

Sample No:	19-3990-8905	**Code:**	1939908905	**Client:**	Minnow
Sample Date:	19 Aug-08	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	X-2		
Sample Age:	65h	**Station:**			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	100 >100	0	#Error	1	N/A

Fisher Exact/Bonferroni-Holm Test

Control vs	Conc-%	Test Stat	P-Value	Decision(0.05)
Negative Control	1.6	1.0000	1.0000	Non-Significant Effect
	3.12	1.0000	1.0000	Non-Significant Effect
	6.25	1.0000	1.0000	Non-Significant Effect
	12.5	1.0000	1.0000	Non-Significant Effect
	25	1.0000	1.0000	Non-Significant Effect
	50	1.0000	1.0000	Non-Significant Effect
	100	1.0000	1.0000	Non-Significant Effect

Data Summary

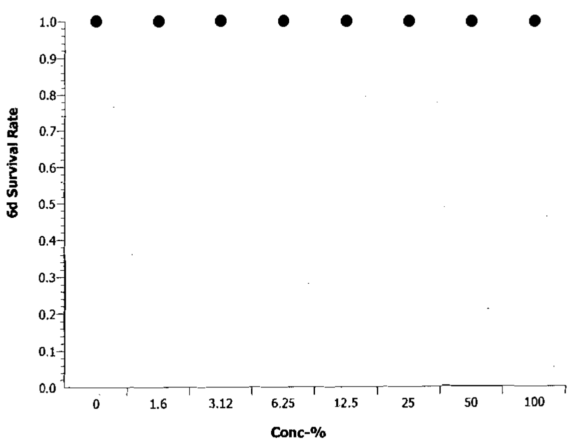
Conc-%	Control Type	No-Resp	Resp	Total
0	Negative Contr	10	0	10
1.6		10	0	10
3.12		10	0	10
6.25		10	0	10
12.5		10	0	10
25		10	0	10
50		10	0	10
100		10	0	10

6d Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	1	1	1	1	1	1	1	1	1	1
1.6		1	1	1	1	1	1	1	1	1	1
3.12		1	1	1	1	1	1	1	1	1	1
6.25		1	1	1	1	1	1	1	1	1	1
12.5		1	1	1	1	1	1	1	1	1	1
25		1	1	1	1	1	1	1	1	1	1
50		1	1	1	1	1	1	1	1	1	1
100		1	1	1	1	1	1	1	1	1	1

Ceriodaphnia 7-d Survival and Reproduction Test			Nautilus Environmental
Analysis No: 13-3948-1491	**Endpoint:** 6d Survival Rate	**CETIS Version:** CETISv1.5.0	
Analyzed: 04 Sep-08 13:39	**Analysis:** STP 2x2 Contingency Tables	**Official Results:** Yes	

Graphics



CETIS Analytical Report

Report Date: 17 Sep-08 12:37 (p 1 of 2)
Link/Link Code: 04-8324-1048/wo08189

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	09-6926-9276	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	17 Sep-08 12:36	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Sample No:	19-3990-8905	**Code:**	1939908905	**Client:**	Minnow
Sample Date:	19 Aug-08	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	X-2		
Sample Age:	65h	**Station:**			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	12.5	25	17.68	8	13.56%

Dunnett's Multiple Comparison Test

Control vs	Conc-%	Test Stat	Critical	MSD	P-Value	Decision(5%)
Negative Control	1.6	-0.2173	2.386	2.196	0.9215	Non-Significant Effect
	3.12	1.195	2.386	2.196	0.3866	Non-Significant Effect
	6.25	1.195	2.386	2.196	0.3866	Non-Significant Effect
	12.5	1.087	2.386	2.196	0.4365	Non-Significant Effect
	25*	4.672	2.386	2.196	0.0001	Significant Effect
	50*	6.194	2.386	2.196	0.0000	Significant Effect
	100*	7.063	2.386	2.196	0.0000	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	491.5875	70.22678	7	16.58	0.0000	Significant Effect
Error	304.9	4.234722	72			
Total	796.4875	74.4615	79			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	14.12	18.48	0.0491	Equal Variances
Distribution	Shapiro-Wilk Normality	0.9795		0.2261	Normal Distribution

Reproduction Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	16.2	15.8	16.6	14	17	0.1952	1.033	6.37%	0.0%
1.6		10	16.4	15.88	16.92	14	18	0.2551	1.35	8.23%	-1.24%
3.12		10	15.1	14.57	15.63	13	18	0.259	1.37	9.08%	6.79%
6.25		10	15.1	14.31	15.89	11	17	0.3827	2.025	13.41%	6.79%
12.5		10	15.2	14.39	16.01	11	18	0.3964	2.098	13.8%	6.17%
25		10	11.9	11	12.8	8	16	0.4405	2.331	19.59%	26.54%
50		10	10.5	9.511	11.49	6	14	0.4818	2.55	24.28%	35.19%
100		10	9.7	8.558	10.84	6	14	0.5567	2.946	30.37%	40.12%

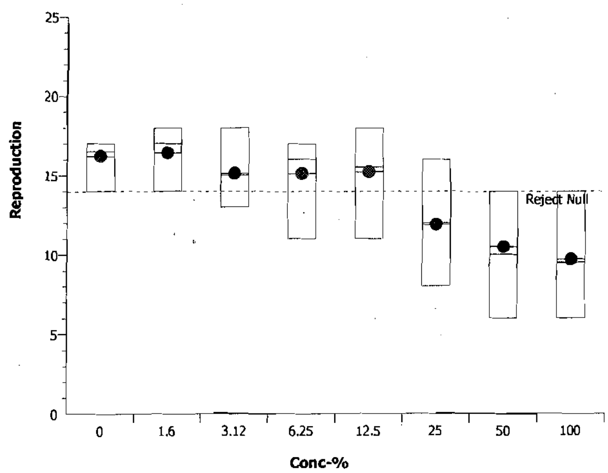
Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

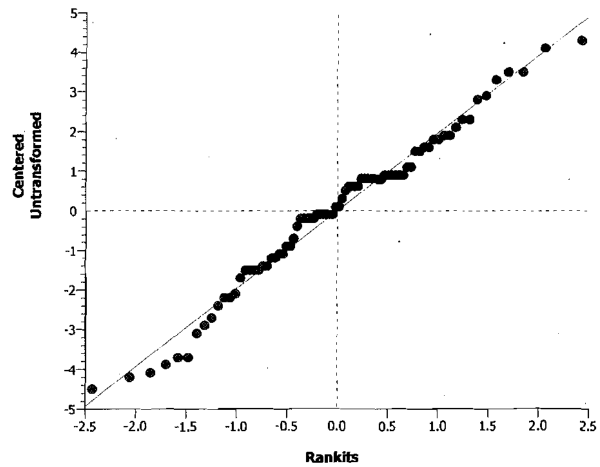
Analysis No:	09-6926-9276	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	17 Sep-08 12:36	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	17	17	17	17	17	16	16	16	15	14
1.6		18	18	17	17	17	17	16	15	15	14
3.12		18	16	16	15	15	15	15	14	14	13
6.25		17	17	16	16	16	16	15	15	12	11
12.5		18	17	17	16	16	15	15	14	13	11
25		16	14	13	13	12	12	11	11	9	8
50		14	14	12	12	11	9	9	9	9	6
100		14	13	12	12	10	9	8	7	6	6

Graphics





CETIS Analytical Report

Report Date: 17 Sep-08 12:37 (p 1 of 2)
Link/Link Code: 04-8324-1048/wo08189

Ceriodaphnia 7-d Survival and Reproduction Test			Nautilus Environmental
Analysis No: 19-1353-0911	**Endpoint:** Reproduction	**CETIS Version:** CETISv1.5.0	
Analyzed: 17 Sep-08 12:36	**Analysis:** Linear Interpolation (ICPIN)	**Official Results:** Yes	

Sample No: 19-3990-8905	**Code:** 1939908905	**Client:** Minnow
Sample Date: 19 Aug-08	**Material:** Industrial Effluent	**Project:**
Receive Date:	**Source:** X-2	
Sample Age: 65h	**Station:**	

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X + 1)	Linear	57951	200	Yes	Two-Point Interpolation

Point Estimates

% Effect	Conc-%	95% LCL	95% UCL
5	2.586	1.97	13.52
10	13.83	2.834	16.14
15	16.49	12.09	20.77
20	19.64	15.48	27.04
25	23.34	18.86	34.7
40	93.33	43.07	N/A
50	> 100	N/A	N/A

Reproduction Summary

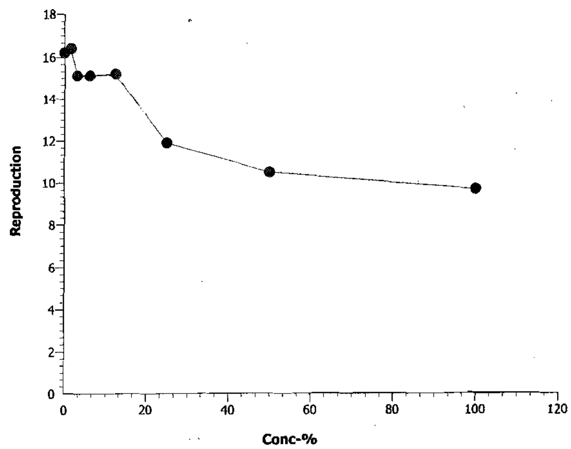
			Calculated Variate						
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Control	10	16.2	14	17	0.1918	1.033	6.37%	0.0%
1.6		10	16.4	14	18	0.2507	1.35	8.23%	-1.24%
3.12		10	15.1	13	18	0.2545	1.37	9.08%	6.79%
6.25		10	15.1	11	17	0.376	2.025	13.41%	6.79%
12.5		10	15.2	11	18	0.3895	2.098	13.8%	6.17%
25		10	11.9	8	16	0.4328	2.331	19.59%	26.54%
50		10	10.5	6	14	0.4734	2.55	24.28%	35.19%
100		10	9.7	6	14	0.547	2.946	30.37%	40.12%

Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	16	15	14	17	16	17	17	17	16	17
1.6		16	15	17	18	17	14	17	15	17	18
3.12		15	16	15	15	18	13	16	15	14	14
6.25		16	16	17	11	15	17	15	16	16	12
12.5		13	16	15	15	14	18	11	17	17	16
25		8	14	11	12	11	13	13	12	16	9
50		9	9	9	14	9	6	12	11	12	14
100		9	13	6	10	12	6	8	12	7	14

Ceriodaphnia 7-d Survival and Reproduction Test					**Nautilus Environmental**
Analysis No:	19-1353-0911	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	17 Sep-08 12:36	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Client: Minnow Environmental

W.O.#: 08188-90

Hardness and Alkalinity Datasheet

	Alkalinity						Hardness			
Sample ID	Sample Date	Sample Volume (mL)	(mL) 0.02N HCL/H_2SO_4 used to pH 4.5	(mL) of 0.02N HCL/H_2SO_4 used to pH 4.2	Total Alkalinity (mg/L$CaCO_3$)		Sample Volume (mL)	Volume of 0.01M EDTA Used (mL)	Total Hardness (mg/L $CaCO_3$)	Technician
X-2	Aug 21/08	50	11.2	11.4	220		10	1.0	10	[illegible]

Notes:

Reviewed by: A. Teng

Date Reviewed: September 17, ~~2007~~ 2008 AT

APPENDIX B - *Pseudokirchneriella subcapitata* Toxicity Test Data

Pseudokirchneriella subcapitata Summary Sheet

Client: UMNNOW
Work Order No.: 08190

Start Date: Aug 21, 2008
Set up by: Ea

Sample Information:

Sample ID: X-2
Sample Date: Aug 19, 2008
Date Received: Aug 21, 2008
Sample Volume: 2 x 20L

Test Organism Information:

Culture Date: Aug 15, 2008
Age of culture (Day 0): 6 d

Zinc Reference Toxicant Results:

Reference Toxicant ID: SC37
Stock Solution ID: 07Zn01
Date Initiated: Aug 8, 2008

72-h IC~~25~~ 50 (95% CL): 17.4 (7.8 - 24.1) µg/L Zn

~~7-d~~ 72-h IC~~25~~ 50 Reference Toxicant Mean ± 2 SD: 16.4 ± 13.1 CV (%): 40

Test Results:

	Algal Growth
NOEC %(v/v)	95.2
LOEC %(v/v)	>95.2
IC25 %(v/v) (95% CL)	>95.2
IC50 %(v/v) (95% CL)	>95.2

Reviewed by: [signature]

Date reviewed: 9 Jan 09

72-h Algal Growth Inhibition Toxicity Test
Water Quality Measurements

Client: MINNOW
Setup by: [illegible]
Sample ID: X-2
Test Date/Time: Aug. 21, 2008 @ 1500h
Work Order No.: 08190
Test Species: *Pseudokirchneriella subcapitata*
Culture Date: Aug 15, 2008
Age of Culture: ~~629.5~~ 6 d
Culture Health: Good
Culture Count: 1 633 2 626
Average: 629.5
Culture Cell Density (c1): 629.5 x 10^4

v1 = 220,000 cells/ml x 100 ml / (c1) 629.5 x 10^4 cells/ml = 3.~~8~~5 mL

Time Zero Counts: 1 22 2 20
Average: 21 x 10^4
No. of Cells/mL: 21 x 10^4
Initial Density: # cells/mL ÷ 220 µL x 10 µL = 9,545

Concentration %(v/v)	Water Quality Measurements pH					Microplates rotated 2X per day?			
	pH	Temp (°C)							
	0 h	0 h	24 h	48 h	72 h	0 h	24 h	48 h	72 h
CONTROL	7.0	23.8	25.6	25.2	24.4	✓	✓ ✓	✓ ✓	✓ ✓
1.48	7.0	23.8	25.6	25.2	24.4	✓	✓ ✓	✓ ✓	✓ ✓
2.95	7.0	23.7	25.6	25.2	24.4	✓	✓ ✓	✓ ✓	✓ ✓
5.9	7.0	23.7	25.6	25.2	24.4	✓	✓ ✓	✓ ✓	✓ ✓
11.9	7.1	23.6	25.6	25.2	24.4	✓	✓ ✓	✓ ✓	✓ ✓
23.8	7.2	23.5	25.6	25.2	24.4	✓	✓ ✓	✓ ✓	✓ ✓
47.6	7.5	23.4	25.6	25.2	24.4	✓	✓ ✓	✓ ✓	✓ ✓
95.2	7.7	23.4	25.6	25.2	24.4	✓	✓ ✓	✓ ✓	✓ ✓
Initials	[illegible]	[illegible]	JLT	[illegible]	[illegible]	[illegible]	JLT	[illegible]	[illegible]

Initial control pH: Well 1: 7.1 Well 2: 7.1

Final control pH: Well 1: 6.8 Well 2: 6.8

Light intensity (lux): 3900
Date measured: Aug 21, 2008

Sample Description: Clear, light yellow

Comments:

Reviewed: A. Tang
Date reviewed: September 17, 2008

Pseudokirchneriella subcapitata Toxicity Test Data Sheet
72-h Algal Cell Counts

Client: MINNOW
Start Date/Time: Aug. 21, 2008 @ 1500h
Work Order #: 08190
Termination Date: Aug. 24, 2008 @ 1300h
Sample ID: X-2
Test set up by: EW

Concentration % (v/v)	Rep	Count 1	Count 2	Count 3	Count 4	Comments	Initials
Control	A	52					EW
	B	44					
	C	50					
	D	42					
	E	33	38				
	F	49					
	G	63	59				
	H	45					
1.48	A	55					
	B	58					
	C	43					
	D	64	61				
2.95	A	45	49				
	B	63					
	C	79					
	D	65					
5.9	A	76					
	B	74					
	C	85					
	D	66					
11.9	A	86					
	B	90					
	C	93					
	D	78					
23.8	A	91					
	B	82					
	C	84					
	D	71					
47.6	A	85					
	B	68					
	C	76					
	D	72					
95.2	A	71					
	B	66					
	C	58					
	D	55					

Comments:

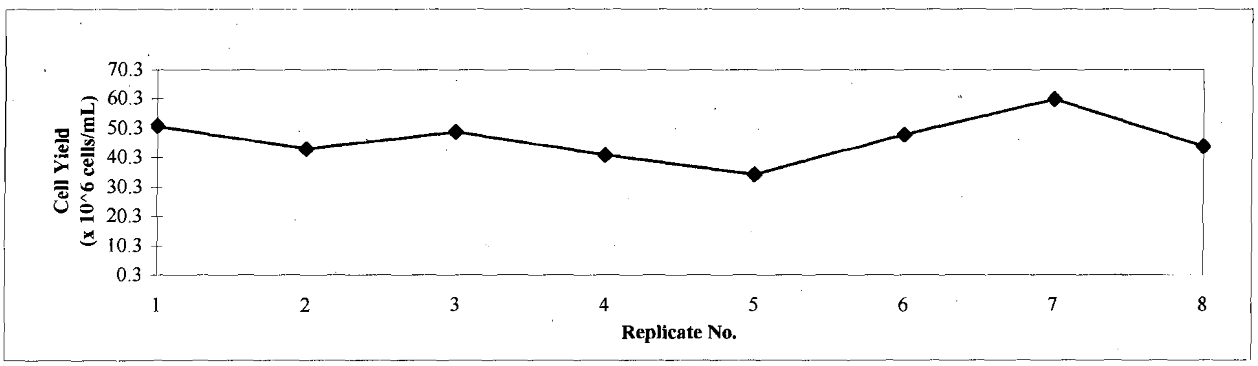
Reviewed by: A. Tang
Date Reviewed: September 17, 2008

72-h *Pseudokirchneriella subcapitata* Test - Trend Analysis by Mann-Kendall Test.

Instructions:
1. Enter the project number, work order number and sample ID in the highlighted cells.
2. Enter the negative control cell yield data (X x 10^6 cells/mL) into the highlighted spreadsheet cells.
3. Compare the calculated S value to the table of critical S values at the bottom of the page.
4. If the calculated S value is smaller than the S value in the table, there is no statistically significant trend.

Client: Minnow　　**Sample ID:** X-2
W.O. No.: 8190　　**Test Date:** 21-Aug-08

Rep No.	1	2	3	4	5	6	7	8	Count of + Signs	Count of - Signs
Data Value	51.0	43.0	49.0	41.0	34.5	48.0	60.0	44.0		
(- Rep 1)		-8.000	-2.000	-10.000	-16.500	-3.000	9.000	-7.000	1	6
(- Rep 2)			6.000	-2.000	-8.500	5.000	17.000	1.000	4	2
(- Rep 3)				-8.000	-14.500	-1.000	11.000	-5.000	1	4
(- Rep 4)					-6.500	7.000	19.000	3.000	3	1
(- Rep 5)						13.500	25.500	9.500	3	0
(- Rep 6)							12.000	-4.000	1	1
(- Rep 7)								-16.000	0	1
								Totals	13	15
									S =	-2



Critical values of (S) at a probability of p = 0.05, when the number of replicates (n) is 10 or less.

n	4	5	6	7	8	9	10
S	4	6	9	11	14	16	19

If your calculated value for S (for the applicable number of replicates) is equal to or less than the corresponding value for S in the above table, then there is no statistically significant trend present. Refer to Gilbert (1987) for complete table of probabilities for the Mann-Kendall test.

Reference:

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, NY. 320 pp.

Sept 17/08

***Pseudokirchneriella subcapitata* Algal Counts**

Client:	Minnow	Start Date/Time:	21-Aug-08 @1500h
WO#:	08190	Termination Date:	24-Aug-08 @1300h
Sample ID:	X-2		
		Initial Cell Density:	9545.4545 cell/mL

Concentration ug/L Zn	Rep	Count 1 (x 10^4)	Count 2 (x 10^4)	Count 3 (x 10^4)	Count 4 (x 10^4)	Mean (x 10^4)	Cell Yield (x 10^4) cell/mL		210000 0.22 0.01 9545.4545
Control	A	52				52	51.0	mean	46.4
	B	44				44	43.0	SD	7.5919953
	C	50				50	49.0	CV	16.376899
	D	42				42	41.0		
	E	33	38			35.5	34.5		
	F	49				49	48.0		
	G	63	59			61	60.0		
	H	45				45	44.0		
1.48	A	55				55	54.0		
	B	58				58	57.0		
	C	43				43	42.0		
	D	64	61			62.5	61.5		
2.95	A	45	49			47	46.0		
	B	63				63	62.0		
	C	79				79	78.0		
	D	65				65	64.0		
5.9	A	76				76	75.0		
	B	74				74	73.0		
	C	85				85	84.0		
	D	66				66	65.0		
11.9	A	86				86	85.0		
	B	90				90	89.0		
	C	93				93	92.0		
	D	78				78	77.0		
23.8	A	91				91	90.0		
	B	82				82	81.0		
	C	84				84	83.0		
	D	71				71	70.0		
47.6	A	85				85	84.0		
	B	68				68	67.0		
	C	76				76	75.0		
	D	72				72	71.0		
95.2	A	71				71	70.0		
	B	66				66	65.0		
	C	58				58	57.0		
	D	55				55	54.0		

APT
Sept 17/08

CETIS Analytical Report

Selenastrum Growth Test					Nautilus Environmental
Analysis No:	16-9860-0293	Endpoint:	Cell Density	CETIS Version:	CETISv1.5.0
Analyzed:	03 Sep-08 17:14	Analysis:	Parametric-Multiple Comparison	Official Results:	Yes

Sample No:	07-7885-7903	Code:	778857903	Client:	Minnow
Sample Date:	19 Aug-08	Material:	Industrial Effluent	Project:	
Receive Date:	21 Aug-08	Source:	X-2		
Sample Age:	48h	Station:			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	95.2	0	#Error	1.05	29.11%

Bonferroni Adj t Test

Control vs	Conc-%	Test Stat	Critical	MSD	P-Value	Decision(5%)
Negative Control	1.48	-1.456	2.613	13.46	1.0000	Non-Significant Effect
	2.95	-3.154	2.613	13.46	1.0000	Non-Significant Effect
	5.9	-5.434	2.613	13.46	1.0000	Non-Significant Effect
	11.9	-7.666	2.613	13.46	1.0000	Non-Significant Effect
	23.8	-6.744	2.613	13.46	1.0000	Non-Significant Effect
	47.6	-5.434	2.613	13.46	1.0000	Non-Significant Effect
	95.2	-2.96	2.613	13.46	1.0000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	6823.389	974.7698	7	13.77	0.0000	Significant Effect
Error	1982.5	70.80357	28			
Total	8805.889	1045.573	35			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	2.073	18.48	0.9557	Equal Variances
Distribution	Shapiro-Wilk Normality	0.9872		0.9448	Normal Distribution

Cell Density Summary

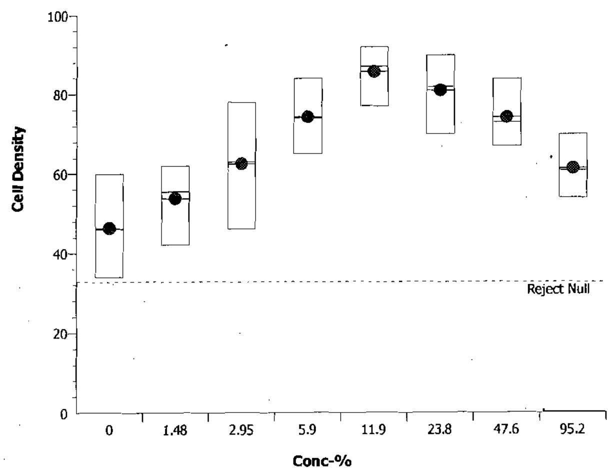
Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	8	46.25	43.26	49.24	34	60	1.456	7.704	16.66%	0.0%
1.48		4	53.75	50.45	57.05	42	62	1.606	8.5	15.81%	-16.22%
2.95		4	62.5	57.42	67.58	46	78	2.476	13.1	20.96%	-35.14%
5.9		4	74.25	71.22	77.28	65	84	1.475	7.805	10.51%	-60.54%
11.9		4	85.75	83.23	88.27	77	92	1.228	6.5	7.58%	-85.41%
23.8		4	81	77.79	84.21	70	90	1.566	8.287	10.23%	-75.14%
47.6		4	74.25	71.43	77.07	67	84	1.375	7.274	9.8%	-60.54%
95.2		4	61.5	58.66	64.34	54	70	1.384	7.326	11.91%	-32.97%

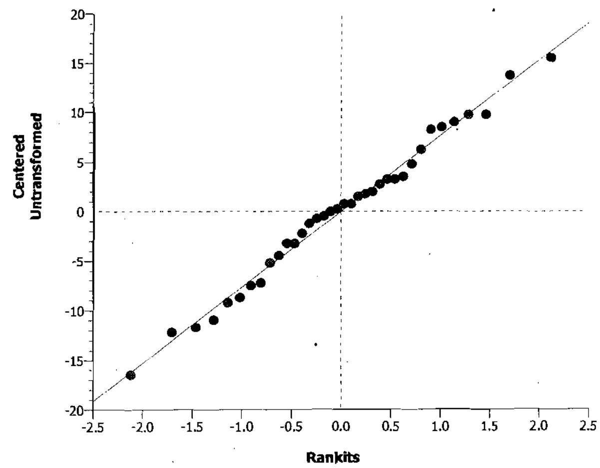
Selenastrum Growth Test			Nautilus Environmental
Analysis No: 16-9860-0293	**Endpoint:** Cell Density	**CETIS Version:** CETISv1.5.0	
Analyzed: 03 Sep-08 17:14	**Analysis:** Parametric-Multiple Comparison	**Official Results:** Yes	

Cell Density Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Contr	60	51	49	48	44	43	41	34
1.48		62	57	54	42				
2.95		78	64	62	46				
5.9		84	75	73	65				
11.9		92	89	85	77				
23.8		90	83	81	70				
47.6		84	75	71	67				
95.2		70	65	57	54				

Graphics





APPENDIX C – Rainbow Trout Juvenile Toxicity Test Data

Rainbow Trout Summary Sheet

Client: Minera Environment

Start Date/Time: Aug 21/08 @ 1800

Work Order No.: 08188

Test Species: *Oncorhynchus mykiss*

Sample Information:

Sample ID: X-2
Sample Date: Aug 19/08
Date Received: Aug 21/08
Sample Volume: 2 x 20L
Other: —

Dilution Water:

Type: Dechlorinated ~~Tap~~ Municipal Tap Water
Hardness (mg/L $CaCO_3$): 10
Alkalinity (mg/L $CaCO_3$): 9

Test Organism Information:

Batch No.: 072908
Source: Fraser Valley Trout Hatchery
Test Volume/No. Fish: 10/10L
Loading Density: 0.34 g/L
Mean Length ± SD (mm): 39 ± 4 — Range: 34 - 44
Mean Weight ± SD (g): 0.34 ± 0.09 — Range: 0.20 - 0.50

SDS Reference Toxicant Results:

Reference Toxicant ID: RT35
Stock Solution ID: 08S03
Date Initiated: Aug 8/08
96-h LC50 (95% CL): 5.0 (4.3 - 5.6)

Reference Toxicant Mean ± 2 SD: 5.4 ± 2.0
Reference Toxicant CV (%): 19.0%

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

Reviewed by: A. Tong

Date reviewed: September 17, 2008

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#:	Minnow Environmental	**Number Fish/Volume:**	10/10L
Sample I.D.	X-2	**7-d % Mortality:**	0.13 %
W.O. #	08188	**Total Pre-aeration Time (mins):**	30
RBT Batch #:	072908	**Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N):**	Y
Date Received/Time:	Aug 21/08 @ 1310		
Date Setup/Time:	Aug 21/08 @ 1800		
Sample Setup By:	[illegible]		

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

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	15.9°C		15.5
pH	7.5		7.6
D.O. (mg/L)	9.9		10.0
Cond. (µS/cm)	165		162

1725

Concentration %(v/v)	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
ctl				10	10	10	10	15.5	14.9	15.0	14.8	15.0	10.1	9.9	10.0	10.1	10.1	7.1	6.9	7.2	7.2	7.4	57	~~5~~ 6
6.25				10	10	10	10	15.4	14.9	15.0	14.8	15.0	10.0	9.8	9.8	10.0	10.1	7.3	7.3	7.3	7.3	7.3	44	50
12.5				10	10	10	9	15.2	14.9	15.0	14.8	15.0	9.9	9.7	9.6	9.9	10.1	7.2	7.2	7.2	7.2	7.3	52	57
25				10	10	10	9	15.0	14.9	15.0	14.8	15.0	9.9	9.1	8.4	10.0	10.1	7.2	7.1	7.1	7.3	7.4	64	70
50				10	10	10 (2)	10	14.9	14.9	15.0	14.8	15.0	10.0	9.3	9.5	9.9	10.1	7.4	7.4	7.4	7.5	7.5	105	110
100				10	10	10	10	15.5	14.9	15.0	14.8	15.0	10.0	9.7	9.3	9.8	10.1	7.6	7.6	7.6	7.6	7.8	162	166
Initials																								

Sample Description/Comments: slight yellowish hue, clear

Fish Description at 96? All remaining fish appear normal

Other Observations: (2) Two fish darker than normal

Reviewed by: A. Teng

Date Reviewed: September 17, 2008

Rainbow trout (Oncorhynchus mykiss) length and weight sheet

Client: Minnow Environmental
W.O. #: 08188
Sample ID: X-2

Date Measured: Aug 25/08
Batch #: 072908

	Length (mm)	Weight (g)
1	39	0.32
2	35	0.26
3	44	0.50
4	35	0.28
5	42	0.39
6	38	0.32
7	36	0.30
8	34	0.20
9	41	0.41
10	43	0.42
Total	387	3.40
Mean	39	0.34
Std. Dev.	4	0.09
Low	34	0.20
High	44	0.50

ART
Sept 17/08

APPENDIX D – Chain-of-Custody Form

Nautilus Environmental

Chain of Custody

☐ **CALIFORNIA** 5550 Morehouse Drive • Suite 150 San Diego, California 92121 Phone 858.587.7333 Fax 858.587.3961

☐ **WASHINGTON** 5009 Pacific Highway East • Suite 2 Tacoma, Washington 98424 Phone 253.922.4296 Fax 253.922.5814

☒ **BRITISH COLUMBIA** 8664 Commerce Court Burnaby British Columbia Canada V5A 4N7 Phone 604.420.8773 Fax 604.357.1361

Date Aug 19 **Page** 1 **of** 1

Sample Collection by: C. Russel

Report to:
Company Minnow Environmental Inc
Address 2 Lamb St
City Georgetown State ON Zip L7G 6C2
Contact Patti Orr
Phone/Email 905 873-3371

Invoice to: SAME
Company
Address
City State Zip
Contact
Phone/Email Porr@minnow-environmental.com

ANALYSES REQUIRED

SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	NUMBER OF CONTAINERS	COMMENTS				4 day Selenastrum	7 day Ceriodaphnia	96h rainbow trout						RECEIPT TEMPERATURE (°C)
X-2	Aug 19	930	water	20L	2	Water sample for toxicity				X	X	X						
										WO# 08190	WO# 08189	WO# 08188						
						rec'd @ 1310L Aug 21/08 JLT												

PROJECT INFORMATION	
CLIENT	
P.O. NO.	
SHIPPED VIA:	

SAMPLE RECEIPT	
TOTAL NO. OF CONTAINERS	2
REC'D GOOD CONDITION	✓
MATCHES TEST SCHEDULE	✓

RELINQUISHED BY (CLIENT)
(Signature) C. Russel (Time)
(Printed Name) Cynthia Russel (Date) Aug 19
(Company) Minnow Environmental

RELINQUISHED BY (COURIER)
(Signature) (Time) 1310L
(Printed Name) (Date) Aug 21/08
(Company) VTL

RECEIVED BY (COURIER)
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY (LABORATORY)
(Signature) [signature] (Time) 1310L
(Printed Name) John T. (Date) Aug 21/08
Nautilus Environmental Log-in No.

SPECIAL INSTRUCTIONS/COMMENTS:

Additional costs may be required for sample disposal or storage. Net 30 unless otherwise contracted.

DISTRIBUTION: WHITE - Nautilus Environmental, COLOR - Originator

Nautilus Environmental

Freshwater Sediment Toxicity Tests

Final Toxicity Test Report

Report date: November 4, 2008

Submitted to:

Minnow Environmental Incorporated
Georgetown, ON

Burnaby Laboratory
8664 Commerce Court
Burnaby, BC
V5A 4N7

Nautilus Environmental

WO#: 08200

Ms. Patti Orr
Minnow Environmental Inc.
2 Lamb St.
Georgetown, ON
L7G 6L2

November 6, 2008

Ms. Orr:

Re: Freshwater sediment toxicity testing on sediment samples collected August 20 and 21, 2008)

Nautilus Environmental is pleased to provide you with the results of the toxicity tests conducted on sediment samples identified as R2, R7 and X2, received on August 25, 2008. Testing was conducted using *Hyalella azteca* following Environment Canada methods. A summary of the test results and methods are provided in the following report.

Please feel free to contact the undersigned at 604-420-8773 should you have any questions or require any additional information.

Nautilus Environmental

Edmund Canaria, R.P. Bio
Environmental Biologist

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LIST OF APPENDICES

1.0 INTRODUCTION

Nautilus Environmental conducted freshwater sediment toxicity tests for Minnow Environmental on sediment samples collected on August 20 and 21, 2008.

The sediment samples were evaluated for toxicity using the 14-d *Hyalella azteca* toxicity test. This report describes the results of this toxicity test. Copies of raw laboratory data sheets and statistical analyses are provided in Appendix A. The chain-of-custody form is provided in Appendix B.

2.0 METHODS

The samples were transported in 4-L plastic buckets and were received at the Nautilus laboratory on August 25, 2008. The samples were stored in the dark at 4 ± 2°C prior to testing and the tests were initiated on September 11, 2008. The 14-d *H. azteca* test was conducted according to procedures described by Environment Canada (1997). Methods and test conditions for the toxicity test are summarized in Table 1. Statistical analyses were performed using the CETIS (Tidepool Scientific Software, 2007) software program. Total ammonia was measured in the overlying water from each sample at test initiation and termination.

2.1 Quality Assurance/Quality Control (QA/QC)

Nautilus follows a comprehensive QA/QC program to ensure that all data generated are of high quality and scientifically defensible. Our QA program is designed to ensure that all tests are performed in accordance with well-established and approved methods (e.g., Environment Canada, US EPA).

To meet these objectives, Nautilus has implemented a number of quality control procedures that include the following:

- Negative controls to ensure that appropriate testing performance criteria are met;
- Positive controls to assess the health and sensitivity of the test organisms;
- Use of appropriate species and life stage to meet the study objectives;
- Appropriate number of replicates to allow the proper statistical analyses;
- Calibration and proper maintenance of instruments to ensure accurate measurements;
- Proper documentation and recordkeeping to allow traceability of performance;

- Adequate supervision and training of staff to ensure that methods are followed;
- Proper handling and storage of samples to ensure sample integrity;
- Procedures in place to address issues that may arise during testing and ensure the implementation of appropriate corrective actions; and
- Rigorous review of data by a registered professional biologist to ensure they are of good quality and scientifically defensible prior to release to the client.

Table 1. Summary of test conditions for the 14-d *Hyalella azteca* sediment toxicity test.

Test organism	*Hyalella azteca*
Test organism source	Aquatic BioSystems, Fort Collins, CO
Test organism age	6 - 8 days
Test type	Static
Test duration	14 days
Test vessel	375-mL glass jars
Test Treatment	100 mL sediment; 175 mL overlying water
No. of organisms	10 per replicate
Number of replicates	5
Control/dilution water	Moderately hard synthetic water prepared from dechlorinated city water
Test solution renewal	None
Test temperature	23 ± 1°C
Feeding	1.5 mL YCT per replicate daily
Light intensity	500 to 100 lux at water surface
Photoperiod	16 hours light/8 hours dark
Aeration	Gentle aeration throughout test
Test protocol	Environment Canada (1997), EPS 1/RM/33
Test endpoint	Survival and dry weight
Test acceptability criteria for controls	Mean control survival of ≥80%; and ≥0.1 mg/amphipod dry weight
Reference toxicant	NaCl

3.0 RESULTS

Results of the 14-d *H. azteca* toxicity test are summarized in Table 2. The total ammonia values measured for the overlying water in each sample are summarized in Table 3.

The sample identified as R7 was the only sample that exhibited a significant reduction in survival relative to the control. There were no significantly significant adverse effects on growth of *H. azteca* in any of the samples. Ammonia concentrations in the overlying water were well below concentrations expected to be associated with adverse effects to this species.

Table 2. Toxicity test results for the 14-d *Hyalella azteca* sediment toxicity test.

Sample ID	Survival (%) (Mean ± SD)	Dry Weight (Mean ± SD)
Control Sediment	88.0 ± 8.4	0.203 ± 0.036
R2	86.0 ± 11.4	0.236 ± 0.072
R7	50.0 ± 15.8 *	0.164 ± 0.054
X2	90.0 ± 7.1	0.186 ± 0.031

Asterisks (*) indicate samples that are significantly different from the control sediment.

SD = Standard Deviation.

Table 3. **Summary of total ammonia concentrations for the 14 day *Hyalella azteca* sediment toxicity tests.**

Sample ID	Overlying Water Total Ammonia (mg/L N)	
	Day 0	**Day 14**
Control Sediment	0.03	0.04
R2	0.02	0.06
R7	0.11	0.08
X2	0.05	0.04

3.1 Quality Assurance/Quality Control

The test met acceptability criteria and water quality parameters remained within an acceptable range throughout the test. The reference toxicant test results for each species are summarized in Table 4. The test results fell within two standard deviations of the mean of historical test results, indicating that the test organisms were of an appropriate degree of sensitivity.

Table 4. Reference toxicant test results.

Test Species	LC50	Acceptable Range (Mean ± 2SD)	CV(%)	Test Date
H. azteca	4.9 g/L NaCl	3.8 ± 2.1 g/L NaCl	27	September 11, 2008

4.0 REFERENCES

Environment Canada. 1997. Biological test method: test for survival and growth in sediment using the freshwater amphipd *Hyalella azteca*. Environmental Protection Series EPS 1/RM/33 December 1997. Environment Canada, Method Development and Application Section, Environmental Technology Centre, Ottawa, ON. 123 pp.

Tidepool Scientific Software. 2007. CETIS comprehensive environmental toxicity information system. Tidepool Scientific Software, McKinleyville, CA. 222 pp.

APPENDIX A - *Hyalella azteca* Toxicity Test Data

Hyalella azteca Sediment Test Summary Sheet

Client: Minnow
Start Date/Time: Sept 11, 2008 1230h
Work Order No. 08200
Set up by: [illegible]

Sample Information:

Sample ID: various
Sample Date: Aug 20 and 21, 2008
Date Received: Aug 25, 2008
Sample Volume: 3x4L

Test Organism Information:

Species: Hyalella azteca
Supplier: ABS
Date received: Sept. 9, 2008
Age or size (Day 0): 6-8 d old

NaCl Reference Toxicant Results:

Reference Toxicant ID: HA15
Stock Solution ID: 08NaO1
Date Initiated: Sept. 11, 2008

96-h LC50 (95% CL): 4.9 (4.1 – 5.9) g/L NaCl

96-h LC50 Reference Toxicant Mean ± 2 SD: 3.8 ± 2.1 CV (%): 27

Test Results:

Sample ID	Survival ± SD (%)	Average Dry Wt. ± SD (mg)
Control Sediment	0.88 ± 0.08	0.20 ~~0.203~~ ± 0.04
R2	0.86 ± 0.11	0.24 ~~0.236~~ ± 0.07
R7	0.50 ± 0.16	0.16 ~~0.164~~ ± 0.05
X2	0.90 ± 0.07	0.19 ~~0.186~~ ± 0.03
		[illegible]

Reviewed by: JRE
Date reviewed: 16 Oct 2008

Chronic *H. azteca* Sediment Toxicity Test Data Sheet

Freshwater Sediment Water Quality

Client: ~~[illegible]~~ Minnow Environmental
Work Order No.: 08200

Start Date: Sept. 11, 2008
Termination Date: Sept 25, 2008
Test Organism: Hyalella azteca

Dissolved oxygen (mg/L)

Sample ID	Day 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Control Sediment	7.8	7.3	72	76	75	77	74	7.7	7.6	7.8	7.5	7.9	7.6	7.6	7.4
R2	76	7.7	71	73	78	77	75	7.6	7.5	7.6	7.6	7.4	7.5	7.7	7.5
R7	78	7.9	72	76	8.0	87	76	7.7	7.8	7.7	7.7	7.6	7.5	7.5	7.6
X2	79	7.9	72	71	76	79	75	7.3	7.4	7.5	7.6	7.6	7.6	7.8	7.8
Technician Initials	[illegible]	JLT	m	[illegible]	[illegible]	[illegible]	[illegible]	JLT	JLT	DKL	BR	DKL	JLT	[illegible]	JLT

pH

Sample ID	Day 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Control Sediment	75	7.8	8.0	79	77	78	79	7.8	7.9	7.8	7.7	7.6	7.9	77	7.5
R2	75	8.1	8.3	8.2	8.1	8.1	8.2	8.1	8.0	8.1	7.4	7.6	7.4	8.1	7.9
R7	76	8.2	8.4	8.2	8.0	8.1	8.1	8.0	8.1	8.1	8.0	8.0	7.9	8.0	8.0
X2	78	8.2	8.4	8.4	8.4	8.4	8.4	8.3	8.2	8.4	8.4	8.4	8.3	8.4	8.3
Technician Initials	[illegible]	JLT	m	[illegible]	[illegible]	[illegible]	[illegible]	JLT	JLT	DKL	BR	DKL	JLT	[illegible]	JLT

Comments:

Reviewed by: MG

Date Reviewed: 16 Oct 2008

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

Client: MINNOW Environmental
Work Order No.: 08200

Start Date: Sept 11, 2008
Termination Date: Sept 25 2008
Test Organism: Hyalella azteca

Temperature (°C)

Sample ID	Day 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CONTROL SED	23.8	23.9	24.5	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	23.9	24.0
R2	23.8	23.9	24.5	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	23.9	24.0
R7	23.8	23.9	24.5	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	23.9	24.0
X2	23.8	23.9	24.5	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	23.9	24.0
Technician Initials	CM	JLT	[illegible]	CM	CM	CM	CM	JLT	JLT	DKL	DKL	DKL	JLT	CM	JLT

Conductivity (µS)

Sample ID	Day 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CONTROL SED	472	484	516	509	501	500	496	495	502	502	490	511	515	513	499
R2	467	485	504	490	500	498	501	507	506	489	491	512	538	536	537
R7	434	459	500	461	464	470	467	479	471	470	467	486	493	491	499
X2	557	590	629	665	686	695	683	692	701	696	701	720	715	706	710
Technician Initials	CM	JLT	[illegible]	CM	CM	CM	CM	JLT	JLT	DKL	DKL	DKL	JLT	CM	JLT

Comments:

Reviewed by: MR

Date Reviewed: 16 Oct 2008

H. azteca Sediment Toxicity Test Data Sheet
Freshwater Sediment Survival and Weight

Client: MNNON
Work Order No.: 08200

Start Date: Sept 11, 2008
Termination Date: Sept. 25, 2008
Test Organism: Hyalella azteca

Sample ID	Rep	No. alive	No. dead	No. missing	Initials	Pan weight (mg)	Pan + organism (mg)	No. weighed	Initials
Control Sediment	A	9	0	1	EC	1045.30	1046.92 ①	9	EC
	B	9	0	1		995.63	997.13	9	
	C	10	0	0		987.52	989.92	10	
	D	8	0	2		1032.46	1034.~~3~~41	8	
	E	8	0	2		999.26	1000.74	8	
R2	A	9	0	1	EC	1048.08	1050.25	9	EC
	B	10	0	0		1056.74	1060.22	10	
	C	9	0	1		1016.07	1018.26	9	
	D	7	0	3		1031.88	1032.96	7	
	E	8	0	2		1045.01	1046.57	8	
R7	A	5	0	5	EC	1022.98	1023.70	5	EC
	B	4	0	6		1053.25	1054.137 ②	4	
	C	6	0	4		1016.38	1017.33	6	
	D	3	0	7		1056.41	1057.01	~~7~~ 3	
	E	7	0	3		979.74	980.36	~~7~~ 7	
X2	A	9	0	1	EC	1010.33	1011.54	9	EC
	B	9	0	1		985.82	987.69	9	
	C	8	0	2		1015.95	1017.~~2~~34	8	
	D	9	0	1		1093.~~3~~40	1095.27	9	
	E	10	0	0		1011.38	1013.32	10	

Comments: ① 1046.90 ; ② 1054.16 reweighed value.

Reviewed by: M

Date Reviewed: 16 Oct 2008

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

Analysis No:	21-3401-4124	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.5.0
Analyzed:	29 Sep-08 16:32	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Sample Code	Sample No	Sample Date	Receive Date	Sample Age	Client Name	Project
2052491426	20-5249-1426	11 Sep-08		N/A		
1327875629	13-2787-5629	20 Aug-08	28 Aug-08	22d 0h		
42996274	00-4299-6274	21 Aug-08	28 Aug-08	21d 0h		
992516272	09-9251-6272	21 Aug-08	28 Aug-08	21d 0h		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
2052491426	Sediment Sample	Control Sediment			
1327875629	Sediment Sample	R2			
42996274	Sediment Sample	R7			
992516272	Sediment Sample	X2			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run					35.5%

Dunnett's Multiple Comparison Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	P-Value	Decision(5%)
2052491426		1327875629	-1.027	2.227	0.0721	0.9643	Non-Significant Effect
		42996274	1.202	2.227	0.0721	0.2583	Non-Significant Effect
		992516272	0.5386	2.227	0.0721	0.5277	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	0.0139518	0.0046506	3	1.775	0.1924	Non-Significant Effect
Error	0.0419177	0.0026199	16			
Total	0.0558695	0.0072705	19			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	3.127	11.34	0.3725	Equal Variances
Distribution	Shapiro-Wilk Normality	0.9813		0.9495	Normal Distribution

Mean Dry Weight-mg Summary

Conc-Sed	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
2052491426	5	0.2031	0.1891	0.2171	0.1667	0.2438	0.006816	0.03607	17.76%	0.0%
1327875629	5	0.2363	0.2083	0.2644	0.1543	0.348	0.01369	0.07243	30.64%	-16.38%
42996274	5	0.1642	0.1431	0.1852	0.08857	0.23	0.01025	0.05425	33.04%	19.16%
992516272	5	0.1856	0.1735	0.1978	0.1344	0.2078	0.005944	0.03145	16.94%	8.59%

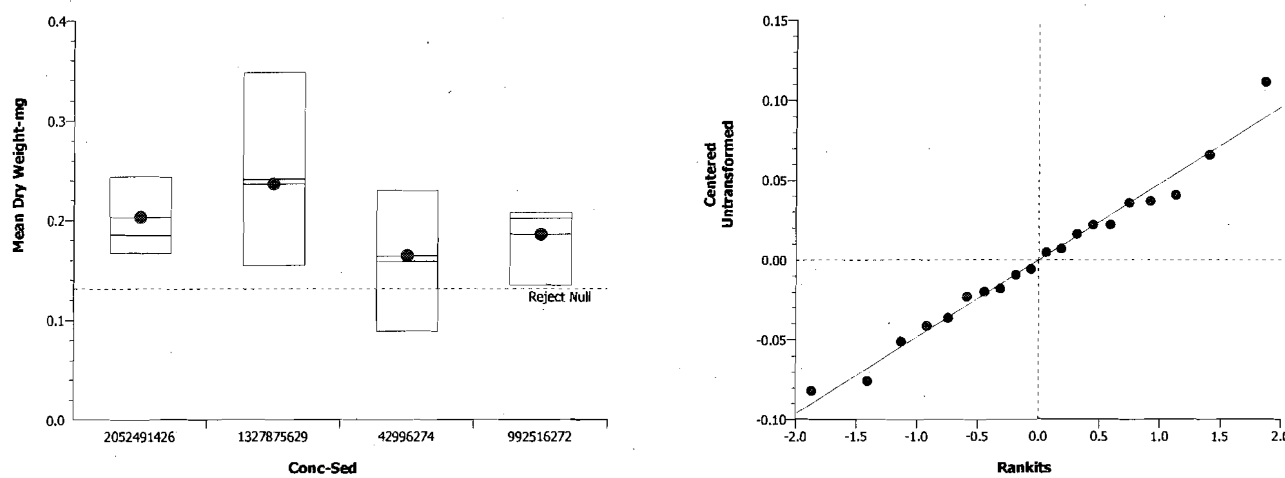
Hyalella 10-d Survival and Growth Sediment Test — **Nautilus Environmental**

Analysis No:	21-3401-4124	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.5.0
Analyzed:	29 Sep-08 16:32	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Mean Dry Weight-mg Detail

Conc-Sed	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
2052491426	0.2438	0.24	0.185	0.18	0.1667
1327875629	0.348	0.2433	0.2411	0.195	0.1543
42996274	0.23	0.2	0.1583	0.144	0.08857
992516272	0.2078	0.2078	0.202	0.1762	0.1344

Graphics



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

Analysis No:	07-7492-0836	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.5.0
Analyzed:	29 Sep-08 16:32	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Sample Code	Sample No	Sample Date	Receive Date	Sample Age	Client Name	Project
2052491426	20-5249-1426	11 Sep-08		N/A		
1327875629	13-2787-5629	20 Aug-08	28 Aug-08	22d 0h		
42996274	00-4299-6274	21 Aug-08	28 Aug-08	21d 0h		
992516272	09-9251-6272	21 Aug-08	28 Aug-08	21d 0h		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
2052491426	Sediment Sample	Control Sediment			
1327875629	Sediment Sample	R2			
42996274	Sediment Sample	R7			
992516272	Sediment Sample	X2			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)		C > T	Not Run					16.84%

Dunnett's Multiple Comparison Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	P-Value	Decision(5%)
2052491426		1327875629	0.2604	2.227	0.1984	0.6484	Non-Significant Effect
		42996274	4.933	2.227	0.1984	0.0002	Significant Effect
		992516272	-0.3186	2.227	0.1984	0.8491	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	0.736671	0.245557	3	12.38	0.0002	Significant Effect
Error	0.3174447	0.0198403	16			
Total	1.054116	0.2653973	19			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	0.7919	11.34	0.8514	Equal Variances
Distribution	Shapiro-Wilk Normality	0.9484		0.3441	Normal Distribution

Survival Rate Summary

Conc-Sed	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
2052491426	5	0.88	0.8476	0.9124	0.8	1	0.01581	0.08367	9.51%	0.0%
1327875629	5	0.86	0.8158	0.9042	0.7	1	0.02155	0.114	13.26%	2.27%
42996274	5	0.5	0.4387	0.5613	0.3	0.7	0.02988	0.1581	31.62%	43.18%
992516272	5	0.9	0.8726	0.9274	0.8	1	0.01336	0.07071	7.86%	-2.27%

Angular (Corrected) Transformed Summary

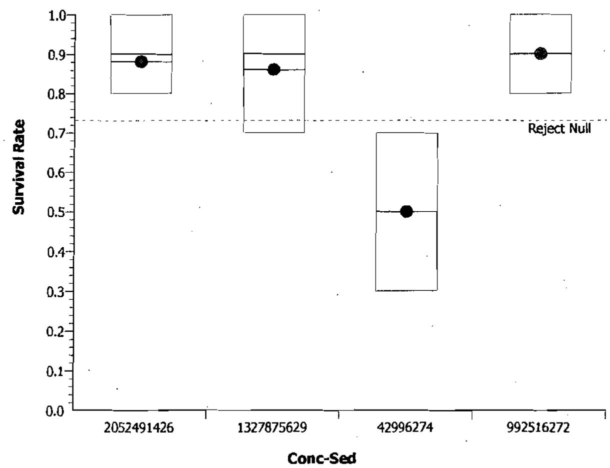
Conc-Sed	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
2052491426	5	1.225	1.176	1.274	1.107	1.412	0.02389	0.1264	10.32%	0.0%
1327875629	5	1.202	1.14	1.264	0.9912	1.412	0.03018	0.1597	13.29%	1.89%
42996274	5	0.7854	0.7226	0.8482	0.5796	0.9912	0.03061	0.162	20.62%	35.88%
992516272	5	1.253	1.211	1.295	1.107	1.412	0.0204	0.1079	8.61%	-2.32%

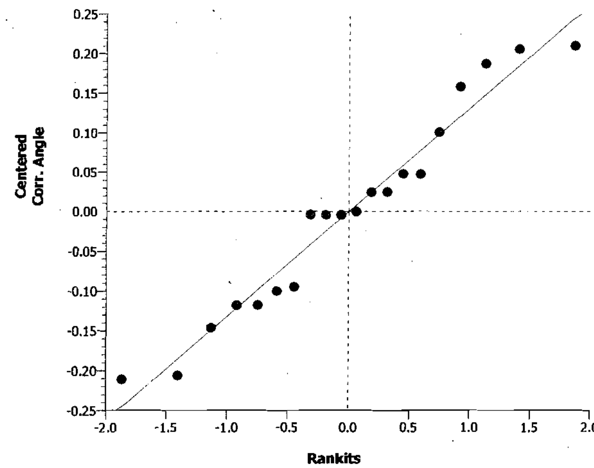
Hyalella 10-d Survival and Growth Sediment Test				Nautilus Environmental
Analysis No: 07-7492-0836	**Endpoint:** Survival Rate		**CETIS Version:** CETISv1.5.0	
Analyzed: 29 Sep-08 16:32	**Analysis:** Parametric-Control vs Treatments		**Official Results:** Yes	

Survival Rate Detail

Conc-Sed	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
2052491426	1	0.9	0.9	0.8	0.8
1327875629	1	0.9	0.9	0.8	0.7
42996274	0.7	0.6	0.5	0.4	0.3
992516272	1	0.9	0.9	0.9	0.8

Graphics





CETIS Summary Report

Report Date: 29 Sep-08 16:34 (p 1 of 1)
Link/Link Code: 09-0464-9527/08200

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

Test Run No:	20-0269-0645	**Test Type:**	Survival-Growth	**Dil Water:**	
Start Date:	11 Sep-08	**Protocol:**	EC/EPS 1/RM/33	**Brine:**	
Ending Date:	25 Sep-08	**Species:**	Hyalella azteca		
Duration:	14d 0h	**Source:**			

Sample Code	Sample No	Sample Date	Receive Date	Sample Age	Client Name	Project
2052491426	20-5249-1426	11 Sep-08		N/A		
1327875629	13-2787-5629	20 Aug-08	28 Aug-08	22d 0h		
42996274	00-4299-6274	21 Aug-08	28 Aug-08	21d 0h		
992516272	09-9251-6272	21 Aug-08	28 Aug-08	21d 0h		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
2052491426	Sediment Sample	Control Sediment			
1327875629	Sediment Sample	R2			
42996274	Sediment Sample	R7			
992516272	Sediment Sample	X2			

Mean Dry Weight-mg Summary

Conc-Sed	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
2052491426	5	0.2031	0.1896	0.2166	0.1667	0.2438	0.006585	0.03607	17.76%	0.0%
1327875629	5	0.2363	0.2093	0.2634	0.1543	0.348	0.01322	0.07243	30.64%	-16.38%
42996274	5	0.1642	0.1439	0.1844	0.08857	0.23	0.009905	0.05425	33.04%	19.16%
992516272	5	0.1856	0.1739	0.1974	0.1344	0.2078	0.005743	0.03145	16.94%	8.59%

Survival Rate Summary

Conc-Sed	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
2052491426	5	0.88	0.8488	0.9112	0.8	1	0.01528	0.08367	9.51%	0.0%
1327875629	5	0.86	0.8174	0.9026	0.7	1	0.02082	0.114	13.26%	2.27%
42996274	5	0.5	0.441	0.559	0.3	0.7	0.02887	0.1581	31.62%	43.18%
992516272	5	0.9	0.8736	0.9264	0.8	1	0.01291	0.07071	7.86%	-2.27%

Mean Dry Weight-mg Detail

Conc-Sed	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
2052491426	0.18	0.1667	0.24	0.2438	0.185
1327875629	0.2411	0.348	0.2433	0.1543	0.195
42996274	0.144	0.23	0.1583	0.2	0.08857
992516272	0.1344	0.2078	0.1762	0.2078	0.202

Survival Rate Detail

Conc-Sed	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
2052491426	0.9	0.9	1	0.8	0.8
1327875629	0.9	1	0.9	0.7	0.8
42996274	0.5	0.4	0.6	0.3	0.7
992516272	0.9	0.9	0.8	0.9	1

Nautilus Environmental
Sediment Toxicity Test - Water Quality Data For Ammonia

Client : Minnow

Work Order No: 08210

Species : Hyalella azteca

Sample Type: Overlying Water

Date Measured: Sept-12/08

	Sample ID	Salinity (ppt)	pH	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)	Tech Init
Day 0	CONTROL SEDIMENT	—	7.5	0.03	—	EC
	R2	—	7.5	0.02	—	
	R7	—	7.6	0.11	—	
	X2	—	7.8	0.05	—	
Day 14	CONTROL SEDIMENT	-	7.5	0.04	—	EC
	R2	—	7.4	0.06	—	
	R7	—	8.0	0.08	—	
	X2	—	8.3	0.04	—	

Comments:

Reviewed by: JRE

Date Reviewed: 16 Oct 2008

Client: Minnow

W.O.#: 0820

Hardness and Alkalinity Datasheet

	Alkalinity					Hardness			
Sample ID	Sample Date	Sample Volume (mL)	(mL) 0.02N HCL/H_2SO_4 used to pH 4.5	(mL) of 0.02N HCL/H_2SO_4 used to pH 4.2	Total Alkalinity (mg/L$CaCO_3$)	Sample Volume (mL)	Volume of 0.01M EDTA Used (mL)	Total Hardness (mg/L $CaCO_3$)	Technician
Control/Dilut	Sept. 10/08	50	3.8	3.9	74	50	4.9	98	Ec
R2	Sept. 4/08	50	4.7	4.8	92	50	7.2	144	
R7		50	4.1	4.2	80	50	7.8	156	
X2		50	7.8	8.1	150	50	7.4	148	
Sediment Control		50	3.5	3.6	68	50	4.7	94	
Control Sediment	Sept 25/08	50	3.2	3.3	62	50	3.5	70	Ec
R2		50	4.6	4.7	90	50	7.5	150	
R7		50	4.2	4.3	82	50	7.3	146	
Y2		50	13.5	13.8	264	20	4.8	240	

Notes:

Reviewed by: JRG

Date Reviewed: 16 Oct 2008

APPENDIX B - Chain-of-Custody Form

Nautilus Environmental

☐ **CALIFORNIA**
5550 Morehouse Drive • Suite 150
San Diego, California 92121
Phone 858.587.7333
Fax 858.587.3961

☐ **WASHINGTON**
5009 Pacific Highway East • Suite 2
Tacoma, Washington 98424
Phone 253.922.4296
Fax 253.922.5814

☐ **BRITISH COLUMBIA**
8664 Commerce Court
Burnaby British Columbia Canada V5A 4N7
Phone 604.420.8773
Fax 604.357.1361

Chain of Custody

Date Aug 21/08 **Page** 1 **of** 1

Sample Collection by: CR, TH, MB

Report to:
Company MINNOW ENVIRONMENTAL
Address 2 LAMB ST
City GEORGETOWN State ON Zip L7G 3M9
Contact PATTI ORR
Phone/Email 905-873-3371 porr@minnow-environmental.com

Invoice to:
Company SAME AS REPORT
Address
City State Zip
Contact
Phone/Email

ANALYSES REQUIRED

SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	NUMBER OF CONTAINERS	COMMENTS	4-d selenastrum / pseudokirchneriella	7-d ceriodaphnia / survival/growth	96-h rainbow trout	14-d hyalella test	RECEIPT TEMPERATURE (°C)
R7	Aug 21 2008		Water	20 L	2		✓	✓	✓		6.6°C
R7	Aug 21 2008		sed	4 L	1					✓	
X2	Aug 21 2008		sed	4 L	1	Rec'd 0945L Aug 25/08 JT				✓	
R2	Aug 20 2008		sed	4 L	1					✓	
							WO #08197	WO #08198	WO #08199	WO #08200	

PROJECT INFORMATION	
CLIENT	MINNOW
P.O. NO.	2254
SHIPPED VIA:	A-1

SAMPLE RECEIPT	
TOTAL NO. OF CONTAINERS	3
REC'D GOOD CONDITION	✓
MATCHES TEST SCHEDULE	✓

RELINQUISHED BY (CLIENT)
(Signature) C Russel (Time)
(Printed Name) CYNTHIA RUSSEL (Date) AUG 21/08
(Company) MINNOW

RELINQUISHED BY (COURIER)
(Signature) (Time) 0945
(Printed Name) (Date) Aug 25/08
(Company) VTZ

RECEIVED BY (COURIER)
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY (LABORATORY)
(Signature) John T (Time) 0945
(Printed Name) John T (Date) Aug 25/08
Nautilus Environmental Log-in No.

SPECIAL INSTRUCTIONS/COMMENTS:

Additional costs may be required for sample disposal or storage. Net 30 unless otherwise contracted.

DISTRIBUTION: WHITE - Nautilus Environmental, COLOR - Originator

Nautilus Environmental

Toxicity Testing on samples identified as R-7, R-2 and X-2 collected in January, 2009

Final Toxicity Test Report

Report date: February 9, 2009

Submitted to:

Minnow Environmental Incorporated
Georgetown, ON

Burnaby Laboratory
8664 Commerce Court
Burnaby, BC
V5A 4N7

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LIST OF APPENDICES

1.0 INTRODUCTION

Nautilus Environmental (Burnaby, BC) conducted sub-lethal and acute toxicity tests for Minnow Environmental on samples identified as R-7, R-2 and X-2, collected on January 15, 2009 and delivered to the Nautilus Environmental Laboratory in Burnaby, BC on January 17, 2009. The samples were collected in 20-L collapsible containers, transported in coolers containing ice packs and stored in the dark at 4° C prior to testing. Toxicity testing was performed on the sample using the following tests:

- *Ceriodaphnia dubia* survival and reproduction
- 72-h *Pseudokirchneriella subcapitata* growth inhibition (formerly identified as *Selenastrum capricornutum*)
- 96-h Rainbow trout *(Oncorhynchus mykiss)* survival

This report describes the results of these toxicity tests. Copies of raw laboratory data sheets and statistical analyses for each test species are provided in Appendices A, B and C. The chain of custody form is provided in Appendix D.

2.0 METHODS

Methods for the toxicity tests are summarized in Tables 1 through 3. Testing was conducted according to procedures described by Environment Canada (2000a, 2007a and 2007b).

Statistical analyses for all the tests were performed using CETIS (Tidepool Scientific Software, 2007).

2.1 Quality Assurance/Quality Control (QA/QC)

Nautilus follows a comprehensive QA/QC program to ensure that data generated are of high quality and scientifically defensible. Our QA program is designed to ensure that all tests are performed in accordance with well-established and approved methods (e.g., Environment Canada, US EPA).

To meet these objectives, Nautilus has implemented a number of quality control procedures that include the following:

- Negative controls to ensure that appropriate testing performance criteria are met;
- Positive control to assess the health and sensitivity of the test organisms;
- Use of appropriate species and life stage to meet the study objectives;
- Appropriate number of replicates to allow the proper statistical analyses;
- Calibration and proper maintenance of instruments to ensure accurate measurements;
- Proper documentation and record keeping to allow traceability of performance;
- Adequate supervision and training of staff to ensure that methods are followed;
- Proper handling and storage to ensure sample integrity;
- Procedures in place to address issues that arise during testing so that appropriate corrective actions can be implemented; and
- Rigorous review of data by a Registered Professional Biologist to ensure they are of good quality and scientifically defensible prior to releasing to the client.

Table 1. Summary of test conditions for the *Ceriodaphnia dubia* survival and reproduction test.

Test organism	*Ceriodaphnia dubia*
Test organism source	In-house culture
Test organism age	<24 hr old neonates produced within 12 hr
Test type	Static renewal
Test duration	7 ± 1 day
Test chamber	20 mL test tube
Test solution volume	15 mL
Test concentrations	Seven concentrations, plus laboratory control
Number of replicates	10
Control/dilution water	20% Perrier water (hardness 80-100mg/L $CaCO_3$)
Test solution renewal	Daily
Test temperature	25 ± 1°C
Number of organisms/chamber	1
Feeding	Daily, with 0.1 ml *Pseudokirchneriella subcapitata* and 0.05 mL YCT
Light intensity	100 to 600 lux
Photoperiod	16 hours light/8 hours dark
Aeration	None
Test protocol	Environment Canada (2007a), EPS 1/RM/21
Test endpoints	Survival and reproduction
Test acceptability criteria for criteria for control	≥80% survival; ≥15 young per surviving control; ≥60% of controls producing three or more broods
Reference Toxicant	Sodium chloride

Table 2. Summary of test conditions for the *Pseudokirchneriella subcapitata* growth inhibition test.

Test organism	*Pseudokirchneriella subcapitata*
Test organism source	In-house culture
Test organism age	3 to 7-day old culture in logarithmic growth phase
Test type	Static
Test duration	72 hours
Test chamber	Microplate
Test solution volume	220 µL
Test concentrations	Seven concentrations, plus laboratory control
Number of replicates	4 for treatments; 8 for control
Control/Dilution water	Deionized or distilled water
Test solution renewal	None
Test temperature	24 ± 2°C
Number of organisms/chamber	10,000 cells/mL
Light intensity	3600 to 4400 lux
Photoperiod	Continuous
Aeration	None
Test protocol	Environment Canada (2007b), EPS 1/RM/25
Test endpoint	Algal cell growth inhibition
Test acceptability criteria for control	≥ 16-fold increase in number of algal cells; no trend; and CV ≤ 20%
Reference toxicant	Zinc

Table 3. Summary of test conditions for the 96-h LC50 rainbow trout test.

Test organism	*Oncorhynchus mykiss*
Test organism source	Commercial hatchery
Test organism age	Juveniles
Test type	Static
Test duration	96 hours
Test chamber	18.2 L glass aquarium
Test solution volume	10 L
Test concentrations	Five concentrations, plus laboratory control
Number of replicates	1
Control/Dilution water	Municipal dechlorinated water
Test solution renewal	None
Test temperature	15 ± 1°C
Number of organisms/chamber	Ten
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light/8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test protocol	Environment Canada (2000b), EPS 1/RM/13
Test endpoint	Survival
Test acceptability criterion for control	Survival ≥ 90%
Reference toxicant	Sodium dodecyl sulphate

3.0 RESULTS

Results of toxicity tests using *C. dubia* are provided in Table 4. No adverse effects were observed on survival of this species in any of the samples. Adverse effects on reproduction of *C. dubia* were observed in samples R-2 and X-2; IC25 values in these samples were 62.6 and 26.9%, respectively. The IC25 for reproduction was >100% in sample R-7, indicating a general lack of toxicity in this sample. It should be noted that reproduction in a number of test concentrations in sample R-7 were determined to be statistically significantly lower than control performance. However, this appears to reflect a high degree of sensitivity to detect differences between the control and test concentrations as a result of the low between-replicate variability associated with the control in this test, rather than providing evidence of a real toxicological effect in the sample. In fact, reproduction in all concentrations of R-7 exceeded that associated with acceptable control performance, suggesting that there was little indication of adverse effects. Consequently, the NOEC and LOEC have not been reported for this sample.

Growth of *P. subcapitata* was inhibited in samples R-2 and X-2, with IC25 values of 62.6 and 26.9%, respectively. No inhibition of growth was observed in sample R-7 (IC25 of >100%). These data are provided in Table 5.

Survival in the 96-h rainbow trout toxicity test was 100% in all concentrations for all samples; the LC50 was >100% in all three samples (Table 6).

3.1 Quality Assurance/Quality Control

The health history of the test organisms used in the exposures was acceptable and met the requirements of the Environment Canada protocols. The tests met all control acceptability criteria and water quality parameters were within acceptable ranges specified in the respective test protocol. There were no deviations from the test protocols.

Results of the reference toxicant tests are summarized in Table 7. Results of these tests were all fell within the acceptable ranges of organism performance (mean ± two standard deviations), based on historical results obtained by the laboratory. These results indicate that the test organisms were of an appropriate degree of sensitivity.

Table 4. Toxicity test results for the *Ceriodaphnia dubia* survival and reproduction test.

	R-7		R-2		X-2	
Concentration (%v/v)	**Survival (%)**	**Reproduction (#/adult)**	**Survival (%)**	**Reproduction (#/adult)**	**Survival (%)**	**Reproduction (#/adult)**
Control	100	19.1 ± 1.4	90	17.6 ± 6.3	100	18.6 ± 2.6
1.56	100	18.8 ± 1.9	100	18.2 ± 0.9	100	17.0 ± 2.2
3.12	100	17.6 ± 1.5	100	17.8 ± 0.8	90	15.5 ± 5.5
6.25	100	15.1 ± 2.5*	100	18.1 ± 1.8	100	17.5 ± 1.6
12.5	100	16.7 ± 1.1*	100	17.6 ± 1.1	100	15.9 ± 2.4
25	100	17.0 ± 1.3*	100	16.3 ± 1.2*	100	14.4 ± 1.3*
50	100	15.4 ± 1.2*	100	15.4 ± 1.0*	90	10.0 ± 1.9*
100	100	16.4 ± 2.4*	100	8.1 ± 1.4*	90	0.2 ± 0.6*
Test endpoint	**Survival (% v/v)**	**Reproduction (% v/v)**	**Survival (% v/v)**	**Reproduction (% v/v)**	**Survival (% v/v)**	**Reproduction (% v/v)**
NOEC	100	See text	100	12.5	100	12.5
LOEC	>100	See text	>100	25	>100	25
LC50	>100	--	>100	--	>100	--
IC25 (95% CL)	--	>100%	--	62.6 (51.4 – 73.1)	--	26.9 (15.6 – 33.3)
IC50 (95% CL)	--	>100%	--	94.5 (83.3 - >100)	--	52.6 (46.4 – 57.5)

Asterisks (*) indicate treatments that are significantly different from the control.
CL = Confidence Limits.
NOEC = No Observed Effect Concentration.
LOEC = Lowest Observed Effect Concentration.
LC = Lethal Concentration.
IC = Inhibition Concentration.
SD = Standard Deviation.

Table 5. Toxicity test results for the *Pseudokirchneriella subcapitata* growth inhibition test. Data are presented as mean ± SD cell density (X 10^4 cells/mL).

Concentration (% v/v)	R-7	R-2	X-2
Control	50.3 ± 5.7	42.7 ± 6.4	49.1 ± 4.8
1.48	70.8 ± 11.2	75.3 ± 6.9	57.8 ± 9.3
2.95	80.0 ± 3.9	105.8 ± 16.0	93.5 ± 11.0
5.95	107.0 ± 3.4	115.8 ± 17.6	114.8 ± 13.8
11.9	134.3 ± 7.4	95.8 ± 24.1	55.8 ± 15.2
23.8	142.5 ± 15.3	90.3 ± 10.5	13.3 ± 3.6 *
47.6	165.0 ± 20.5	42.8 ± 14.0	2.0 ± 0.8 *
95.2	195.3 ± 12.3	8.0 ± 2.9 *	1.0 ± 1.4 *
Test endpoint	**Cell Density (% v/v)**	**Cell Density (% v/v)**	**Cell Density (% v/v)**
NOEC	95.2	47.6	11.9
LOEC	>95.2	95.2	23.8
IC25 (95% CL)	>95.2	58.9 (NC)	14.8 (13.6 – 16.5)
IC50 (95% CL)	>95.2	72.9 (NC)	17.3 (15.4 – 20.3)

NOEC = No Observed Effect Concentration.
LOEC = Lowest Observed Effect Concentration.
IC = Inhibition Concentration.
SD = Standard Deviation.
NC = Not Calculable; data for this sample analyzed by log-linear interpolation (with cell density in concentrations exceeding control growth assigned control growth rate) because of failure of assumptions of nonlinear regression models

Table 6. Survival (%) in the 96-h LC50 juvenile rainbow trout (*Oncorhynchus mykiss*) test.

Concentration (% v/v)	R-7	R-2	X-2
Control	100	100	100
6.25	100	100	100
12.5	100	100	100
25.0	100	100	100
50.0	100	100	100
100.0	100	100	100
Test endpoint	**Survival (% v/v)**	**Survival (% v/v)**	**Survival (% v/v)**
LC50	>100	>100	>100

LC = Lethal Concentration.

Table 7. Reference toxicant test results.

Species	Endpoint	Historical range (mean ± 2 SD)	CV(%)	Date
C. dubia	Survival (EC50): 2.0 g/L NaCl	1.7 ± 0.8	23	January 28, 2009
	Reproduction (IC50): 1.3 g/L NaCl	1.1 ± 0.3	14	
P. subcapitata	Growth (IC50): 14.7 µg/L Zn	16.4 ± 10.8	33	January 18, 2009
O.mykiss (juvenile)	Survival (LC50): 5.3 mg/L SDS	5.2 ± 2.3	22	January 5, 2009

REFERENCES

Environment Canada. 2000. Biological test method: reference method for determining acute lethality of effluents to rainbow trout. Environmental Protection Series. Report EPS 1/RM/13, Second Edition, December 2000, including May 2007 amendments. Environment Canada, Method Development and Application Section, Environmental Technology Centre, Ottawa, ON. 23 pp.

Environment Canada. 2007a. Biological test method: test of reproduction and survival using the cladoceran *Ceriodaphnia dubia*. Environmental Protection Series. Report EPS 1/RM/21, Second Edition, February 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON. 74 pp.

Environment Canada. 2007b. Biological test method: growth inhibition test using the freshwater alga. Environmental Protection Series, Report EPS 1/RM/25. Second Edition, March 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON. 53 pp.

Tidepool Scientific Software. 2007. CETIS comprehensive environmental toxicity information system, version 1.5.0D. Tidepool Scientific Software, McKinleyville, CA. 222 pp.

APPENDIX A – *Ceriodaphnia dubia* Toxicity Test Data

Ceriodaphnia dubia Summary Sheet

Client: Minnow
Work Order No.: 09018

Start Date/Time: Jan 17/09 @ 1500h
Set up by: AM

Sample Information:

Sample ID: E-7
Sample Date: Jan 15/09
Date Received: Jan 17/09
Sample Volume: 2x20L

Test Organism Information:

Broodstock No.: 010609
Age of young (Day 0): <24 (w/in 12-h)
Avg No. young in first 3 broods of previous 7 d: 24
Mortality (%) in previous 7 d: 0
Avg. No. of young in previous brood: 11

NaCl Reference Toxicant Results:

Reference Toxicant ID: Cd 39
Stock Solution ID: 08NaC4
Date Initiated: Jan 28/09

7-d LC50 (95% CL): 2.0 (1.7-2.3) g/L NaCl
7-d IC50 (95% CL): 1.3 (1.1-1.5) g/L NaCl

7-d LC50 Reference Toxicant Mean ± 2 SD: 1.7 ± 0.8 CV (%): 23
7-d IC50 Reference Toxicant Mean ± 2 SD: 1.1 ± 0.3 CV (%): 14

Test Results:

	Survival	Reproduction
NOEC %(v/v)	100	3.12
LOEC %(v/v)	>100	6.25
LC50 %(v/v) (95% CL)	>100	
IC25 %(v/v) (95% CL)		63.3(51.4-74.1) ~~>100~~
IC50 %(v/v) (95% CL)		94.9(84.8-100.0) ~~>100~~

Reviewed by: A. Tang

Date reviewed: February 5, 2009

Chronic Freshwater Toxicity Test
Initial and Final Water Quality Measurements

Client: Minnow
Sample ID: E-7
Work Order #: 09018

Start Date & Time: Jan 17/09 @ 1500h
Stop Date: Jan 23/09 @ 1540h
Test Species: *Ceriodaphnia dubia*

% (v/v) Concentration Control	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	25.0	25.8	24.2	25.9	24.1	25.4	24.7	25.3	24.7	25.5	24.5	25.4		
DO (mg/L)	8.1	7.5	7.9	7.6	8.2	7.4	8.0	7.9	8.1	7.2	8.2	6.4		
pH	8.1	7.9	8.1	8.0	8.1	8.1	8.1	7.7	8.1	7.7	8.1	8.1		
Cond. (µS/cm)	212	210		213		216		214		215				
Initials	AWD	EK	EK	BRL	BRL	A	A	A	A	A	A	A		

1.6 Concentration	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	24.9	25.8	24.3	25.9	24.6	25.4	24.4	25.3	24.5	25.5	24.7	25.4		
DO (mg/L)	8.3	7.5	8.1	7.5	8.0	7.5	8.1	7.9	8.2	7.6	8.0	6.5		
pH	8.1	7.9	8.0	8.0	8.0	8.0	8.0	7.9	8.0	7.7	8.1	8.2		
Cond. (µS/cm)	214	212		212		213		215		217		224		
Initials	AWD	EK	EK	BRL	BRL	A	A	A	A	A	A			

12.5 Concentration	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	24.8	25.8	24.4	25.9	24.7	25.4	24.3	25.3	24.5	25.5	24.7	25.4		
DO (mg/L)	8.3	7.4	8.2	7.3	8.0	7.4	8.0	7.7	8.1	7.6	8.0	6.6		
pH	8.0	7.9	7.9	8.0	8.0	8.1	8.0	7.9	7.9	7.7	8.0	8.1		
Cond. (µS/cm)	219	218		218		221		220		222		235		
Initials	AWD	EK	EK	BRL	BRL	A	A	A	A	A	A			

100 Concentration	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	24.9	25.8	24.5	25.9	24.5 / 24.7	25.4	24.3	25.3	24.0	25.5	24.4	25.4		
DO (mg/L)	8.3	7.4	8.2	7.3	8.1	7.6	8.1	7.7	8.1	7.6	8.0	6.9		
pH	7.5	7.9	7.6	8.1	7.7	8.0	7.8	8.0	7.7	7.9	7.8	8.2		
Cond. (µS/cm)	299	265		264		265		267		269		270		
Initials	A	EK	EK	BRL	BRL	A	A	A	A	A	A	A		

	Control	100		
Hardness*	100	320		
Alkalinity*	80	128		

* mg/L as CaCO3

Analysts: AWD, A

Reviewed by: ARG
Date reviewed: Feb 5/09

Sample Description: ① clear

Comments:

Chronic Freshwater Toxicity Test
C. dubia Reproduction Data

Client: Minnow
Sample ID: R-7
Work Order: 09 0?8 ?

Start Date & Time: Jan 17/09 @ 1500h
Stop Date & Time: Jan 23/09 @ 1540h
Set up by: [illegible]

% (v/v)

Concentration: Control

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BRL
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
4	3	3	4	5	3	4	3	3	4	4	[illegible]
5	8	9	8	6	9	8	8	7	8	8	[illegible]
6	6	8	7	7	9	9	7	8	8	7	[illegible]
7											
8											
Total	17	20	19	18	21	21	18	18	20	19	[illegible]

Concentration: 1.6

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BRL
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
4	4	3	5	3	3	4	3	4	4	4	[illegible]
5	5	9	8	8	8	8	7	6	8	8	[illegible]
6	7	8	9	9	7	8	9	6	6	7	[illegible]
7											
8											
Total	16	20	22	20	18	20	19	16	18	19	[illegible]

Concentration: 3.12

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BRL
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
4	3	✓	3	3	4	3	3	3	3	5	[illegible]
5	7	6	9	8	8	8	8	9	7	6	[illegible]
6	7	8	7	7	7	6	7	6	7	8	[illegible]
7											
8											
Total	17	14	19	18	19	17	18	18	17	19	[illegible]

Concentration: 6.25

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BRL
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
4	✓	✓	3	4	✓	✓	4	5	3	3	[illegible]
5	6	6	7	6	5	7	8	7	9	5	[illegible]
6	6	6	5	6	7	8	7	5	6	7	[illegible]
7											
8											
Total	12	12	15	16	12	15	19	17	18	15	[illegible]

Concentration: 12.5

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓		[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BRL
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
4	4	3	4	4	4	4	3	4	4	✓	[illegible]
5	7	8	7	9	7	6	7	5	7	8	[illegible]
6	6	7	5	6	5	6	7	7	5	8	[illegible]
7											
8											
Total	17	18	16	19	16	16	17	16	16	16	[illegible]

Concentration: 25

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BRL
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
4	3	✓	4	3	4	3	4	2	3	3	[illegible]
5	7	7	7	5	8	7	8	8	8	9	[illegible]
6	6	8	7	7	6	7	6	6	8	5	[illegible]
7											
8											
Total	16	15	18	15	18	17	18	17	19	17	[illegible]

Concentration: 50

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BRL
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
4	2	4	2	3	3	4	2	✓	3	3	[illegible]
5	9	5	7	9	5	4	6	7	8	5	[illegible]
6	5	7	5	6	7	6	6	7	5	7	[illegible]
7											
8											
Total	16	16	15	18	15	14	15	14	16	15	[illegible]

Concentration: 100

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BRL
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
4	3	4	✓	3	3	3	✓	3	3	2	[illegible]
5	9	7	6	7	7	8	6	7	7	5	[illegible]
6	7	8	7	7	7	8	7	6	7	7	[illegible]
7											
8											
Total	19	19	13	17	17	19	13	16	17	14	[illegible]

Concentration:

Days	A	B	C	D	E	F	G	H	I	J	Init
1											
2											
3											
4											
5											
6											
7											
8											
Total											

Notes: X = mortality.

Sample Description: 1
Comments:

Reviewed by: A. Tong

Date reviewed: February 5, 2009

CETIS Analytical Report

Report Date: 27 Jan-09 15:46 (p 1 of 2)
Link/Link Code: 05-4762-0404/wo09018R7

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	15-3847-1869	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	27 Jan-09 15:41	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Sample No:	10-8979-6432	**Code:**	1089796432	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	R-7		
Sample Age:	63h	**Station:**			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	3.12	6.25	4.416	32.05	9.65%

Dunnett's Multiple Comparison Test

Control	vs	Conc-%	Test Stat	Critical	MSD	P-Value	Decision(5%)
Negative Control		1.56	0.3885	2.386	1.843	0.7511	Non-Significant Effect
		3.12	1.942	2.386	1.843	0.1248	Non-Significant Effect
		6.25*	5.18	2.386	1.843	0.0000	Significant Effect
		12.5*	3.108	2.386	1.843	0.0079	Significant Effect
		25*	2.719	2.386	1.843	0.0225	Significant Effect
		50*	4.791	2.386	1.843	0.0000	Significant Effect
		100*	3.496	2.386	1.843	0.0025	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	146.2875	20.89821	7	7.008	0.0000	Significant Effect
Error	214.7	2.981945	72			
Total	360.9875	23.88016	79			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	12.6	18.48	0.0825	Equal Variances
Distribution	Shapiro-Wilk Normality	0.9796		0.2311	Normal Distribution

Reproduction Summary

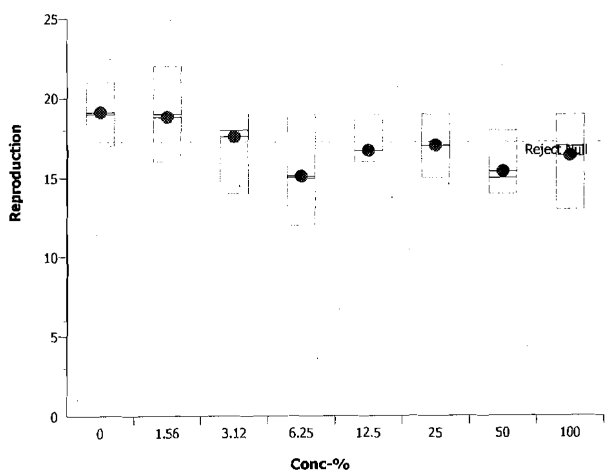
Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	19.1	18.57	19.63	17	21	0.259	1.37	7.17%	0.0%
1.56		10	18.8	18.07	19.53	16	22	0.3541	1.874	9.97%	1.57%
3.12		10	17.6	17.02	18.18	14	19	0.2845	1.506	8.55%	7.85%
6.25		10	15.1	14.13	16.07	12	19	0.4752	2.514	16.65%	20.94%
12.5		10	16.7	16.29	17.11	16	19	0.2002	1.059	6.34%	12.57%
25		10	17	16.48	17.52	15	19	0.252	1.333	7.84%	10.99%
50		10	15.4	14.94	15.86	14	18	0.2218	1.174	7.62%	19.37%
100		10	16.4	15.48	17.32	13	19	0.4472	2.366	14.43%	14.14%

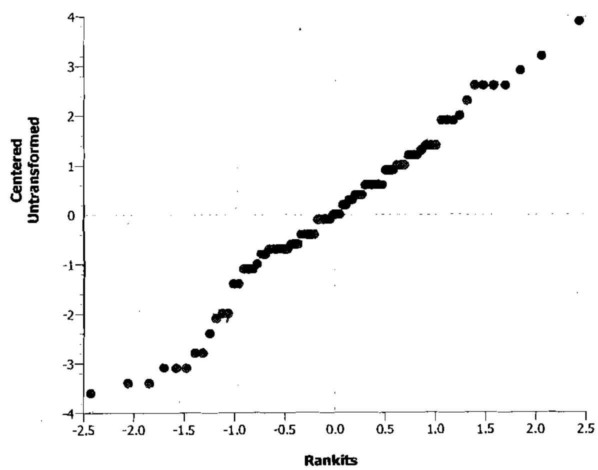
Ceriodaphnia 7-d Survival and Reproduction Test			**Nautilus Environmental**
Analysis No: 15-3847-1869	**Endpoint:** Reproduction	**CETIS Version:** CETISv1.5.0	
Analyzed: 27 Jan-09 15:41	**Analysis:** Parametric-Control vs Treatments	**Official Results:** Yes	

Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	21	21	20	20	19	19	18	18	18	17
1.56		22	20	20	20	19	19	18	18	16	16
3.12		19	19	19	18	18	18	17	17	17	14
6.25		19	18	17	16	15	15	15	12	12	12
12.5		19	18	17	17	16	16	16	16	16	16
25		19	18	18	18	17	17	17	16	15	15
50		18	16	16	16	15	15	15	15	14	14
100		19	19	19	17	17	17	16	14	13	13

Graphics





CETIS Analytical Report

Report Date: 27 Jan-09 15:46 (p 1 of 2)
Link/Link Code: 05-4762-0404/wo09018R7

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	02-4213-6362	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	27 Jan-09 15:45	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Sample No:	10-8979-6432	**Code:**	1089796432	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	R-7		
Sample Age:	63h	**Station:**			

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X + 1)	Linear	57951	200	Yes	Two-Point Interpolation

Point Estimates

% Effect	Conc-%	95% LCL	95% UCL
5	2.319	0.7477	3.581
10	3.902	2.528	5.573
15	26.56	4.354	N/A
20	> 100	N/A	N/A
25	> 100	N/A	N/A
40	> 100	N/A	N/A
50	> 100	N/A	N/A

Reproduction Summary

			Calculated Variate						
Conc-%	**Control Type**	**Count**	**Mean**	**Min**	**Max**	**Std Err**	**Std Dev**	**CV%**	**Diff%**
0	Negative Control	10	19.1	17	21	0.2545	1.37	7.17%	0.0%
1.56		10	18.8	16	22	0.348	1.874	9.97%	1.57%
3.12		10	17.6	14	19	0.2796	1.506	8.55%	7.85%
6.25		10	15.1	12	19	0.4669	2.514	16.65%	20.94%
12.5		10	16.7	16	19	0.1967	1.059	6.34%	12.57%
25		10	17	15	19	0.2476	1.333	7.84%	10.99%
50		10	15.4	14	18	0.218	1.174	7.62%	19.37%
100		10	16.4	13	19	0.4394	2.366	14.43%	14.14%

Reproduction Detail

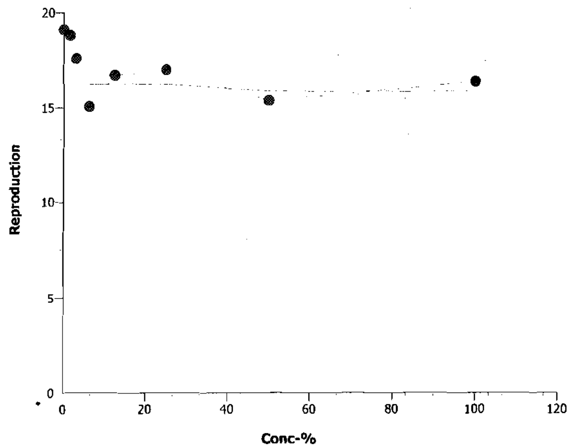
Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	21	21	18	18	20	19	17	20	19	18
1.56		16	20	22	20	18	20	19	16	18	19
3.12		17	14	19	18	19	17	18	18	17	19
6.25		12	12	15	16	12	15	19	17	18	15
12.5		17	18	16	19	16	16	17	16	16	16
25		16	15	18	15	18	17	18	17	19	17
50		16	16	15	18	15	14	15	14	16	15
100		19	19	13	17	17	19	13	16	17	14

CETIS Analytical Report

Report Date: 27 Jan-09 15:46 (p 2 of 2)
Link/Link Code: 05-4762-0404/wo09018R7

Ceriodaphnia 7-d Survival and Reproduction Test			Nautilus Environmental
Analysis No: 02-4213-6362	**Endpoint:** Reproduction	**CETIS Version:** CETISv1.5.0	
Analyzed: 27 Jan-09 15:45	**Analysis:** Linear Interpolation (ICPIN)	**Official Results:** Yes	

Graphics



CETIS Analytical Report

Report Date: 27 Jan-09 15:46 (p 1 of 2)
Link/Link Code: 05-4762-0404/wo09018R7

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	15-4175-6638	**Endpoint:**	6d Survival Rate	**CETIS Version:**	CETISv1.5.0
Analyzed:	27 Jan-09 15:41	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes

Sample No:	10-8979-6432	**Code:**	1089796432	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	R-7		
Sample Age:	63h	**Station:**			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	100	>100	#Error	1	N/A

Fisher Exact/Bonferroni-Holm Test

Control vs	Conc-%	Test Stat	P-Value	Decision(0.05)
Negative Control	1.56	1.0000	1.0000	Non-Significant Effect
	3.12	1.0000	1.0000	Non-Significant Effect
	6.25	1.0000	1.0000	Non-Significant Effect
	12.5	1.0000	1.0000	Non-Significant Effect
	25	1.0000	1.0000	Non-Significant Effect
	50	1.0000	1.0000	Non-Significant Effect
	100	1.0000	1.0000	Non-Significant Effect

Data Summary

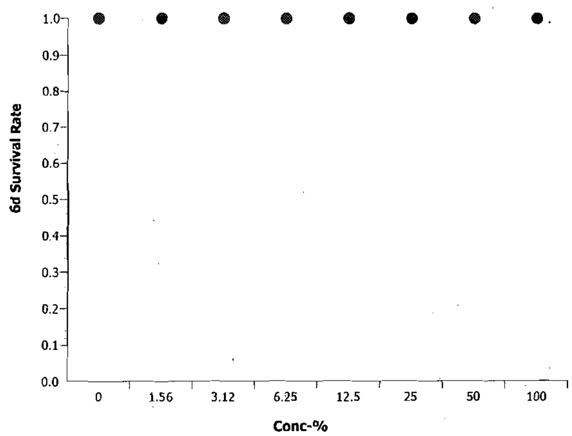
Conc-%	Control Type	No-Resp	Resp	Total
0	Negative Contr	10	0	10
1.56		10	0	10
3.12		10	0	10
6.25		10	0	10
12.5		10	0	10
25		10	0	10
50		10	0	10
100		10	0	10

6d Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	1	1	1	1	1	1	1	1	1	1
1.56		1	1	1	1	1	1	1	1	1	1
3.12		1	1	1	1	1	1	1	1	1	1
6.25		1	1	1	1	1	1	1	1	1	1
12.5		1	1	1	1	1	1	1	1	1	1
25		1	1	1	1	1	1	1	1	1	1
50		1	1	1	1	1	1	1	1	1	1
100		1	1	1	1	1	1	1	1	1	1

Ceriodaphnia 7-d Survival and Reproduction Test					Nautilus Environmental
Analysis No: 15-4175-6638		**Endpoint:** 6d Survival Rate		**CETIS Version:** CETISv1.5.0	
Analyzed: 27 Jan-09 15:41		**Analysis:** STP 2x2 Contingency Tables		**Official Results:** Yes	

Graphics



CETIS Summary Report

Report Date: 27 Jan-09 15:46 (p 1 of 2)
Link/Link Code: 05-4762-0404/wo09018R7

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Test Run No:	01-0400-2009	**Test Type:**	Reproduction-Survival (7d)	**Dil Water:**	
Start Date:	17 Jan-09 15:00	**Protocol:**	EC/EPS 1/RM/21	**Brine:**	
Ending Date:	23 Jan-09 15:33	**Species:**	Ceriodaphnia dubia		
Duration:	6d 1h	**Source:**			

Sample No:	10-8979-6432	**Code:**	1089796432	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	R-7		
Sample Age:	63h	**Station:**			

Comparison Summary

Analysis No	Endpoint	NOEL	LOEL	TOEL	PMSD	Method
15-4175-6638	6d Survival Rate	100	0	#Error	N/A	Fisher Exact/Bonferroni-Holm Test
15-3847-1869	Reproduction	3.12	6.25	4.416	9.65%	Dunnett's Multiple Comparison Test

Point Estimate Summary

Analysis No	Endpoint	% Effect	Conc-%	95% LCL	95% UCL	Method
02-4213-6362	Reproduction	5	2.319	0.7477	3.581	Linear Interpolation (ICPIN)
		10	3.902	2.528	5.573	
		15	26.56	4.354	N/A	
		20	> 100	N/A	N/A	
		25	> 100	N/A	N/A	
		40	> 100	N/A	N/A	
		50	> 100	N/A	N/A	

6d Survival Rate Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	1	1	1	1	1	0	0	0.0%	0.0%
1.56		10	1	1	1	1	1	0	0	0.0%	0.0%
3.12		10	1	1	1	1	1	0	0	0.0%	0.0%
6.25		10	1	1	1	1	1	0	0	0.0%	0.0%
12.5		10	1	1	1	1	1	0	0	0.0%	0.0%
25		10	1	1	1	1	1	0	0	0.0%	0.0%
50		10	1	1	1	1	1	0	0	0.0%	0.0%
100		10	1	1	1	1	1	0	0	0.0%	0.0%

Reproduction Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	19.1	18.59	19.61	17	21	0.2502	1.37	7.17%	0.0%
1.56		10	18.8	18.1	19.5	16	22	0.3421	1.874	9.97%	1.57%
3.12		10	17.6	17.04	18.16	14	19	0.2749	1.506	8.55%	7.85%
6.25		10	15.1	14.16	16.04	12	19	0.4591	2.514	16.65%	20.94%
12.5		10	16.7	16.3	17.1	16	19	0.1934	1.059	6.34%	12.57%
25		10	17	16.5	17.5	15	19	0.2434	1.333	7.84%	10.99%
50		10	15.4	14.96	15.84	14	18	0.2143	1.174	7.62%	19.37%
100		10	16.4	15.52	17.28	13	19	0.432	2.366	14.43%	14.14%

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

6d Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	1	1	1	1	1	1	1	1	1	1
1.56		1	1	1	1	1	1	1	1	1	1
3.12		1	1	1	1	1	1	1	1	1	1
6.25		1	1	1	1	1	1	1	1	1	1
12.5		1	1	1	1	1	1	1	1	1	1
25		1	1	1	1	1	1	1	1	1	1
50		1	1	1	1	1	1	1	1	1	1
100		1	1	1	1	1	1	1	1	1	1

Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	17	20	19	18	21	21	18	18	20	19
1.56		16	20	22	20	18	20	19	16	18	19
3.12		17	14	19	18	19	17	18	18	17	19
6.25		12	12	15	16	12	15	19	17	18	15
12.5		17	18	16	19	16	16	17	16	16	16
25		16	15	18	15	18	17	18	17	19	17
50		16	16	15	18	15	14	15	14	16	15
100		19	19	13	17	17	19	13	16	17	14

Ceriodaphnia dubia Summary Sheet

Client: Minnow
Work Order No.: 09018

Start Date/Time: Jan 17/09 @ 1550h
Set up by: AM

Sample Information:

Sample ID: R-2
Sample Date: Jan 15/09
Date Received: Jan 17/09
Sample Volume: 2x25L

Test Organism Information:

Broodstock No.: 010609
Age of young (Day 0): <24 (w/in 12-h)
Avg No. young in first 3 broods of previous 7 d: 24
Mortality (%) in previous 7 d: 0
Avg. No. of young in previous brood: 12

NaCl Reference Toxicant Results:

Reference Toxicant ID: Cd 39
Stock Solution ID: 08Na04
Date Initiated: Jan 28/09

7-d LC50 (95% CL): 2.0 (1.7 - 2.3) g/L NaCl
7-d IC50 (95% CL): 1.3 (1.1 - 1.5) g/L NaCl

7-d LC50 Reference Toxicant Mean ± 2 SD: 1.7 ± 0.8 CV (%): 23
7-d IC50 Reference Toxicant Mean ± 2 SD: 1.1 ± 0.3 CV (%): 14

Test Results:

	Survival	Reproduction
NOEC %(v/v)	100	12.5
LOEC %(v/v)	>100	25
LC50 %(v/v) (95% CL)	>100	
IC25 %(v/v) (95% CL)		62.6 (51.4 - 73.1)
IC50 %(v/v) (95% CL)		94.5 (83.3 - 100)

Reviewed by: A. Tang

Date reviewed: February 5, 2009

Chronic Freshwater Toxicity Test
Initial and Final Water Quality Measurements

Client: mimwd
Sample ID: R-2
Work Order #: 09018

Start Date & Time: Jan 17/09 @ 1550h
Stop Date: Jan 23/09 @ 1600h
Test Species: *Ceriodaphnia dubia*

% (v/v) Concentration: Control	Day 0 init	Day 1 old	Day 1 new	Day 2 old	Day 2 new	Day 3 old	Day 3 new	Day 4 old	Day 4 new	Day 5 old	Day 5 new	Day 6 old	Day 6 new	Day 7 final
Temperature (°C)	25.0	25.8	24.2	25.9	24.1	25.4	24.7	24.9	24.2	25.5	24.5	25.9		
DO (mg/L)	8.1	7.5	7.9	7.5	8.2	8.1	8.0	7.4	8.1	7.2	8.2	7.1		
pH	8.1	7.9	8.1	8.0	8.1	8.0	8.1	7.9	8.1	7.9	8.1	7.9		
Cond. (µS/cm)	212	210		213		216		214		215		216		
Initials	AWS	[illegible]	[illegible]	BRL	BRL	A	A	A	A	A	A	A		

1.6 Concentration	Day 0 init	Day 1 old	Day 1 new	Day 2 old	Day 2 new	Day 3 old	Day 3 new	Day 4 old	Day 4 new	Day 5 old	Day 5 new	Day 6 old	Day 6 new	Day 7 final
Temperature (°C)	24.8	25.8	24.3	25.9	24.1	25.4	24.5	24.9	24.6	25.5	24.8	25.9		
DO (mg/L)	8.2	7.7	8.1	7.4	8.0	8.1	8.0	7.5	8.1	7.7	8.1	7.0		
pH	7.8	7.8	8.0	8.0	8.0	7.9	8.1	7.8	7.9	7.9	8.1	8.0		
Cond. (µS/cm)	219	222		226		222		221		237		260		
Initials	AWS	[illegible]	[illegible]	BRL	BRL	A	A		A	A		A		

12.5 Concentration	Day 0 init	Day 1 old	Day 1 new	Day 2 old	Day 2 new	Day 3 old	Day 3 new	Day 4 old	Day 4 new	Day 5 old	Day 5 new	Day 6 old	Day 6 new	Day 7 final
Temperature (°C)	24.6	25.8	24.5	25.9	24.1	25.4	24.2	24.9	24.2	25.5	24.8	25.9		
DO (mg/L)	8.2	7.5	8.2	7.3	8.0	8.1	8.1	7.5	8.1	7.4	8.1	7.1		
pH	7.6	7.8	7.9	8.0	8.0	8.0	8.0	7.8	7.7	7.8	8.1	8.1		
Cond. (µS/cm)	284	279		~~277~~ 285		271		275		288		301		
Initials	AWS	[illegible]	[illegible]	BRL	BRL	A	A	A	A	A	A	A		

100 Concentration	Day 0 init	Day 1 old	Day 1 new	Day 2 old	Day 2 new	Day 3 old	Day 3 new	Day 4 old	Day 4 new	Day 5 old	Day 5 new	Day 6 old	Day 6 new	Day 7 final
Temperature (°C)	24.5	25.8	24.5	25.9	24.1	25.4	24.6	24.9	24.0	25.5	24.6	25.9		
DO (mg/L)	8.3	7.5	8.2	7.3	8.0	8.1	8.2	7.6	8.1	7.6	8.0	7.2		
pH	7.2	8.0	7.6	8.2	7.7	8.1	7.7	7.9	7.6	8.0	7.7	8.2		
Cond. (µS/cm)	685	696		695		691		695		695		681		
Initials	A	[illegible]	[illegible]	BRL	BRL	A	A	A	A	A	A	A		

	Control	100		
Hardness*	100	500		
Alkalinity*	80	182		

* mg/L as CaCO3

Analysts: AWS, BRL
Reviewed by: ART
Date reviewed: Feb 5/09

Sample Description: (1) Clear

Comments:

Chronic Freshwater Toxicity Test
C. dubia Reproduction Data

Client: Manon
Sample ID: R-2
Work Order: 09018

Start Date & Time: Jan 17 /09 @ 1550h
Stop Date & Time: Jan 23 /09 @ 1600h
Set up by: AO

% (v/v)

Concentration: Control

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BR
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	3	3	3	4	3	3	4	3	X	4	A
5	8	9	8	9	9	7	9	6		8	A
6	8	9	7	9	7	8	7	9		9	A
7											
8											
Total	19	21	18	22	19	18	20	18	3	21	A

Concentration: 1.6

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BR
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	3	4	3	✓	5	4	3	4	4	4	A
5	8	8	9	8	6	8	7	5	7	9	A
6	8	7	7	9	8	6	7	8	7	6	A
7											
8											
Total	19	19	19	17	19	18	17	17	18	19	A

Concentration: 3.12

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BR
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	3	3	3	4	2	2	3	3	3	4	A
5	8	9	7	8	7	10	8	7	9	7	A
6	7	6	7	7	7	6	7	8	6	7	A
7											
8											
Total	18	18	17	19	16	18	18	18	18	18	A

Concentration: 6.25

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BRL
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	3	4	5	3	3	4	4	✓	3	4	A
5	8	8	10	9	8	7	7	6	8	7	A
6	7	7	6	7	7	7	7	8	6	8	A
7											
8											
Total	18	19	21	19	18	18	18	14	17	19	A

Concentration: 12.5

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BRL
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	4	3	4	4	4	3	4	4	4	4	A
5	8	9	6	7	6	9	6	7	9	7	A
6	6	6	7	6	5	6	8	7	6	7	A
7											
8											
Total	18	18	17	17	15	18	18	18	19	18	A

Concentration: 25

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BRL
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	4	3	3	4	4	3	4	4	3	4	A
5	8	7	8	8	7	6	7	8	7	7	A
6	6	6	5	5	4	5	6	5	6	6	A
7											
8											
Total	18	16	16	17	15	14	17	17	16	17	A

Concentration: 50

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BRL
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	4	3	3	4	3	4	3	3	4	4	A
5	6	7	7	6	7	8	7	7	7	6	A
6	5	5	5	6	4	5	4	6	5	6	A
7											
8											
Total	15	15	15	16	14	17	14	16	16	16	A

Concentration: 100

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BRL
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
4	4	3	✓	3	✓	2	✓	✓	2	✓	A
5	5	6	5	4	4	5	5	6	4	4	A
6	✓	✓	3	✓	4	✓	5	4	✓	3	A
7											
8											
Total	9	9	8	7	8	7	10	10	6	7	A

Concentration:

Days	A	B	C	D	E	F	G	H	I	J	Init
1											
2											
3											
4											
5											
6											
7											
8											
Total											

Notes: X = mortality.

Sample Description: 1
Comments:

Reviewed by: A. Tong

Date reviewed: February 5, 2009

CETIS Analytical Report

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	06-0563-1232	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	27 Jan-09 16:03	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Sample No:	18-7276-1336	**Code:**	1872761336	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	R2		
Sample Age:	64h	**Station:**			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Rank		C > T	Not Run	12.5	25	17.68	8	15.2%

Steel Many-One Rank Test

Control	vs	Conc-%	Test Stat	Critical	Ties	P-Value	Decision(5%)
Negative Control		1.56	88	74	2	0.3437	Non-Significant Effect
		3.12	79.5	74	2	0.1224	Non-Significant Effect
		6.25	90	74	3	0.4122	Non-Significant Effect
		12.5	78	74	2	0.0975	Non-Significant Effect
		25*	66.5	74	1	0.0107	Significant Effect
		50*	65	74	0	0.0076	Significant Effect
		100*	65	74	0	0.0076	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	803.1875	114.7411	7	18.27	0.0000	Significant Effect
Error	452.3	6.281944	72			
Total	1255.488	121.023	79			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	81.92	18.48	0.0000	Unequal Variances
Distribution	Shapiro-Wilk Normality	0.5818		0.0000	Non-normal Distribution

Reproduction Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	17.6	15.14	20.06	0	22	1.199	6.346	36.05%	0.0%
1.56		10	18.2	17.84	18.56	17	19	0.1737	0.9189	5.05%	-3.41%
3.12		10	17.8	17.49	18.11	16	19	0.1491	0.7888	4.43%	-1.14%
6.25		10	18.1	17.41	18.79	14	21	0.3386	1.792	9.9%	-2.84%
12.5		10	17.6	17.18	18.02	15	19	0.2031	1.075	6.11%	0.0%
25		10	16.3	15.85	16.75	14	18	0.2191	1.16	7.11%	7.39%
50		10	15.4	15.03	15.77	14	17	0.1826	0.9661	6.27%	12.5%
100		10	8.1	7.569	8.631	6	10	0.259	1.37	16.92%	53.98%

Rank Transformed Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	60.8	51.52	70.08	1	80	4.521	23.92	39.35%	0.0%
1.56		10	55.5	49.26	61.74	34.5	69.5	3.039	16.08	28.98%	8.72%
3.12		10	49.25	44.6	53.9	24.5	69.5	2.265	11.99	24.34%	19.0%
6.25		10	54.25	46.79	61.71	13.5	78	3.637	19.24	35.47%	10.77%
12.5		10	46.85	41.35	52.35	18	69.5	2.68	14.18	30.27%	22.94%
25		10	29.5	25.27	33.73	13.5	52	2.06	10.9	36.95%	51.48%
50		10	21.35	18.87	23.83	13.5	34.5	1.211	6.408	30.01%	64.88%
100		10	6.5	5.351	7.649	2	10.5	0.5599	2.963	45.58%	89.31%

CETIS Analytical Report

Report Date: 27 Jan-09 16:06 (p 2 of 2)
Link/Link Code: 01-1357-1429/wo09018R2

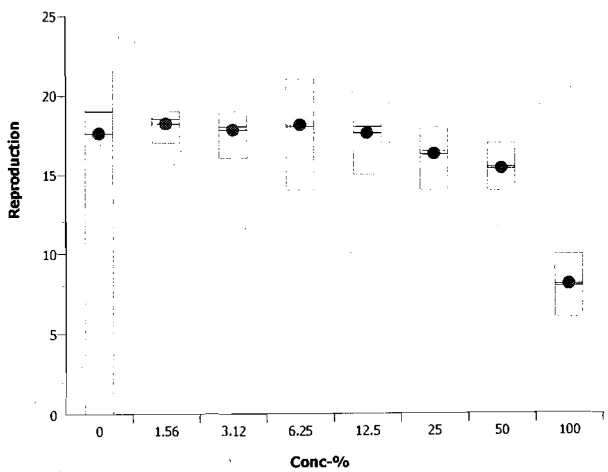
Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

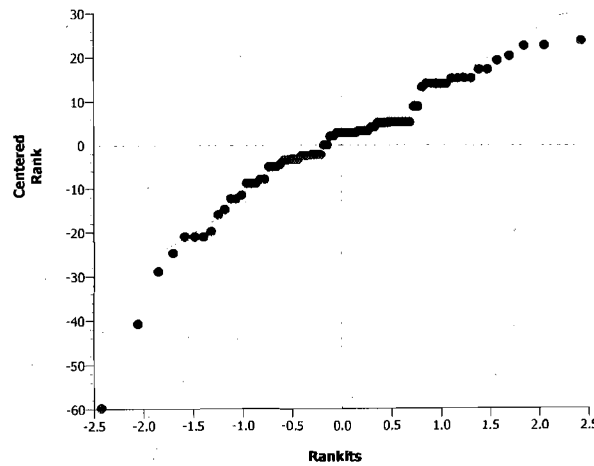
Analysis No:	06-0563-1232	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	27 Jan-09 16:03	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	22	21	21	20	19	19	18	18	18	0
1.56		19	19	19	19	19	18	18	17	17	17
3.12		19	18	18	18	18	18	18	18	17	16
6.25		21	19	19	19	18	18	18	18	17	14
12.5		19	18	18	18	18	18	18	17	17	15
25		18	17	17	17	17	16	16	16	15	14
50		17	16	16	16	16	15	15	15	14	14
100		10	10	9	9	8	8	7	7	7	6

Graphics





CETIS Analytical Report

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	04-8503-9896	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	05 Feb-09 12:19	**Analysis:**	Nonlinear Regression	**Official Results:**	Yes

Sample No:	18-7276-1336	**Code:**	1872761336	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	R2		
Sample Age:	64h	**Station:**			

Non-Linear Regression Options

Model Function	X Transform	Y Transform	Weighting Function	PTBS Function
3P Log-Logistic EV [Y=A/(1+(X/D)^C)]	None	None	Normal [W=1]	Off [Y*=Y]

Regression Summary

Iters	Log LL	AICc	Adj R2	Optimize	F Stat	Critical	P-Value	Decision(1%)
10	-110.5	227.4	0.6186	Yes	0.4587	3.283	0.8056	Non-Significant Lack of Fit

Point Estimates

% Effect	Conc-%	95% LCL	95% UCL
SNEC	47.83	33.49	58.87
10	41.47	25.11	52.39
15	49.32	35.37	60.35
20	56.19	43.82	67.04
25	62.59	51.42	73.09
40	81.16	71.55	91.32
50	94.47	83.3	107.1

Regression Parameters

Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(5%)
A	17.75	0.3502	17.05	18.45	50.69	0.0000	Significant Parameter
C	2.668	0.5545	1.564	3.773	4.813	0.0000	Significant Parameter
D	94.47	6.093	82.34	106.6	15.51	0.0000	Significant Parameter

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(1%)
Model	788.7789	394.3895	2	65.07	0.0000	Significant
Lack of Fit	14.40857	2.881715	5	0.4587	0.8056	Non-Significant
Pure Error	452.3	6.281944	72			
Residual	466.7086	6.06115	77			

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(1%)
Variances	Mod Levene Equality of Variance	1.402	2.898	0.2179	Equal Variances
Distribution	Shapiro-Wilk Normality	0.5932		0.0000	Non-normal Distribution

Reproduction Summary

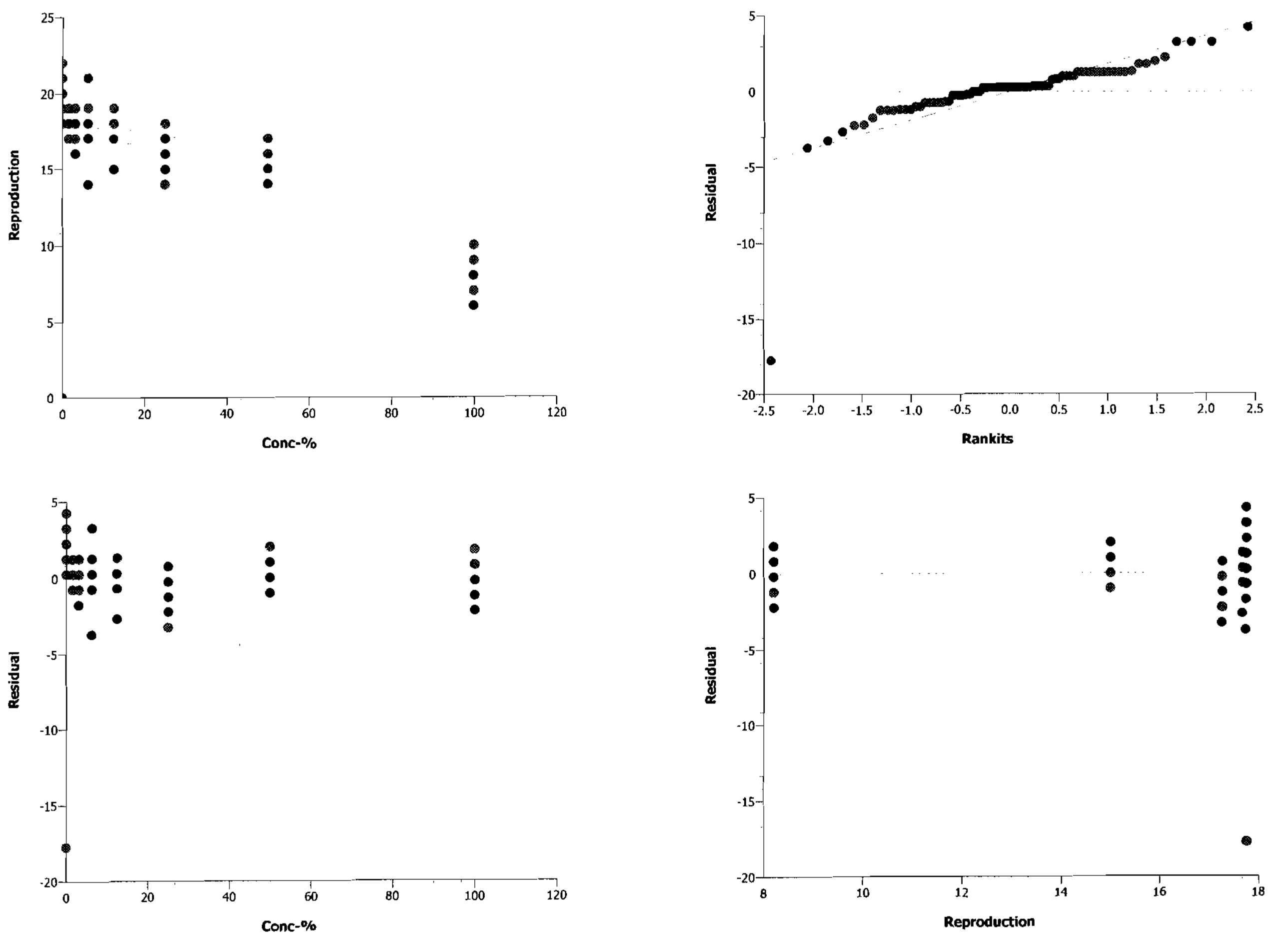
			Calculated Variate						
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Control	10	17.6	0	22	1.178	6.346	36.05%	0.0%
1.56		10	18.2	17	19	0.1706	0.9189	5.05%	-3.41%
3.12		10	17.8	16	19	0.1465	0.7888	4.43%	-1.14%
6.25		10	18.1	14	21	0.3328	1.792	9.9%	-2.84%
12.5		10	17.6	15	19	0.1996	1.075	6.11%	0.0%
25		10	16.3	14	18	0.2153	1.16	7.11%	7.39%
50		10	15.4	14	17	0.1794	0.9661	6.27%	12.5%
100		10	8.1	6	10	0.2545	1.37	16.92%	53.98%

Ceriodaphnia 7-d Survival and Reproduction Test			Nautilus Environmental
Analysis No: 04-8503-9896	**Endpoint:** Reproduction	**CETIS Version:** CETISv1.5.0	
Analyzed: 05 Feb-09 12:19	**Analysis:** Nonlinear Regression	**Official Results:** Yes	

Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	19	21	18	22	19	18	20	18	0	21
1.56		19	19	19	17	19	18	17	17	18	19
3.12		18	18	17	19	16	18	18	18	18	18
6.25		18	19	21	19	18	18	18	14	17	19
12.5		18	18	17	17	15	18	18	18	19	18
25		18	16	16	17	15	14	17	17	16	17
50		15	15	15	16	14	17	14	16	16	16
100		9	9	8	7	8	7	10	10	6	7

Graphics



CETIS Analytical Report

Report Date: 27 Jan-09 16:06 (p 1 of 2)
Link/Link Code: 01-1357-1429/wo09018R2

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	11-6770-9004	**Endpoint:**	6d Survival Rate	**CETIS Version:**	CETISv1.5.0
Analyzed:	27 Jan-09 16:03	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes

Sample No:	18-7276-1336	**Code:**	1872761336	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	R2		
Sample Age:	64h	**Station:**			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	100	>100	#Error	1	N/A

Fisher Exact/Bonferroni-Holm Test

Control vs	Conc-%	Test Stat	P-Value	Decision(0.05)
Negative Control	1.56	1.0000	1.0000	Non-Significant Effect
	3.12	1.0000	1.0000	Non-Significant Effect
	6.25	1.0000	1.0000	Non-Significant Effect
	12.5	1.0000	1.0000	Non-Significant Effect
	25	1.0000	1.0000	Non-Significant Effect
	50	1.0000	1.0000	Non-Significant Effect
	100	1.0000	1.0000	Non-Significant Effect

Data Summary

Conc-%	Control Type	No-Resp	Resp	Total
0	Negative Contr	9	1	10
1.56		10	0	10
3.12		10	0	10
6.25		10	0	10
12.5		10	0	10
25		10	0	10
50		10	0	10
100		10	0	10

6d Survival Rate Detail

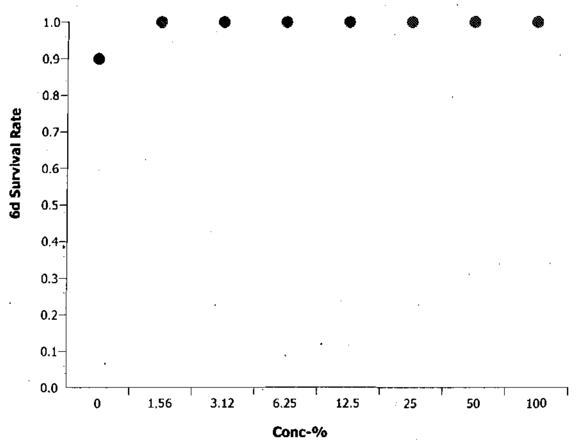
Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	1	1	1	1	1	1	1	1	1	0
1.56		1	1	1	1	1	1	1	1	1	1
3.12		1	1	1	1	1	1	1	1	1	1
6.25		1	1	1	1	1	1	1	1	1	1
12.5		1	1	1	1	1	1	1	1	1	1
25		1	1	1	1	1	1	1	1	1	1
50		1	1	1	1	1	1	1	1	1	1
100		1	1	1	1	1	1	1	1	1	1

 Analyst:_______ QA: ART Feb 5/09

Ceriodaphnia 7-d Survival and Reproduction Test	**Nautilus Environmental**

Analysis No:	11-6770-9004	**Endpoint:**	6d Survival Rate	**CETIS Version:**	CETISv1.5.0
Analyzed:	27 Jan-09 16:03	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes

Graphics



CETIS Summary Report

Report Date: 27 Jan-09 16:06 (p 1 of 2)
Link/Link Code: 01-1357-1429/wo09018R2

Ceriodaphnia 7-d Survival and Reproduction Test — Nautilus Environmental

Test Run No:	00-7157-6818	**Test Type:**	Reproduction-Survival (7d)	**Dil Water:**	
Start Date:	17 Jan-09 15:50	**Protocol:**	EC/EPS 1/RM/21	**Brine:**	
Ending Date:	23 Jan-09 16:00	**Species:**	Ceriodaphnia dubia		
Duration:	6d 0h	**Source:**			

Sample No:	18-7276-1336	**Code:**	1872761336	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	R2		
Sample Age:	64h	**Station:**			

Comparison Summary

Analysis No	Endpoint	NOEL	LOEL	TOEL	PMSD	Method
11-6770-9004	6d Survival Rate	100	0	#Error	N/A	Fisher Exact/Bonferroni-Holm Test
06-0563-1232	Reproduction	12.5	25	17.68	15.2%	Steel Many-One Rank Test

Point Estimate Summary

Analysis No	Endpoint	% Effect	Conc-%	95% LCL	95% UCL	Method
20-9444-5754	Reproduction	5	17.01	0.6222	31.73	Linear Interpolation (ICPIN)
		10	28.47	2.07	51.23	
		15	50.79	13.76	55.61	
		20	55.32	23.35	60.51	
		25	60.25	50.25	65.58	
		40	77.78	67.17	84.69	
		50	92.17	80.85	N/A	

6d Survival Rate Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	0.9	0.7819	1	0	1	0.05774	0.3162	35.14%	0.0%
1.56		10	1	1	1	1	1	0	0	0.0%	-11.11%
3.12		10	1	1	1	1	1	0	0	0.0%	-11.11%
6.25		10	1	1	1	1	1	0	0	0.0%	-11.11%
12.5		10	1	1	1	1	1	0	0	0.0%	-11.11%
25		10	1	1	1	1	1	0	0	0.0%	-11.11%
50		10	1	1	1	1	1	0	0	0.0%	-11.11%
100		10	1	1	1	1	1	0	0	0.0%	-11.11%

Reproduction Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	17.6	15.23	19.97	0	22	1.159	6.346	36.05%	0.0%
1.56		10	18.2	17.86	18.54	17	19	0.1678	0.9189	5.05%	-3.41%
3.12		10	17.8	17.51	18.09	16	19	0.144	0.7888	4.43%	-1.14%
6.25		10	18.1	17.43	18.77	14	21	0.3272	1.792	9.9%	-2.84%
12.5		10	17.6	17.2	18	15	19	0.1963	1.075	6.11%	0.0%
25		10	16.3	15.87	16.73	14	18	0.2117	1.16	7.11%	7.39%
50		10	15.4	15.04	15.76	14	17	0.1764	0.9661	6.27%	12.5%
100		10	8.1	7.588	8.612	6	10	0.2502	1.37	16.92%	53.98%

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

6d Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	1	1	1	1	1	1	1	1	0	1
1.56		1	1	1	1	1	1	1	1	1	1
3.12		1	1	1	1	1	1	1	1	1	1
6.25		1	1	1	1	1	1	1	1	1	1
12.5		1	1	1	1	1	1	1	1	1	1
25		1	1	1	1	1	1	1	1	1	1
50		1	1	1	1	1	1	1	1	1	1
100		1	1	1	1	1	1	1	1	1	1

Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	19	21	18	22	19	18	20	18	0	21
1.56		19	19	19	17	19	18	17	17	18	19
3.12		18	18	17	19	16	18	18	18	18	18
6.25		18	19	21	19	18	18	18	14	17	19
12.5		18	18	17	17	15	18	18	18	19	18
25		18	16	16	17	15	14	17	17	16	17
50		15	15	15	16	14	17	14	16	16	16
100		9	9	8	7	8	7	10	10	6	7

Ceriodaphnia dubia Summary Sheet

Client: Minnow
Work Order No.: 09018

Start Date/Time: Jan 17/09 @ 1615
Set up by: Am

Sample Information:

Sample ID: X-2
Sample Date: Jan 15/09
Date Received: Jan /09
Sample Volume: 2 x 20L

Test Organism Information:

Broodstock No.: 010609
Age of young (Day 0): <24 (w/in 12-h)
Avg No. young in first 3 broods of previous 7 d: 24
Mortality (%) in previous 7 d: 0
Avg. No. of young in previous brood: 13

NaCl Reference Toxicant Results:

Reference Toxicant ID: Cd 39
Stock Solution ID: 08NaC04
Date Initiated: Jan 28/09

7-d LC50 (95% CL): 2.0 (1.7 - 2.3) g/L NaCl
7-d IC50 (95% CL): 1.3 (1.1 - 1.5) g/L NaCl

7-d LC50 Reference Toxicant Mean ± 2 SD: 1.7 ± 0.8 CV (%): 23
7-d IC50 Reference Toxicant Mean ± 2 SD: 1.1 ± 0.3 CV (%): 14

Test Results:

	Survival	Reproduction
NOEC %(v/v)	100	12.5
LOEC %(v/v)	>100	25.0
LC50 %(v/v) (95% CL)	>100	
IC25 %(v/v) (95% CL)		26.8 (15.6 - 33.3)
IC50 %(v/v) (95% CL)		52.6 (46.4 - 57.5)

Reviewed by: A. Teng

Date reviewed: February 5, 2009

Chronic Freshwater Toxicity Test
Initial and Final Water Quality Measurements

Client: Nanisivik
Sample ID: Y-2
Work Order #: 09018

Start Date & Time: Jan 12/09 @ 1615h
Stop Date: Jan 23/09 @ 1645h
Test Species: *Ceriodaphnia dubia*

% (v/v) Concentration: Control	Day 0 init.	Day 1 old	Day 1 new	Day 2 old	Day 2 new	Day 3 old	Day 3 new	Day 4 old	Day 4 new	Day 5 old	Day 5 new	Day 6 old	Day 6 new	Day 7 final
Temperature (°C)	25.2	25.8	24.2	25.9	24.1	25.5	24.9	24.9	24.9	25.5	24.5	25.6		
DO (mg/L)	8.1	7.5	7.9	7.5	8.2	7.3	8.0	7.6	8.1	7.2	8.2	6.6		
pH	8.1	7.9	8.1	8.1	8.1	7.9	8.1	7.9	8.1	7.9	8.1	7.7		
Cond. (µS/cm)	212	210		213		216		214		215		232		
Initials	AWD	ECC	ECC	BRL	BRL	A	A	A	A	A	A	A		

1.6 Concentration	Day 0 init.	Day 1 old	Day 1 new	Day 2 old	Day 2 new	Day 3 old	Day 3 new	Day 4 old	Day 4 new	Day 5 old	Day 5 new	Day 6 old	Day 6 new	Day 7 final
Temperature (°C)	24.9	25.8	24.3	25.9	24.6	25.5	24.6	24.9	24.5	25.5	24.3	25.6		
DO (mg/L)	8.2	7.5	8.1	7.5	8.0	7.4	8.1	7.7	8.1	7.4	8.1	6.7		
pH	7.8	7.7	8.0	8.0	8.0	7.8	8.0	7.9	8.1	7.9	8.2	7.9		
Cond. (µS/cm)	212	214		216		222		225		223		244		
Initials	AWD	ECC	ECC	BRL	BRL	A	A	A	A	A	A	A		

12.5 Concentration	Day 0 init.	Day 1 old	Day 1 new	Day 2 old	Day 2 new	Day 3 old	Day 3 new	Day 4 old	Day 4 new	Day 5 old	Day 5 new	Day 6 old	Day 6 new	Day 7 final
Temperature (°C)	24.7	25.8	24.5	25.9	24.6	25.5	24.5	24.9	24.3	25.5	24.2	25.6		
DO (mg/L)	8.2	7.4	8.2	7.8	8.0	7.4	8.0	7.6	8.0	7.4	8.0	6.6		
pH	7.8	7.8	7.8	8.0	8.0	7.9	8.0	8.0	8.0	7.9	8.1	8.1		
Cond. (µS/cm)	234	229		229		235		231		237		249		
Initials	AWD	ECC	ECC	BRL	BRL	A	A	A	A	A	A	A		

100 Concentration	Day 0 init.	Day 1 old	Day 1 new	Day 2 old	Day 2 new	Day 3 old	Day 3 new	Day 4 old	Day 4 new	Day 5 old	Day 5 new	Day 6 old	Day 6 new	Day 7 final
Temperature (°C)	24.6	25.8	24.4	25.9	24.3	25.5	24.3	24.9	24.3	25.5	24.4	25.6		
DO (mg/L)	8.3	7.4	8.2	7.5	7.9	7.5	8.0	7.5	8.0	7.5	8.0	6.7		
pH	7.4	7.9	7.3	8.1	7.4	8.0	7.6	7.9	7.6	8.0	7.6	8.1		
Cond. (µS/cm)	341	342		343		342		348		342		339		
Initials	A	ECC	ECC	BRL	BRL	A	A	A	A	A	A	A		

	Control	100		
Hardness*	100	250		
Alkalinity*	80	138		

* mg/L as CaCO3

Analysts: AWD, ECC
Reviewed by: ART
Date reviewed: Feb 5/09

Sample Description: 1 clear

Comments:

Chronic Freshwater Toxicity Test
C. dubia Reproduction Data

Client: Inmand
Sample ID: X-2
Work Order: 09018

Start Date & Time: Jan 17/09 @ 1615h
Stop Date & Time: Jan 23/09 @ 1645h
Set up by: [illegible]

% (v/v)

Concentration: Control

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
4	4	3	3	3	3	4	3	✓	4	5	[illegible]
5	8	6	9	9	✓	9	10	10	8	9	[illegible]
6	6	9	6	7	10	9	6	7	8	8	[illegible]
7											
8											
Total	18	18	18	19	13	22	19	17	20	22	[illegible]

Concentration: 1.6

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
4	3	✓	3	4	4	4	3	4	4	4	[illegible]
5	8	8	✓	8	7	7	7	6	5	6	[illegible]
6	7	8	9	7	8	7	6	9	7	7	[illegible]
7											
8											
Total	18	16	12	19	19	18	16	19	16	17	[illegible]

Concentration: 3.12

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	X	✓	[illegible]
3	✓	✓	✓	✓	✓	✓	✓	✓		✓	[illegible]
4	3	~~X~~	4	3	3	4	4	3		3	[illegible]
5	7	6	8	6	8	7	6	8		7	[illegible]
6	7	7	6	7	6	8	7	7		6	[illegible]
7											
8	17	[illegible]									
Total	17	17	18	16	17	19	17	18	0	16	[illegible]

Concentration: 6.25

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
4	3	4	4	3	3	3	5	3	4	✓	[illegible]
5	8	8	9	7	9	9	8	9	7	8	[illegible]
6	7	5	7	6	6	6	5	6	7	6	[illegible]
7											
8											
Total	18	17	20	16	18	18	18	18	18	14	[illegible]

Concentration: 12.5

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
4	✓	✓	4	✓	3	4	4	3	4	✓	[illegible]
5	7	7	8	8	7	8	7	8	✓	7	[illegible]
6	8	7	7	9	6	7	6	5	7	8	[illegible]
7											
8											
Total	15	14	19	17	16	19	17	16	11	15	[illegible]

Concentration: 25

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
4	2	2	2	2	2	4	2	3	3	✓	[illegible]
5	6	7	7	7	8	7	8	6	8	5	[illegible]
6	6	6	5	6	6	5	4	5	4	7	[illegible]
7											
8											
Total	13	15	14	15	16	16	14	14	15	12	[illegible]

Concentration: 50

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
4	✓	✓	3	2	2	✓	3	2	2	✓	[illegible]
5	6	5	5	3	5	4	5	4	5+	6	[illegible]
6	6	5	✓	4	5	5	5	3		5	[illegible]
7											
8											
Total	12	10	8	9	12	9	13	9	7+	11	[illegible]

Concentration: 100

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	[illegible]
3	✓	✓	✓	✓	✓	✓	✓	✓	✓		[illegible]
4	✓	✓	✓	✓	✓	✓	✓	✓	✓		[illegible]
5	✓	✓	✓	✓	✓	✓	✓	✓	✓		[illegible]
6	✓	✓	✓	✓	✓	2	✓	✓	✓		[illegible]
7											
8											
Total	0 →				→	2	0 →		→		[illegible]

Concentration:

Days	A	B	C	D	E	F	G	H	I	J	Init
1											
2											
3											
4											
5											
6											
7											
8											
Total											

Notes: X = mortality.

Sample Description: (1)
Comments:

Reviewed by: A. Tery

Date reviewed: February 5, 2009

Version 2.0 Issued January 23, 2008

Nautilus Environmental

CETIS Analytical Report

Report Date: 27 Jan-09 16:16 (p 1 of 2)
Link/Link Code: 10-5325-1354/wo09018X2

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	07-8336-8174	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	27 Jan-09 16:14	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Sample No:	09-4362-1698	**Code:**	943621698	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	X2		
Sample Age:	64h	**Station:**			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Rank		C > T	Not Run	12.5	25	17.68	8	15.15%

Steel Many-One Rank Test

Control	vs	Conc-%	Test Stat	Critical	Ties	P-Value	Decision(5%)
Negative Control		1.56	84.5	74	3	0.2367	Non-Significant Effect
		3.12	76	74	3	0.0705	Non-Significant Effect
		6.25	87	74	3	0.3111	Non-Significant Effect
		12.5	75	74	2	0.0593	Non-Significant Effect
		25*	63.5	74	1	0.0053	Significant Effect
		50*	55.5	74	1	0.0006	Significant Effect
		100*	55	74	0	0.0005	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	2538.188	362.5982	7	51.98	0.0000	Significant Effect
Error	502.3	6.976389	72			
Total	3040.488	369.5746	79			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	44.47	18.48	0.0000	Unequal Variances
Distribution	Shapiro-Wilk Normality	0.7542		0.0000	Non-normal Distribution

Reproduction Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	18.6	17.6	19.6	13	22	0.4896	2.591	13.93%	0.0%
1.56		10	17	16.16	17.84	12	19	0.4082	2.16	12.71%	8.6%
3.12		10	15.5	13.36	17.64	0	19	1.044	5.523	35.63%	16.67%
6.25		10	17.5	16.89	18.11	14	20	0.2988	1.581	9.04%	5.91%
12.5		10	15.9	14.98	16.82	11	19	0.4494	2.378	14.96%	14.52%
25		10	14.4	13.91	14.89	12	16	0.239	1.265	8.78%	22.58%
50		10	10	9.246	10.75	7	13	0.3673	1.944	19.44%	46.24%
100		10	0.2	-0.04524	0.4452	0	2	0.1195	0.6325	316.2%	98.92%

Rank Transformed Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	64.35	57.88	70.82	25	79.5	3.155	16.69	25.94%	0.0%
1.56		10	53.85	47.15	60.55	21.5	72.5	3.266	17.28	32.1%	16.32%
3.12		10	48.9	41.93	55.87	5.5	72.5	3.399	17.98	36.78%	24.01%
6.25		10	57.1	51.88	62.32	29	77.5	2.544	13.46	23.57%	11.27%
12.5		10	44.55	37.7	51.4	18.5	72.5	3.338	17.66	39.64%	30.77%
25		10	31.85	29.34	34.36	21.5	41.5	1.226	6.485	20.36%	50.51%
50		10	17.35	15.72	18.98	12	25	0.7931	4.197	24.19%	73.04%
100		10	6.05	5.376	6.724	5.5	11	0.3287	1.739	28.75%	90.6%

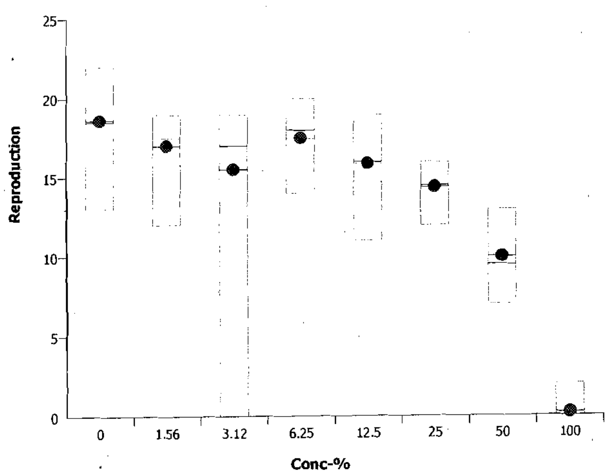
Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

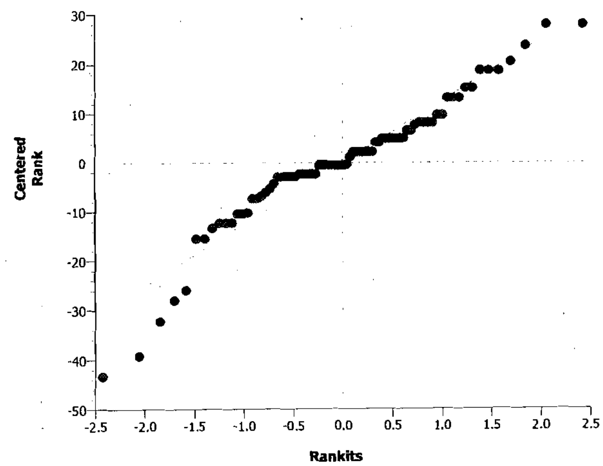
Analysis No:	07-8336-8174	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	27 Jan-09 16:14	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	22	22	20	19	19	18	18	18	17	13
1.56		19	19	19	18	18	17	16	16	16	12
3.12		19	18	18	17	17	17	17	16	16	0
6.25		20	18	18	18	18	18	18	17	16	14
12.5		19	19	17	17	16	16	15	15	14	11
25		16	16	15	15	15	14	14	14	13	12
50		13	12	12	11	10	9	9	9	8	7
100		2	0	0	0	0	0	0	0	0	0

Graphics





CETIS Analytical Report

Report Date: 27 Jan-09 16:16 (p 1 of 2)
Link/Link Code: 10-5325-1354/wo09018X2

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	03-1834-6544	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	27 Jan-09 16:16	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Sample No:	09-4362-1698	**Code:**	943621698	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	X2		
Sample Age:	64h	**Station:**			

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X + 1)	Linear	57951	200	Yes	Two-Point Interpolation

Point Estimates

% Effect	Conc-%	95% LCL	95% UCL
5	0.727	0.3379	12.7
10	2.279	0.79	16.99
15	13.04	1.395	25.27
20	20.08	2.505	28.86
25	26.85	15.57	33.3
40	41.7	35.47	51.36
50	52.55	46.41	57.54

Reproduction Summary

			Calculated Variate						
Conc-%	**Control Type**	**Count**	**Mean**	**Min**	**Max**	**Std Err**	**Std Dev**	**CV%**	**Diff%**
0	Negative Control	10	18.6	13	22	0.4811	2.591	13.93%	0.0%
1.56		10	17	12	19	0.4011	2.16	12.71%	8.6%
3.12		10	15.5	0	19	1.026	5.523	35.63%	16.67%
6.25		10	17.5	14	20	0.2936	1.581	9.04%	5.91%
12.5		10	15.9	11	19	0.4416	2.378	14.96%	14.52%
25		10	14.4	12	16	0.2349	1.265	8.78%	22.58%
50		10	10	7	13	0.3609	1.944	19.44%	46.24%
100		10	0.2	0	2	0.1174	0.6325	316.2%	98.92%

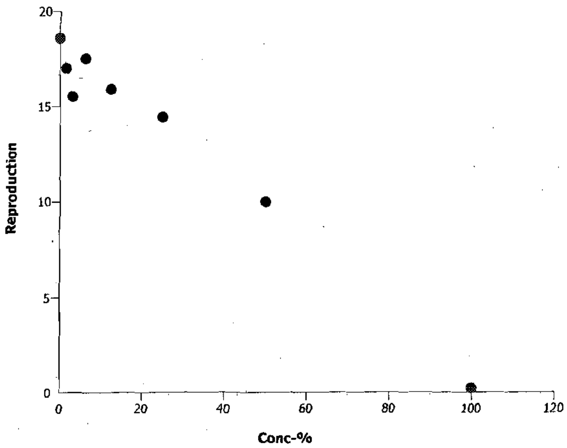
Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	18	18	18	19	13	22	19	17	20	22
1.56		18	16	12	19	19	18	16	19	16	17
3.12		17	17	18	16	17	19	17	18	0	16
6.25		18	17	20	16	18	18	18	18	18	14
12.5		15	14	19	17	16	19	17	16	11	15
25		13	15	14	15	16	16	14	14	15	12
50		12	10	8	9	12	9	13	9	7	11
100		0	0	0	0	0	2	0	0	0	0

***Ceriodaphnia* 7-d Survival and Reproduction Test**	**Nautilus Environmental**

Analysis No:	03-1834-6544	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	27 Jan-09 16:16	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



CETIS Analytical Report

Report Date: 27 Jan-09 16:16 (p 1 of 2)
Link/Link Code: 10-5325-1354/wo09018X2

Ceriodaphnia 7-d Survival and Reproduction Test			Nautilus Environmental
Analysis No: 09-2176-2674	**Endpoint:** 6d Survival Rate	**CETIS Version:** CETISv1.5.0	
Analyzed: 27 Jan-09 16:14	**Analysis:** STP 2x2 Contingency Tables	**Official Results:** Yes	

Sample No: 09-4362-1698	**Code:** 943621698	**Client:** Minnow
Sample Date: 15 Jan-09	**Material:** Industrial Effluent	**Project:**
Receive Date:	**Source:** X2	
Sample Age: 64h	**Station:**	

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	100 >100	0	#Error	1	N/A

Fisher Exact/Bonferroni-Holm Test

Control vs	Conc-%	Test Stat	P-Value	Decision(0.05)
Negative Control	1.56	1.0000	1.0000	Non-Significant Effect
	3.12	0.5000	1.0000	Non-Significant Effect
	6.25	1.0000	1.0000	Non-Significant Effect
	12.5	1.0000	1.0000	Non-Significant Effect
	25	1.0000	1.0000	Non-Significant Effect
	50	0.5000	1.0000	Non-Significant Effect
	100	0.5000	1.0000	Non-Significant Effect

Data Summary

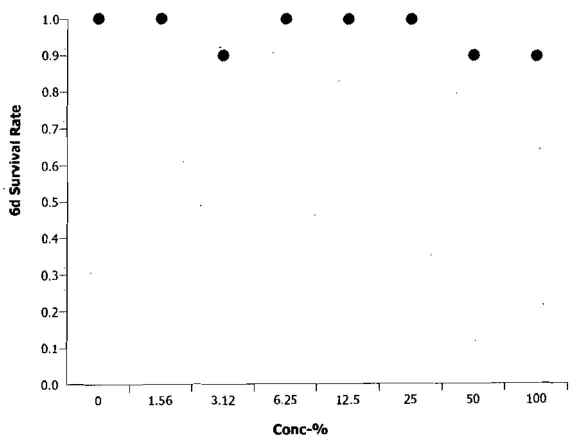
Conc-%	Control Type	No-Resp	Resp	Total
0	Negative Contr	10	0	10
1.56		10	0	10
3.12		9	1	10
6.25		10	0	10
12.5		10	0	10
25		10	0	10
50		9	1	10
100		9	1	10

6d Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	1	1	1	1	1	1	1	1	1	1
1.56		1	1	1	1	1	1	1	1	1	1
3.12		1	1	1	1	1	1	1	1	1	0
6.25		1	1	1	1	1	1	1	1	1	1
12.5		1	1	1	1	1	1	1	1	1	1
25		1	1	1	1	1	1	1	1	1	1
50		1	1	1	1	1	1	1	1	1	0
100		1	1	1	1	1	1	1	1	1	0

Ceriodaphnia 7-d Survival and Reproduction Test					**Nautilus Environmental**
Analysis No:	09-2176-2674	**Endpoint:**	6d Survival Rate	**CETIS Version:**	CETISv1.5.0
Analyzed:	27 Jan-09 16:14	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes

Graphics



CETIS Summary Report

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Test Run No:	12-2847-8368	**Test Type:**	Reproduction-Survival (7d)	**Dil Water:**	
Start Date:	17 Jan-09 16:15	**Protocol:**	EC/EPS 1/RM/21	**Brine:**	
Ending Date:	23 Jan-09 16:45	**Species:**	Ceriodaphnia dubia		
Duration:	6d 0h	**Source:**			

Sample No:	09-4362-1698	**Code:**	943621698	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	X2		
Sample Age:	64h	**Station:**			

Comparison Summary

Analysis No	Endpoint	NOEL	LOEL	TOEL	PMSD	Method
09-2176-2674	6d Survival Rate	100	0	#Error	N/A	Fisher Exact/Bonferroni-Holm Test
07-8336-8174	Reproduction	12.5	25	17.68	15.15%	Steel Many-One Rank Test

Point Estimate Summary

Analysis No	Endpoint	% Effect	Conc-%	95% LCL	95% UCL	Method
03-1834-6544	Reproduction	5	0.727	0.3379	12.7	Linear Interpolation (ICPIN)
		10	2.279	0.79	16.99	
		15	13.04	1.395	25.27	
		20	20.08	2.505	28.86	
		25	26.85	15.57	33.3	
		40	41.7	35.47	51.36	
		50	52.55	46.41	57.54	

6d Survival Rate Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	1	1	1	1	1	0	0	0.0%	0.0%
1.56		10	1	1	1	1	1	0	0	0.0%	0.0%
3.12		10	0.9	0.7819	1	0	1	0.05774	0.3162	35.14%	10.0%
6.25		10	1	1	1	1	1	0	0	0.0%	0.0%
12.5		10	1	1	1	1	1	0	0	0.0%	0.0%
25		10	1	1	1	1	1	0	0	0.0%	0.0%
50		10	0.9	0.7819	1	0	1	0.05774	0.3162	35.14%	10.0%
100		10	0.9	0.7819	1	0	1	0.05774	0.3162	35.14%	10.0%

Reproduction Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	18.6	17.63	19.57	13	22	0.473	2.591	13.93%	0.0%
1.56		10	17	16.19	17.81	12	19	0.3944	2.16	12.71%	8.6%
3.12		10	15.5	13.44	17.56	0	19	1.008	5.523	35.63%	16.67%
6.25		10	17.5	16.91	18.09	14	20	0.2887	1.581	9.04%	5.91%
12.5		10	15.9	15.01	16.79	11	19	0.4342	2.378	14.96%	14.52%
25		10	14.4	13.93	14.87	12	16	0.2309	1.265	8.78%	22.58%
50		10	10	9.274	10.73	7	13	0.3549	1.944	19.44%	46.24%
100		10	0.2	-0.03616	0.4362	0	2	0.1155	0.6325	316.2%	98.92%

 Analyst:________ QA: IT Feb 5/09

Ceriodaphnia 7-d Survival and Reproduction Test **Nautilus Environmental**

6d Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	1	1	1	1	1	1	1	1	1	1
1.56		1	1	1	1	1	1	1	1	1	1
3.12		1	1	1	1	1	1	1	1	0	1
6.25		1	1	1	1	1	1	1	1	1	1
12.5		1	1	1	1	1	1	1	1	1	1
25		1	1	1	1	1	1	1	1	1	1
50		1	1	1	1	1	1	1	1	0	1
100		1	1	1	1	1	1	1	1	1	0

Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	18	18	18	19	13	22	19	17	20	22
1.56		18	16	12	19	19	18	16	19	16	17
3.12		17	17	18	16	17	19	17	18	0	16
6.25		18	17	20	16	18	18	18	18	18	14
12.5		15	14	19	17	16	19	17	16	11	15
25		13	15	14	15	16	16	14	14	15	12
50		12	10	8	9	12	9	13	9	7	11
100		0	0	0	0	0	2	0	0	0	0

Client: Minnow

W.O.#: ~~D83~~ 09018

Hardness and Alkalinity Datasheet

	Alkalinity						Hardness			
Sample ID	Sample Date	Sample Volume (mL)	(mL) 0.02N HCL/H_2SO_4 used to pH 4.5	(mL) of 0.02N HCL/H_2SO_4 used to pH 4.2	Total Alkalinity (mg/L$CaCO_3$)		Sample Volume (mL)	Volume of 0.01M EDTA Used (mL)	Total Hardness (mg/L $CaCO_3$)	Technician
X-2	Jan 26/09	50.0	7.1	7.3	138		100 ①	2.5	250	AW
R-2	↓	↓	9.2	9.3	~~128~~ 182		↓	5.0	500	↓
R-7	↓	↓	6.5	6.6	128		↓	3.2	320	↓

Notes: ① diluted to 100 mL w/ DI H2O

Reviewed by: A. Teng

Date Reviewed: February 5, 2009

APPENDIX B - *Pseudokirchneriella subcapitata* Toxicity Test Data

Pseudokirchneriella subcapitata Summary Sheet

Client: MINNOW
Work Order No.: 09018

Start Date: Jan 18, 2009
Set up by: EK

Sample Information:

Sample ID: R7
Sample Date: Jan 15, 2009
Date Received: Jan. 17, 2009
Sample Volume: 2 x 20L

Test Organism Information:

Culture Date: Jan 15, 2009
Age of culture (Day 0): 3 d

Zinc Reference Toxicant Results:

Reference Toxicant ID: SC42
Stock Solution ID: 07Zn01
Date Initiated: Jan. 18, 2009

72-h IC50 (95% CL): 14.7 (11.3 – 17.2) µg/L Zn

72-h IC50 Reference Toxicant Mean ± 2 SD: 16.4 ± 10.8 µg/L Zn CV (%): 33

Test Results:

	Algal Growth
NOEC %(v/v)	~~100~~ EK 95.2
LOEC %(v/v)	>~~100~~ EK 95.2
IC25 %(v/v) (95% CL)	>95.2
IC50 %(v/v) (95% CL)	>95.2

Reviewed by: A. Tang

Date reviewed: February 5, 2009

72-h Algal Growth Inhibition Toxicity Test
Water Quality Measurements

Client : Minnow
Setup by: [illegible]
Sample ID: R7
Test Date/Time: 18-Jan-09 1330h
Work Order No.: 09018
Test Species: *Pseudokirchneriella subcapitata*

Culture Date: Jan 15/09 Age of Culture: 3d Culture Health: Good
Culture Count: 1 46 2 49 Average: 47.5 Culture Cell Density (c1): 47.5x104

$$v1 = \frac{220{,}000 \text{ cells/ml} \times 10 \text{ ml}}{(c1)\ 47.5 \times 10^4 \text{ cells/ml}} = 46.3 \text{ mL}$$

Time Zero Counts: 1 21 2 25 Average: 23 x104
No. of Cells/mL: 23x104 Initial Density: # cells/mL ÷ 220 µL x 10 µL = 10,454

Concentration %(v/v)	Water Quality Measurements					Microplates rotated 2X per day?			
	pH	Temp (°C)							
	0 h	0 h	24 h	48 h	72 h	0 h	24 h	48 h	72 h
Control	6.9	24.3	24.5	24.5	24.6	✓	✓ ✓	✓✓	✓
1.5	7.1	24.3	24.5	24.5	24.6	✓	✓ ✓	✓ ✓	✓
3.0	7.3	24.3	24.5	24.5	24.6	✓	✓ ✓	✓ ✓	✓
5.9	7.4	24.3	24.5	24.5	24.6	✓	✓ ✓	✓✓	✓
11.9	7.5	24.3	24.5	24.5	24.6	✓	✓✓	✓ ✓	✓
23.8	7.6	24.3	24.5	24.5	24.6	✓	✓ ✓	✓✓	✓
47.6	7.8	24.3	24.5	24.5	24.6	✓	✓✓	✓ ✓	✓
95.2	7.9	24.3	24.5	24.5	24.6	✓	✓ ✓	✓✓	✓
Initials	[illegible]	[illegible]	JLT	JLT	JLT	[illegible]	JLT	JLT	JLT

Initial control pH: Well 1: 6.5 Well 2: 6.5
Final control pH: Well 1: 6.5 Well 2: 6.5
Light intensity (lux): 3850 Date measured: Jan 18/09
Sample Description: Clear sample
Comments:

Reviewed: A. Teng Date reviewed: February 5, 2009

Pseudokirchneriella subcapitata Toxicity Test Data Sheet
72-h Algal Cell Counts

Client: Minnow | Start Date/Time: 18-Jan-09 1330h
Work Order #: 09018 | Termination Date: 21-Jan-09
Sample ID: R7 | Test set up by: EW

%(v/v)

Concentration	Rep	Count 1	Count 2	Count 3	Count 4	Comments	Initials
Control	A	42					EW
	B	51					
	C	49					
	D	58	63				
	E	52					
	F	47					
	G	56					
	H	52					
1.5	A	79					
	B	83					
	C	64	68				
	D	57	60				
3	A	76					
	B	80					
	C	85					
	D	83					
5.9	A	109					
	B	112					
	C	109					
	D	107					
11.9	A	133					
	B	139					
	C	126					
	D	143					
23.8	A	145					
	B	149					
	C	122					
	D	158					
47.6	A	155					
	B	143					
	C	187					
	D	179					
95.2	A	194					
	B	180					
	C	203					
	D	208					

Comments:

Reviewed by: A. Tang | Date Reviewed: February 5, 2009

Pseudokirchneriella subcapitata **Algal Counts**

Client:	Minnow	Start Date/Time:	18-Jan-09 @1330h	
WO#:	09018	Termination Date:	21-Jan-09 @1300h	
Sample ID:	R7			
		Initial Cell Density:	10454.545 cell/mL	230000
				0.22
				0.01

Concentration ug/L Zn	Rep	Count 1 ($x 10^4$)	Count 2 ($x 10^4$)	Count 3 ($x 10^4$)	Count 4 ($x 10^4$)	Mean ($x 10^4$)	Cell Yield ($x 10^4$) cell/mL		10454.545
Control	A	42				42	41.0	mean	50.1
	B	51				51	50.0	SD	5.5801786
	C	49				49	48.0	CV	11.128741
	D	58	63			60.5	59.5		
	E	52				52	51.0		
	F	47				47	46.0		
	G	56				56	55.0		
	H	52				52	51.0		
1.48	A	79				79	78.0		
	B	83				83	82.0		
	C	64	68			66	65.0		
	D	57	60			58.5	57.5		
2.95	A	76				76	75.0		
	B	80				80	79.0		
	C	85				85	84.0		
	D	83				83	82.0		
5.9	A	109				109	108.0		
	B	112				112	111.0		
	C	104				104	103.0		
	D	107				107	106.0		
11.9	A	133				133	132.0		
	B	139				139	138.0		
	C	126				126	125.0		
	D	143				143	142.0		
23.8	A	145				145	144.0		
	B	149				149	148.0		
	C	122				122	121.0		
	D	158				158	157.0		
47.6	A	155				155	154.0		
	B	143				143	142.0		
	C	187				187	186.0		
	D	179				179	178.0		
95.2	A	194				194	193.0		
	B	180				180	179.0		
	C	203				203	202.0		
	D	208				208	207.0		

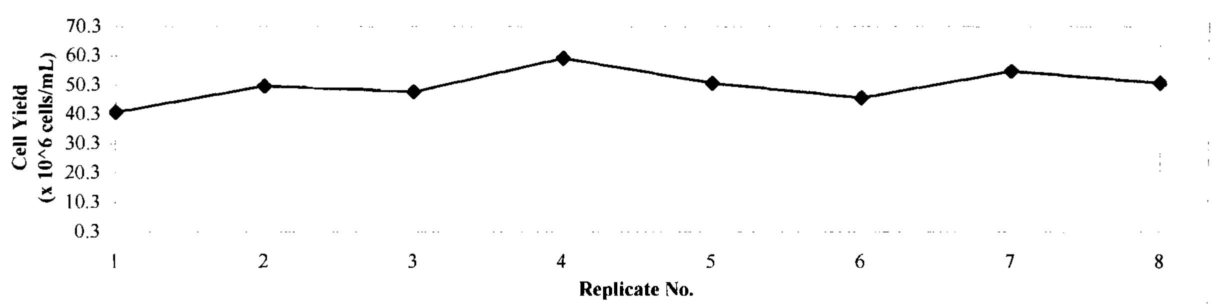
ART
Feb5/09

72-h *Pseudokirchneriella subcapitata* Test - Trend Analysis by Mann-Kendall Test.

Instructions:
1. Enter the project number, work order number and sample ID in the highlighted cells.
2. Enter the negative control cell yield data (X x 10^6 cells/mL) into the highlighted spreadsheet cells.
3. Compare the calculated S value to the table of critical S values at the bottom of the page.
4. If the calculated S value is smaller than the S value in the table, there is no statistically significant trend.

Client: Minnow **Sample ID:** R7
W.O. No.: 09018 **Test Date:** 18-Jan-09

Rep No.	1	2	3	4	5	6	7	8	Count of + Signs	Count of - Signs
Data Value	41.0	50.0	48.0	59.5	51.0	46.0	55.0	51.0		
(- Rep 1)		9.000	7.000	18.500	10.000	5.000	14.000	10.000	7	0
(- Rep 2)			-2.000	9.500	1.000	-4.000	5.000	1.000	4	2
(- Rep 3)				11.500	3.000	-2.000	7.000	3.000	4	1
(- Rep 4)					-8.500	-13.500	-4.500	-8.500	0	4
(- Rep 5)						-5.000	4.000	0.000	1	1
(- Rep 6)							9.000	5.000	2	0
(- Rep 7)								-4.000	0	1
								Totals	18	9
									S =	9



Critical values of (S) at a probability of p = 0.05, when the number of replicates (n) is 10 or less.

n	4	5	6	7	8	9	10
S	4	6	9	11	14	16	19

If your calculated value for S (for the applicable number of replicates) is equal to or less than the corresponding value for S in the above table, then there is no statistically significant trend present. Refer to Gilbert (1987) for complete table of probabilities for the Mann-Kendall test.

Reference:

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, NY. 320 pp.

ART
Feb 5/09

CETIS Analytical Report

Report Date: 02 Feb-09 12:27 (p 1 of 2)
Link/Link Code: 05-2516-6930/09018

Selenastrum Growth Test			Nautilus Environmental
Analysis No: 12-8580-1482	**Endpoint:** Cell Density	**CETIS Version:** CETISv1.5.0	
Analyzed: 02 Feb-09 12:26	**Analysis:** Parametric-Multiple Comparison	**Official Results:** Yes	

Sample No: 19-6628-7808	**Code:** 1966287808	**Client:** Minnow
Sample Date: 15 Jan-09	**Material:** Industrial Effluent	**Project:**
Receive Date: 17 Jan-09	**Source:** R-7	
Sample Age: 72h	**Station:**	

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	95.2	> 95.2	#Error	1.05	34.38%

Bonferroni Adj t Test

Control vs	Conc-%	Test Stat	Critical	MSD	P-Value	Decision(5%)
Negative Control	1.48	-3.1	2.613	17.28	1.0000	Non-Significant Effect
	2.95	-4.499	2.613	17.28	1.0000	Non-Significant Effect
	5.9	-8.582	2.613	17.28	1.0000	Non-Significant Effect
	11.9	-12.7	2.613	17.28	1.0000	Non-Significant Effect
	23.8	-13.95	2.613	17.28	1.0000	Non-Significant Effect
	47.6	-17.35	2.613	17.28	1.0000	Non-Significant Effect
	95.2	-21.93	2.613	17.28	1.0000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	86094	12299.14	7	105.5	0.0000	Significant Effect
Error	3264.75	116.5982	28			
Total	89358.75	12415.74	35			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	15.55	18.48	0.0296	Equal Variances
Distribution	Shapiro-Wilk Normality	0.9802		0.7525	Normal Distribution

Cell Density Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	8	50.25	48.04	52.46	41	60	1.077	5.701	11.35%	0.0%
1.48		4	70.75	66.42	75.08	58	82	2.112	11.18	15.8%	-40.8%
2.95		4	80	78.48	81.52	75	84	0.74	3.916	4.9%	-59.2%
5.9		4	107	105.7	108.3	103	111	0.6362	3.367	3.15%	-112.9%
11.9		4	134.3	131.4	137.1	125	142	1.4	7.411	5.52%	-167.2%
23.8		4	142.5	136.6	148.4	121	157	2.897	15.33	10.76%	-183.6%
47.6		4	165	157.1	172.9	142	186	3.873	20.49	12.42%	-228.4%
95.2		4	195.3	190.5	200	179	207	2.322	12.28	6.29%	-288.6%

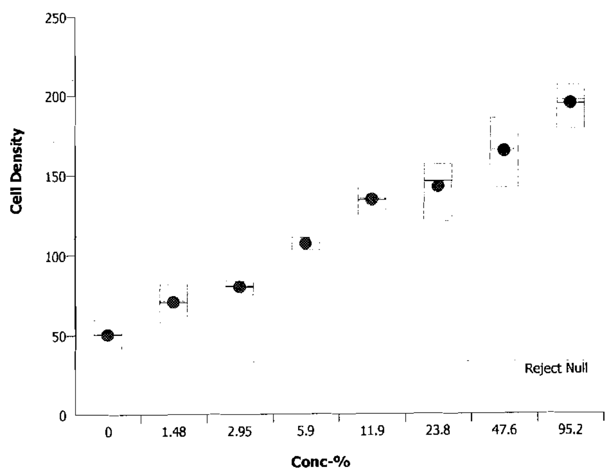
Selenastrum Growth Test	**Nautilus Environmental**

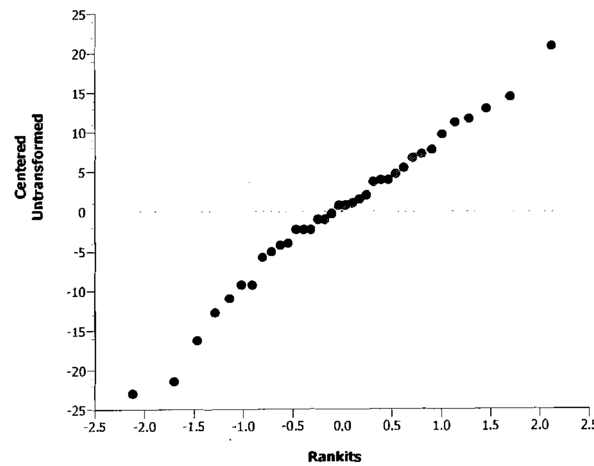
Analysis No:	12-8580-1482	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.5.0
Analyzed:	02 Feb-09 12:26	**Analysis:**	Parametric-Multiple Comparison	**Official Results:**	Yes

Cell Density Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Contr	60	55	51	51	50	48	46	41
1.48		82	78	65	58				
2.95		84	82	79	75				
5.9		111	108	106	103				
11.9		142	138	132	125				
23.8		157	148	144	121				
47.6		186	178	154	142				
95.2		207	202	193	179				

Graphics





CETIS Summary Report

Report Date: 02 Feb-09 12:27 (p 1 of 1)
Link/Link Code: 05-2516-6930/09018

Selenastrum Growth Test — **Nautilus Environmental**

Test Run No:	07-2318-1582	**Test Type:**	Cell Growth	**Dil Water:**	Deionized Water
Start Date:	18 Jan-09	**Protocol:**	EC/EPS 1/RM/25	**Brine:**	
Ending Date:	21 Jan-09	**Species:**	Selenastrum capricornutum		
Duration:	72h	**Source:**	In-House Culture		

Sample No:	19-6628-7808	**Code:**	1966287808	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	17 Jan-09	**Source:**	R-7		
Sample Age:	72h	**Station:**			

Comparison Summary

Analysis No	Endpoint	NOEL	LOEL	TOEL	PMSD	Method
12-8580-1482	Cell Density	95.2	> 95.2	#Error	34.38%	Bonferroni Adj t Test

Cell Density Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	8	50.25	48.12	52.38	41	60	1.041	5.701	11.35%	0.0%
1.48		4	70.75	66.58	74.92	58	82	2.041	11.18	15.8%	-40.8%
2.95		4	80	78.54	81.46	75	84	0.7149	3.916	4.9%	-59.2%
5.9		4	107	105.7	108.3	103	111	0.6146	3.367	3.15%	-112.9%
11.9		4	134.3	131.5	137	125	142	1.353	7.411	5.52%	-167.2%
23.8		4	142.5	136.8	148.2	121	157	2.799	15.33	10.76%	-183.6%
47.6		4	165	157.3	172.7	142	186	3.742	20.49	12.42%	-228.4%
95.2		4	195.3	190.7	199.8	179	207	2.243	12.28	6.29%	-288.6%

Cell Density Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Contr	41	50	48	60	51	46	55	51
1.48		78	82	65	58				
2.95		75	79	84	82				
5.9		108	111	103	106				
11.9		132	138	125	142				
23.8		144	148	121	157				
47.6		154	142	186	178				
95.2		193	179	202	207				

Pseudokirchneriella subcapitata Summary Sheet

Client: MINNOW

Work Order No.: 09018

Start Date: Jan. 18, 2009

Set up by: [illegible]

Sample Information:

Sample ID: R2

Sample Date: Jan. 15, 2009

Date Received: Jan. 17, 2009

Sample Volume: 2 X 20L

Test Organism Information:

Culture Date: ~~SC42~~ Jan. 15, 2009

Age of culture (Day 0): 3d

Zinc Reference Toxicant Results:

Reference Toxicant ID: SC42

Stock Solution ID: 07Zn01

Date Initiated: Jan. 18, 2009

72-h IC50 (95% CL): 14.7 (11.3 - 17.2) µg/L Zn

72-h IC50 Reference Toxicant Mean ± 2 SD: 16.4 ± 10.8 µg/L Zn CV (%): 33

Test Results:

	Algal Growth
NOEC %(v/v)	47.6
LOEC %(v/v)	95.2
IC25 %(v/v) (95% CL)	~~89.3~~ 58.9
IC50 %(v/v) (95% CL)	~~91.8~~ 72.9

Reviewed by: A. Teng

Date reviewed: February 5, 2009

72-h Algal Growth Inhibition Toxicity Test
Water Quality Measurements

Client : Minnow **Setup by:** EW

Sample ID: R2 **Test Date/Time:** 18-Jan-09 1330h

Work Order No.: 09018 **Test Species:** *Pseudokirchneriella subcapitata*

Culture Date: Jan 15/09 **Age of Culture:** 3 d **Culture Health:** Good

Culture Count: 1 ~~27~~ 44 2 ~~28~~ 49 **Average:** 47.5 **Culture Cell Density (c1):** 47.5 x 10^4

$$v1 = \frac{220{,}000 \text{ cells/ml} \times 100 \text{ ml}}{(c1)\ 475 \times 10^4 \text{ cells/ml}} = 46.3 \text{ mL}$$

Time Zero Counts: 1 21 2 25 **Average:** 23 x 10^4

No. of Cells/mL: 23 x 10^4 **Initial Density:** # cells/mL ÷ 220 µL x 10 µL = 10,454

Concentration % (v/v)	Water Quality Measurements					Microplates rotated 2X per day?			
	pH	Temp (°C)							
	0 h	0 h	24 h	48 h	72 h	0 h	24 h	48 h	72 h
Control	6.9	24.3	24.5	24.5	24.6	✓	✓✓	✓✓	✓
1.5	7.1	24.3	24.5	24.5	24.6	✓	✓✓	✓✓	✓
3.0	7.2	24.3	24.5	24.5	24.6	✓	✓✓	✓✓	✓
5.9	7.2	24.3	24.5	24.5	24.6	✓	✓✓	✓✓	✓
11.9	7.5	24.3	24.5	24.5	24.6	✓	✓✓	✓✓	✓
23.8	7.7	24.3	24.5	24.5	24.6	✓	✓✓	✓✓	✓
47.6	7.8	24.3	24.5	24.5	24.6	✓	✓✓	✓✓	✓
95.2	8.0	24.3	24.5	24.5	24.6	✓	✓✓	✓✓	✓
Initials	EW	EW	JLT	JLT	JLT	EW	JLT	JLT	JLT

Initial control pH: Well 1: 6.5 Well 2: 6.5

Final control pH: Well 1: 6.5 Well 2: 6.5

Light intensity (lux): 3811 **Date measured:** Jan 18/09

Sample Description: Clear sample

Comments:

Reviewed: A-Tong **Date reviewed:** February 5, 2009

Pseudokirchneriella subcapitata Toxicity Test Data Sheet
72-h Algal Cell Counts

Client: Minnow
Work Order #: 09018
Sample ID: R2

Start Date/Time: 18-Jan-09 1330h
Termination Date: 21-Jan-09
Test set up by: EU

Concentration % (v/v)	Rep	Count 1	Count 2	Count 3	Count 4	Comments	Initials
Control	A	48					EU
	B	42					
	C	35					
	D	49					
	E	39					
	F	37					
	G	53					
	H	47					
1.5	A	79					
	B	84					
	C	68					
	D	74					
3	A	98					
	B	126					
	C	113					
	D	90					
5.9	A	121					
	B	130					
	C	91					
	D	125					
11.9	A	88					
	B	76					
	C	95					
	D	132	129				
23.8	A	105					
	B	83					
	C	94					
	D	83					
47.6	A	49					
	B	65	57				
	C	30					
	D	35					
95.2	A	9					
	B	13					
	C	6					
	D	8					

Comments:

Reviewed by: A. Tang   Date Reviewed: February 5, 2009

Pseudokirchneriella subcapitata **Algal Counts**

Client:	Minnow	Start Date/Time:	18-Jan-09 @1330h
WO#:	09018	Termination Date:	21-Jan-09 @1300h
Sample ID:	R2		
		Initial Cell Density:	10454.545 cell/mL

Concentration ug/L Zn	Rep	Count 1 (x 10^4)	Count 2 (x 10^4)	Count 3 (x 10^4)	Count 4 (x 10^4)	Mean (x 10^4)	Cell Yield (x 10^4) cell/mL		230000 0.22 0.01 10454.545
Control	A	48				48	47.0	mean	42.7
	B	42				42	41.0	SD	6.4309519
	C	35				35	34.0	CV	15.059174
	D	49				49	48.0		
	E	39				39	38.0		
	F	37				37	36.0		
	G	53				53	52.0		
	H	47				47	46.0		
1.48	A	79				79	78.0		
	B	84				84	83.0		
	C	68				68	67.0		
	D	74				74	73.0		
2.95	A	98				98	97.0		
	B	126				126	125.0		
	C	113				113	112.0		
	D	90				90	89.0		
5.9	A	121				121	120.0		
	B	130				130	129.0		
	C	91				91	90.0		
	D	125				125	124.0		
11.9	A	85				85	84.0		
	B	76				76	75.0		
	C	95				95	94.0		
	D	132	129			130.5	129.5		
23.8	A	105				105	104.0		
	B	83				83	82.0		
	C	94				94	93.0		
	D	83				83	82.0		
47.6	A	49				49	48.0		
	B	65	57			61	60.0		
	C	30				30	29.0		
	D	35				35	34.0		
95.2	A	9				9	8.0		
	B	13				13	12.0		
	C	6				6	5.0		
	D	8				8	7.0		

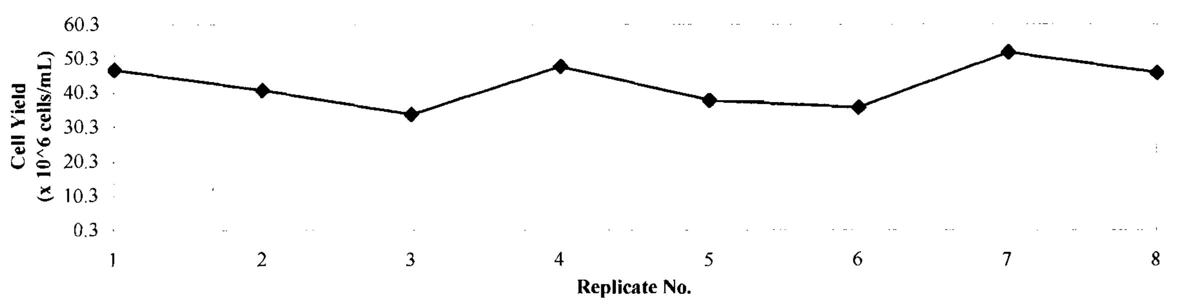
ART
Feb 5/09

72-h *Pseudokirchneriella subcapitata* Test - Trend Analysis by Mann-Kendall Test.

Instructions:
1. Enter the project number, work order number and sample ID in the highlighted cells.
2. Enter the negative control cell yield data (X x 10^6 cells/mL) into the highlighted spreadsheet cells.
3. Compare the calculated S value to the table of critical S values at the bottom of the page.
4. If the calculated S value is smaller than the S value in the table, there is no statistically significant trend.

Client: Minnow **Sample ID:** R2
W.O. No.: 09018 **Test Date:** 18-Jan-09

Rep No.	1	2	3	4	5	6	7	8	Count of + Signs	Count of - Signs
Data Value	47.0	41.0	34.0	48.0	38.0	36.0	52.0	46.0		
(- Rep 1)		-6.000	-13.000	1.000	-9.000	-11.000	5.000	-1.000	2	5
(- Rep 2)			-7.000	7.000	-3.000	-5.000	11.000	5.000	3	3
(- Rep 3)				14.000	4.000	2.000	18.000	12.000	5	0
(- Rep 4)					-10.000	-12.000	4.000	-2.000	1	3
(- Rep 5)						-2.000	14.000	8.000	2	1
(- Rep 6)							16.000	10.000	2	0
(- Rep 7)								-6.000	0	1
								Totals	15	13
									S =	2



Critical values of (S) at a probability of p = 0.05, when the number of replicates (n) is 10 or less.

n	4	5	6	7	8	9	10
S	4	6	9	11	14	16	19

If your calculated value for S (for the applicable number of replicates) is equal to or less than the corresponding value for S in the above table, then there is no statistically significant trend present.
Refer to Gilbert (1987) for complete table of probabilities for the Mann-Kendall test.

Reference:

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, NY. 320 pp.

ART
Feb 5/09

CETIS Analytical Report

Report Date: 02 Feb-09 12:38 (p 1 of 2)
Link/Link Code: 08-3074-2938/09018R2

Selenastrum Growth Test — **Nautilus Environmental**

Analysis No:	18-6995-4543	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.5.0
Analyzed:	02 Feb-09 12:37	**Analysis:**	Parametric-Multiple Comparison	**Official Results:**	Yes

Sample No:	13-6441-9010	**Code:**	1364419010	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	17 Jan-09	**Source:**	R2		
Sample Age:	72h	**Station:**			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	47.6	95.2	67.32	2.101	49.08%

Bonferroni Adj t Test

Control vs	Conc-%	Test Stat	Critical	MSD	P-Value	Decision(5%)
Negative Control	1.48	-4.047	2.613	20.98	1.0000	Non-Significant Effect
	2.95	-7.844	2.613	20.98	1.0000	Non-Significant Effect
	5.9	-9.09	2.613	20.98	1.0000	Non-Significant Effect
	11.9	-6.599	2.613	20.98	1.0000	Non-Significant Effect
	23.8	-5.914	2.613	20.98	1.0000	Non-Significant Effect
	47.6	0	2.613	20.98	1.0000	Non-Significant Effect
	95.2*	4.327	2.613	20.98	0.0006	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	42120.22	6017.175	7	34.98	0.0000	Significant Effect
Error	4816	172	28			
Total	46936.22	6189.175	35			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	15.37	18.48	0.0316	Equal Variances
Distribution	Shapiro-Wilk Normality	0.9778		0.6703	Normal Distribution

Cell Density Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	8	42.75	40.26	45.24	34	52	1.215	6.431	15.04%	0.0%
1.48		4	75.25	72.59	77.91	67	83	1.294	6.85	9.1%	-76.02%
2.95		4	105.8	99.55	111.9	89	125	3.021	15.99	15.12%	-147.4%
5.9		4	115.8	108.9	122.6	90	129	3.318	17.56	15.17%	-170.8%
11.9		4	95.75	86.4	105.1	75	130	4.558	24.12	25.19%	-124.0%
23.8		4	90.25	86.17	94.33	82	104	1.99	10.53	11.67%	-111.1%
47.6		4	42.75	37.31	48.19	29	60	2.652	14.03	32.83%	0.0%
95.2		4	8	6.858	9.142	5	12	0.5563	2.944	36.8%	81.29%

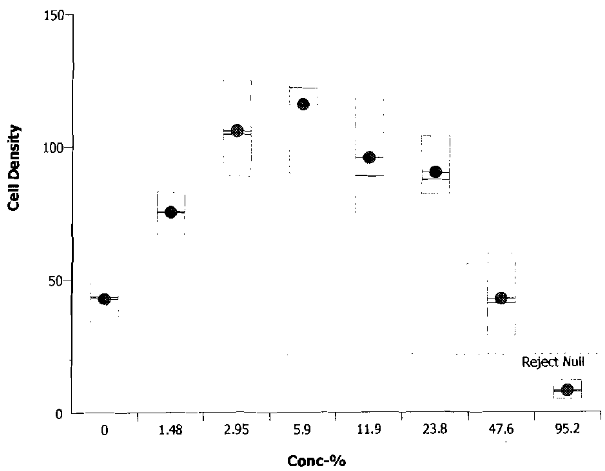
Selenastrum Growth Test **Nautilus Environmental**

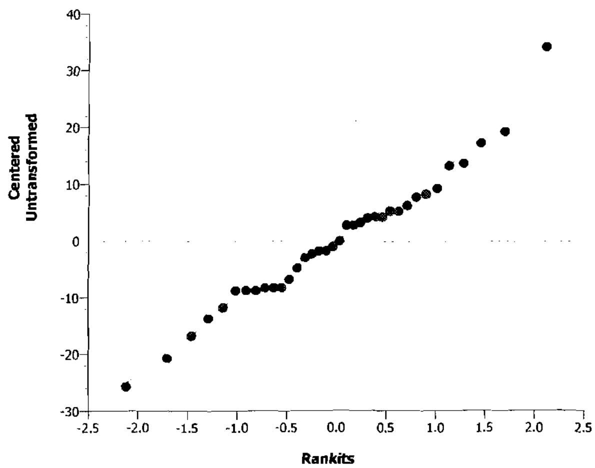
Analysis No:	18-6995-4543	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.5.0
Analyzed:	02 Feb-09 12:37	**Analysis:**	Parametric-Multiple Comparison	**Official Results:**	Yes

Cell Density Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Contr	52	48	47	46	41	38	36	34
1.48		83	78	73	67				
2.95		125	112	97	89				
5.9		129	124	120	90				
11.9		130	94	84	75				
23.8		104	93	82	82				
47.6		60	48	34	29				
95.2		12	8	7	5				

Graphics





CETIS Analytical Report

Selenastrum Growth Test — **Nautilus Environmental**

Analysis No:	01-6244-2538	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.5.0
Analyzed:	05 Feb-09 11:24	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Sample No:	15-1943-1302	**Code:**	1519431302	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	17 Jan-09	**Source:**	R2		
Sample Age:	72h	**Station:**			

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X + 1)	Linear	57951	1	Yes	Two-Point Interpolation

Point Estimates

% Effect	Conc-%	95% LCL	95% UCL
5	49.68	N/A	N/A
10	51.85	N/A	N/A
15	54.12	N/A	N/A
20	56.48	N/A	N/A
25	58.94	N/A	N/A
40	66.98	N/A	N/A
50	72.93	N/A	N/A

Cell Density Summary

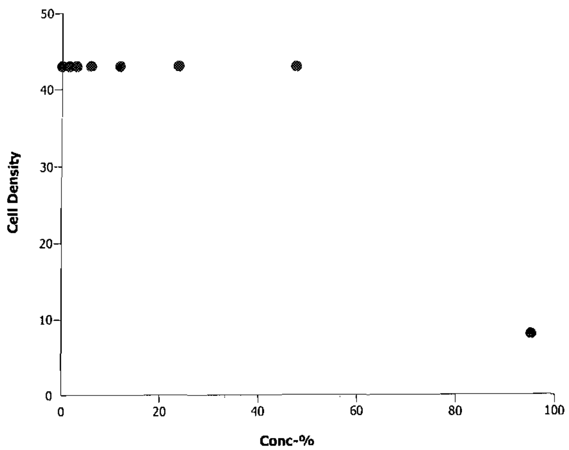
			Calculated Variate						
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Control	1	43	43	43	0	0	0.0%	0.0%
1.48		1	43	43	43	0	0	0.0%	0.0%
2.95		1	43	43	43	0	0	0.0%	0.0%
5.9		1	43	43	43	0	0	0.0%	0.0%
11.9		1	43	43	43	0	0	0.0%	0.0%
23.8		1	43	43	43	0	0	0.0%	0.0%
47.6		1	43	43	43	0	0	0.0%	0.0%
95.2		1	8	8	8	0	0	0.0%	81.4%

Cell Density Detail

Conc-%	Control Type	Rep 1
0	Negative Control	43
1.48		43
2.95		43
5.9		43
11.9		43
23.8		43
47.6		43
95.2		8

Selenastrum Growth Test					***Nautilus Environmental***
Analysis No:	01-6244-2538	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.5.0
Analyzed:	05 Feb-09 11:24	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Graphics



Pseudokirchneriella subcapitata Summary Sheet

Client: MINNOW
Work Order No.: 09018

Start Date: Jan 18, 2009
Set up by: [illegible]

Sample Information:

Sample ID: X2
Sample Date: Jan 15, 2009
Date Received: Jan 17, 2009
Sample Volume: 2x20L

Test Organism Information:

Culture Date: Jan. 15, 2009
Age of culture (Day 0): 3 d

Zinc Reference Toxicant Results:

Reference Toxicant ID: SC42
Stock Solution ID: 07Zn01
Date Initiated: Jan. 18, 2009

72-h IC50 (95% CL): 14.7 (11.3 – 17.2) µg/L Zn

72-h IC50 Reference Toxicant Mean ± 2 SD: 16.4 ± 10.8 µg/L Zn CV (%): 33

Test Results:

	Algal Growth
NOEC %(v/v)	11.9
LOEC %(v/v)	23.8
IC25 %(v/v) (95% CL)	14.8 (13.6 – 16.5)
IC50 %(v/v) (95% CL)	17.3 (15.4 – 20.3)

Reviewed by: A. Tang

Date reviewed: February 5, 2009

72-h Algal Growth Inhibition Toxicity Test
Water Quality Measurements

Client : Minnow

Setup by: [illegible]

Sample ID: X2

Test Date/Time: 18-Jan-09 1330h

Work Order No.: 09018

Test Species: *Pseudokirchneriella subcapitata*

Culture Date: Jan 15/09 Age of Culture: 3d Culture Health: Good

Culture Count: 1 46 2 49 Average: 47.5 Culture Cell Density (c1): 47.5 X104

$$v1 = \frac{220{,}000 \text{ cells/ml} \times 100 \text{ ml}}{(c1)\ 47.5 \times 10^4 \text{ cells/ml}} = 46.3 \text{ ml}$$

Time Zero Counts: 1 21 2 25 Average: 23 X104

No. of Cells/mL: 23 X 104 Initial Density: # cells/mL ÷ 220 µL x 10 µL = 10,454

Concentration % (v/v)	Water Quality Measurements					Microplates rotated 2X per day?			
	pH	Temp (ºC)							
	0 h	0 h	24 h	48 h	72 h	0 h	24 h	48 h	72 h
Control	6.9	24.3	24.5	24.5	24.6	✓	✓ ✓	✓ ✓	✓
1.5	7.1	24.3	24.5	24.5	24.6	✓	✓ ✓	✓ ✓	✓
3.0	7.1	24.3	24.5	24.5	24.6	✓	✓ ✓	✓ ✓	✓
5.9	7.2	24.3	24.5	24.5	24.6	✓	✓ ✓	✓ ✓	✓
11.9	7.3	24.3	24.5	24.5	24.6	✓	✓ ✓	✓ ✓	✓
23.8	7.4	24.3	24.5	24.5	24.6	✓	✓ ✓	✓ ✓	✓
47.6	7.6	24.3	24.5	24.5	24.6	✓	✓ ✓	✓ ✓	✓
95.2	7.8	24.3	24.5	24.5	24.6	✓	✓ ✓	✓ ✓	✓
Initials	[illegible]	[illegible]	JLT	JLT	JLT	[illegible]	JLT	JLT	JLT

Initial control pH: Well 1: 6.5 Well 2: 6.5

Final control pH: Well 1: 6.5 Well 2: 6.5

Light intensity (lux): 3800 Date measured: Jan 18/09

Sample Description: clear sample

Comments:

Reviewed: A. Teng Date reviewed: February 5, 2009

Pseudokirchneriella subcapitata Toxicity Test Data Sheet
72-h Algal Cell Counts

Client:	Minnow	Start Date/Time:	18-Jan-09 1330h
Work Order #:	09018	Termination Date:	21-Jan-09
Sample ID:	X2	Test set up by:	[illegible]

% (V/V)

Concentration	Rep	Count 1	Count 2	Count 3	Count 4	Comments	Initials
Control	A	50					[illegible]
	B	56					
	C	53					
	D	49					
	E	52					
	F	41					
	G	54					
	H	46					
1.5	A	64					
	B	47					
	C	68					
	D	56					
3	A	76	81				
	B	98					
	C	96					
	D	105					
5.9	A	107					
	B	122					
	C	102					
	D	132					
11.9	A	53					
	B	39	35				
	C	71					
	D	66					
23.8	A	15					
	B	19					
	C	11					
	D	12					
47.6	A	3					
	B	2					
	C	3					
	D	4					
95.2	A	0					
	B	4					
	C	0					
	D	2					

Comments:

Reviewed by: A. Teng Date Reviewed: February 5, 2009

***Pseudokirchneriella subcapitata* Algal Counts**

Client:	Minnow	Start Date/Time:	18-Jan-09 @1330h
WO#:	09018	Termination Date:	21-Jan-09 @1300h
Sample ID:	X2		
		Initial Cell Density:	10454.545 cell/mL

Concentration ug/L Zn	Rep	Count 1 ($x 10^4$)	Count 2 ($x 10^4$)	Count 3 ($x 10^4$)	Count 4 ($x 10^4$)	Mean ($x 10^4$)	Cell Yield ($x 10^4$) cell/mL		230000 0.22 0.01 10454.545
Control	A	50				50	49.0	mean	49.1
	B	56				56	55.0	SD	4.8236767
	C	53				53	52.0	CV	9.8282832
	D	49				49	48.0		
	E	52				52	51.0		
	F	41				41	40.0		
	G	54				54	53.0		
	H	46				46	45.0		
1.48	A	64				64	63.0		
	B	47				47	46.0		
	C	68				68	67.0		
	D	56				56	55.0		
2.95	A	76	81			78.5	77.5		
	B	98				98	97.0		
	C	96				96	95.0		
	D	105				105	104.0		
5.9	A	107				107	106.0		
	B	122				122	121.0		
	C	102				102	101.0		
	D	132				132	131.0		
11.9	A	53				53	52.0		
	B	39	35			37	36.0		
	C	71				71	70.0		
	D	66				66	65.0		
23.8	A	15				15	14.0		
	B	19				19	18.0		
	C	11				11	10.0		
	D	12				12	11.0		
47.6	A	3				3	2.0		
	B	2				2	1.0		
	C	3				3	2.0		
	D	4				4	3.0		
95.2	A	0				0	-1.0		
	B	4				4	3.0		
	C	0				0	-1.0		
	D	2				2	1.0		

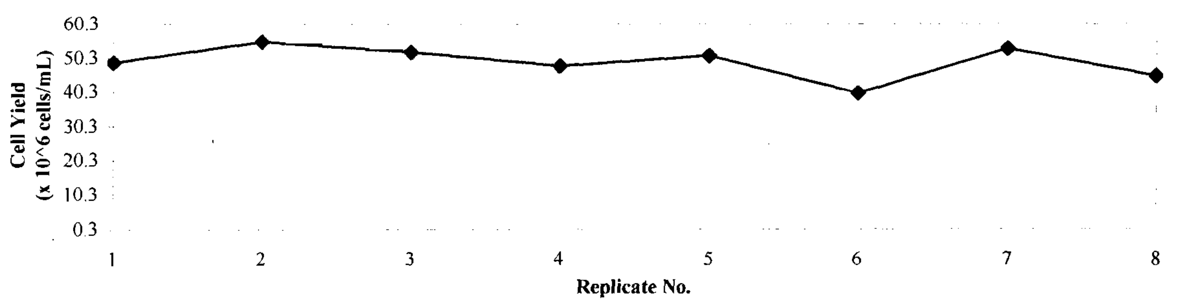
AET
Feb 5/09

72-h *Pseudokirchneriella subcapitata* Test - Trend Analysis by Mann-Kendall Test.

Instructions:
1. Enter the project number, work order number and sample ID in the highlighted cells.
2. Enter the negative control cell yield data (X x 10^6 cells/mL) into the highlighted spreadsheet cells.
3. Compare the calculated S value to the table of critical S values at the bottom of the page.
4. If the calculated S value is smaller than the S value in the table, there is no statistically significant trend.

Client: Minnow **Sample ID:** X2
W.O. No.: 09018 **Test Date:** 18-Jan-09

Rep No.	1	2	3	4	5	6	7	8	Count of + Signs	Count of - Signs
Data Value	49.0	55.0	52.0	48.0	51.0	40.0	53.0	45.0		
(- Rep 1)		6.000	3.000	-1.000	2.000	-9.000	4.000	-4.000	4	3
(- Rep 2)			-3.000	-7.000	-4.000	-15.000	-2.000	-10.000	0	6
(- Rep 3)				-4.000	-1.000	-12.000	1.000	-7.000	1	4
(- Rep 4)					3.000	-8.000	5.000	-3.000	2	2
(- Rep 5)						-11.000	2.000	-6.000	1	2
(- Rep 6)							13.000	5.000	2	0
(- Rep 7)								-8.000	0	1
								Totals	10	18
									S =	-8



Critical values of (S) at a probability of p = 0.05, when the number of replicates (n) is 10 or less.

n	4	5	6	7	8	9	10
S	4	6	9	11	14	16	19

If your calculated value for S (for the applicable number of replicates) is equal to or less than the corresponding value for S in the above table, then there is no statistically significant trend present. Refer to Gilbert (1987) for complete table of probabilities for the Mann-Kendall test.

Reference:

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, NY. 320 pp.

ART
Feb 5/09

CETIS Analytical Report

Report Date: 02 Feb-09 12:32 (p 1 of 2)
Link/Link Code: 10-2958-5413/09018X2

Selenastrum Growth Test — **Nautilus Environmental**

Analysis No:	21-3839-1698	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.5.0
Analyzed:	02 Feb-09 12:31	**Analysis:**	Nonparametric-Multiple Comparison	**Official Results:**	Yes

Sample No:	20-0422-7219	**Code:**	2004227219	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	17 Jan-09	**Source:**	X-2		
Sample Age:	72h	**Station:**			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Rank		C > T	Not Run	11.9	23.8	16.83	8.403	28.17%

Wilcoxon/Bonferroni Adj Test

Control vs	Conc-%	Test Stat	Critical	Ties	P-Value	Decision(5%)
Negative Control	1.48	35.5		1	1.0000	Non-Significant Effect
	2.95	42		0	1.0000	Non-Significant Effect
	5.9	42		0	1.0000	Non-Significant Effect
	11.9	31.5		1	1.0000	Non-Significant Effect
	23.8*	10		0	0.0121	Significant Effect
	47.6*	10		0	0.0121	Significant Effect
	95.2*	10		0	0.0121	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	48856.1	6979.442	7	93.29	0.0000	Significant Effect
Error	2094.875	74.81696	28			
Total	50950.97	7054.259	35			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	27.25	18.48	0.0003	Unequal Variances
Distribution	Shapiro-Wilk Normality	0.9645		0.2951	Normal Distribution

Cell Density Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	8	49.13	47.25	51	40	55	0.9116	4.824	9.82%	0.0%
1.48		4	57.75	54.15	61.35	46	67	1.755	9.287	16.08%	-17.56%
2.95		4	93.5	89.22	97.78	78	104	2.085	11.03	11.8%	-90.33%
5.9		4	114.8	109.4	120.1	101	131	2.602	13.77	12.0%	-133.6%
11.9		4	55.75	49.86	61.64	36	70	2.872	15.2	27.26%	-13.49%
23.8		4	13.25	11.86	14.64	10	18	0.6792	3.594	27.12%	73.03%
47.6		4	2	1.683	2.317	1	3	0.1543	0.8165	40.82%	95.93%
95.2		4	1	0.4516	1.548	0	3	0.2673	1.414	141.4%	97.96%

Rank Transformed Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	8	18.63	17.34	19.91	14	23.5	0.6242	3.303	17.73%	0.0%
1.48		4	22.88	21.01	24.74	16	27	0.9076	4.802	20.99%	-22.82%
2.95		4	30.75	30.09	31.41	29	33	0.3227	1.708	5.55%	-65.1%
5.9		4	34.25	33.59	34.91	32	36	0.3227	1.708	4.99%	-83.89%
11.9		4	21.88	19.27	24.48	13	28	1.269	6.713	30.69%	-17.45%
23.8		4	10.5	9.999	11	9	12	0.244	1.291	12.3%	43.62%
47.6		4	5.5	4.867	6.133	3.5	7.5	0.3086	1.633	29.69%	70.47%
95.2		4	3.5	2.403	4.597	1.5	7.5	0.5345	2.828	80.81%	81.21%

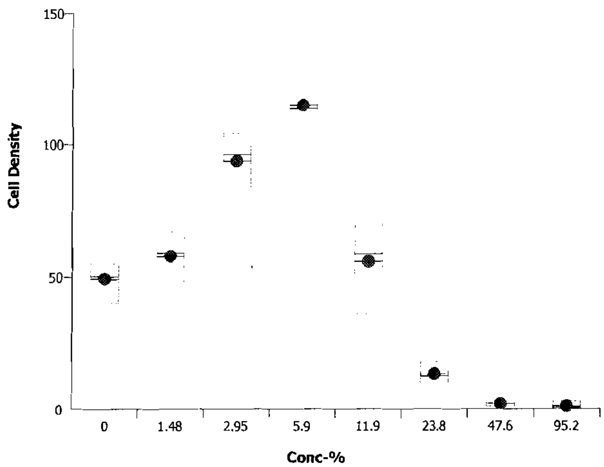
Selenastrum Growth Test | **Nautilus Environmental**

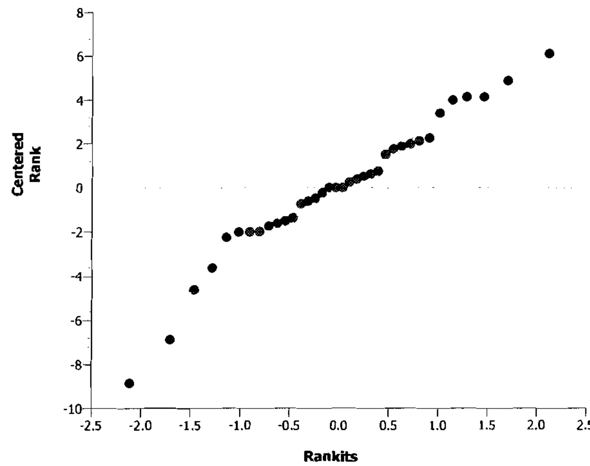
Analysis No:	21-3839-1698	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.5.0
Analyzed:	02 Feb-09 12:31	**Analysis:**	Nonparametric-Multiple Comparison	**Official Results:**	Yes

Cell Density Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Contr	55	53	52	51	49	48	45	40
1.48		67	63	55	46				
2.95		104	97	95	78				
5.9		131	121	106	101				
11.9		70	65	52	36				
23.8		18	14	11	10				
47.6		3	2	2	1				
95.2		3	1	0	0				

Graphics





CETIS Analytical Report

Report Date: 04 Feb-09 11:27 (p 1 of 2)
Link/Link Code: 10-2958-5413/09018X2

Selenastrum Growth Test — **Nautilus Environmental**

Analysis No:	13-7521-0420	**Endpoint:**	Cell Density	**CETIS Version:**	CETISv1.5.0
Analyzed:	04 Feb-09 10:52	**Analysis:**	Nonlinear Regression	**Official Results:**	Yes

Sample No:	20-0422-7219	**Code:**	2004227219	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	17 Jan-09	**Source:**	X-2		
Sample Age:	72h	**Station:**			

Non-Linear Regression Options

Model Function	X Transform	Y Transform	Weighting Function	PTBS Function
4P Log-Logistic+Hormesis EV [Y=A(1+EX)/(1+(2ED+1)(X/D)^C)]	None	None	Normal [W=1]	Off [Y*=Y]

Regression Summary

Iters	Log LL	AICc	Adj R2	Optimize	F Stat	Critical	P-Value	Decision(1%)
8	-96.21	201.8	0.9404	Yes	2.274	4.074	0.0864	Non-Significant Lack of Fit

Point Estimates

% Effect	Conc-%	95% LCL	95% UCL
SNEC	15.81	14.31	17.94
10	13.76	N/A	15.04
15	14.08	N/A	15.48
20	14.44	13.27	15.96
25	14.81	13.56	16.49
40	16.16	14.57	18.48
50	17.3	15.41	20.31

Regression Parameters

Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(5%)
A	46.08	2.875	40.23	51.94	16.03	0.0000	Significant Parameter
C	3.835	0.4501	2.918	4.752	8.521	0.0000	Significant Parameter
D	17.3	1.259	14.74	19.86	13.75	0.0000	Significant Parameter
E	0.3303	0.0544	0.2195	0.4411	6.072	0.0000	Significant Parameter

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(1%)
Model	48175.7	16058.56	3	185.2	0.0000	Significant
Lack of Fit	680.4034	170.1008	4	2.274	0.0864	Non-Significant
Pure Error	2094.875	74.81696	28			
Residual	2775.278	86.72745	32			

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	27.25	18.48	0.0003	Unequal Variances
Distribution	Shapiro-Wilk Normality	0.9466		0.0816	Normal Distribution

Cell Density Summary

			Calculated Variate						
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Control	8	49.13	40	55	0.8957	4.824	9.82%	0.0%
1.48		4	57.75	46	67	1.725	9.287	16.08%	-17.56%
2.95		4	93.5	78	104	2.048	11.03	11.8%	-90.33%
5.9		4	114.8	101	131	2.557	13.77	12.0%	-133.6%
11.9		4	55.75	36	70	2.822	15.2	27.26%	-13.49%
23.8		4	13.25	10	18	0.6674	3.594	27.12%	73.03%
47.6		4	2	1	3	0.1516	0.8165	40.82%	95.93%
95.2		4	1	0	3	0.2626	1.414	141.4%	97.96%

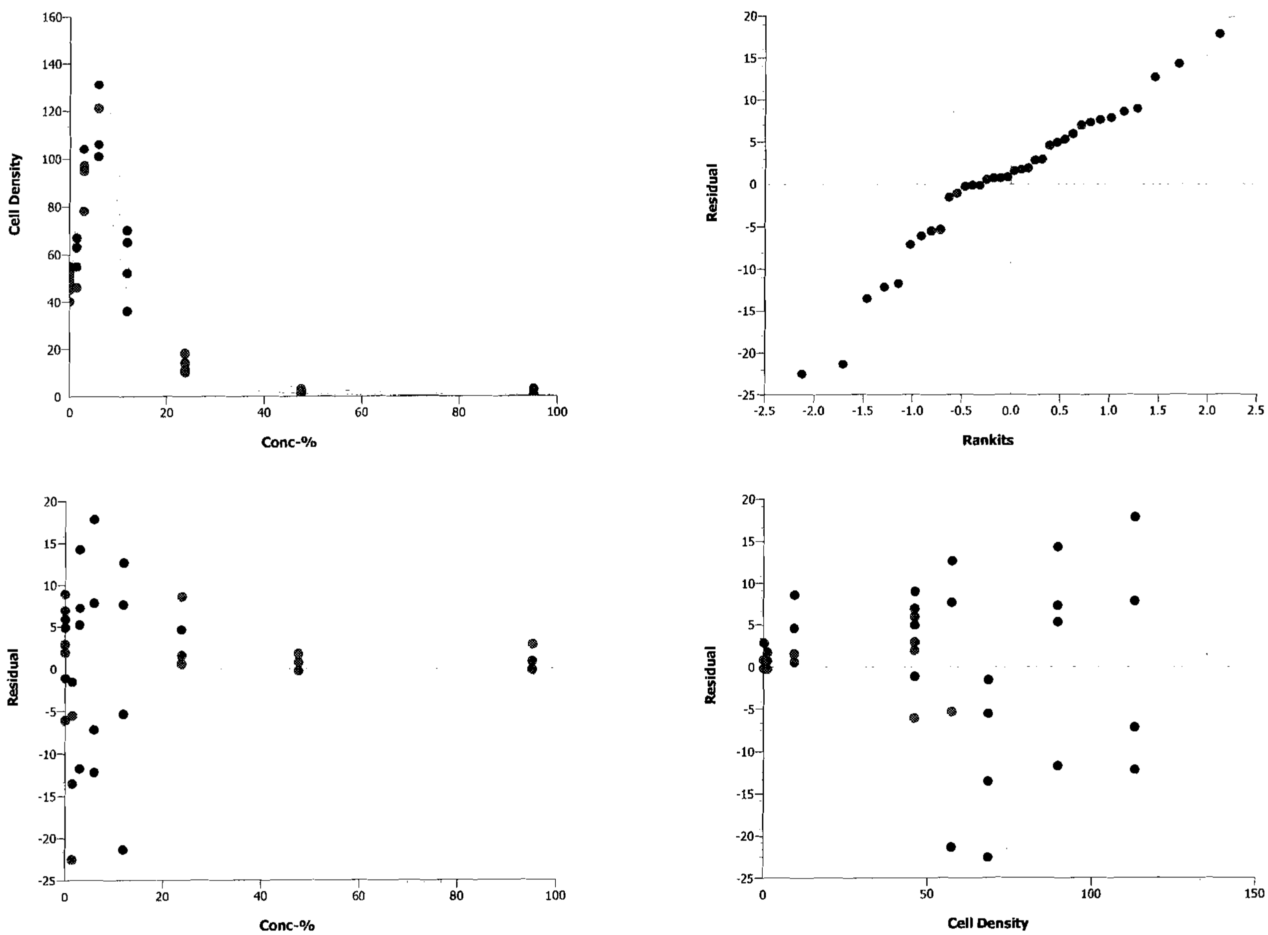
Selenastrum Growth Test — **Nautilus Environmental**

Analysis No: 13-7521-0420	**Endpoint:** Cell Density	**CETIS Version:** CETISv1.5.0	
Analyzed: 04 Feb-09 10:52	**Analysis:** Nonlinear Regression	**Official Results:** Yes	

Cell Density Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	49	55	52	48	51	40	53	45
1.48		63	46	67	55				
2.95		78	97	95	104				
5.9		106	121	101	131				
11.9		52	36	70	65				
23.8		14	18	10	11				
47.6		2	1	2	3				
95.2		0	3	0	1				

Graphics



CETIS Summary Report

Report Date: 04 Feb-09 11:27 (p 1 of 1)
Link/Link Code: 10-2958-5413/09018X2

Selenastrum Growth Test — **Nautilus Environmental**

Test Run No:	07-2318-1582	**Test Type:**	Cell Growth	**Dil Water:**	Deionized Water
Start Date:	18 Jan-09	**Protocol:**	EC/EPS 1/RM/25	**Brine:**	
Ending Date:	21 Jan-09	**Species:**	Selenastrum capricornutum		
Duration:	72h	**Source:**	In-House Culture		

Sample No:	20-0422-7219	**Code:**	2004227219	**Client:**	Minnow
Sample Date:	15 Jan-09	**Material:**	Industrial Effluent	**Project:**	
Receive Date:	17 Jan-09	**Source:**	X-2		
Sample Age:	72h	**Station:**			

Point Estimate Summary

Analysis No	Endpoint	% Effect	Conc-%	95% LCL	95% UCL	Method
13-7521-0420	Cell Density	SNEC	15.81	14.31	17.94	Nonlinear Regression
		10	13.76	N/A	15.04	
		15	14.08	N/A	15.48	
		20	14.44	13.27	15.96	
		25	14.81	13.56	16.49	
		40	16.16	14.57	18.48	
		50	17.3	15.41	20.31	

Cell Density Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	8	49.13	47.32	50.93	40	55	0.8807	4.824	9.82%	0.0%
1.48		4	57.75	54.28	61.22	46	67	1.696	9.287	16.08%	-17.56%
2.95		4	93.5	89.38	97.62	78	104	2.014	11.03	11.8%	-90.33%
5.9		4	114.8	109.6	119.9	101	131	2.514	13.77	12.0%	-133.6%
11.9		4	55.75	50.08	61.42	36	70	2.774	15.2	27.26%	-13.49%
23.8		4	13.25	11.91	14.59	10	18	0.6562	3.594	27.12%	73.03%
47.6		4	2	1.695	2.305	1	3	0.1491	0.8165	40.82%	95.93%
95.2		4	1	0.4719	1.528	0	3	0.2582	1.414	141.4%	97.96%

Cell Density Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Contr	49	55	52	48	51	40	53	45
1.48		63	46	67	55				
2.95		78	97	95	104				
5.9		106	121	101	131				
11.9		52	36	70	65				
23.8		14	18	10	11				
47.6		2	1	2	3				
95.2		0	3	0	1				

APPENDIX C – Rainbow Trout Juvenile Toxicity Test Data

Rainbow Trout Summary Sheet

Client: Minnow Environmental
Start Date/Time: Jan 20/09 @
Work Order No.: 09016
Test Species: *Oncorhynchus mykiss*

Sample Information:

Sample ID: R-7
Sample Date: Jan. 15/2009
Date Received: Jan. 17/2009
Sample Volume: 2x20L
Other:

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L $CaCO_3$): 12
Alkalinity (mg/L $CaCO_3$): 10

Test Organism Information:

Batch No.: 120208
Source: Sun Valley
Test Volume/No. Fish: 10/10
Loading Density: 0.43
Mean Length ± SD (mm): 37 ± 2 Range: 34 - 39
Mean Weight ± SD (g): 0.43 ± 0.05 Range: 0.35 - 0.50

SDS Reference Toxicant Results:

Reference Toxicant ID: RT41
Stock Solution ID: 08505
Date Initiated: Jan 5/09
96-h LC50 (95% CL): 5.3 (4.3 - 6.6) mg/L SDS

Reference Toxicant Mean ± 2 SD: 5.2 ± 2.3 mg/L SDS
Reference Toxicant CV (%): 21.7

Test Results: The 96hr LC50 is estimated @ > 100% (v/v)

Reviewed by: A. Teng
Date reviewed: February 5, 2009

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: Minnow Environmental
Sample I.D. R-7
W.O. # 09016
RBT Batch #: 120208
Date Collected/Time: Jan 15/09 @ 1000h
Date Setup/Time: Jan 20/09 @ 0845h
Sample Setup By: JLT

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

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

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	14.1		14.1
pH	7.5		7.5
D.O. (mg/L)	10.1		10.1
Cond. (µS/cm)	261		261

Concentration %(v/v)	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
control				10	10	10	10	14.0	14.0	14.0	14.0	14.2	10.1	10.1	10.1	10.1	10.1	7.0	6.9	7.0	6.9	7.1	30	37
6.25				10	10	10	10	14.0	14.0	14.0	14.0	14.2	10.0	10.1	10.1	10.1	10.1	7.0	7.1	7.1	7.0	7.2	46	56
12.5				10	10	10	10	14.0	14.0	14.0	14.0	14.2	10.1	10.1	10.1	10.1	10.1	7.2	7.3	7.3	7.3	7.4	~~47~~ 61	66
25				10	10	10	10	14.1	14.0	14.0	14.0	14.2	10.0	10.1	10.1	10.1	10.0	7.3	7.3	7.3	7.4	7.5	~~140~~ 83	89
50				10	10	10	10	14.1	14.0	14.0	14.0	14.2	10.0	10.1	10.1	10.0	10.0	7.4	7.5	7.5	7.5	7.7	140	145
100				10	10	10	10	14.1	14.0	14.0	14.0	14.2	10.1	10.1	10.0	10.0	10.1	7.5	7.7	7.7	7.7	8.0	261	264
Initials				JLT	JLT	JLT	^	JLT	JLT	JLT	JLT	^	JLT	JLT	JLT	JLT	^	JLT	JLT	JLT	JLT	^	JLT	^

Sample Description/Comments: clear

Fish Description at 96? all fish appear ok

Other Observations:

Reviewed by: A. Teng

Date Reviewed: February 5, 2009

Rainbow Trout Summary Sheet

Client: Minnow Environmental
Start Date/Time: Jan 20/09 @ 0850h

Work Order No.: 09016
Test Species: *Oncorhynchus mykiss*

Sample Information:

Sample ID: R-2
Sample Date: Jan. 15/2009
Date Received: Jan. 17/2009
Sample Volume: 2x20L
Other:

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L $CaCO_3$): 12
Alkalinity (mg/L $CaCO_3$): 10

Test Organism Information:

Batch No.: 120208
Source: Sun Valley
Test Volume/No. Fish: 10/10
Loading Density: 0.42
Mean Length ± SD (mm): 36 ± 2 Range: 34 - 40
Mean Weight ± SD (g): 0.42 ± 0.06 Range: 0.34 - 0.52

SDS Reference Toxicant Results:

Reference Toxicant ID: RT41
Stock Solution ID: 08505
Date Initiated: Jan 5/09
96-h LC50 (95% CL): 5.3 (4.3 - 6.6) mg/L SDS

Reference Toxicant Mean ± 2 SD: 5.2 ± 2.3 mg/L SDS
Reference Toxicant CV (%): 21.7

Test Results: the 96hr LC50 is estimated at >100% (v/v)

Reviewed by: A. Teng
Date reviewed: February 5, 2009

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#:	Minnow Environmental	**Number Fish/Volume:**	10/10L
Sample I.D.	R-2	**7-d % Mortality:**	0%
W.O. #	09016	**Total Pre-aeration Time (mins):**	30
RBT Batch #:	120208	**Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N):**	Y
Date Collected/Time:	Jan 15/09 @ 1400h		
Date Setup/Time:	Jan 20/09 @ 0850h		
Sample Setup By:	JLT		

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

Undiluted Sample WQ

Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	14.1		14.1
pH	7.4		7.4
D.O. (mg/L)	10.3		10.2
Cond. (µS/cm)	685		686

Concentration %(v/v)	# Survivors							Temperature (°C)				
	1	**2**	**4**	**24**	**48**	**72**	**96**	**0**	**24**	**48**	**72**	**96**
control				10	10	10	10	14.0	14.0	14.0	14.0	14.2
6.25				10	10	10	10	14.0	14.0	14.0	14.0	14.2
12.5				10	10	10	10	14.0	14.0	14.0	14.0	14.2
25				10	10	10	10	14.1	14.0	14.0	14.0	14.2
50				10	10	10	10	14.1	14.0	14.0	14.0	14.2
100				10	10	10	10	14.1	14.0	14.0	14.0	14.2
Initials				JLT	JLT	JLT	~	JLT	JLT	JLT	JLT	~

Concentration %(v/v)	Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
	0	**24**	**48**	**72**	**96**	**0**	**24**	**48**	**72**	**96**	**0**	**96**
control	10.1	10.1	10.1	10.0	10.1	7.0	6.9	7.0	6.9	7.1	30	37
6.25	10.1	10.0	10.1	10.1	10.2	7.0	7.1	7.1	7.0	7.0	79	84
12.5	10.0	10.0	10.0	10.0	10.1	7.1	7.4	7.4	7.5	7.2	127	132
25	10.0	9.9	10.0	10.0	10.1	7.2	7.5	7.6	7.6	7.4	197	199
50	10.1	10.0	10.0	10.0	10.1	7.3	7.6	7.7	7.7	7.7	397	389
100	10.2	10.0	10.0	10.0	10.1	7.4	7.7	7.8	7.8	7.9	686	683
Initials	JLT	JLT	JLT	JLT	~	JLT	JLT	JLT	JLT	~	JLT	~

Sample Description/Comments: clear

Fish Description at 96? all fish appear OK

Other Observations:

Reviewed by: A. Tang

Date Reviewed: February 5, 2009

Rainbow Trout Summary Sheet

Client: Minnow Environmental Start Date/Time: Jan 20/09 @ 0855h.

Work Order No.: 09016 Test Species: *Oncorhynchus mykiss*

Sample Information:

Sample ID: X-2
Sample Date: Jan. 15/2009 ~~@ 1530~~
Date Received: Jan. 17/2009
Sample Volume: 2x20L
Other:

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L $CaCO_3$): 12
Alkalinity (mg/L $CaCO_3$): 10

Test Organism Information:

Batch No.: 120208
Source: Sun Valley
Test Volume/No. Fish: 10/10
Loading Density: 0.42
Mean Length ± SD (mm): 36 ± 2 Range: 34 - 39
Mean Weight ± SD (g): 0.42 ± 0.06 Range: 0.35 - 0.50

SDS Reference Toxicant Results:

Reference Toxicant ID: RT41
Stock Solution ID: 08505
Date Initiated: Jan 5/09
96-h LC50 (95% CL): 5.3 (4.3-6.6) mg/L SDS

Reference Toxicant Mean ± 2 SD: 5.2 ± 2.3 mg/L SDS
Reference Toxicant CV (%): 21.7

Test Results: the 96hr LC50 is estimated at > 100% (v/v)

Reviewed by: A. Tang Date reviewed: February 5, 2009

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#:	Minnow Environmental	**Number Fish/Volume:**	10/10L
Sample I.D.	X-2	**7-d % Mortality:**	0 %
W.O. #	09016	**Total Pre-aeration Time (mins):**	30
RBT Batch #:	120208	**Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N):**	Y
Date Collected/Time:	Jan 15/09 @ 1530h		
Date Setup/Time:	Jan 20/09 @ 0855h		
Sample Setup By:	JLT		
D.O. meter:	DO-1		
pH meter:	pH-1		
Cond. Meter:	C-1		

Undiluted Sample WQ

Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	14.1		14.1
pH	7.2		7.2
D.O. (mg/L)	10.2		10.2
Cond. (µS/cm)	338		338

Concentration %(v/v)	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
	1	**2**	**4**	**24**	**48**	**72**	**96**	**0**	**24**	**48**	**72**	**96**	**0**	**24**	**48**	**72**	**96**	**0**	**24**	**48**	**72**	**96**	**0**	**96**
control				10	10	10	10	14.0	14.0	14.0	14.0	14.2	10.1	10.1	10.1	10.1	10.1	7.0	6.9	7.0	6.9	7.1	30	37
6.25				10	10	10	10	14.0	14.0	14.0	14.0	14.2	10.1	10.1	10.1	10.1	10.1	7.0	7.1	7.1	7.0	7.2	51	56
12.5				10	10	10	10	14.0	14.0	14.0	14.0	14.2	10.1	10.1	10.1	10.1	10.1	7.1	7.3	7.2	7.2	7.4	74	79
25				10	10	10	10	14.0	14.0	14.0	14.0	14.2	10.1	10.1	10.0	10.1	10.2	7.1	7.3	7.3	7.4	7.5	107	111
50				10	10	10	10	14.1	14.0	14.0	14.0	14.2	10.1	10.0	10.0	10.0	10.2	7.1	7.4	7.5	7.5	7.7	195	187
100				10	10	10	10	14.1	14.0	14.0	14.0	14.2	10.2	9.9	10.0	10.0	10.2	7.2	7.6	7.6	7.6	7.8	338	342
Initials				JLT	JLT	JLT	~	JLT	JLT	JLT	JLT	~	JLT	JLT	JLT	JLT	~	JLT	JLT	JLT	JLT	~	JLT	~

Sample Description/Comments: clear

Fish Description at 96? all fish appear ok

Other Observations:

Reviewed by: A. Teng

Date Reviewed: February 5, 2009

APPENDIX D – Chain–of-Custody Form

Nautilus Environmental

☐ **CALIFORNIA**
5550 Morehouse Drive • Suite 150
San Diego, California 92121
Phone 858.587.7333
Fax 858.587.3961

☐ **WASHINGTON**
5009 Pacific Highway East • Suite 2
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Fax 253.922.5814

☐ **BRITISH COLUMBIA**
8664 Commerce Court
Burnaby, British Columbia, Canada V5A 4N3
Phone 604.420.8773
Fax 604.357.1361

Chain of Custody

Date 15/01/09 Page 1 of 1

Sample Collection by: Laberge Environmental Services

Report to:
Company Minnow Environmental
Address
City State Zip
Contact
Phone/Email porr@minnow-environmental.com

Invoice to:
Company Minnow Environmental
Address 2 Lamb St.
City Georgetown State ONT Zip L7G 3M9
Contact Patti Orr
Phone/Email 905-873-3371 x 23

SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	NUMBER OF CONTAINERS	COMMENTS	ACUTE TROUT ① LC50	SUBLETHAL ALGAE	CERIODAPHNIA							TEMPERATURE (°C)
R-7	15/01/09	10:00	H_2O	pl.	2×20L		✓	✓	✓							
R-2	15/01/09	14:00	H_2O	pl.	2×20L		✓	✓	✓					7.3		
X-2	15/01/09	15:30	H_2O	pl.	2×20L		✓	✓	✓							
							wo#09016	wo#09017	wo#09018				2			

PROJECT INFORMATION	SAMPLE RECEIPT	
CLIENT MINNOW	TOTAL NO. OF CONTAINERS	6
P.O. NO.	REC'D GOOD CONDITION	✓
SHIPPED VIA: AIR NORTH / VTL	MATCHES TEST SCHEDULE	✓

SPECIAL INSTRUCTIONS/COMMENTS:

RELINQUISHED BY (CLIENT)	RELINQUISHED BY (COURIER)
(Signature) [signature] (Time)	(Signature) (Time)
(Printed Name) Ken Nordin (Date)	(Printed Name) (Date)
(Company) Laberge Environmental	(Company)
RECEIVED BY ~~(COURIER)~~ LABORATORY	RECEIVED BY LABORATORY
(Signature) AWD (Time) 1330h	(Signature) (Time)
(Printed Name) A Diewold (Date) Jan 17/09	(Printed Name) (Date)
(Company)	Nautilus Environmental Log-in No.

Additional costs may be required for sample disposal or storage. Net 30 unless otherwise contracted.

DISTRIBUTION: WHITE - Nautilus Environmental, COLOR - Originator

① as per JRE instruction

APPENDIX C

Habitat Descriptions and Photographs

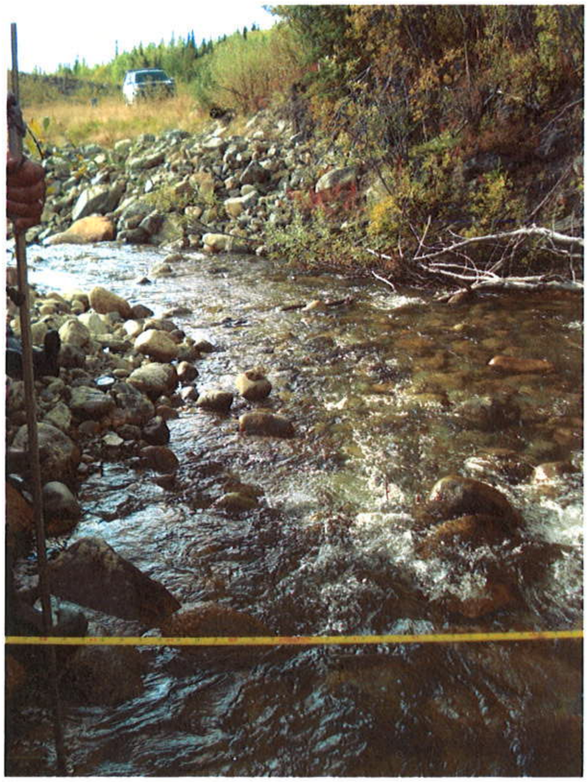
Table C.1: Habitat summary for Vangorda Creek sampling areas, Faro Mine, August 2007.

Characteristics		Reference				Effluent-Exposed (Vangorda Creek)		
		Upper West Fork Vangorda Creek (Ref-1)	Upper South Fork Rose Creek (Ref-2)	Next Creek (Nex-C1)	Upper Vangorda Creek (V1)	V27	V5	V8
Average Length of Reach Assessd (m)		50	10	50	7.8 (4.5 - 13.0)	11.2 (9 - 14)	9.6 (8.0 - 10)	15
Bottom Flow Velocity (m/s)	Mean	0.31 (0.12 - 0.65)	0.37 (0.08 - 0.80)	0.25 (0.03 - 0.72)	0.22 (0.12 - 0.42)	0.16 (0.12 - 0.21)	0.22 (0.18 - 0.24)	0.13 (0.09 - 0.18)
	Maximum	0.65	0.8	0.72	0.5 (0.32 - 0.72)	0.45 (0.36 - 0.62)	0.53 (0.44 - 0.66)	0.38 (0.26 - 0.74)
Depth (m)	Mean	0.10	0.23 (0.050 - 0.390)	0.19 (0.130 - 0.260)	0.17 (0.01 - 0.48)	0.21 (0.08 - 0.40)	0.14 (0.03 - 0.35)	0.26 (0.08 - 0.40)
	Maximum	0.25	0.45	0.35	0.37 (0.19 - 0.50)	0.40 (0.34 - 0.46)	0.30 (0.24 - 0.37)	0.39 (0.35 - 0.43)
Width (m)	Wetted	1.6 (1.43 - 1.8))	7.7 (4.5 - 11)	6.1 (4.5 - 9.0)	4.7 (4.3 - 5.3)	4.5 (4.1 - 5.1)	3.4 (2.7 - 4.0)	5.19 (3.23 - 6.59)
	Bankfull	2.1 (1.61 - 2.52)	8.6 (6.0 - 11)	6.5 (5.0 - 9.0)	7.4 (6.7 - 8.5)	6.1 (5.3 - 7.8)	5.6 (5.2 - 6.5)	7.8 (6.0 - 10.1)
Gradient	%	4.8	4.8	4	6.8	2.8	3.2	3.9
Water Appearance		clear; colourless	clear; colourless	clear; colourless	clear	clear	slightly turbid/cloudy	mostly clear; slightly turbid light brown
General Morphology	%pool	0	30	0	<5 (0 - 10)	0	<5 (0 - 5)	0
	%riffle	100	70	100	85 (25 - 100)	60 (30 - 100)	65 (50 - 80)	30 (20 - 50)
	%run	0	0	0	25 (0 - 70)	40 (0 - 80)	35 (15 - 50)	70 (50 - 80)
Bank Condition		mostly stable	Stable/No Bank Erosion	Stable/No Bank Erosion	Stable/No Bank Erosion	Stable/No Bank Erosion	Stable/No Bank Erosion	moderately stable
Substrate (% areal coverage)	%bedrock	0	0	0	<5 (0 - 5)	0	0	0
	%boulder	25	55	10	50 (20-65)	30 (15 - 50)	30 (20-45)	40 (20 - 60)
	%cobble	40	30	55	45 (30 - 75)	55 (40 - 65)	15 (5 - 25)	45 (30 - 60)
	%gravel	20	15	35	<10 (5 - 25)	15 (10 - 20)	45 (30- 50)	10 (10 - 15)
	%sand&finer	15		0	0	<5	10 (5 - 20)	5 (<1 - <15)
Instream Cover (%total Surface)	undercut banks	0	0	0	0	<5	5 (0 - <10)	<5 (0 - 5)
	boulder	10	70	< 5	20 (10 - 20)	15 (10 - 30)	10 (5 - 15)	15 (10 - 20)
	woody debris	0	< 5	< 5	5 (5 - 75)	0	7.5 (<5-10)	5 (0 - 10)
	deep pool	<5	30	5	<5 (0 - 10)	0	0	<5 (0 - 10)
	macrophytes	0	0	0	0	0	0	0
Av. Residual (Refuge) Pool Depth (m)		0.1	0.25	0.1	< 0.2	< 0.2	< 0.1	< 0.2
Overhead Canopy (%Surface)	Dense	0	0	0	0	0	0	0
	Partially Open	0	10	60	15 (0 - 25)	15 (5 - 25)	85 (75 - 90)	30 (5 - 45)
	Open	100	90	40	85 (75 - 100)	85 (75 - 95)	15 (0 - 25)	70 (35 - 95)
Riparian Vegetation Types	descending dominance	willow, scattered black poplar, cinqfoil, some dwarf birch	willow, scattered poplar, then spruce	spruce, willow, black poplar	willow , moss, spruce, dwarf birch, berry shrubs, cinqfoil, rip-rap	willow, grasses, alder, moss, cinqfoil, equisetum, spruce	alder, willow, moss, equisetum, highbush cranberry, poplar, grass	alder, willow , grasses, poplar, forbs, berry shrubs, spruce, moss
Aquatic Vegetation (% areal coverage)	Emergent	0	0	0	0	0	0	0
	Submergent	0	0	0	0	0	0	0
	Floating	0	0	0	0	0	0	0
	Attached Algae	< 5	< 5	< 1	<10	0	0	0
Surrounding Land Use		U/S of old gravel pit haul road	Haul Road ~30m D/S of site	old gravel pit haul road	U/S mine road; forest	none; mature forest	forest	bridges/road crossings
Evidence of Anthropogenic Disturbance		modified channel, likely to ensure flow to culvert	none	culverts, pushed around substrate	rip-rap & metal culverts	none	none	bridges/road crossings
General Comments/Notes		Stream channel much smaller & shallower than Vangorda but substrate is comparable, in spots, to lower Vangorda. First sample taken 22m U/S of culvert, with next 2 samples taken U/S of that.	Assessed a very small portion of the stream, afterwhich the gradient was steeper with larger boulders. Mayflies noted when shocking. Conductivity will not calibrate, used Hanna meter instead. Site is more a pool/step kind of habitat with an increasing gradient that becomes a canyon type environment.	Sampled D/S of culverts. Loosely compacted substrate. U/S of road has alot of moss, channel narrows to < 9m. Small woody debris and some overhanging willow. LWD up on banks indicating Hgh water mark/flow.	Most sites have some orange fuzzy moss on rocks	Some sites in valley with access down steep hills	Lots of fines and small gravel making Hess sampling difficult	

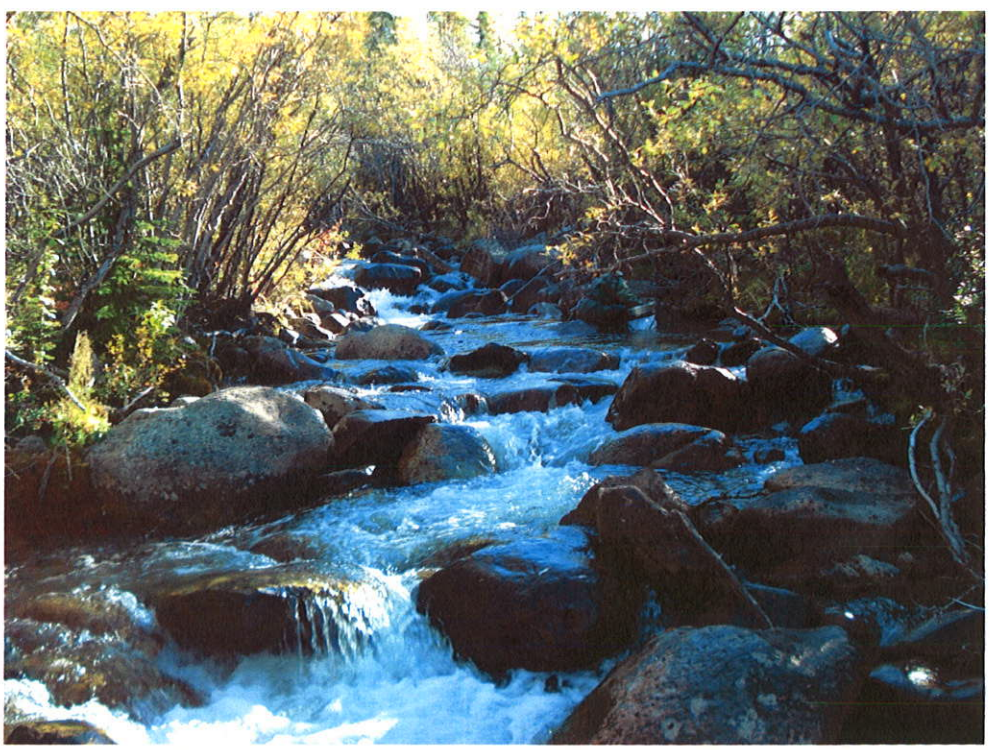
[a] Numbers provided represent mean values with numbers in parenthesis representing the corresponding range for each respective description.
[b] Morphology type based on Rosgen (1994) classification. B= moderately entrenched, moderate-gradient, riffle-dominated channel with infrequently spaced pools, very stable plan and profile, stable banks; C= low-gradient, meandering, alluvial riffle-pool, channels with point-bars, broad, well-defined floodplains E= low-gradient, meandering, riffle/pool stream with low width:depth ratio and little deposition, very efficient and stable, high meander width ratio; G= entrenched, "gully" step-pool channel, on moderate gradients, with low width:depth ratio

Reference Area V1, Upper Vangorda Creek

a) V1-02 - 2007



b) V1-04 - 2007



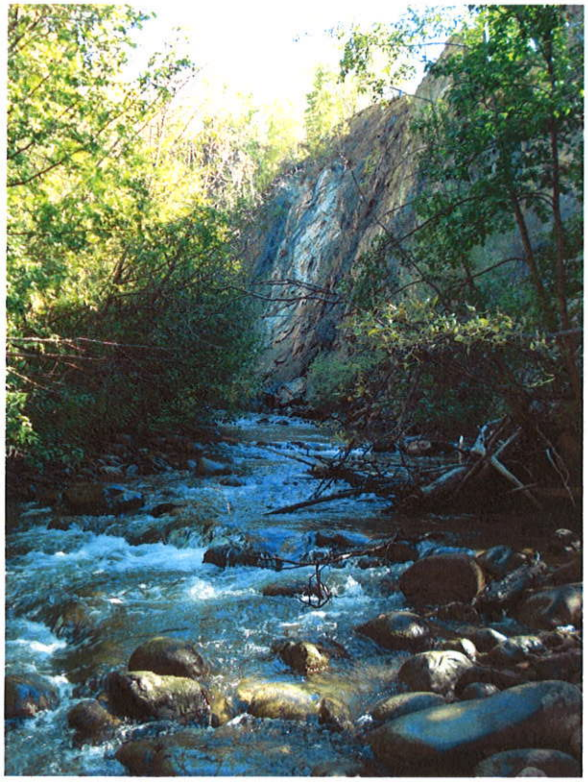
Area V27, Vangorda Creek

a) V27-02 - 2007

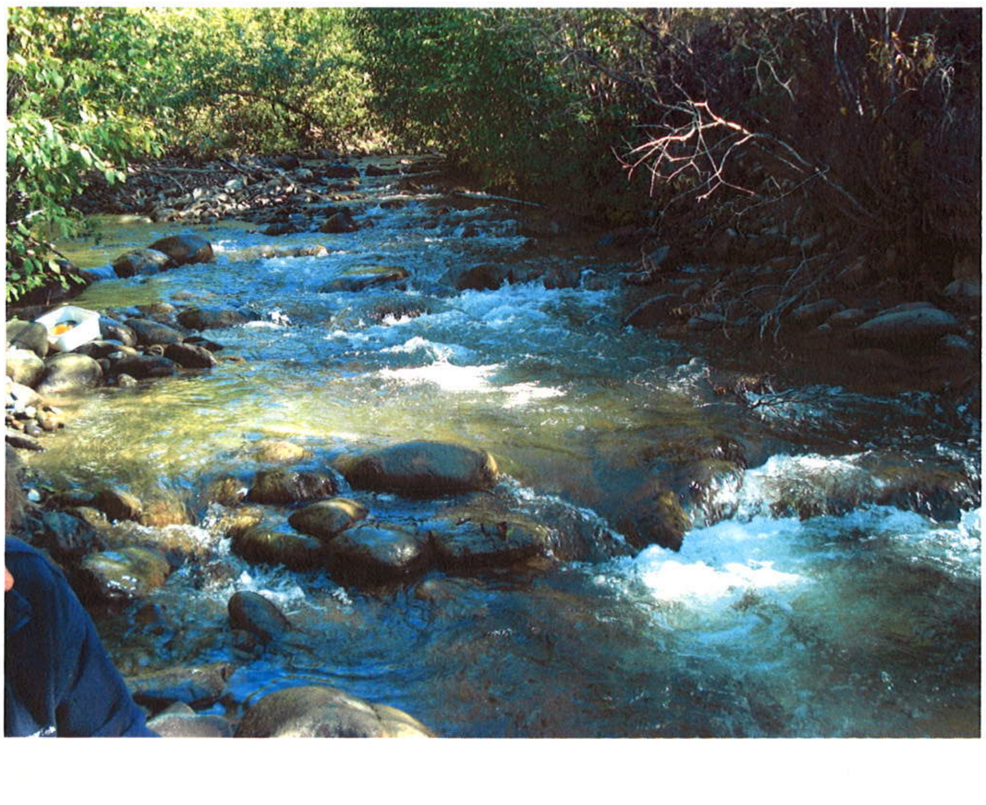
b) V27-03 - 2007

Area V8, Vangorda Creek

a) V8-04 - 2007



b) V8-03 - 2007



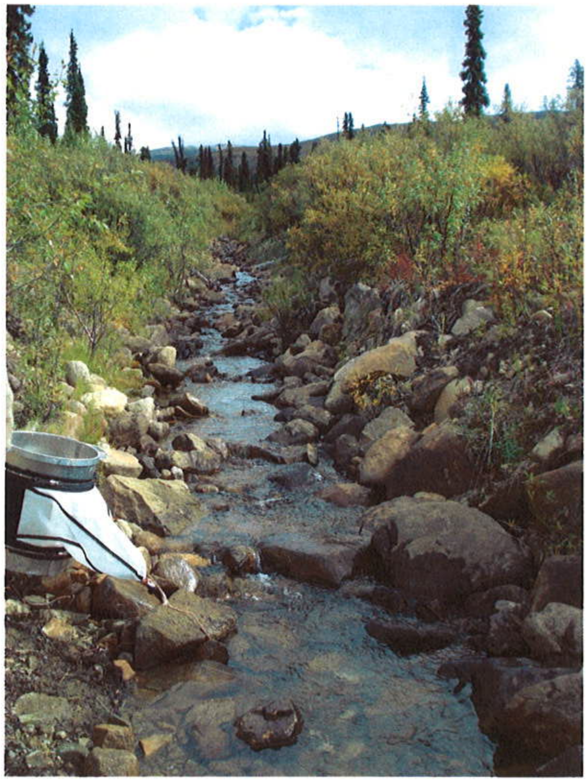
Area V5, West Fork Vangorda Creek

a) V5-01 - 2007

b) V5-02 - 2007

Area REF1, Upper West Fork Vangorda Creek

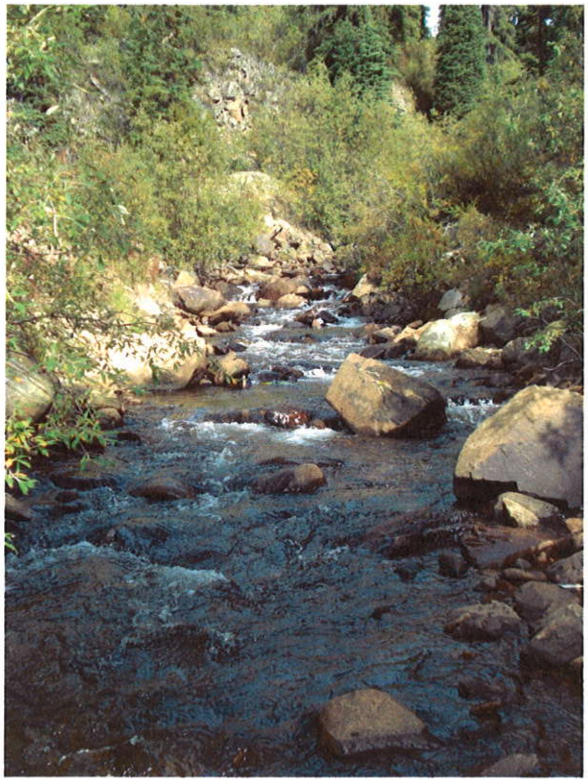
a) VR - 2007



b) VR - 2008

Area REF2, Upper South Fork Rose Creek

a) USFR - 2007



b) USFR - 2008

Reference Area Next Creek

a) NEC - 2007

b) NEC - 2008

a) X2 - 2008

b) R2 - 2008

a) R7 - 2008

b) FC - 2008

a) BLC - 2008

b) STC - 2008

a) HOC - 2008

b) BEC - 2008

a) GRC - 2008

b) BTT - 2008

a) BUC - 2008

Table C.2: Habitat summary for Rose Creek sampling areas, Faro Mine, August 2008.

Characteristics		Reference												Mine-Exposed	
		UWFV (VR)	USFR	Next Creek (NEC,NXT, NEXC)	R7	FC	BLC	STC	BEC	HOC	GRC	BTT	BUC	X2	R2
Average Length of Reach Assessd (m)		40		25		30	50	20	20	30	25	25	20		50
Bottom Flow Velocity (m/s)	Mean	0.29	0.35	0.22	0.3	0.4	0.25	0.35	0.6	0.35	0.5	0.5	0.6	0.42	0.43
Depth (m)	Mean	0.15	0.19	0.09	0.1	0.28	0.4	0.35	0.2	0.2	0.2	0.15	0.15	0.38	0.47
	Maximum	0.18	0.30	0.15	0.15	0.6	0.8	0.6	0.25	0.3	0.25	0.2	0.4	0.7	0.6
Width (m)	Wetted	1.5	8.5	6	7	3.5	26	12	3.5	12	2.5	5	4	5.75	11
	Bankfull	2	9.5	7.5	8	5	30	13	4	12	10	6	5	8	11
Gradient (reach sampled)	%	3	7	4	3	4	2	3.5	2	3		4	2.5	3.5	2
Water Appearance		clear	clear	clear	clear	clear	clear	clear, blue	clear	-	clear, brown	clear, brown	clear, brown	clear	clear, brown
General Morphology	%pool	0	3	0	0	0	0	0	0	0	0	0	0	0	0
	%riffle	100	97	100	10	50	50	20	20	50	90	100	100	50	0
	%run	0	0	0	90	50	50	80	80	50	10	0	0	50	100
Bank Condition		moderate	stable	moderate	unstable to moderate	stable	moderate to stable	stable		stable	unstable			moderate	unstable to moderate
Substrate (% areal coverage)	%bedrock	0	10	0	0	0	0	0	0	0	0	10	0	0	0
	%boulder	10	20	5	5	60	5	20	0	5	0	20	5	40	0
	%cobble	70	50	80	0	20	70	60	65	55	45	50	70	40	35
	%gravel	20	20	15	80	10	20	10	25	30	45	10	10	15	35
	%sand&finer	some	0	0	10	10	5	10	10	10	10	10	15	5	30
Instream Cover (%total Surface)	undercut banks	0	0	0	10	10	2	5	10	10	0	20	5	5	10
	boulder	10	40	5	5	0	0	25	0	10	0	30	2	10	0
	woody debris	0	0	5	0	0	2	0	10	5	10	0	0	0	<5
	deep pool	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	macrophytes	0	0	0	0	0	0	0	20	0	0	0	0	0	0
Av. Residual (Refuge) Pool Depth (m)		-	0.3	-	-	-	-	-	-	-	-	-	-	-	-
Overhead Canopy (%Surface)	Dense	0	0	0	0	0	0	0	0	0	0	50	0	0	0
	Partially Open	0	70	5	0	100	0	0	100	0	0	50	100	0	0
	Open	100	30	95	100	0	100	100	0	100	100	0	0	100	100
Riparian Vegetation Types	descending dominance	willow/cherry, black spruce, moss	willow, scattered poplar, spruce	willow, black spruce	grasses, willow, black spruce	willow, moss, sedges	alder, aspen, willow, black spruce	willow, black spruce, sedges	small willow, sedges	willow, sedges, alder, black & white spruce	aspen, willow, spruce	poplar, black spruce, willow, moss	grasses, shrubs, willow, alder, black spruce	willow, black spruce, alder, blueberry, moss	black spruce, willow, sedges
Aquatic Vegetation (% areal coverage)	Emergent	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Submergent	0	0	0	0	0	0	0	25	0	0	0	0	0	0
	Floating	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Attached Algae	25	50	5	30	30	30	30	20	20	<3 (thin film on cobble)	70	0	50	0
Surrounding Land Use		U/S of haul road	mine north of haul road	quarry to west, treed	forest	road d/s, beside ATV trail	old bridge u/s	culvert & road u/s		culvert & road u/s	road d/s	undisturbed, natural, soil black	natural, hwy u/s	U/S of Anvil access road D/S of "S" wells	mine upstream
General Comments/Notes					sediment chemistry & toxicity sample taken near confluence with Faro Creek.				wetland area upstream			waterfall u/s, lots of algae but habitat similar to X2 & R2		d/s of GW inputs from S-wells, Faro Mine	d/s of Faro Mine effluent and GW discharges. Slight brown stain on rocks

APPENDIX D

Benthic Invertebrate Data
Raw Data, Summary Statistics,
and Correspondence Analysis Results

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
		Hess	K&S	Hess	K&S	Hess	K&S	Hess	K&S	Hess	Hess	Hess	K&S	Hess	K&S	Hess	Hess	Hess	Hess	Hess	K&S	K&S	K&S	Hess
	New Sample Code:	**VRH8**	**VRK**	**X2aH**	**X2aK**	**X2aH**	**X2bK**	**X2cH**	**X2cK**	**X2dH**	**X2eH**	**USFRH8**	**USFRK**	**NECH8**	**NECK**	**R2aH**	**R2bH**	**R2cH**	**R2dH**	**R2eH**	**R2aK**	**R2bK**	**R2cK**	**R7H**
	Original Sample ID:	**VR-Hess**	**VR-K&S**	**X2-1 Hess**	**X2-1 K&S**	**X2-2 Hess**	**X2-2 K&S**	**X2-3 Hess**	**X2-3 K&S**	**X2-4 Hess**	**X2-5 Hess**	**USFR-Hess**	**USFR-K&S**	**NEC-Hess**	**NEC-K&S**	**R2-1 Hess**	**R2-2 Hess**	**R2-3 Hess**	**R2-4 Hess**	**R2-5 Hess**	**R2-1 K&S**	**R2-2 K&S**	**R2-3 K&S**	**R7 Hess**
Order: Ephemeroptera	nymph (juv./dam.)																							
Order: Ephemeroptera	adult														4									
Family: Ameletidae														9										
Ameletus sp.	nymph			7	1			13		27	87	53	10	9	30				13					
Family: Baetidae	nymph (juv./dam.)		55		2			13	8			27		27	4	193	587	200	173		93	92	77	
Baetis sp.	nymph	53	10	20	5	7	4	13		13			24			20	10	13	20	143	3	2	6	
Baetis bicaudatus	nymph	23	18	13	4		16	13	8									3		7				
Baetis tricaudatus	nymph												4		1	7			73	7	1	2	13	
Acentrella sp.	nymph				26	13	8	40	8							100	50	57	27	20	6	4	13	
Fallceon sp.	nymph													217		27								
Family: Heptageniidae	nymph (juv./dam.)	100	15	233	111	80	4	27	8		60	200	135		335	87	380	160	300	133	85	91	103	167
Rhithrogena sp.	nymph												4											
Cinygmula sp.	nymph	7	3	40	10	27		13		53		53	7	80	11		10	27	13	7	1		2	60
Epeorus sp.	nymph	3	5	13	9	13		13		13		47	78		32	13	43	83	0	37	3	3	11	
Family: Leptophlebiidae	nymph (juv./dam.)													182										
Family: Ephemerellidae	nymph (juv./dam.)	80	22	160	69	73	20	227	24	40	53	720	268		136	13	640	350	100	80	32	5	26	173
Drunella sp.	nymph											7												
Drunella spinifera	nymph																							
Drunella grandis	nymph																							7
Serratella sp.	nymph																7			7	1			
Ephemerella sp.	nymph							27																27
Drunella coloradensis	nymph			13	5				8			7	9	52	4		7	10						7
Drunella doddsi	nymph			13	11	7	8					40	45	17	4	87	60	170	13	77	11	8	15	
Serratella tibialis	nymph																							
Order: Plecoptera	nymph (juv./dam.)	13	8		4	33		13	8								160	147	20	133	15	10	7	87
Order: Plecoptera	adult												1											
Family: Chloroperlidae	nymph (juv./dam.)	23	24	13									4	26		40	190	93	100		18	1		53
Sweltsa sp.	nymph	17	3		3	20					7	33	4	157	16	7	17		13	17		1		
Suwallia sp.	nymph		1	13	5	7								9	28	113	47	20	27	3	11	14	11	147
Alloperla fraterna	nymph																							
Paraperla sp.	nymph																							
Family: Perlodidae	nymph		2	7			4	13	8			27	5			47		13	7	3	3	3	3	7
Isoperla sp.	nymph																							
Megarcys sp.	nymph	7	5																					
Skwala sp.	nymph				1												10	23				1	2	
Kogotus sp.	nymph																							
Rickera sp.	nymph																				1			
Cultus sp.	nymph																				1			
Family: Perlidae	nymph		1	7																				
Hesperoperla sp.	nymph																							
Family: Nemouridae	nymph (juv./dam.)																							
Podmosta sp.	nymph													165										
Zapada sp.	nymph	97	26	387	33	113	40	280	56	80	13	2060	673	35	144	33	267		40	80	8	6	18	353
Zapada oregonensis/haysi	nymph	3		100	13	113	8	173	32	173	27	40	26	35	62	20	13	13	27	3	2	2	8	420
Zapada columbiana	nymph											73	48	17	2									
Zapada cinctipes	nymph			67	7	20	8	120	48	13	7	53	17	35	18		13	13		13	1			33
Visoka sp.																								
Family: Capniidae	nymph (juv./dam.)	380	114	187	200	153	64	80	48	27	187	33	8	53	61	127	213	310	340	10	36	59	76	620
Family: Leuctridae	nymph (juv./dam.)				1							47	9		2		53	13		3				
Family: Taeniopterygidae	nymph (juv./dam.)																			10	2			27
Taenionema sp.	nymph			40	6		4	13					8									1		
Order: Trichoptera	adult																							
Order: Trichoptera	larvae (dam./juv.)				1																			
Order: Trichoptera	pupae							40	8										7					
Family: Hydropsychidae	larvae (juv./dam.)											13	24				3							
Parapsyche sp.	larvae			20	2				8	13			15		1		7	23		3				
Arctopsyche sp.	larvae																							
Hydropsyche sp.	larvae																							
Family: Rhyacophilidae																								
Rhyacophila sp.	larvae			47	10	60	16	13	8		7	13	6	61	18	7	13	60		23	1		3	7

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2008 Hess	2008 K&S	2008 Hess	2008 K&S	2008 Hess	2008 K&S	2008 Hess	2008 K&S	2008 Hess	2008 Hess	2008 Hess	2008 K&S	2008 Hess	2008 K&S	2008 Hess	2008 Hess	2008 Hess	2008 Hess	2008 Hess	2008 K&S	2008 K&S	2008 K&S	2008 Hess
	New Sample Code:	**VRH8**	**VRK**	**X2aH**	**X2aK**	**X2aH**	**X2bK**	**X2cH**	**X2cK**	**X2dH**	**X2eH**	**USFRH8**	**USFRK**	**NECH8**	**NECK**	**R2aH**	**R2bH**	**R2cH**	**R2dH**	**R2eH**	**R2aK**	**R2bK**	**R2cK**	**R7H**
	Original Sample ID:	**VR-Hess**	**VR-K&S**	**X2-1 Hess**	**X2-1 K&S**	**X2-2 Hess**	**X2-2 K&S**	**X2-3 Hess**	**X2-3 K&S**	**X2-4 Hess**	**X2-5 Hess**	**USFR-Hess**	**USFR-K&S**	**NEC-Hess**	**NEC-K&S**	**R2-1 Hess**	**R2-2 Hess**	**R2-3 Hess**	**R2-4 Hess**	**R2-5 Hess**	**R2-1 K&S**	**R2-2 K&S**	**R2-3 K&S**	**R7 Hess**
Family: Philopodamidae																								
Wormaldia sp.	larvae																							
Family: Glossosomatidae																								
Glossosoma sp.	larvae			67	13	7	12				13	27	36						7		2	1		7
Family: Uenoidae	larvae (juv./dam.)																							
Oligophlebodes sp.	larvae																							
Family: Hydroptilidae	pupae																							
Hydroptila sp.	larvae																							
Stactobiella sp.	larvae																							
Oxyethira sp.	larvae																							
Family: Brachycentridae																								
Micrasema sp.	larvae			7		27		27	16															
Brachycentrus sp.	larvae															13				3				
Family: Lepidostomatidae																								
Lepidostoma sp.	larvae																							
Family: Limnephilidae	larvae (juv./dam.)			7										9	4									
Ecclisomyia sp.	larvae		1																					
Dicosmoecus sp.	larvae					13																		
Order: Coleoptera	larvae (juv./dam.)																							
Family: Dytiscidae	larvae																							
Family: Elmidae	adult																							
Order: Diptera UID	larvae			20		7																		53
Order: Diptera UID	pupae																							
Order: Diptera UID A	larvae																							
Order: Diptera UID B	larvae																							
Order: Diptera	pupae											13												
Order: Diptera	adult																							
Order: Diptera	larvae																							
Family: Tipulidae	larvae (dam./juv.)															7								
Antocha sp.	larvae													9										
Dicranota sp.	larvae	3		7	1			53		13	13	13			4	20				27	3		1	53
Hexatoma sp.	larvae																							
Limnophila sp.	larvae																							
Rhabdomastix sp.	larvae																							
Hesperoconopa sp.	larvae																							
Gonomyodes sp.	larvae																							
Tipula sp.	larvae																							
Family: Ceratopogonidae																								
Bezzia/Palpomyia sp.	larvae			7	9	47	8	40	64	13				9	4	13	10	80	87	3	1	7	6	
Family: Psychodidae	larvae				1																			
Family: Psychodidae UID	larvae																							
Pericoma sp.	larvae					7													7		3	1	1	
Family: Deuterophlebiidae	pupae															7		43						
Deuterophlebia sp.	larvae																	13					1	
Family: Blephariceridae																								
Agathon sp.	larvae																							
Family: Empididae	larvae (dam.)			7																				
Chelifera/Metachela sp.	larvae	7	1	20	19	47		13	24		7	13	4			20	3	30	13	73	4	6	8	153
Oreogeton sp.	larvae	3													4									
Clinocera sp.	larvae					7		13					4											
Family: Simuliidae	pupae	13		60	2	60	16	320					4	26		40	177		27	73			2	33
Simulium sp.	larvae			313	10	47	44	160	8				4		5	67	530	407	7	87	6	4	13	
Prosimulium sp.	larvae	83	86														3					1		
Family: Chironomidae	larvae													104										
Family: Chironomidae	pupa	40		140	32	780	32			493	93	13		70			10			13	3			
Subfamily : Chironominae	larvae																							
Tribe : Tanytarsini	larvae																							
Cladotanytarsus sp.	larvae																							
Micropsectra/Tanytarsus sp.	larvae				1																			
Neostempellina sp.	larvae																							

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
		Hess	K&S	Hess	K&S	Hess	K&S	Hess	K&S	Hess	Hess	Hess	K&S	Hess	K&S	Hess	Hess	Hess	Hess	Hess	K&S	K&S	K&S	Hess
	New Sample Code:	**VRH8**	**VRK**	**X2aH**	**X2aK**	**X2aH**	**X2bK**	**X2cH**	**X2cK**	**X2dH**	**X2eH**	**USFRH8**	**USFRK**	**NECH8**	**NECK**	**R2aH**	**R2bH**	**R2cH**	**R2dH**	**R2eH**	**R2aK**	**R2bK**	**R2cK**	**R7H**
	Original Sample ID:	**VR-Hess**	**VR-K&S**	**X2-1 Hess**	**X2-1 K&S**	**X2-2 Hess**	**X2-2 K&S**	**X2-3 Hess**	**X2-3 K&S**	**X2-4 Hess**	**X2-5 Hess**	**USFR-Hess**	**USFR-K&S**	**NEC-Hess**	**NEC-K&S**	**R2-1 Hess**	**R2-2 Hess**	**R2-3 Hess**	**R2-4 Hess**	**R2-5 Hess**	**R2-1 K&S**	**R2-2 K&S**	**R2-3 K&S**	**R7 Hess**
Pseudochironomus sp.	larvae																							
Rheotanytarsus sp.	larvae											873	138											
Stempellinella sp.	larvae											280	92										3	
Stempellina sp	larvae																							
Tanytarsus sp.	larvae																							
Subfamily: Orthocladiinae	larvae	3																		187				
Acricotopus sp.	larvae																							
Brillia sp.	larvae																							
Cardiocladius sp.	larvae																							
Chaetocladius sp.	larvae	23	6																					
Corynoneura sp.	larvae												8	381										
Cricotopus/Orthocladius sp.	larvae		5	3127	421	6573	660	7040	1832	3267	1487	833	52		107	1173	800	387	1620	150	52	22	57	3347
Cricotopus/Orthocladius sp. A	larvae																							
Cricotopus/Orthocladius sp. B	larvae																							
Diplocladius sp.	larvae													121									2	
Eukiefferiella sp.	larvae	80	15	673	80	960	132	1773	312	667	233	200			65		117	67	13	10	34	8	3	440
Heleniella sp.	larvae																							
Hydrobaenus sp.	larvae																							
Nanocladius	larvae																							
Parorthocladius sp.	larvae																							
Rheocricotopus sp.	larvae											120	28											
Synorthocladius sp.	larvae		1		12	167		120																53
Thienemanniella sp.	larvae			20	25	813	76	440	152													2		
Tvetenia sp.	larvae	103	11									147	8											
Subfamily: Diamesinae	larvae																							
Diamesa sp.	larvae	27	21	127	40	233	88	360						260							3	7	6	
Pagastia sp.	larvae	3		293	48	1507	132	493	232	2213					49	520	467	620	347	660	29		93	613
Pseudodiamesa sp.	larvae																							
Potthastia longimana group	larvae																							
Prodiamesa sp.	larvae	3																						
Subfamily: Tanypodinae	larvae				15	173	32	213	32	147	107	80								180				
Thienemannimyia Group	larvae			33	1												190	13	93			19	7	
Procladius sp.	larvae																							
Family: Syriphidae	larvae																							
Family: Psychodidae																								
Pericoma sp.	larvae																							
Family : Stratiomyiidae	larvae																							
Order: Lepidoptera	larvae																							
Order: Hemiptera																								
Family: Corixidae	larvae	3												17										
Order: Collembola	larvae	3					4					53												27
Order : Thysanoptera (terr)																								
Class: Crustacea																								
Order: Ostracoda			1	7	6	67	8	133	16		60	27				13			7			1	1	13
Order: Cladocera																						2		
Order: Copepoda													8						13				3	
Phylum: Annelida																								
Class: Oligochaeta				7																				
Family: Naididae		507	41	427	17	93	8	720	32		813	160	16		8	107		27	27		1	1	7	393
Family : Tubificidae																								
Phylum: Nematoda		3		40	9	80	12	267	24	27	120	440	52		8	127	17	73	47	23	4	1	7	53
Order: Tricladida																								
Polycelis coronata														43										
Class: Turbellaria																								
Class: Mollusca																								
Order: Bivalvia																								

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
		Hess	K&S	Hess	K&S	Hess	K&S	Hess	K&S	Hess	Hess	Hess	K&S	Hess	K&S	Hess	Hess	Hess	Hess	Hess	K&S	K&S	K&S	Hess
	New Sample Code:	**VRH8**	**VRK**	**X2aH**	**X2aK**	**X2aH**	**X2bK**	**X2cH**	**X2cK**	**X2dH**	**X2eH**	**USFRH8**	**USFRK**	**NECH8**	**NECK**	**R2aH**	**R2bH**	**R2cH**	**R2dH**	**R2eH**	**R2aK**	**R2bK**	**R2cK**	**R7H**
	Original Sample ID:	**VR-Hess**	**VR-K&S**	**X2-1 Hess**	**X2-1 K&S**	**X2-2 Hess**	**X2-2 K&S**	**X2-3 Hess**	**X2-3 K&S**	**X2-4 Hess**	**X2-5 Hess**	**USFR-Hess**	**USFR-K&S**	**NEC-Hess**	**NEC-K&S**	**R2-1 Hess**	**R2-2 Hess**	**R2-3 Hess**	**R2-4 Hess**	**R2-5 Hess**	**R2-1 K&S**	**R2-2 K&S**	**R2-3 K&S**	**R7 Hess**
Family: Sphaeriidae																								
Pisidium sp.																								
Sphaerium simile																								
Order: Gastropoda																								
Family: Valvatidae													4											
Family : Physidae																								
Physa sp.																								
Family : Planorbidae																								
Class : Arachnida																								
Order : Mesostigmata																								
Order: Prostigmata	deutonymph	3		67	4	120	28	387	24	67	7	53	8			27	7		47		12	6	6	
Order: Prostigmata UID	adult														4					53		1		27
Order: Prostigmata	juvenile																							
Family: Hydrozetidae	adult	3	1		1	7	4					27												
Family: Torrenticolidae																								
Torrenticola	adult																							
Family: Linmesiidae																								
Limnesia	adult								8															27
Family: Hygrobatidae																								
Hygrobates	adult					60	4	13	32				4	9					7				1	
Family: Hydryphantidae																								
Wandesia	adult																							
Family: Lebertiidae																								
Lebertia	adult			93	10	67	32	147	176	93			4			7			40		3	1		
Family: Aturidae														9										
Aturus	adult	7		93	17	433	72	667	112	440	87	133	44		8	13		27	20	53	2		3	133
Family: Feltriidae														17										
Feltria	adult	7		60	12	147	8	293	64	93	53	160	8						27		1		1	
Family: Sperchontidae																								
Sperchon	adult	7		67	12	193	36	160	120	293	40	27	12		8	60		53	107	80	8	1	3	187
Sperchonopsis sp.	adult																							
Family : Mideopsidae																								
Mideopsis sp.	adult																							
Hydra sp.														2268										
Order: Hirudinea																								
Family: Piscicolidae																								
TOTAL SUBSAMPLE		**1743**	**502**	**7187**	**1357**	**13480**	**1652**	**15000**	**3568**	**8280**	**3580**	**7240**	**1970**	**4536**	**1191**	**3173**	**5130**	**3643**	**3873**	**2497**	**506**	**397**	**629**	**7807**

juv. = juvenile, dam. = damaged

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
		K&S	K&S	Hess	K&S	Hess	Hess	Hess	Hess	Hess	K&S	K&S	K&S	Hess	K&S	Hess	K&S	Hess	K&S	Hess	K&S	Hess	K&S	Hess
	New Sample Code:	**R7aK**	**R7bK**	**FCH**	**FCK**	**BLCaH**	**BLCbH**	**BLCcH**	**BLCdH**	**BLCeH**	**BLCaK**	**BLCbK**	**BLCcK**	**STCH**	**STCK**	**BECH**	**BECK**	**HOCH**	**HOCK**	**GRCH**	**GRCK**	**BTTH**	**BTTK**	**BUCH**
	Original Sample ID:	**R7-1 K&S**	**R7-2 K&S**	**FC1 Hess**	**FC1 K&S**	**BLC1 Hess**	**BLC2 Hess**	**BLC-3 Hess**	**BLC-4 Hess**	**BLC-5 Hess**	**BLC-1 K&S**	**BLC-2 K&S**	**BLC-3 K&S**	**STC Hess**	**STC K&S**	**BEC Hess**	**BEC K&S**	**HOC Hess**	**HOC K&S**	**GRC Hess**	**GRC K&S**	**BTT Hess**	**BTT K&S**	**BUC Hess**
Order: Ephemeroptera	nymph (juv./dam.)																							
Order: Ephemeroptera	adult	1	1															3						
Family: Ameletidae																								
Ameletus sp.	nymph	4	19	67	20			3			1	5											64	
Family: Baetidae	nymph (juv./dam.)		1		2				13		1	1	7					147	14		6	133	277	230
Baetis sp.	nymph		4				3				1	1				7	16	7		3		1700	128	7
Baetis bicaudatus	nymph		1																		1			
Baetis tricaudatus	nymph						3	23		3	2	4	6	3		60	14	7	1			100	32	23
Acentrella sp.	nymph	4			2	7	27			13	3	5	6	7				93	17	3				
Fallceon sp.	nymph																							
Family: Heptageniidae	nymph (juv./dam.)	32	52	27	18	13	220	190	120	37	26	78	29		3			20	2	7	2		32	297
Rhithrogena sp.	nymph					113	437	80	147	173	33	35	16	3						10				
Cinygmula sp.	nymph		26				13			23	3	3	2	7	1			10						10
Epeorus sp.	nymph	2	1	40			20				2	2	2	10										23
Family: Leptophlebiidae	nymph (juv./dam.)																					133	373	7
Family: Ephemerellidae	nymph (juv./dam.)	96	113	80	34	167	3	30	27	107	6	22	23	3	1			100	5					23
Drunella sp.	nymph	1											2					27						7
Drunella spinifera	nymph						3	23		17		2	10											3
Drunella grandis	nymph																							
Serratella sp.	nymph						10			10														
Ephemerella sp.	nymph	1	4		2					27														
Drunella coloradensis	nymph		1																					
Drunella doddsi	nymph	17	25			100	83	33	53	13	3	13	2	3	3			70	3					83
Serratella tibialis	nymph																							
Order: Plecoptera	nymph (juv./dam.)	8		80	6				27	293	1	11	3		1			33	2		1		32	
Order: Plecoptera	adult																							
Family: Chloroperlidae	nymph (juv./dam.)						13	3							2							133		
Sweltsa sp.	nymph	1	1	53	12	20	60	70	80	107	2	18	8											67
Suwallia sp.	nymph	55	20	40	2		3		27		2	2		13				7						50
Alloperla fraterna	nymph																							
Paraperla sp.	nymph																							
Family: Perlodidae	nymph	5	1		2	7	43	33	40	113	1	1	14		1	53		10		3				7
Isoperla sp.	nymph													3										
Megarcys sp.	nymph																							
Skwala sp.	nymph						20		13		1	1	2	3				3						3
Kogotus sp.	nymph							7	13															
Rickera sp.	nymph					13	3																	
Cultus sp.	nymph					7																		
Family: Perlidae	nymph																						543	
Hesperoperla sp.	nymph																						32	
Family: Nemouridae	nymph (juv./dam.)															580						133		
Podmosta sp.	nymph																26							
Zapada sp.	nymph	37	72	587	88	53	80	83	13	53	4	12	27	53	1			190	4	7	9		192	217
Zapada oregonensis/haysi	nymph	22	48	187	14	7					1	1	2	120			1	3				367		
Zapada columbiana	nymph			120										57										
Zapada cinctipes	nymph	15	21	200	20									3			1			13			192	13
Visoka sp.																								
Family: Capniidae	nymph (juv./dam.)	50	239		30	393	297	410	253	303	55	181	120	270	6			27	4	17	9	567		87
Family: Leuctridae	nymph (juv./dam.)	4		40				3		7				53										33
Family: Taeniopterygidae	nymph (juv./dam.)	8			4		43		13				17					183						97
Taenionema sp.	nymph		11								12	12							18	50	9			
Order: Trichoptera	adult																							
Order: Trichoptera	larvae (dam./juv.)									27	4	4											64	
Order: Trichoptera	pupae					53			13							53		7						33
Family: Hydropsychidae	larvae (juv./dam.)					60		7	27	27	2	2					1	143		7				127
Parapsyche sp.	larvae	1		13																3				3
Arctopsyche sp.	larvae															7								
Hydropsyche sp.	larvae																							
Family: Rhyacophilidae																								
Rhyacophila sp.	larvae	2			2	27	87	3	13	37	4	6	6		1			3	2					3

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
		K&S	K&S	Hess	K&S	Hess	Hess	Hess	Hess	Hess	K&S	K&S	K&S	Hess	K&S	Hess	K&S	Hess	K&S	Hess	K&S	Hess	K&S	Hess
	New Sample Code:	**R7aK**	**R7bK**	**FCH**	**FCK**	**BLCaH**	**BLCbH**	**BLCcH**	**BLCdH**	**BLCeH**	**BLCaK**	**BLCbK**	**BLCcK**	**STCH**	**STCK**	**BECH**	**BECK**	**HOCH**	**HOCK**	**GRCH**	**GRCK**	**BTTH**	**BTTK**	**BUCH**
	Original Sample ID:	**R7-1 K&S**	**R7-2 K&S**	**FC1 Hess**	**FC1 K&S**	**BLC1 Hess**	**BLC2 Hess**	**BLC-3 Hess**	**BLC-4 Hess**	**BLC-5 Hess**	**BLC-1 K&S**	**BLC-2 K&S**	**BLC-3 K&S**	**STC Hess**	**STC K&S**	**BEC Hess**	**BEC K&S**	**HOC Hess**	**HOC K&S**	**GRC Hess**	**GRC K&S**	**BTT Hess**	**BTT K&S**	**BUC Hess**
Family: Philopodamidae																								
Wormaldia sp.	larvae															13	2							
Family: Glossosomatidae																								
Glossosoma sp.	larvae	16		40						27						1213	100	20		13				43
Family: Uenoidae	larvae (juv./dam.)					107			13															
Oligophlebodes sp.	larvae						20	13				2												
Family: Hydroptilidae	pupae						13			3						113								
Hydroptila sp.	larvae					53	3	3	13															
Stactobiella sp.	larvae						13																	
Oxyethira sp.	larvae															53								
Family: Brachycentridae																								
Micrasema sp.	larvae															220							96	
Brachycentrus sp.	larvae															313	43	3						
Family: Lepidostomatidae																								
Lepidostoma sp.	larvae																						96	7
Family: Limnephilidae	larvae (juv./dam.)			27			3		13			2	2									267	596	
Ecclisomyia sp.	larvae				2			17																
Dicosmoecus sp.	larvae																							
Order: Coleoptera	larvae (juv./dam.)											2												
Family: Dytiscidae	larvae					7																		
Family: Elmidae	adult																							
Order: Diptera UID	larvae	4												53	2									
Order: Diptera UID	pupae																							
Order: Diptera UID A	larvae																							
Order: Diptera UID B	larvae																							
Order: Diptera	pupae			27					13					3			4			3				
Order: Diptera	adult										10	10												
Order: Diptera	larvae																							
Family: Tipulidae	larvae (dam./juv.)	4		27		7																		
Antocha sp.	larvae																					2033	128	43
Dicranota sp.	larvae		21	93	4								4					7				133	96	10
Hexatoma sp.	larvae					7						2												3
Limnophila sp.	larvae	4				13												13						
Rhabdomastix sp.	larvae						17		13					7										3
Hesperoconopa sp.	larvae					13		3		27														
Gonomyodes sp.	larvae																							
Tipula sp.	larvae																							
Family: Ceratopogonidae																								
Bezzia/Palpomyia sp.	larvae	4				53		47		7		4		3	1			3		3				17
Family: Psychodidae	larvae		1																					
Family: Psychodidae UID	larvae																							
Pericoma sp.	larvae	12				60	113	17	13	53	3	13												
Family: Deuterophlebiidae	pupae													3										
Deuterophlebia sp.	larvae														1									
Family: Blephariceridae																								
Agathon sp.	larvae																		1					
Family: Empididae	larvae (dam.)													53										
Chelifera/Metachela sp.	larvae	28	9			13	37	50	40	50	3	3	2	20				20		7	1	1167	330	
Oreogeton sp.	larvae																	17	1			100		7
Clinocera sp.	larvae													70										
Family: Simuliidae	pupae		7	27												200		13						
Simulium sp.	larvae		9						13		3	3		3		593	49	20	1	20	2	133		53
Prosimulium sp.	larvae															53				7				
Family: Chironomidae	larvae																							
Family: Chironomidae	pupa		16	27	10		3			10	2	2	13		3									33
Subfamily : Chironominae	larvae																							
Tribe : Tanytarsini	larvae																							
Cladotanytarsus sp.	larvae															1280	51							
Micropsectra/Tanytarsus sp.	larvae				4				67	53						633							1120	3
Neostempellina sp.	larvae																							

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2008 K&S	2008 K&S	2008 Hess	2008 K&S	2008 Hess	2008 Hess	2008 Hess	2008 Hess	2008 Hess	2008 K&S	2008 K&S	2008 K&S	2008 Hess	2008 K&S	2008 Hess	2008 K&S	2008 Hess	2008 K&S	2008 Hess	2008 K&S	2008 Hess	2008 K&S	2008 Hess
	New Sample Code:	**R7aK**	**R7bK**	**FCH**	**FCK**	**BLCaH**	**BLCbH**	**BLCcH**	**BLCdH**	**BLCeH**	**BLCaK**	**BLCbK**	**BLCcK**	**STCH**	**STCK**	**BECH**	**BECK**	**HOCH**	**HOCK**	**GRCH**	**GRCK**	**BTTH**	**BTTK**	**BUCH**
	Original Sample ID:	**R7-1 K&S**	**R7-2 K&S**	**FC1 Hess**	**FC1 K&S**	**BLC1 Hess**	**BLC2 Hess**	**BLC-3 Hess**	**BLC-4 Hess**	**BLC-5 Hess**	**BLC-1 K&S**	**BLC-2 K&S**	**BLC-3 K&S**	**STC Hess**	**STC K&S**	**BEC Hess**	**BEC K&S**	**HOC Hess**	**HOC K&S**	**GRC Hess**	**GRC K&S**	**BTT Hess**	**BTT K&S**	**BUC Hess**
Pseudochironomus sp.	larvae																							
Rheotanytarsus sp.	larvae					233		40									185					2333		10
Stempellinella sp.	larvae																							
Stempellina sp	larvae	4								133											1			
Tanytarsus sp.	larvae																							
Subfamily: Orthocladiinae	larvae																	60				8667	4508	7
Acricotopus sp.	larvae																							
Brillia sp.	larvae																							
Cardiocladius sp.	larvae				10																			
Chaetocladius sp.	larvae																							
Corynoneura sp.	larvae																							
Cricotopus/Orthocladius sp.	larvae	361	143	1027	120	6407	807	5480	3827	3507	41	371	289	6127	17	287	363	240	2	170	2		298	160
Cricotopus/Orthocladius sp. A	larvae																							
Cricotopus/Orthocladius sp. B	larvae																							
Diplocladius sp.	larvae																							
Eukiefferiella sp.	larvae	2	24	387	10		23	67	93		8	8	30	523	19	8507	89	453	14	150	12	1100		10
Heleniella sp.	larvae								13			2												
Hydrobaenus sp.	larvae																							
Nanocladius	larvae																							
Parorthocladius sp.	larvae																							
Rheocricotopus sp.	larvae																							
Synorthocladius sp.	larvae	12	17							53														
Thienemanniella sp.	larvae																	27						7
Tvetenia sp.	larvae																					8667	4006	13
Subfamily: Diamesinae	larvae																							
Diamesa sp.	larvae																				2			
Pagastia sp.	larvae	172	228	2173	74	693			107	27		2	18	73			32	57						
Pseudodiamesa sp.	larvae																							
Potthastia longimana group	larvae																17			3				
Prodiamesa sp.	larvae																							
Subfamily: Tanypodinae	larvae																						533	
Thienemannimyia Group	larvae															2020	18							
Procladius sp.	larvae																							7
Family: Syriphidae	larvae																							
Family: Psychodidae																								
Pericoma sp.	larvae																							
Family : Stratiomyiidae	larvae																							
Order: Lepidoptera	larvae							3																
Order: Hemiptera																								
Family: Corixidae	larvae																							
Order: Collembola	larvae	4		13																				
Order : Thysanoptera (terr)																								
Class: Crustacea																								
Order: Ostracoda		4		13		107	13	13			2	2				1033	32		1			100		7
Order: Cladocera																						133		
Order: Copepoda																53			1			1833	384	
Phylum: Annelida																								
Class: Oligochaeta																								
Family: Naididae		21	24	93		187	257	27	27	30	2	2		283	12	1133	85	30	7	3	1	2733	831	
Family : Tubificidae																								
Phylum: Nematoda		20	31	173	8	60	40	20		27	1	3	8	7	2	47	6			3	2	2400	245	7
Order: Tricladida																								
Polycelis coronata															1									
Class: Turbellaria																								
Class: Mollusca																								
Order: Bivalvia																								

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2008 K&S	2008 K&S	2008 Hess	2008 K&S	2008 Hess	2008 Hess	2008 Hess	2008 Hess	2008 Hess	2008 K&S	2008 K&S	2008 K&S	2008 Hess	2008 K&S	2008 Hess	2008 K&S	2008 Hess	2008 K&S	2008 Hess	2008 K&S	2008 Hess	2008 K&S	2008 Hess
	New Sample Code:	**R7aK**	**R7bK**	**FCH**	**FCK**	**BLCaH BLC1**	**BLCbH BLC2**	**BLCcH BLC-3**	**BLCdH BLC-4**	**BLCeH BLC-5**	**BLCaK BLC-1**	**BLCbK BLC-2**	**BLCcK BLC-3**	**STCH**	**STCK**	**BECH**	**BECK**	**HOCH**	**HOCK**	**GRCH**	**GRCK**	**BTTH**	**BTTK**	**BUCH**
	Original Sample ID:	**R7-1 K&S**	**R7-2 K&S**	**FC1 Hess**	**FC1 K&S**	**Hess**	**Hess**	**Hess**	**Hess**	**Hess**	**K&S**	**K&S**	**K&S**	**STC Hess**	**STC K&S**	**BEC Hess**	**BEC K&S**	**HOC Hess**	**HOC K&S**	**GRC Hess**	**GRC K&S**	**BTT Hess**	**BTT K&S**	**BUC Hess**
Family: Sphaeriidae																								
Pisidium sp.																						400		3
Sphaerium simile										3														
Order: Gastropoda																								
Family: Valvatidae																								
Family : Physidae																								
Physa sp.																	1					133	245	
Family : Planorbidae																	25					100		
Class : Arachnida																								
Order : Mesostigmata																								
Order: Prostigmata	deutonymph	8		80	8	7			13			2	2			227		27				100	32	
Order: Prostigmata UID	adult														1	53								
Order: Prostigmata	juvenile																							
Family: Hydrozetidae	adult			13																		700	149	
Family: Torrenticolidae																								
Torrenticola	adult								13		1	1										400	96	13
Family: Linmesiidae																								
Limnesia	adult					7		13								213				3	2			
Family: Hygrobatidae																								
Hygrobates	adult			80	4							4	2				16							7
Family: Hydryphantidae																								
Wandesia	adult									27					1									
Family: Lebertiidae																								
Lebertia	adult	4	8	107	22	53	3	27	13		1	5		107				13						10
Family: Aturidae																								
Aturus	adult	84	32	240	46	160		107	80	160		16		53	3	53		7			1	133		7
Family: Feltriidae																								
Feltria	adult	28	16	80	8		13	53	40		2	6			5				1			433		
Family: Sperchontidae																								
Sperchon	adult	48	17	80	22	120	3	30	53	30		8		117	2	207	81	27	1					13
Sperchonopsis sp.	adult																16							
Family : Mideopsidae																								
Mideopsis sp.	adult									53														
Hydra sp.																	16							
Order: Hirudinea																								
Family: Piscicolidae																								
TOTAL SUBSAMPLE		**1210**	**1265**	**6360**	**610**	**9407**	**2857**	**7033**	**5373**	**5670**	**239**	**897**	**675**	**8120**	**90**	**19280**	**1290**	**2150**	**102**	**510**	**63**	**37467**	**15750**	**1957**

juv. = juvenile, dam. = damaged

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2008 K&S	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess
	New Sample Code:	**BUCK**	**X2aA**	**X2bA**	**X2cA**	**X2dA**	**X2eA**	**R2aA**	**R2bA**	**R2cA**	**R2dA**	**R2eA**	**R7aA**	**R7bA**	**R7cA**	**R7dA**	**R7eA**	**VRH7**	**USFRH7**	**NECH7**	**V1aH**	**V1bH**	**V1cH**	**V1dH**
	Original Sample ID:	**BUC K&S**	**X-2A**	**X-2B**	**X-2C**	**X-2D**	**X-2E**	**R2-A**	**R2-B**	**R2-C**	**R2-D**	**R2-E**	**R7-A**	**R7-B**	**R7-C**	**R7-D**	**R7-E**	**VR**	**USFR**	**NEC-1**	**V1-01**	**V1-02**	**V1-03**	**V1-04**
Order: Ephemeroptera	nymph (juv./dam.)																	7					3	
Order: Ephemeroptera	adult																							
Family: Ameletidae																								
Ameletus sp.	nymph								1	5								40	33	53	107		47	27
Family: Baetidae	nymph (juv./dam.)	355	36	32	8	36	136	88	40	53	437	668	32	64	6	272	40							
Baetis sp.	nymph																8	13	507		187	270	133	60
Baetis bicaudatus	nymph					2								8				53		7	13		3	3
Baetis tricaudatus	nymph	10					8		1		4	4												
Acentrella sp.	nymph			16					4			12												
Fallceon sp.	nymph																							
Family: Heptageniidae	nymph (juv./dam.)	460		16	8	2	16	7	2	5	65	40	312	80	45	160	88	7	120	500	1683	1393	1683	987
Rhithrogena sp.	nymph	5																			440	7	33	73
Cinygmula sp.	nymph	10		24					4				24		3			7	20	13		7	17	
Epeorus sp.	nymph	5								2					1			7	13	7	143	57	210	230
Family: Leptophlebiidae	nymph (juv./dam.)																							
Family: Ephemerellidae	nymph (juv./dam.)	40	36	24	4		16	1	4	1	20	32	120	152	18	256	136		653	33	80	163	13	27
Drunella sp.	nymph																							
Drunella spinifera	nymph		16																					
Drunella grandis	nymph											4												
Serratella sp.	nymph										4	16												
Ephemerella sp.	nymph	5																						
Drunella coloradensis	nymph		16				16														3	3	3	7
Drunella doddsi	nymph	40		16								8			2				60					
Serratella tibialis	nymph																							
Order: Plecoptera	nymph (juv./dam.)	10	8	32	4	20	56	18	4	4	75			112	12		32		7	13			387	133
Order: Plecoptera	adult																							
Family: Chloroperlidae	nymph (juv./dam.)	10																20		107	80	53	23	10
Sweltsa sp.	nymph	10											16					7	20	53	140	10	50	20
Suwallia sp.	nymph														1						680	70	127	27
Alloperla fraterna	nymph																			80	37			103
Paraperla sp.	nymph																				10			13
Family: Perlodidae	nymph	5						3	3	1	10	8	24	16	4	32	16		73	7				
Isoperla sp.	nymph																							
Megarcys sp.	nymph																				7	3		7
Skwala sp.	nymph								4															
Kogotus sp.	nymph							8																
Rickera sp.	nymph																							
Cultus sp.	nymph																							
Family: Perlidae	nymph										14													
Hesperoperla sp.	nymph																							
Family: Nemouridae	nymph (juv./dam.)		16																					
Podmosta sp.	nymph																							
Zapada sp.	nymph	380	60	72	4		264	8	6	1	78	108	672	848	63	1424	600		527	27	320	270	53	403
Zapada oregonensis/haysi	nymph		140	224	12	16	8	61		9	79	104	328	600	30	784	152	7	7	20	160	40	97	90
Zapada columbiana	nymph			24												16					10	10	57	40
Zapada cinctipes	nymph	30	40	80	4	2	8				21	60	440	480	62	736	336		27				3	
Visoka sp.																								
Family: Capniidae	nymph (juv./dam.)	15	8	40		2	24	5	1	11	35	52	224	80	68		312	27	20	47	1097	430	560	437
Family: Leuctridae	nymph (juv./dam.)	5																	7	20		53	37	
Family: Taeniopterygidae	nymph (juv./dam.)	85																						
Taenionema sp.	nymph		16				16				20			24	6	96	8							
Order: Trichoptera	adult																							
Order: Trichoptera	larvae (dam./juv.)																							
Order: Trichoptera	pupae																	7	60					
Family: Hydropsychidae	larvae (juv./dam.)	70									25	20							20	7				
Parapsyche sp.	larvae	25				16					8	16	16			16			13	13	43	7	27	20
Arctopsyche sp.	larvae																							
Hydropsyche sp.	larvae																							
Family: Rhyacophilidae																								
Rhyacophila sp.	larvae		4			18	16			4	42		8		1	16	8			160	23	3	13	77

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2007	2007	2007	2007	2007	2007	2007
		K&S	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	Hess	Hess	Hess	Hess	Hess	Hess	Hess
	New Sample Code:	**BUCK**	**X2aA**	**X2bA**	**X2cA**	**X2dA**	**X2eA**	**R2aA**	**R2bA**	**R2cA**	**R2dA**	**R2eA**	**R7aA**	**R7bA**	**R7cA**	**R7dA**	**R7eA**	**VRH7**	**USFRH7**	**NECH7**	**V1aH**	**V1bH**	**V1cH**	**V1dH**
	Original Sample ID:	**BUC K&S**	**X-2A**	**X-2B**	**X-2C**	**X-2D**	**X-2E**	**R2-A**	**R2-B**	**R2-C**	**R2-D**	**R2-E**	**R7-A**	**R7-B**	**R7-C**	**R7-D**	**R7-E**	**VR**	**USFR**	**NEC-1**	**V1-01**	**V1-02**	**V1-03**	**V1-04**
Family: Philopodamidae																								
Wormaldia sp.	larvae																							
Family: Glossosomatidae																								
Glossosoma sp.	larvae	20		16													8		20			107	53	43
Family: Uenoidae	larvae (juv./dam.)																							
Oligophlebodes sp.	larvae																							
Family: Hydroptilidae	pupae																							
Hydroptila sp.	larvae																							
Stactobiella sp.	larvae																							
Oxyethira sp.	larvae																							
Family: Brachycentridae																								
Micrasema sp.	larvae						8	1		1														
Brachycentrus sp.	larvae																							
Family: Lepidostomatidae																								
Lepidostoma sp.	larvae																							
Family: Limnephilidae	larvae (juv./dam.)										5									7				
Ecclisomyia sp.	larvae																							
Dicosmoecus sp.	larvae			24				8		3	16		8			16								
Order: Coleoptera	larvae (juv./dam.)																							
Family: Dytiscidae	larvae																							
Family: Elmidae	adult																							
Order: Diptera UID	larvae							104	1															
Order: Diptera UID	pupae																							
Order: Diptera UID A	larvae																							
Order: Diptera UID B	larvae																							
Order: Diptera	pupae																							
Order: Diptera	adult																	33	20	7	27	3		3
Order: Diptera	larvae																							
Family: Tipulidae	larvae (dam./juv.)																							
Antocha sp.	larvae																							
Dicranota sp.	larvae	5					8							32		16			20	20		53		
Hexatoma sp.	larvae																							
Limnophila sp.	larvae										5													
Rhabdomastix sp.	larvae																							
Hesperoconopa sp.	larvae																							
Gonomyodes sp.	larvae																							
Tipula sp.	larvae																							
Family: Ceratopogonidae																								
Bezzia/Palpomyia sp.	larvae						8				4													
Family: Psychodidae	larvae																							
Family: Psychodidae UID	larvae										5				1									
Pericoma sp.	larvae	5					8	3			5	8	24	16	3	16	16							
Family: Deuterophlebiidae	pupae																							
Deuterophlebia sp.	larvae																							
Family: Blephariceridae																								
Agathon sp.	larvae																							
Family: Empididae	larvae (dam.)																							
Chelifera/Metachela sp.	larvae									1				8	2			13	20					
Oreogeton sp.	larvae																				3		7	
Clinocera sp.	larvae			16																				
Family: Simuliidae	pupae		4	40		16	40			3	4	8			1			20			13		3	
Simulium sp.	larvae	20	72	40	4	36	128	23	11	7	20	120		16		208	16							
Prosimulium sp.	larvae			8		4	56	1	4		5	24		80		144		7						
Family: Chironomidae	larvae								16				1488	1648										
Family: Chironomidae	pupa	45	672	880	28	336		48		4	8		24	16		32	16				103		13	
Subfamily : Chironominae	larvae																							
Tribe : Tanytarsini	larvae						16																	
Cladotanytarsus sp.	larvae																							
Micropsectra/Tanytarsus sp.	larvae									72	125	136												
Neostempellina sp.	larvae																		127					

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2008 K&S	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess
	New Sample Code:	**BUCK**	**X2aA**	**X2bA**	**X2cA**	**X2dA**	**X2eA**	**R2aA**	**R2bA**	**R2cA**	**R2dA**	**R2eA**	**R7aA**	**R7bA**	**R7cA**	**R7dA**	**R7eA**	**VRH7**	**USFRH7**	**NECH7**	**V1aH**	**V1bH**	**V1cH**	**V1dH**
	Original Sample ID:	**BUC K&S**	**X-2A**	**X-2B**	**X-2C**	**X-2D**	**X-2E**	**R2-A**	**R2-B**	**R2-C**	**R2-D**	**R2-E**	**R7-A**	**R7-B**	**R7-C**	**R7-D**	**R7-E**	**VR**	**USFR**	**NEC-1**	**V1-01**	**V1-02**	**V1-03**	**V1-04**
Pseudochironomus sp.	larvae																		73					
Rheotanytarsus sp.	larvae	20							2				192	16	2									
Stempellinella sp.	larvae																8							
Stempellina sp	larvae																							
Tanytarsus sp.	larvae																	7					13	
Subfamily: Orthocladiinae	larvae		96			300	1920					144				288				67	1333		200	
Acricotopus sp.	larvae																							
Brillia sp.	larvae																						47	
Cardiocladius sp.	larvae																							
Chaetocladius sp.	larvae																							
Corynoneura sp.	larvae				8		8		3	1			16						13	20				
Cricotopus/Orthocladius sp.	larvae	110	696	1176	768	112	2200	36	35	104	410	248	560	448	18	416	400							
Cricotopus/Orthocladius sp. A	larvae																		113	33	780	860	430	1400
Cricotopus/Orthocladius sp. B	larvae																							
Diplocladius sp.	larvae																							
Eukiefferiella sp.	larvae	25		336	40	50	504	70	67	37	75	120				432	56	633	153	107	1360	427	133	450
Heleniella sp.	larvae																							
Hydrobaenus sp.	larvae												16											
Nanocladius	larvae																							
Parorthocladius sp.	larvae																							
Rheocricotopus sp.	larvae												16						133					
Synorthocladius sp.	larvae																		27					
Thienemanniella sp.	larvae		28	24	28		32												7					
Tvetenia sp.	larvae		24				8			13	35	40	536	1040	51	3552	1160			73				
Subfamily: Diamesinae	larvae																							
Diamesa sp.	larvae		952	448	132	360	720	9	9		33	24						1100						
Pagastia sp.	larvae	10	700	536	240	212	2960	153	47	60	189	244	232	240	27	208	128			33	27	267	27	167
Pseudodiamesa sp.	larvae																	7						
Potthastia longimana group	larvae							1		3														
Prodiamesa sp.	larvae																							
Subfamily: Tanypodinae	larvae																							
Thienemannimyia Group	larvae							39	12	15	15	80							13					
Procladius sp.	larvae																							
Family: Syriphidae	larvae																							
Family: Psychodidae																								
Pericoma sp.	larvae																	7						
Family : Stratiomyiidae	larvae																							
Order: Lepidoptera	larvae																							
Order: Hemiptera																								
Family: Corixidae	larvae																							
Order: Collembola	larvae								2															
Order : Thysanoptera (terr)																								
Class: Crustacea																								
Order: Ostracoda		5								3	14							7						
Order: Cladocera																								
Order: Copepoda															1									
Phylum: Annelida																								
Class: Oligochaeta						2	32										8	40	7	7		53		
Family: Naididae		10	4	16	4	2		5	1	2	10	12	16	56		16	8							
Family : Tubificidae																								
Phylum: Nematoda			36	48	4	16	112	3		5	4	16		64	2	48	72	7	67	13	27		3	
Order: Tricladida																								
Polycelis coronata																								
Class: Turbellaria																								
Class: Mollusca																								
Order: Bivalvia																								

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2008 K&S	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2008 AS	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess
	New Sample Code:	**BUCK**	**X2aA**	**X2bA**	**X2cA**	**X2dA**	**X2eA**	**R2aA**	**R2bA**	**R2cA**	**R2dA**	**R2eA**	**R7aA**	**R7bA**	**R7cA**	**R7dA**	**R7eA**	**VRH7**	**USFRH7**	**NECH7**	**V1aH**	**V1bH**	**V1cH**	**V1dH**
	Original Sample ID:	**BUC K&S**	**X-2A**	**X-2B**	**X-2C**	**X-2D**	**X-2E**	**R2-A**	**R2-B**	**R2-C**	**R2-D**	**R2-E**	**R7-A**	**R7-B**	**R7-C**	**R7-D**	**R7-E**	**VR**	**USFR**	**NEC-1**	**V1-01**	**V1-02**	**V1-03**	**V1-04**
Family: Sphaeriidae																								
Pisidium sp.																								
Sphaerium simile																								
Order: Gastropoda									1															
Family: Valvatidae																								
Family : Physidae																								
Physa sp.																								
Family : Planorbidae																								
Class : Arachnida																								
Order : Mesostigmata																								
Order: Prostigmata	deutonymph	5	32	16			40	24	4	3	35	84	64	48	4	48	152			7			27	
Order: Prostigmata UID	adult																8						3	27
Order: Prostigmata	juvenile					16												7						
Family: Hydrozetidae	adult		16				8		2					16	2	16	24							
Family: Torrenticolidae																								
Torrenticola	adult	5																		7				
Family: Linmesiidae																								
Limnesia	adult			8				5	2	4	5				1									
Family: Hygrobatidae																								
Hygrobates	adult		4	8				1		1	5		16		1	32	24			7				27
Family: Hydryphantidae																								
Wandesia	adult																							
Family: Lebertiidae																								
Lebertia	adult		4	8		12	72	4	2		35	16	16		5	16	16		13	13				
Family: Aturidae																								
Aturus	adult	5	40	8	20	20	64	13	2	4	30	24	104	64	30	80	120		40	13			80	
Family: Feltriidae																								
Feltria	adult			32	24		32	12	5	1	40	64	96	96	5	208	32					53		
Family: Sperchontidae																								
Sperchon	adult		4	16	8			21	2		15	36	128	32	13	48	64		47	13			30	27
Sperchonopsis sp.	adult																							
Family : Mideopsidae																								
Mideopsis sp.	adult																							
Hydra sp.																								
Order: Hirudinea																								
Family: Piscicolidae										5														
TOTAL SUBSAMPLE		**1865**	**3780**	**4304**	**1352**	**1608**	**9568**	**783**	**304**	**442**	**2094**	**2600**	**5768**	**6400**	**491**	**9648**	**4072**	**2090**	**3100**	**1614**	**8936**	**4672**	**4648**	**4938**

juv. = juvenile, dam. = damaged

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 Hess	2007 AS	2007 AS	2007 AS	2007 AS	2007 AS	2007 AS	2007 AS	2007 AS	2007 AS	2007 AS
	New Sample Code:	V1eH	V27aH	V27bH	V27cH	V27dH	V27eH	V5aH	V5bH	V5cH	V5dH	V5eH	V8aH	V8bH	V8cH	V8dH	V8eH	V1aA	V1bA	V1cA	V1dA	V1eA	V5aA	V5bA	V5cA	V5dA	V5eA
	Original Sample ID:	V1-05	V27-01	V27-02	V27-03	V27-04	V27-05	V5-01	V5-02	V5-03	V5-04	V5-05	V8-01	V8-02	V8-03	V8-04	V8-05	V1-A	V1-B	V1-C	V1-D	V1-E	V5-A	V5-B	V5-C	V5-D	V5-E
Order: Ephemeroptera	nymph (juv./dam.)																										
Order: Ephemeroptera	adult																										
Family: Ameletidae																											
Ameletus sp.	nymph	27	93	27	13	60	83						13						22		3			2			
Family: Baetidae	nymph (juv./dam.)																										
Baetis sp.	nymph	200	800	800	493	693	1040	13	7	20	60	7	93		80	80	53	8		16	25	368		24		4	32
Baetis bicaudatus	nymph					17		3										1	1								
Baetis tricaudatus	nymph																										
Acentrella sp.	nymph																7										
Fallceon sp.	nymph																										
Family: Heptageniidae	nymph (juv./dam.)	1903	3227	3453	1507	2880	2267	23	23	37	33	27	280	147	173	187	173	16	18	24	56	32	8	64	16	4	16
Rhithrogena sp.	nymph	20	13	53	93	17	20	3	3	3			27	13	13		13	9	3	6	4	4					
Cinygmula sp.	nymph	37	13	13			7				3						13		8		2		2				
Epeorus sp.	nymph	117	67	80	13	73	90	10	47	47	37	113	27	13		27	27	20	3	19	9	45	6	8	2	21	7
Family: Leptophlebiidae	nymph (juv./dam.)																										
Family: Ephemerellidae	nymph (juv./dam.)	123		67	13		53							27					1		4		24				
Drunella sp.	nymph																										
Drunella spinifera	nymph																										
Drunella grandis	nymph																										
Serratella sp.	nymph																										
Ephemerella sp.	nymph																										
Drunella coloradensis	nymph	10																1	2		2						
Drunella doddsi	nymph		27	13		10	80						27		13		13	1									
Serratella tibialis	nymph																										
Order: Plecoptera	nymph (juv./dam.)	7	400					113	33	53	73	53	520	560	453	267	120	6		112	52	40	184	216	272	36	416
Order: Plecoptera	adult																										
Family: Chloroperlidae	nymph (juv./dam.)	7		80	160	227	10		23	10	20	10	13	27	13											2	32
Sweltsa sp.	nymph	93	40			57	17		7			7			13	27	7	1	1								
Suwallia sp.	nymph	133	93	173	147	17	147	3	47	47	27	43		13	67									6			
Alloperla fraterna	nymph		93	67		53	3						13		27					4							
Paraperla sp.	nymph																										
Family: Perlodidae	nymph																			4						2	
Isoperla sp.	nymph																										
Megarcys sp.	nymph	3				3			10	3	3									5	4	4			1	1	1
Skwala sp.	nymph												13														
Kogotus sp.	nymph																										
Rickera sp.	nymph																										
Cultus sp.	nymph																										
Family: Perlidae	nymph																										
Hesperoperla sp.	nymph																										
Family: Nemouridae	nymph (juv./dam.)																										
Podmosta sp.	nymph																										
Zapada sp.	nymph	297	720	1013	200	910	1133		17		13	3	13	13	187	240	60	15				153	412	124			
Zapada oregonensis/haysi	nymph	120	40	67	13	17	37	17	20	17	20	20	53			27	47	12	3	68	45	54	90	146	107	27	87
Zapada columbiana	nymph	37	53	27	13	33	60	3	3		3		13			27	13	7		11	9	55	4	14	43	5	6
Zapada cinctipes	nymph							7	3		7		40	80		27	7					2	6		4		
Visoka sp.																											
Family: Capniidae	nymph (juv./dam.)	623	907	853	680	680	677	127	97	167	270	87	493	480	400	187	233	3	4	8	16	24	98	218	104	8	176
Family: Leuctridae	nymph (juv./dam.)	20	293	173	40	77	40		37		7	10	13	53	293	53	20							8			
Family: Taeniopterygidae	nymph (juv./dam.)																										
Taenionema sp.	nymph																87	1			4	16	2	8	32	12	5
Order: Trichoptera	adult						3																				
Order: Trichoptera	larvae (dam./juv.)	13	240		133	240	27	60	10	27	73	10	27	13	13		27	11									
Order: Trichoptera	pupae									3																	
Family: Hydropsychidae	larvae (juv./dam.)		107	93		27	137	20	7		27	13	27	13	27		33			8	16	9	56	34	16	10	80
Parapsyche sp.	larvae	20	40	13		3	47		3		7	7		13		27	7	1		8	4	8		16	8	3	10
Arctopsyche sp.	larvae																										
Hydropsyche sp.	larvae	3																									
Family: Rhyacophilidae																											
Rhyacophila sp.	larvae	30	133	120	80	50	97	73	40	57	57	57	93	93	133	187	93	2		4	3	19	176	152	177	36	339

Table D.1: Raw Benthic Data (#/m² for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
		Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS
	New Sample Code:	**V1eH**	**V27aH**	**V27bH**	**V27cH**	**V27dH**	**V27eH**	**V5aH**	**V5bH**	**V5cH**	**V5dH**	**V5eH**	**V8aH**	**V8bH**	**V8cH**	**V8dH**	**V8eH**	**V1aA**	**V1bA**	**V1cA**	**V1dA**	**V1eA**	**V5aA**	**V5bA**	**V5cA**	**V5dA**	**V5eA**
	Original Sample ID:	**V1-05**	**V27-01**	**V27-02**	**V27-03**	**V27-04**	**V27-05**	**V5-01**	**V5-02**	**V5-03**	**V5-04**	**V5-05**	**V8-01**	**V8-02**	**V8-03**	**V8-04**	**V8-05**	**V1-A**	**V1-B**	**V1-C**	**V1-D**	**V1-E**	**V5-A**	**V5-B**	**V5-C**	**V5-D**	**V5-E**
Family: Philopodamidae																											
Wormaldia sp.	larvae																										
Family: Glossosomatidae																											
Glossosoma sp.	larvae	107	640	667	160	483	827	10	23	53	77	27	27					3	2	4							
Family: Uenoidae	larvae (juv./dam.)																										
Oligophlebodes sp.	larvae																									2	
Family: Hydroptilidae	pupae																										
Hydroptila sp.	larvae												13	27	40	187	7										
Stactobiella sp.	larvae																										
Oxyethira sp.	larvae																										
Family: Brachycentridae																											
Micrasema sp.	larvae																										
Brachycentrus sp.	larvae																										
Family: Lepidostomatidae																											
Lepidostoma sp.	larvae																										
Family: Limnephilidae	larvae (juv./dam.)	27		147			133	13	7				27				20					2	8				
Ecclisomyia sp.	larvae							3						40	27									2			
Dicosmoecus sp.	larvae																										
Order: Coleoptera	larvae (juv./dam.)																			1							
Family: Dytiscidae	larvae					3																					
Family: Elmidae	adult																										
Order: Diptera UID	larvae																										
Order: Diptera UID	pupae																										
Order: Diptera UID A	larvae								3																		
Order: Diptera UID B	larvae									3	13																
Order: Diptera	pupae																					8					
Order: Diptera	adult						30	3	10	23	47	7				27	7										
Order: Diptera	larvae			13								7		13			13							4			
Family: Tipulidae	larvae (dam./juv.)																										
Antocha sp.	larvae																										
Dicranota sp.	larvae	17				3	27	10			7	7		27		27	7								24	2	2
Hexatoma sp.	larvae																										
Limnophila sp.	larvae																										2
Rhabdomastix sp.	larvae											3		13													
Hesperoconopa sp.	larvae						27				20							1									
Gonomyodes sp.	larvae							13			3	13															
Tipula sp.	larvae																								1		
Family: Ceratopogonidae																											
Bezzia/Palpomyia sp.	larvae																										
Family: Psychodidae	larvae																										
Family: Psychodidae UID	larvae																										
Pericoma sp.	larvae																										
Family: Deuterophlebiidae	pupae																										
Deuterophlebia sp.	larvae																										
Family: Blephariceridae																											
Agathon sp.	larvae																										
Family: Empididae	larvae (dam.)																	0				8					
Chelifera/Metachela sp.	larvae		67	53		7	3	30	10	3	3	3	53	13	107	160	60						8		16		32
Oreogeton sp.	larvae	3	1440	1573	533	1003	923	3		3			13		67		7										
Clinocera sp.	larvae									7																	
Family: Simuliidae	pupae	7				7	53	7	3	3		27	40					0				1	6	14			3
Simulium sp.	larvae																			8		27	96		8	4	1
Prosimulium sp.	larvae					27																	24	48			64
Family: Chironomidae	larvae																										
Family: Chironomidae	pupa					320	53		20	13	40	33						7	3	28	20	72	70	32			
Subfamily : Chironominae	larvae																										
Tribe : Tanytarsini	larvae																										
Cladotanytarsus sp.	larvae																										
Micropsectra/Tanytarsus sp.	larvae		13		53																						
Neostempellina sp.	larvae																										

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
		Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS
	New Sample Code:	**V1eH**	**V27aH**	**V27bH**	**V27cH**	**V27dH**	**V27eH**	**V5aH**	**V5bH**	**V5cH**	**V5dH**	**V5eH**	**V8aH**	**V8bH**	**V8cH**	**V8dH**	**V8eH**	**V1aA**	**V1bA**	**V1cA**	**V1dA**	**V1eA**	**V5aA**	**V5bA**	**V5cA**	**V5dA**	**V5eA**
	Original Sample ID:	**V1-05**	**V27-01**	**V27-02**	**V27-03**	**V27-04**	**V27-05**	**V5-01**	**V5-02**	**V5-03**	**V5-04**	**V5-05**	**V8-01**	**V8-02**	**V8-03**	**V8-04**	**V8-05**	**V1-A**	**V1-B**	**V1-C**	**V1-D**	**V1-E**	**V5-A**	**V5-B**	**V5-C**	**V5-D**	**V5-E**
Pseudochironomus sp.	larvae																										
Rheotanytarsus sp.	larvae																										
Stempellinella sp.	larvae																										
Stempellina sp	larvae																										
Tanytarsus sp.	larvae			27			30																				
Subfamily: Orthocladiinae	larvae	333		493	120	160	303	73				37			80			6			52	94	144				
Acricotopus sp.	larvae						27																				
Brillia sp.	larvae			13			113											2		28	27	29	184	56	35	2	
Cardiocladius sp.	larvae																										
Chaetocladius sp.	larvae	13	67	13			3		3								120				67				236	8	241
Corynoneura sp.	larvae												13						1								
Cricotopus/Orthocladius sp.	larvae																										
Cricotopus/Orthocladius sp. A	larvae	1467	187	160	40	33	7	670	297	163	333	243	5000	4067	2533	5387	880	17	6	66	29	128	320	138	72	6	32
Cricotopus/Orthocladius sp. B	larvae														387												
Diplocladius sp.	larvae																										
Eukiefferiella sp.	larvae	463	13	80				153	43	20	47	127	427	80			13	7	3	32	4	56	248		24	14	82
Heleniella sp.	larvae																										
Hydrobaenus sp.	larvae																										
Nanocladius	larvae																										
Parorthocladius sp.	larvae			13																							
Rheocricotopus sp.	larvae																										
Synorthocladius sp.	larvae					27									67	27								48			
Thienemanniella sp.	larvae																										
Tvetenia sp.	larvae			93		80	133					47											8				
Subfamily: Diamesinae	larvae																										
Diamesa sp.	larvae							67	30	17	57	33						1			4						
Pagastia sp.	larvae	113						17	13	7	40	7	40							5	6	32		82			
Pseudodiamesa sp.	larvae																			1							
Potthastia longimana group	larvae																										
Prodiamesa sp.	larvae																										
Subfamily: Tanypodinae	larvae																										
Thienemannimyia Group	larvae					27	3								13												
Procladius sp.	larvae																										
Family: Syriphidae	larvae							7																			
Family: Psychodidae																											
Pericoma sp.	larvae		13				7	20		7	10	3				27	7			8		8	10	26	136	6	176
Family : Stratiomyiidae	larvae																							2	1		1
Order: Lepidoptera	larvae																										1
Order: Hemiptera					13					3																	
Family: Corixidae	larvae																										
Order: Collembola	larvae							7	3	7	7	10													16		
Order : Thysanoptera (terr)																										2	
Class: Crustacea																											
Order: Ostracoda																											
Order: Cladocera																											
Order: Copepoda																											
Phylum: Annelida																											
Class: Oligochaeta						3		193	23	7	273	127					7	0					24				
Family: Naididae																									2		
Family : Tubificidae																											
Phylum: Nematoda		3	40	13			30		7	3	10	10	227	67	120	187	33	0									
Order: Tricladida																											
Polycelis coronata																											
Class: Turbellaria													13	27													
Class: Mollusca																											
Order: Bivalvia																											

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
		Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS
	New Sample Code:	**V1eH**	**V27aH**	**V27bH**	**V27cH**	**V27dH**	**V27eH**	**V5aH**	**V5bH**	**V5cH**	**V5dH**	**V5eH**	**V8aH**	**V8bH**	**V8cH**	**V8dH**	**V8eH**	**V1aA**	**V1bA**	**V1cA**	**V1dA**	**V1eA**	**V5aA**	**V5bA**	**V5cA**	**V5dA**	**V5eA**
	Original Sample ID:	**V1-05**	**V27-01**	**V27-02**	**V27-03**	**V27-04**	**V27-05**	**V5-01**	**V5-02**	**V5-03**	**V5-04**	**V5-05**	**V8-01**	**V8-02**	**V8-03**	**V8-04**	**V8-05**	**V1-A**	**V1-B**	**V1-C**	**V1-D**	**V1-E**	**V5-A**	**V5-B**	**V5-C**	**V5-D**	**V5-E**
Family: Sphaeriidae																											
Pisidium sp.																											
Sphaerium simile																											
Order: Gastropoda											7																
Family: Valvatidae																											
Family : Physidae																											
Physa sp.																											
Family : Planorbidae																											
Class : Arachnida																											1
Order : Mesostigmata																									24		
Order: Prostigmata	deutonymph		13				80	7								27	7										
Order: Prostigmata UID	adult														13		13										
Order: Prostigmata	juvenile													13													
Family: Hydrozetidae	adult																	1									
Family: Torrenticolidae																											
Torrenticola	adult												80														
Family: Linmesiidae																											
Limnesia	adult																										
Family: Hygrobatidae																											
Hygrobates	adult	40												13				1		8							
Family: Hydryphantidae																											
Wandesia	adult						27																				
Family: Lebertiidae																											
Lebertia	adult	13	13										13		13												
Family: Aturidae																											
Aturus	adult		67	13		107	107	13				13	53	227	120	107	53	1									
Family: Feltriidae																											
Feltria	adult	93					27	40	27	43					13	53				4			56	40	24	6	32
Family: Sperchontidae																											
Sperchon	adult	40	13	13	13	30	27	27	7	3	17		160	67	120	80	33	4		4		8				2	
Sperchonopsis sp.	adult																										
Family : Mideopsidae																											
Mideopsis sp.	adult																										
Hydra sp.																											
Order: Hirudinea																											
Family: Piscicolidae																											
TOTAL SUBSAMPLE		**6582**	**9985**	**10569**	**4530**	**8464**	**9075**	**1861**	**966**	**879**	**1751**	**1251**	**7984**	**6238**	**5652**	**7659**	**2340**	**166**	**81**	**494**	**467**	**1306**	**2274**	**1532**	**1401**	**225**	**1877**

juv. = juvenile, dam. = damaged

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
		AS	AS	AS	AS	AS	AS	AS	AS	AS	AS
	New Sample Code:	V27aA	V27bA	V27cA	V27eA	V27dA	V8aA	V8bA	V8cA	V8eA	V8dA
	Original Sample ID:	**V27-A**	**V27-B**	**V27-C**	**V27-E**	**V27-D**	**V8-A**	**V8-B**	**V8-C**	**V8-E**	**V8-D**
Order: Ephemeroptera	nymph (juv./dam.)										
Order: Ephemeroptera	adult										
Family: Ameletidae											
Ameletus sp.	nymph			1	4				1	4	
Family: Baetidae	nymph (juv./dam.)										
Baetis sp.	nymph	24	36	41	9	370	2	16	7	96	18
Baetis bicaudatus	nymph										
Baetis tricaudatus	nymph										
Acentrella sp.	nymph										
Fallceon sp.	nymph										
Family: Heptageniidae	nymph (juv./dam.)	50	56	62	5	130	10	10	10	50	42
Rhithrogena sp.	nymph	69	6	4	1	3	15	9	6	6	
Cinygmula sp.	nymph	43	53	34	2	2	10	3	7		
Epeorus sp.	nymph	64	20	3		14	12	16	27	6	2
Family: Leptophlebiidae	nymph (juv./dam.)										
Family: Ephemerellidae	nymph (juv./dam.)										
Drunella sp.	nymph										
Drunella spinifera	nymph							1			
Drunella grandis	nymph										
Serratella sp.	nymph										
Ephemerella sp.	nymph										
Drunella coloradensis	nymph										
Drunella doddsi	nymph	2	9	3	1			2	5	4	
Serratella tibialis	nymph	1						1	1		
Order: Plecoptera	nymph (juv./dam.)	75	22	5	1	65		75	87	286	272
Order: Plecoptera	adult										
Family: Chloroperlidae	nymph (juv./dam.)		1								
Sweltsa sp.	nymph	4		1	1		1				
Suwallia sp.	nymph										
Alloperla fraterna	nymph								1		
Paraperla sp.	nymph										
Family: Perlodidae	nymph								2	8	
Isoperla sp.	nymph										
Megarcys sp.	nymph	3	2	1		3		3			
Skwala sp.	nymph										
Kogotus sp.	nymph										
Rickera sp.	nymph										
Cultus sp.	nymph										
Family: Perlidae	nymph										
Hesperoperla sp.	nymph										
Family: Nemouridae	nymph (juv./dam.)										
Podmosta sp.	nymph										
Zapada sp.	nymph	102			40	322	10	25	5	230	128
Zapada oregonensis/haysi	nymph	299	26	41	19	69	40	148	93	184	98
Zapada columbiana	nymph	12	2	5	10	20	6	16	11	48	14
Zapada cinctipes	nymph				1					70	42
Visoka sp.											
Family: Capniidae	nymph (juv./dam.)	22	7	4	2		2	14	29	78	56
Family: Leuctridae	nymph (juv./dam.)										
Family: Taeniopterygidae	nymph (juv./dam.)										
Taenionema sp.	nymph	148	7	4			27	40	97		
Order: Trichoptera	adult										
Order: Trichoptera	larvae (dam./juv.)	1		2	7	40		1			
Order: Trichoptera	pupae										
Family: Hydropsychidae	larvae (juv./dam.)	99	30	17	18	41	13	47	60	222	90
Parapsyche sp.	larvae	25	8	1	3	5	3	13	7	10	6
Arctopsyche sp.	larvae										
Hydropsyche sp.	larvae										
Family: Rhyacophilidae											
Rhyacophila sp.	larvae	134	30	10	10	34	22	46	34	114	50

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
		AS	AS	AS	AS	AS	AS	AS	AS	AS	AS
	New Sample Code:	**V27aA**	**V27bA**	**V27cA**	**V27eA**	**V27dA**	**V8aA**	**V8bA**	**V8cA**	**V8eA**	**V8dA**
	Original Sample ID:	**V27-A**	**V27-B**	**V27-C**	**V27-E**	**V27-D**	**V8-A**	**V8-B**	**V8-C**	**V8-E**	**V8-D**
Family: Philopodamidae											
Wormaldia sp.	larvae										
Family: Glossosomatidae											
Glossosoma sp.	larvae	5	63	29	12	24				4	
Family: Uenoidae	larvae (juv./dam.)										
Oligophlebodes sp.	larvae		10	2					3		
Family: Hydroptilidae	pupae										
Hydroptila sp.	larvae								1		8
Stactobiella sp.	larvae										
Oxyethira sp.	larvae										
Family: Brachycentridae											
Micrasema sp.	larvae										
Brachycentrus sp.	larvae										
Family: Lepidostomatidae											
Lepidostoma sp.	larvae										
Family: Limnephilidae	larvae (juv./dam.)				4				1		
Ecclisomyia sp.	larvae	4									
Dicosmoecus sp.	larvae										
Order: Coleoptera	larvae (juv./dam.)										
Family: Dytiscidae	larvae										
Family: Elmidae	adult										
Order: Diptera UID	larvae										
Order: Diptera UID	pupae										
Order: Diptera UID A	larvae										
Order: Diptera UID B	larvae										
Order: Diptera	pupae										
Order: Diptera	adult	1						1	2		
Order: Diptera	larvae	1						1			
Family: Tipulidae	larvae (dam./juv.)										
Antocha sp.	larvae										
Dicranota sp.	larvae	1						1			8
Hexatoma sp.	larvae										
Limnophila sp.	larvae										
Rhabdomastix sp.	larvae										
Hesperoconopa sp.	larvae										
Gonomyodes sp.	larvae										
Tipula sp.	larvae										
Family: Ceratopogonidae											
Bezzia/Palpomyia sp.	larvae										
Family: Psychodidae	larvae										
Family: Psychodidae UID	larvae										
Pericoma sp.	larvae										
Family: Deuterophlebiidae	pupae										
Deuterophlebia sp.	larvae										
Family: Blephariceridae											
Agathon sp.	larvae										
Family: Empididae	larvae (dam.)										
Chelifera/Metachela sp.	larvae	2						2		4	16
Oreogeton sp.	larvae		4	2	4	18					
Clinocera sp.	larvae					8					
Family: Simuliidae	pupae	4			1			4		2	2
Simulium sp.	larvae	29	6	7			4	13	12	4	2
Prosimulium sp.	larvae		2		5	137			5	28	16
Family: Chironomidae	larvae										
Family: Chironomidae	pupa				3	36	3	14	6	12	32
Subfamily : Chironominae	larvae										
Tribe : Tanytarsini	larvae										
Cladotanytarsus sp.	larvae										
Micropsectra/Tanytarsus sp.	larvae										
Neostempellina sp.	larvae										

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
		AS	AS	AS	AS	AS	AS	AS	AS	AS	AS
	New Sample Code:	**V27aA**	**V27bA**	**V27cA**	**V27eA**	**V27dA**	**V8aA**	**V8bA**	**V8cA**	**V8eA**	**V8dA**
	Original Sample ID:	**V27-A**	**V27-B**	**V27-C**	**V27-E**	**V27-D**	**V8-A**	**V8-B**	**V8-C**	**V8-E**	**V8-D**
Pseudochironomus sp.	larvae										
Rheotanytarsus sp.	larvae										
Stempellinella sp.	larvae										
Stempellina sp	larvae										
Tanytarsus sp.	larvae									2	
Subfamily: Orthocladiinae	larvae										
Acricotopus sp.	larvae										
Brillia sp.	larvae	2	1	3	9	64		42	19	60	110
Cardiocladius sp.	larvae										
Chaetocladius sp.	larvae		3				28	167	288	310	152
Corynoneura sp.	larvae										2
Cricotopus/Orthocladius sp.	larvae										
Cricotopus/Orthocladius sp. A	larvae	2	1	29	14		9	45	32	112	272
Cricotopus/Orthocladius sp. B	larvae										
Diplocladius sp.	larvae										
Eukiefferiella sp.	larvae	7	6	21	8	224		10	6		136
Heleniella sp.	larvae										
Hydrobaenus sp.	larvae										
Nanocladius	larvae										
Parorthocladius sp.	larvae										
Rheocricotopus sp.	larvae										
Synorthocladius sp.	larvae										
Thienemanniella sp.	larvae										
Tvetenia sp.	larvae				8						
Subfamily: Diamesinae	larvae										
Diamesa sp.	larvae										
Pagastia sp.	larvae			2	1	48					70
Pseudodiamesa sp.	larvae										
Potthastia longimana group	larvae										
Prodiamesa sp.	larvae										
Subfamily: Tanypodinae	larvae										
Thienemannimyia Group	larvae										
Procladius sp.	larvae										
Family: Syriphidae	larvae										
Family: Psychodidae											
Pericoma sp.	larvae	2						2	1	4	
Family : Stratiomyiidae	larvae										
Order: Lepidoptera	larvae					1					
Order: Hemiptera											
Family: Corixidae	larvae										
Order: Collembola	larvae	3						3			
Order : Thysanoptera (terr)											
Class: Crustacea											
Order: Ostracoda		1						1			
Order: Cladocera											
Order: Copepoda											
Phylum: Annelida											
Class: Oligochaeta						8					
Family: Naididae											
Family : Tubificidae									1		
Phylum: Nematoda											
Order: Tricladida											
Polycelis coronata											
Class: Turbellaria											
Class: Mollusca											
Order: Bivalvia											

Table D.1: Raw Benthic Data (#/m^2 for Hess; #/3-min kick for K S; #/substrate for AS), combined data 2007 and 2008.

		2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
		AS	AS	AS	AS	AS	AS	AS	AS	AS	AS
	New Sample Code:	**V27aA**	**V27bA**	**V27cA**	**V27eA**	**V27dA**	**V8aA**	**V8bA**	**V8cA**	**V8eA**	**V8dA**
	Original Sample ID:	**V27-A**	**V27-B**	**V27-C**	**V27-E**	**V27-D**	**V8-A**	**V8-B**	**V8-C**	**V8-E**	**V8-D**
Family: Sphaeriidae											
Pisidium sp.											
Sphaerium simile											
Order: Gastropoda											
Family: Valvatidae											
Family : Physidae											
Physa sp.											
Family : Planorbidae											
Class : Arachnida											
Order : Mesostigmata											
Order: Prostigmata	deutonymph										
Order: Prostigmata UID	adult										
Order: Prostigmata	juvenile										
Family: Hydrozetidae	adult										
Family: Torrenticolidae											
Torrenticola	adult										
Family: Linmesiidae											
Limnesia	adult										
Family: Hygrobatidae											
Hygrobates	adult										
Family: Hydryphantidae											
Wandesia	adult										
Family: Lebertiidae											
Lebertia	adult			1							
Family: Aturidae											
Aturus	adult	36				8	9	24	11	16	56
Family: Feltriidae											
Feltria	adult										
Family: Sperchontidae											
Sperchon	adult	3			3			3	7	4	8
Sperchonopsis sp.	adult										
Family : Mideopsidae											
Mideopsis sp.	adult										
Hydra sp.											
Order: Hirudinea											
Family: Piscicolidae											
TOTAL SUBSAMPLE		**1280**	**411**	**335**	**206**	**1694**	**226**	**819**	**885**	**1978**	**1708**

juv. = juvenile, dam. = damaged

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	Hess	K&S	Hess	K&S	Hess	K&S	Hess	K&S	Hess	Hess	Hess	K&S	Hess
	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
SAMPLE TYPE	reference	reference	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	reference	reference	reference
SAMPLE CODE	VRH8	VRK	X2aH	X2aK	X2aH	X2bK	X2cH	X2cK	X2dH	X2eH	USFRH8	USFRK	NECH8
Ameletidae	0.00	0.00	6.67	1.00	0.00	0.00	13.33	0.00	26.67	87.00	53.33	10.00	17.33
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	76.67	83.00	33.33	37.00	20.00	28.00	80.00	24.00	13.33	0.00	26.67	28.00	243.33
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	110.00	23.00	286.67	130.00	120.00	4.00	53.33	8.00	66.67	60.00	300.00	224.00	80.00
Leptophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	182.00
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	80.00	22.00	186.67	85.00	80.00	28.00	253.33	32.00	40.00	53.00	773.33	322.00	69.33
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	41.01	29.27	26.67	8.12	28.75	0.00	0.00	0.00	0.00	33.00	33.33	8.00	192.00
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	6.84	7.32	6.67	1.01	0.00	4.00	13.59	8.33	0.00	7.00	26.67	5.00	0.00
Perlidae (includes Hesperoperla ID'd)	0.00	1.05	6.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	102.53	27.18	553.33	53.79	265.94	56.00	584.58	141.67	266.67	47.00	2226.67	764.00	286.00
Capniidae	389.62	119.18	186.67	202.97	165.31	64.00	81.57	50.00	26.67	187.00	33.33	8.00	53.33
Leuctridae	0.00	0.00	0.00	1.01	0.00	0.00	0.00	0.00	0.00	0.00	46.67	9.00	0.00
Taeniopterygidae (includes Taenionema sp. ID'd)	0.00	0.00	40.00	6.09	0.00	4.00	13.59	0.00	0.00	0.00	0.00	8.00	0.00
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	0.00	0.00	20.00	2.08	0.00	0.00	0.00	8.00	13.33	0.00	13.33	39.00	0.00
Rhyacophila sp.	0.00	0.00	46.67	10.40	60.00	16.00	13.33	8.00	0.00	7.00	13.33	6.00	60.67
Wormaldia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glossosoma sp.	0.00	0.00	66.67	13.52	6.67	12.00	0.00	0.00	0.00	13.00	26.67	36.00	0.00
Uenoidae (includes Oligophlebodes sp. ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydroptilidae (includes Hydroptila sp., Oxyethira sp., Stactobiella sp., Hydroptila pupae)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Micrasema sp.	0.00	0.00	6.67	0.00	26.67	0.00	26.67	16.00	0.00	0.00	0.00	0.00	0.00
Brachycentrus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidostoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	0.00	1.00	6.67	0.00	13.33	0.00	0.00	0.00	0.00	7.00	0.00	0.00	8.67
Coleoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dytiscidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Antocha sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.67
Dicranota sp.	3.33	0.00	6.67	1.00	0.00	0.00	53.33	0.00	13.33	13.33	13.33	0.00	0.00
Hexatoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnophila sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rhabdomastix sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hesperoconopa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gonomyodes sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tipula sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bezzia/Palpomyia sp.	0.00	0.00	6.67	9.00	46.67	8.00	40.00	64.00	13.33	13.00	0.00	0.00	8.67
Psychodidae	0.00	0.00	0.00	1.00	6.67	0.00	0.00	0.00	0.00	7.00	0.00	0.00	0.00
Deuterophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agathon sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	10.00	1.00	26.67	19.00	53.33	0.00	26.67	24.00	0.00	7.00	13.33	8.00	0.00
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	96.67	86.00	373.33	12.00	106.67	60.00	480.00	8.00	0.00	40.00	0.00	8.00	26.00
Tanytarsini (Tribe)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cladotanytarsus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Neostempellina sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pseudochironomus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheotanytarsus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	873.33	138.00	0.00
Stempellinella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	280.00	92.00	0.00
Stempellina sp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brillia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cardiocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaetocladius sp.	23.71	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Corynoneura sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	433.33
Cricotopus/Orthocladius sp.	0.00	5.00	3126.67	421.00	6573.33	660.00	7040.00	1832.00	3266.67	1487.00	833.33	52.00	0.00
Diplocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	137.88
Eukiefferiella sp.	81.29	15.00	673.33	80.00	960.00	132.00	1773.33	312.00	666.67	233.00	200.00	0.00	0.00
Heleniella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrobaenus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parorthocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheocricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	120.00	28.00	0.00
Synorthocladius sp.	0.00	1.00	0.00	12.00	166.67	0.00	120.00	0.00	0.00	60.00	0.00	0.00	0.00
Thienemanniella sp.	0.00	0.00	20.00	25.00	813.33	76.00	440.00	152.00	0.00	20.00	0.00	0.00	0.00
Tvetenia sp.	105.00	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	146.67	8.00	0.00
Diamesa sp.	26.67	21.00	126.67	40.00	233.33	88.00	360.00	0.00	0.00	0.00	0.00	0.00	295.45
Pagastia sp.	3.33	0.00	293.33	48.00	1506.67	132.00	493.33	232.00	2213.33	533.00	0.00	0.00	0.00
Pseudodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potthastia longimana group	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prodiamesa sp.	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tanypodinae	0.00	0.00	33.33	16.00	173.33	32.00	213.33	32.00	146.67	107.00	80.00	0.00	0.00
Syrphidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stratiomyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	Hess	K&S	Hess	K&S	Hess	K&S	Hess	K&S	Hess	Hess	Hess	K&S	Hess
	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
SAMPLE TYPE	reference	reference	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	reference	reference	reference
SAMPLE CODE	VRH8	VRK	X2aH	X2aK	X2aH	X2bK	X2cH	X2cK	X2dH	X2eH	USFRH8	USFRK	NECH8
Hemiptera (includes Corixidae ID'd)	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.33
Collembola	3.33	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	53.33	0.00	0.00
Ostracoda	0.00	1.00	6.67	6.00	66.67	8.00	133.33	16.00	0.00	60.00	26.67	0.00	0.00
Cladocera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	0.00	0.00	0.00
Copepoda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00
Oligochaeta	506.67	41.00	433.33	17.00	93.33	8.00	720.00	32.00	0.00	813.00	160.00	16.00	0.00
Nematoda	3.33	0.00	40.00	9.00	80.00	12.00	266.67	24.00	26.67	120.00	440.00	52.00	0.00
Class Turbellaria (includes triclad Polycelis coronata)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.00
Pisidium sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sphaerium simile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gastropoda (includes Physa [=Physella?], Planorbidae, Valvatidae, and Gastropoda UID)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00
Mesostigmata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	26.67	1.00	380.00	56.00	1026.67	184.00	1666.67	536.00	986.67	207.00	400.00	80.00	34.67
Hydra	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2268.00
Pisicolidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	K&S	Hess	Hess	Hess	Hess	Hess	K&S	K&S	K&S	Hess	K&S	K&S	Hess
	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
SAMPLE TYPE	reference	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	reference	reference	reference	reference
SAMPLE CODE	NECK	R2aH	R2bH	R2cH	R2dH	R2eH	R2aK	R2bK	R2cK	R7H	R7aK	R7bK	FCH
Ameletidae	30.00	0.00	0.00	0.00	13.33	0.00	0.00	0.00	0.00	0.00	4.00	18.60	66.67
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	5.00	346.67	646.67	273.33	293.33	176.67	103.00	100.00	109.00	0.00	4.00	6.50	0.00
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	378.00	100.00	433.33	270.00	313.33	176.67	89.00	94.00	116.00	226.67	34.00	79.20	66.67
Leptophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	144.00	100.00	713.33	530.00	113.33	163.33	44.00	13.00	41.00	213.33	115.00	143.60	80.00
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	44.00	160.00	302.56	146.58	145.06	38.60	34.24	17.82	11.65	210.44	58.27	21.00	99.42
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	0.00	46.67	11.94	47.42	6.91	6.43	5.90	4.45	5.30	7.01	5.20	1.30	0.00
Perlidae (includes Hesperoperla ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	226.00	53.33	350.34	34.49	69.08	186.59	12.99	8.91	27.54	848.78	77.01	140.70	1164.64
Capniidae	61.00	126.67	254.79	400.93	352.29	19.30	42.51	65.70	80.51	652.37	52.03	238.50	0.00
Leuctridae	2.00	0.00	63.70	17.24	0.00	6.43	0.00	0.00	0.00	0.00	4.16	0.00	42.61
Taeniopterygidae (includes Taenionema sp. ID'd)	0.00	0.00	0.00	0.00	0.00	19.30	2.36	1.11	0.00	28.06	8.32	10.60	0.00
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	1.00	0.00	10.00	23.33	0.00	3.33	0.00	0.00	0.00	0.00	1.00	0.00	13.33
Rhyacophila sp.	18.00	6.67	13.33	60.00	0.00	23.33	1.00	0.00	3.00	6.67	2.00	0.00	0.00
Wormaldia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glossosoma sp.	0.00	0.00	0.00	0.00	6.67	0.00	2.00	1.00	0.00	6.67	16.00	0.00	40.00
Uenoidae (includes Oligophlebodes sp. ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydroptilidae (includes Hydroptila sp., Oxyethira sp., Stactobiella sp., Hydroptila pupae)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Micrasema sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brachycentrus sp.	0.00	13.33	0.00	0.00	0.00	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidostoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.67
Coleoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dytiscidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Antocha sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dicranota sp.	4.00	27.00	0.00	0.00	0.00	26.67	3.00	0.00	1.00	53.33	0.00	21.20	120.00
Hexatoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnophila sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00
Rhabdomastix sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hesperoconopa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gonomyodes sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tipula sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bezzia/Palpomyia sp.	4.00	13.33	10.00	80.00	86.67	3.33	1.00	7.00	6.00	0.00	4.00	0.00	0.00
Psychodidae	0.00	0.00	0.00	0.00	6.67	0.00	3.00	1.00	1.00	0.00	12.00	1.30	0.00
Deuterophlebiidae	0.00	6.67	0.00	56.67	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
Agathon sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	4.00	20.00	3.33	30.00	13.33	73.33	4.00	6.00	8.00	153.33	28.00	9.30	0.00
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	5.00	106.67	710.00	406.67	33.33	160.00	6.00	5.00	15.00	33.33	0.00	15.80	26.67
Tanytarsini (Tribe)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cladotanytarsus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Neostempellina sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pseudochironomus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheotanytarsus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stempellinella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00
Stempellina sp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00
Acricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brillia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cardiocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaetocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Corynoneura sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cricotopus/Orthocladius sp.	107.00	1173.33	800.00	386.67	1620.00	325.00	52.00	22.00	57.00	3346.67	361.00	142.80	1026.67
Diplocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00
Eukiefferiella sp.	65.00	0.00	116.67	66.67	13.33	21.67	34.00	8.00	3.00	440.00	2.00	24.00	386.67
Heleniella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrobaenus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parorthocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheocricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Synorthocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	53.33	12.00	17.30	0.00
Thienemanniella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00
Tvetenia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	3.00	7.00	6.00	0.00	0.00	0.00	0.00
Pagastia sp.	49.00	520.00	466.67	620.00	346.67	660.00	29.00	0.00	93.00	613.33	172.00	227.80	2173.33
Pseudodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potthastia longimana group	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tanypodinae	0.00	0.00	190.00	13.33	93.33	180.00	0.00	19.00	7.00	0.00	0.00	0.00	0.00
Syrphidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stratiomyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	K&S	Hess	Hess	Hess	Hess	Hess	K&S	K&S	K&S	Hess	K&S	K&S	Hess
	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
SAMPLE TYPE	reference	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	reference	reference	reference	reference
SAMPLE CODE	NECK	R2aH	R2bH	R2cH	R2dH	R2eH	R2aK	R2bK	R2cK	R7H	R7aK	R7bK	FCH
Hemiptera (includes Corixidae ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Collembola	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.67	4.00	0.00	13.33
Ostracoda	0.00	13.33	0.00	0.00	6.67	0.00	0.00	1.00	1.00	13.33	4.00	0.00	13.33
Cladocera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00
Copepoda	0.00	0.00	0.00	0.00	13.33	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00
Oligochaeta	8.00	106.67	0.00	26.67	26.67	0.00	1.00	1.00	7.00	393.33	21.00	24.00	93.33
Nematoda	8.00	126.67	16.67	73.33	46.67	23.33	4.00	1.00	7.00	53.33	20.00	30.50	173.33
Class Turbellaria (includes triclad Polycelis coronata)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pisidium sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sphaerium simile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gastropoda (includes Physa [=Physella?], Planorbidae, Valvatidae, and Gastropoda UID)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mesostigmata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	20.00	106.67	6.67	80.00	246.67	186.67	26.00	9.00	14.00	373.33	172.00	73.30	680.00
Hydra	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pisicolidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	K&S	Hess	Hess	Hess	Hess	Hess	K&S	K&S	K&S	Hess	K&S	Hess	K&S
	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
SAMPLE TYPE	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference
SAMPLE CODE	FCK	BLCaH	BLCbH	BLCcH	BLCdH	BLCeH	BLCaK	BLCbK	BLCcK	STCH	STCK	BECH	BECK
Ameletidae	20.00	0.00	0.00	3.33	0.00	0.00	1.00	5.00	0.00	0.00	0.00	0.00	0.00
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	4.00	6.67	33.33	23.33	13.33	16.67	7.00	11.00	18.60	10.00	0.00	66.67	30.00
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	18.00	126.67	690.00	270.00	266.67	233.33	64.00	118.00	49.80	20.00	4.00	0.00	0.00
Leptophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	36.00	266.67	100.00	86.67	80.00	173.33	9.00	37.00	37.00	6.67	4.00	0.00	0.00
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	14.49	20.00	76.67	73.33	112.94	160.30	4.05	20.96	8.11	13.33	2.20	0.00	0.00
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	2.07	26.67	66.67	40.00	70.59	170.32	2.03	2.10	16.02	6.67	1.10	53.33	0.00
Perlidae (includes Hesperoperla ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	126.26	60.00	80.00	83.33	14.12	80.15	5.06	13.63	29.80	233.33	1.10	580.00	28.00
Capniidae	31.05	393.33	296.67	410.00	268.24	455.87	55.71	189.73	122.04	270.00	6.60	0.00	0.00
Leuctridae	0.00	0.00	0.00	3.33	0.00	10.02	0.00	0.00	0.00	53.33	0.00	0.00	0.00
Taeniopterygidae (includes Taenionema sp. ID'd)	4.14	0.00	43.33	0.00	14.12	0.00	12.15	12.58	17.23	0.00	0.00	0.00	0.00
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	0.00	60.00	0.00	6.67	26.67	34.29	3.33	2.67	0.00	0.00	0.00	6.67	1.00
Rhyacophila sp.	2.00	26.67	86.67	3.33	13.33	47.14	6.67	8.00	6.00	0.00	1.00	0.00	0.00
Wormaldia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.33	2.00
Glossosoma sp.	0.00	0.00	0.00	0.00	0.00	34.29	0.00	0.00	0.00	0.00	0.00	1213.33	100.00
Uenoidae (includes Oligophlebodes sp. ID'd)	0.00	107.00	20.00	13.33	13.00	0.00	0.00	2.67	0.00	0.00	0.00	0.00	0.00
Hydroptilidae (includes Hydroptila sp., Oxyethira sp., Stactobiella sp., Hydroptila pupae)	0.00	53.33	30.00	3.33	13.33	4.29	0.00	0.00	0.00	0.00	0.00	166.67	0.00
Micrasema sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	220.00	0.00
Brachycentrus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	313.33	43.00
Lepidostoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	2.00	0.00	3.33	16.67	13.33	0.00	0.00	2.67	2.00	0.00	0.00	0.00	0.00
Coleoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00
Dytiscidae	0.00	6.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Antocha sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dicranota sp.	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00
Hexatoma sp.	0.00	8.14	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00
Limnophila sp.	0.00	16.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rhabdomastix sp.	0.00	0.00	16.67	0.00	13.33	0.00	0.00	0.00	0.00	6.67	0.00	0.00	0.00
Hesperoconopa sp.	0.00	16.27	0.00	3.33	0.00	26.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gonomyodes sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tipula sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bezzia/Palpomyia sp.	0.00	53.33	0.00	46.67	0.00	6.67	0.00	4.00	0.00	3.33	1.00	0.00	0.00
Psychodidae	0.00	60.00	113.33	16.67	13.33	53.33	3.00	13.00	0.00	0.00	0.00	0.00	0.00
Deuterophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.33	1.00	0.00	0.00
Agathon sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	0.00	13.33	36.67	50.00	40.00	50.00	3.00	3.00	2.00	143.33	0.00	0.00	0.00
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	0.00	0.00	0.00	0.00	13.33	0.00	3.00	3.00	0.00	3.33	0.00	846.67	49.00
Tanytarsini (Tribe)	4.00	0.00	0.00	0.00	66.67	53.33	0.00	0.00	0.00	0.00	0.00	633.33	0.00
Cladotanytarsus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1280.00	51.00
Neostempellina sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pseudochironomus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheotanytarsus sp.	0.00	233.33	0.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	185.00
Stempellinella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stempellina sp	0.00	0.00	0.00	0.00	0.00	133.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brillia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cardiocladius sp.	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaetocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Corynoneura sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cricotopus/Orthocladius sp.	120.00	6406.67	806.67	5480.00	3826.67	3506.67	41.00	371.00	288.80	6126.67	17.00	286.67	363.00
Diplocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eukiefferiella sp.	10.00	0.00	23.33	66.67	93.33	0.00	8.00	8.00	30.20	523.33	19.00	8506.67	89.00
Heleniella sp.	0.00	0.00	0.00	0.00	13.33	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00
Hydrobaenus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parorthocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheocricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Synorthocladius sp.	0.00	0.00	0.00	0.00	0.00	53.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thienemanniella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tvetenia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pagastia sp.	74.00	693.33	0.00	0.00	106.67	26.67	0.00	2.00	18.40	73.33	0.00	0.00	32.00
Pseudodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potthastia longimana group	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.00
Prodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tanypodinae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2020.00	18.00
Syrphidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stratiomyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidoptera	0.00	0.00	0.00	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	K&S	Hess	Hess	Hess	Hess	Hess	K&S	K&S	K&S	Hess	K&S	Hess	K&S
	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
SAMPLE TYPE	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference	reference
SAMPLE CODE	FCK	BLCaH	BLCbH	BLCcH	BLCdH	BLCeH	BLCaK	BLCbK	BLCcK	STCH	STCK	BECH	BECK
Hemiptera (includes Corixidae ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Collembola	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ostracoda	0.00	106.67	13.33	13.33	0.00	0.00	2.00	2.00	0.00	0.00	0.00	1033.33	32.00
Cladocera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Copepoda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	53.33	0.00
Oligochaeta	0.00	186.67	256.67	26.67	26.67	30.00	2.00	2.00	0.00	283.33	12.00	1133.33	85.00
Nematoda	8.00	60.00	40.00	20.00	0.00	26.67	1.00	3.00	8.00	6.67	2.00	46.67	6.00
Class Turbellaria (includes triclad Polycelis coronata)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
Pisidium sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sphaerium simile	0.00	0.00	0.00	0.00	0.00	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gastropoda (includes Physa [=Physella?], Planorbidae, Valvatidae, and Gastropoda UID)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.00
Mesostigmata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	110.00	346.67	20.00	230.00	213.33	270.00	4.00	42.00	4.00	276.67	12.00	753.33	113.00
Hydra	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.00
Pisicolidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	Hess	K&S	Hess	K&S	Hess	K&S	Hess	K&S	AS	AS	AS	AS	AS
	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
SAMPLE TYPE	reference	reference	reference	reference	reference	reference	reference	reference	exposed	exposed	exposed	exposed	exposed
SAMPLE CODE	HOCH	HOCK	GRCH	GRCK	BTTH	BTTK	BUCH	BUCK	X2aA	X2bA	X2cA	X2dA	X2eA
Ameletidae	0.00	0.00	0.00	0.00	0.00	64.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	253.33	32.00	6.67	7.00	1933.33	437.00	260.00	365.00	36.00	48.00	8.00	38.00	144.00
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	30.00	2.00	16.67	2.00	0.00	32.00	330.00	480.00	0.00	40.00	8.00	2.00	16.00
Leptophlebiidae	0.00	0.00	0.00	0.00	133.33	373.00	6.67	0.00	0.00	0.00	0.00	0.00	0.00
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	196.67	8.00	0.00	0.00	0.00	0.00	116.67	85.00	68.00	40.00	4.00	0.00	32.00
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	7.19	0.00	0.00	0.00	133.33	0.00	116.67	20.37	0.00	0.00	0.00	0.00	0.00
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	14.38	0.00	3.33	0.00	0.00	0.00	10.00	5.09	0.00	0.00	0.00	0.00	0.00
Perlidae (includes Hesperoperla ID'd)	0.00	0.00	0.00	0.00	0.00	594.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	208.56	4.31	20.00	9.33	500.00	396.81	230.00	417.59	263.31	429.09	24.00	36.00	329.00
Capniidae	28.77	4.31	16.67	9.33	566.67	0.00	86.67	15.28	8.23	42.91	0.00	4.00	28.20
Leuctridae	0.00	0.00	0.00	0.00	0.00	0.00	33.33	5.09	0.00	0.00	0.00	0.00	0.00
Taeniopterygidae (includes Taenionema sp. ID'd)	197.77	19.38	50.00	9.33	0.00	0.00	96.67	86.57	16.46	0.00	0.00	0.00	18.80
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	143.33	0.00	10.00	0.00	0.00	0.00	130.00	95.00	0.00	0.00	0.00	16.00	0.00
Rhyacophila sp.	3.33	2.00	0.00	0.00	0.00	0.00	3.33	0.00	4.00	0.00	0.00	18.00	16.00
Wormaldia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glossosoma sp.	20.00	0.00	13.33	0.00	0.00	0.00	43.33	20.00	0.00	16.00	0.00	0.00	0.00
Uenoidae (includes Oligophlebodes sp. ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydroptilidae (includes Hydroptila sp., Oxyethira sp., Stactobiella sp., Hydroptila pupae)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Micrasema sp.	0.00	0.00	0.00	0.00	0.00	103.80	0.00	0.00	0.00	0.00	0.00	0.00	8.00
Brachycentrus sp.	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidostoma sp.	0.00	0.00	0.00	0.00	0.00	103.80	6.67	0.00	0.00	0.00	0.00	0.00	0.00
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	0.00	0.00	0.00	0.00	266.67	644.41	0.00	0.00	0.00	24.00	0.00	0.00	0.00
Coleoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dytiscidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Antocha sp.	0.00	0.00	0.00	0.00	2033.33	128.00	43.33	0.00	0.00	0.00	0.00	0.00	0.00
Dicranota sp.	6.67	0.00	0.00	0.00	133.33	96.00	10.00	5.00	0.00	0.00	0.00	0.00	8.00
Hexatoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	3.33	0.00	0.00	0.00	0.00	0.00	0.00
Limnophila sp.	13.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rhabdomastix sp.	0.00	0.00	0.00	0.00	0.00	0.00	3.33	0.00	0.00	0.00	0.00	0.00	0.00
Hesperoconopa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gonomyodes sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tipula sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bezzia/Palpomyia sp.	3.33	0.00	3.33	0.00	0.00	0.00	16.67	0.00	0.00	0.00	0.00	0.00	8.00
Psychodidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	8.00
Deuterophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agathon sp.	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	36.67	1.00	6.67	1.00	1266.67	330.00	6.67	0.00	0.00	16.00	0.00	0.00	0.00
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	33.33	1.00	26.67	2.00	133.33	0.00	53.33	20.00	76.00	88.00	4.00	56.00	224.00
Tanytarsini (Tribe)	0.00	0.00	0.00	0.00	0.00	1120.00	3.33	0.00	0.00	0.00	0.00	0.00	16.00
Cladotanytarsus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Neostempellina sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pseudochironomus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheotanytarsus sp.	0.00	0.00	0.00	0.00	2333.33	0.00	10.00	20.00	0.00	0.00	0.00	0.00	0.00
Stempellinella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stempellina sp	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brillia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cardiocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaetocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Corynoneura sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	13.58
Cricotopus/Orthocladius sp.	260.00	2.00	170.00	2.00	0.00	610.12	165.61	110.00	785.33	1176.00	768.00	319.41	3734.88
Diplocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eukiefferiella sp.	491.11	14.00	150.00	12.00	2076.11	0.00	10.35	25.00	0.00	336.00	40.00	142.59	855.63
Heleniella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrobaenus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parorthocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheocricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Synorthocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thienemanniella sp.	28.89	0.00	0.00	0.00	0.00	0.00	6.90	0.00	31.59	24.00	28.00	0.00	54.33
Tvetenia sp.	0.00	0.00	0.00	0.00	16357.22	8201.88	13.80	0.00	27.08	0.00	0.00	0.00	13.58
Diamesa sp.	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	952.00	448.00	132.00	360.00	720.00
Pagastia sp.	56.67	0.00	0.00	0.00	0.00	0.00	0.00	10.00	700.00	536.00	240.00	212.00	2960.00
Pseudodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potthastia longimana group	0.00	0.00	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tanypodinae	0.00	0.00	0.00	0.00	0.00	533.00	6.67	0.00	0.00	0.00	0.00	0.00	0.00
Syrphidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stratiomyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	Hess	K&S	Hess	K&S	Hess	K&S	Hess	K&S	AS	AS	AS	AS	AS
	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
SAMPLE TYPE	reference	reference	reference	reference	reference	reference	reference	reference	exposed	exposed	exposed	exposed	exposed
SAMPLE CODE	HOCH	HOCK	GRCH	GRCK	BTTH	BTTK	BUCH	BUCK	X2aA	X2bA	X2cA	X2dA	X2eA
Hemiptera (includes Corixidae ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Collembola	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ostracoda	0.00	1.00	0.00	0.00	100.00	0.00	6.67	5.00	0.00	0.00	0.00	0.00	0.00
Cladocera	0.00	0.00	0.00	0.00	133.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Copepoda	0.00	1.00	0.00	0.00	1833.33	384.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oligochaeta	30.00	7.00	3.33	1.00	2733.33	831.00	0.00	10.00	4.00	16.00	4.00	4.00	32.00
Nematoda	0.00	0.00	3.33	2.00	2400.00	245.00	6.67	0.00	36.00	48.00	4.00	16.00	112.00
Class Turbellaria (includes triclad Polycelis coronata)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pisidium sp.	0.00	0.00	0.00	0.00	400.00	0.00	3.33	0.00	0.00	0.00	0.00	0.00	0.00
Sphaerium simile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gastropoda (includes Physa [=Physella?], Planorbidae, Valvatidae, and Gastropoda UID)	0.00	0.00	0.00	0.00	233.33	245.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mesostigmata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	73.33	2.00	3.33	3.00	1766.67	277.00	50.00	15.00	100.00	96.00	52.00	48.00	216.00
Hydra	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pisicolidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS
	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
SAMPLE TYPE	minimally exposed	minimally exposed	minimally exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed
SAMPLE CODE	R1aA	R1bA	R1cA	R2aA	R2bA	R2cA	R2dA	R2eA	R3aA	R3bA	R3cA	R4aA	R4bA
Ameletidae	0.00	0.00	0.00	0.00	1.00	4.60	0.00	0.00	0.00	0.00	0.00	0.00	15.00
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	34.00	40.00	73.00	88.40	45.00	53.30	441.00	684.00	824.00	536.00	1024.00	15.60	78.00
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	0.00	0.00	0.00	6.50	6.00	7.20	65.00	40.00	16.00	95.00	72.00	153.40	510.00
Leptophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	4.00	5.00	15.00	1.30	4.00	1.30	24.00	60.00	32.00	40.00	20.00	23.40	130.00
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.98	21.32
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	0.00	0.00	14.36	12.90	9.00	1.52	12.92	8.00	8.26	15.42	32.37	21.55	50.76
Perlidae (includes Hesperoperla ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	18.09	0.00	8.26	0.00	0.00	0.00	0.00
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	76.26	161.00	229.74	83.97	7.71	12.40	229.95	272.00	446.16	143.16	226.60	192.92	333.02
Capniidae	19.06	0.00	7.18	6.33	1.29	12.98	45.21	52.00	41.31	113.43	89.02	296.74	258.90
Leuctridae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taeniopterygidae (includes Taenionema sp. ID'd)	16.68	0.00	28.72	0.00	0.00	0.00	25.84	0.00	0.00	0.00	0.00	0.00	0.00
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	0.00	0.00	0.00	0.00	0.00	0.00	33.00	36.00	8.00	10.00	0.00	5.20	0.00
Rhyacophila sp.	0.00	8.00	16.00	0.00	0.00	4.00	42.00	0.00	0.00	5.00	4.00	0.00	0.00
Wormaldia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glossosoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uenoidae (includes Oligophlebodes sp. ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydroptilidae (includes Hydroptila sp., Oxyethira sp., Stactobiella sp., Hydroptila pupae)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Micrasema sp.	2.00	5.00	0.00	1.30	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brachycentrus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00
Lepidostoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	0.00	0.00	0.00	8.00	0.00	3.30	21.00	0.00	0.00	0.00	0.00	0.00	0.00
Coleoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dytiscidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Antocha sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dicranota sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	0.00	5.00
Hexatoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnophila sp.	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
Rhabdomastix sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hesperoconopa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gonomyodes sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tipula sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bezzia/Palpomyia sp.	0.00	10.00	0.00	0.00	0.00	0.00	4.00	0.00	8.00	0.00	16.00	5.20	0.00
Psychodidae	0.00	16.00	0.00	2.60	0.00	0.00	10.00	8.00	16.00	20.00	8.00	26.20	5.00
Deuterophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agathon sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	0.00	13.00	0.00	0.00	0.00	1.30	0.00	0.00	0.00	0.00	0.00	2.60	0.00
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	76.00	73.00	120.00	24.70	15.00	9.10	29.00	152.00	112.00	80.00	132.00	2.60	25.00
Tanytarsini (Tribe)	0.00	0.00	0.00	0.00	0.00	71.50	125.00	136.00	136.00	55.44	248.00	0.00	0.00
Cladotanytarsus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Neostempellina sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pseudochironomus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheotanytarsus sp.	0.00	15.00	40.00	0.00	2.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.00
Stempellinella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stempellina sp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brillia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cardiocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaetocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Corynoneura sp.	0.00	0.00	0.00	0.00	3.27	1.30	0.00	0.00	0.00	0.00	0.00	5.20	5.00
Cricotopus/Orthocladius sp.	76.00	160.00	101.99	36.40	38.20	104.00	410.00	335.53	664.00	145.14	252.00	44.20	153.00
Diplocladius sp.	0.00	55.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eukiefferiella sp.	90.00	1065.00	1127.01	69.50	73.13	36.50	75.00	162.35	200.00	115.91	144.00	26.20	4.00
Heleniella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrobaenus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parorthocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheocricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Synorthocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thienemanniella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tvetenia sp.	0.00	0.00	0.00	0.00	0.00	13.00	35.00	54.12	152.00	125.99	96.00	39.00	45.00
Diamesa sp.	56.00	0.00	0.00	9.10	9.82	0.00	33.00	24.00	0.00	0.00	0.00	0.00	0.00
Pagastia sp.	334.00	325.00	168.00	152.50	51.30	60.00	189.00	244.00	224.00	60.48	132.00	127.80	82.00
Pseudodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potthastia longimana group	0.00	0.00	0.00	1.30	0.00	2.60	0.00	0.00	8.00	5.04	0.00	0.00	5.00
Prodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tanypodinae	0.00	0.00	0.00	39.00	13.10	14.50	15.00	80.00	0.00	0.00	24.00	0.00	0.00
Syrphidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stratiomyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS
	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
SAMPLE TYPE	minimally exposed	minimally exposed	minimally exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed
SAMPLE CODE	R1aA	R1bA	R1cA	R2aA	R2bA	R2cA	R2dA	R2eA	R3aA	R3bA	R3cA	R4aA	R4bA
Hemiptera (includes Corixidae ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Collembola	2.00	30.00	5.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	2.60	5.00
Ostracoda	0.00	0.00	0.00	0.00	0.00	2.60	14.00	0.00	0.00	0.00	0.00	0.00	5.00
Cladocera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Copepoda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oligochaeta	32.00	0.00	0.00	5.20	1.00	2.00	10.00	12.00	40.00	20.00	12.00	13.00	19.00
Nematoda	6.00	15.00	0.00	2.60	0.00	4.60	4.00	16.00	8.00	10.00	148.00	10.40	10.00
Class Turbellaria (includes triclad Polycelis coronata)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pisidium sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sphaerium simile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gastropoda (includes Physa [=Physella?], Planorbidae, Valvatidae, and Gastropoda UID)	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mesostigmata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	32.00	35.00	35.00	79.50	19.00	13.00	165.00	224.00	208.00	80.00	128.00	57.40	113.00
Hydra	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pisicolidae	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS
	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
SAMPLE TYPE	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	reference	reference	reference	reference
SAMPLE CODE	R4cA	R4dA	R4eA	R5aA	R5bA	R5cA	R6aA	R6bA	R6cA	R7aA	R7bA	R7cA	R7dA
Ameletidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	228.00	1320.00	240.00	102.00	13.00	5.00	524.00	536.00	61.20	32.00	72.00	6.00	272.00
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	332.00	920.00	188.00	28.00	8.50	1.00	169.29	184.00	87.40	336.00	80.00	49.00	160.00
Leptophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	28.00	136.00	108.00	40.00	19.60	6.00	185.42	160.00	85.00	120.00	152.00	20.00	256.00
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	12.21	8.07	0.00	2.00	0.00	0.00	0.00	0.00	0.00	16.00	0.00	1.05	0.00
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	8.14	113.01	24.00	8.00	4.17	0.00	8.24	24.57	8.21	24.00	16.88	4.21	32.00
Perlidae (includes Hesperoperla ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	256.50	1081.66	412.00	198.00	125.88	34.00	1162.39	900.95	248.54	1440.00	2033.44	162.95	2960.00
Capniidae	179.14	589.26	144.00	16.00	5.57	0.00	164.88	98.29	51.98	224.00	84.38	71.49	0.00
Leuctridae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taeniopterygidae (includes Taenionema sp. ID'd)	0.00	0.00	0.00	8.00	2.78	0.00	16.49	8.19	5.47	0.00	25.31	6.31	96.00
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	8.00	40.00	8.00	18.00	19.10	3.00	104.00	64.00	31.80	16.00	0.00	0.00	16.00
Rhyacophila sp.	0.00	16.00	8.00	0.00	0.00	0.00	0.00	8.00	0.00	8.00	0.00	1.00	16.00
Wormaldia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glossosoma sp.	4.00	0.00	4.00	0.00	0.00	0.00	0.00	8.00	5.20	0.00	0.00	0.00	0.00
Uenoidae (includes Oligophlebodes sp. ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydroptilidae (includes Hydroptila sp., Oxyethira sp., Stactobiella sp., Hydroptila pupae)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Micrasema sp.	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brachycentrus sp.	0.00	16.00	8.00	2.00	0.00	0.00	0.00	8.00	0.00	0.00	0.00	0.00	0.00
Lepidostoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	4.00	0.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	16.00
Coleoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dytiscidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Antocha sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dicranota sp.	4.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	0.00	16.00
Hexatoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnophila sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rhabdomastix sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hesperoconopa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gonomyodes sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tipula sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bezzia/Palpomyia sp.	4.00	32.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Psychodidae	8.00	96.00	28.00	8.00	2.00	0.00	16.00	8.00	5.20	24.00	16.00	4.00	16.00
Deuterophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agathon sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	0.00	0.00	0.00	0.00	0.00	1.00	8.00	0.00	0.00	0.00	8.00	2.00	0.00
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	40.00	192.00	52.00	70.00	19.00	13.00	344.00	360.00	229.20	0.00	96.00	1.00	352.00
Tanytarsini (Tribe)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cladotanytarsus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Neostempellina sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pseudochironomus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheotanytarsus sp.	0.00	80.00	52.00	40.00	22.20	21.00	24.00	16.00	5.20	374.20	31.12	2.00	0.00
Stempellinella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stempellina sp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brillia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cardiocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaetocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Corynoneura sp.	0.00	0.00	4.00	0.00	2.00	0.00	0.00	0.00	0.00	31.18	0.00	0.00	0.00
Cricotopus/Orthocladius sp.	46.00	248.00	92.00	30.00	52.10	56.00	0.00	56.00	0.00	1091.43	871.34	18.00	443.23
Diplocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eukiefferiella sp.	8.36	288.00	36.00	98.00	11.80	12.00	168.21	88.00	35.25	0.00	0.00	0.00	460.28
Heleniella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrobaenus sp.	0.00	0.00	0.00	86.00	230.10	117.00	265.60	0.00	0.00	31.18	0.00	0.00	0.00
Parorthocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheocricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.18	0.00	0.00	0.00
Synorthocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thienemanniella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tvetenia sp.	8.36	192.00	20.00	44.00	13.00	15.00	230.19	104.00	67.55	1044.65	2022.75	51.00	3784.49
Diamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pagastia sp.	121.27	744.00	128.00	138.00	29.90	34.00	152.00	80.00	40.40	452.16	466.79	27.00	208.00
Pseudodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potthastia longimana group	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tanypodinae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Syrphidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stratiomyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidoptera	8.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS
	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
SAMPLE TYPE	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	reference	reference	reference	reference
SAMPLE CODE	R4cA	R4dA	R4eA	R5aA	R5bA	R5cA	R6aA	R6bA	R6cA	R7aA	R7bA	R7cA	R7dA
Hemiptera (includes Corixidae ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Collembola	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ostracoda	0.00	16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cladocera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Copepoda	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	2.60	0.00	0.00	1.00	0.00
Oligochaeta	4.00	16.00	16.00	2.00	2.00	0.00	8.00	0.00	2.60	16.00	56.00	0.00	16.00
Nematoda	12.00	48.00	0.00	2.00	3.30	0.00	8.00	8.00	4.00	0.00	64.00	2.00	48.00
Class Turbellaria (includes triclad Polycelis coronata)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pisidium sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sphaerium simile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gastropoda (includes Physa [=Physella?], Planorbidae, Valvatidae, and Gastropoda UID)	0.00	0.00	0.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mesostigmata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	72.00	200.00	136.00	100.00	36.40	36.00	72.00	48.00	39.00	424.00	256.00	61.00	448.00
Hydra	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pisicolidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	AS	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess
	2008	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
SAMPLE TYPE	reference	reference	reference	reference	reference	reference	reference	reference	reference	exposed	exposed	exposed	exposed
SAMPLE CODE	R7eA	VRH7	USFRH7	NECH7	V1aH	V1bH	V1cH	V1dH	V1eH	V27aH	V27bH	V27cH	V27dH
Ameletidae	0.00	41.89	33.00	53.00	107.00	0.00	47.03	27.00	27.00	93.00	27.00	13.00	60.00
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	48.00	69.12	507.00	7.00	200.00	270.00	136.10	63.00	200.00	800.00	800.00	493.00	710.00
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	88.00	21.99	153.00	520.00	2266.00	1464.00	1944.43	1290.00	2077.00	3320.00	3599.00	1613.00	2970.00
Leptophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	136.00	0.00	713.00	33.00	83.00	166.00	16.01	34.00	133.00	27.00	80.00	13.00	10.00
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	0.00	27.00	20.21	248.64	947.00	133.00	276.86	193.01	234.22	266.38	320.00	307.00	354.00
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	16.36	0.00	73.75	7.25	7.00	3.00	0.00	7.81	3.02	0.00	0.00	0.00	3.00
Perlidae (includes Hesperoperla ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	1112.45	7.00	566.77	48.69	490.00	320.00	290.71	594.64	456.38	958.24	1107.00	226.00	960.00
Capniidae	319.01	27.00	20.21	48.69	1097.00	430.00	775.21	487.54	626.27	1069.04	853.00	680.00	680.00
Leuctridae	0.00	0.00	7.07	20.72	0.00	53.00	51.22	0.00	20.11	345.34	173.00	40.00	77.00
Taeniopterygidae (includes Taenionema sp. ID'd)	8.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	0.00	0.00	33.00	20.00	43.00	7.00	27.00	20.00	24.60	185.35	106.00	0.00	42.79
Rhyacophila sp.	8.00	0.00	0.00	160.00	23.00	3.00	13.00	77.00	32.09	167.70	120.00	124.33	71.31
Wormaldia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glossosoma sp.	8.00	0.00	20.00	0.00	0.00	107.00	53.00	43.00	114.44	806.96	667.00	248.67	688.90
Uenoidae (includes Oligophlebodes sp. ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydroptilidae (includes Hydroptila sp., Oxyethira sp., Stactobiella sp., Hydroptila pupae)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Micrasema sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brachycentrus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidostoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	0.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	28.88	0.00	147.00	0.00	0.00
Coleoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dytiscidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Antocha sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dicranota sp.	0.00	0.00	20.00	20.00	0.00	53.00	0.00	0.00	17.00	0.00	0.00	0.00	3.00
Hexatoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnophila sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rhabdomastix sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hesperoconopa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gonomyodes sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tipula sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bezzia/Palpomyia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Psychodidae	16.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00	0.00	0.00	0.00
Deuterophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agathon sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	0.00	13.00	20.00	0.00	3.00	0.00	7.00	0.00	3.00	1507.00	1626.00	533.00	1010.00
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	16.00	27.00	0.00	0.00	13.00	0.00	3.00	0.00	7.00	0.00	0.00	0.00	34.00
Tanytarsini (Tribe)	0.00	7.00	0.00	0.00	0.00	0.00	13.00	0.00	0.00	13.00	27.00	53.00	0.00
Cladotanytarsus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Neostempellina sp.	0.00	0.00	127.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pseudochironomus sp.	0.00	0.00	73.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheotanytarsus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stempellinella sp.	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stempellina sp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brillia sp.	0.00	0.00	0.00	0.00	0.00	0.00	62.41	0.00	0.00	0.00	30.23	0.00	0.00
Cardiocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaetocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.23	67.00	30.23	0.00	0.00
Corynoneura sp.	0.00	0.00	13.00	25.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cricotopus/Orthocladius sp.	400.00	0.00	113.00	42.49	1265.86	860.00	570.98	1400.00	1718.42	187.00	372.04	160.00	70.71
Diplocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eukiefferiella sp.	56.00	633.00	153.00	137.77	2207.14	427.00	176.61	450.00	542.35	13.00	186.02	0.00	0.00
Heleniella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrobaenus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parorthocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.23	0.00	0.00
Rheocricotopus sp.	0.00	0.00	133.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Synorthocladius sp.	0.00	0.00	27.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.86
Thienemanniella sp.	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tvetenia sp.	1160.00	0.00	0.00	93.99	0.00	0.00	0.00	0.00	0.00	0.00	216.25	0.00	171.43
Diamesa sp.	0.00	1100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pagastia sp.	128.00	0.00	0.00	33.00	27.00	267.00	27.00	167.00	113.00	0.00	0.00	0.00	0.00
Pseudodiamesa sp.	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potthastia longimana group	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tanypodinae	0.00	0.00	13.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.00
Syrphidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stratiomyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	AS	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess
	2008	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
SAMPLE TYPE	reference	reference	reference	reference	reference	reference	reference	reference	reference	exposed	exposed	exposed	exposed
SAMPLE CODE	R7eA	VRH7	USFRH7	NECH7	V1aH	V1bH	V1cH	V1dH	V1eH	V27aH	V27bH	V27cH	V27dH
Hemiptera (includes Corixidae ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00	0.00
Collembola	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ostracoda	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cladocera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Copepoda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oligochaeta	16.00	40.00	7.00	7.00	0.00	53.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Nematoda	72.00	7.00	67.00	13.00	27.00	0.00	3.00	0.00	3.00	40.00	13.00	0.00	0.00
Class Turbellaria (includes triclad Polycelis coronata)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pisidium sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sphaerium simile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gastropoda (includes Physa [=Physella?], Planorbidae, Valvatidae, and Gastropoda UID)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mesostigmata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	440.00	7.00	100.00	60.00	0.00	53.00	140.00	81.00	186.00	106.00	26.00	13.00	137.00
Hydra	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pisicolidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	AS	AS
	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
SAMPLE TYPE	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	reference	reference
SAMPLE CODE	V27eH	V5aH	V5bH	V5cH	V5dH	V5eH	V8aH	V8bH	V8cH	V8dH	V8eH	V1aA	V1bA
Ameletidae	83.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00	0.00	0.00	0.00	0.00	22.00
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	1040.00	16.00	7.00	20.00	60.00	7.00	93.00	0.00	80.00	80.00	60.00	9.00	1.00
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	2384.00	36.00	73.00	87.00	73.00	140.00	334.00	173.00	186.00	214.00	226.00	45.00	32.00
Leptophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	133.00	0.00	0.00	0.00	0.00	0.00	27.00	27.00	13.00	0.00	13.00	2.00	3.00
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	177.00	5.16	86.63	69.38	56.27	77.67	46.36	73.63	174.36	39.26	8.77	1.15	1.00
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	0.00	0.00	11.25	3.65	3.59	0.00	23.18	0.00	0.00	0.00	0.00	0.00	0.00
Perlidae (includes Hesperoperla ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	1230.00	46.43	48.38	20.69	51.48	29.77	212.19	171.20	271.71	466.76	159.15	39.23	3.00
Capniidae	677.00	218.41	109.13	203.27	323.27	112.62	879.08	883.60	581.20	271.91	291.99	3.46	4.00
Leuctridae	40.00	0.00	41.63	0.00	8.38	12.94	23.18	97.56	425.73	77.07	25.06	0.00	0.00
Taeniopterygidae (includes Taenionema sp. ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	109.03	1.15	0.00
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	188.00	30.08	11.25	0.00	48.77	21.92	30.90	27.82	28.55	27.00	46.75	2.83	0.00
Rhyacophila sp.	99.11	109.81	45.00	70.99	81.77	62.48	106.43	99.50	140.62	187.00	108.69	5.67	0.00
Wormaldia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glossosoma sp.	844.99	15.04	25.88	66.01	110.46	29.60	30.90	0.00	0.00	0.00	0.00	8.50	2.00
Uenoidae (includes Oligophlebodes sp. ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydroptilidae (includes Hydroptila sp., Oxyethira sp., Stactobiella sp., Hydroptila pupae)	0.00	0.00	0.00	0.00	0.00	0.00	14.88	28.89	42.29	187.00	8.18	0.00	0.00
Micrasema sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brachycentrus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidostoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	135.89	24.07	7.88	0.00	0.00	0.00	30.90	42.80	28.55	0.00	23.38	0.00	0.00
Coleoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dytiscidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Antocha sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dicranota sp.	27.00	10.00	0.00	0.00	7.00	7.00	0.00	27.00	0.00	27.00	7.00	0.00	0.00
Hexatoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnophila sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rhabdomastix sp.	0.00	0.00	0.00	0.00	0.00	3.00	0.00	13.00	0.00	0.00	0.00	0.00	0.00
Hesperoconopa sp.	27.00	0.00	0.00	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Gonomyodes sp.	0.00	13.00	0.00	0.00	3.00	13.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tipula sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bezzia/Palpomyia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Psychodidae	7.00	20.00	0.00	7.00	10.00	3.00	0.00	0.00	0.00	27.00	7.00	0.00	0.00
Deuterophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agathon sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	926.00	33.00	10.00	13.00	3.00	3.00	66.00	13.00	174.00	160.00	67.00	0.00	0.00
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	53.00	7.00	3.00	3.00	0.00	27.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00
Tanytarsini (Tribe)	30.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cladotanytarsus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Neostempellina sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pseudochironomus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheotanytarsus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stempellinella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stempellina sp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acricotopus sp.	55.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brillia sp.	233.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.46	0.00
Cardiocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaetocladius sp.	6.21	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	120.00	0.00	0.00
Corynoneura sp.	0.00	0.00	0.00	0.00	0.00	0.00	13.00	0.00	0.00	0.00	0.00	0.00	1.00
Cricotopus/Orthocladius sp.	14.49	729.43	297.00	163.00	333.00	264.56	5000.00	4067.00	2998.21	5387.00	880.00	20.92	6.00
Diplocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eukiefferiella sp.	0.00	166.57	43.00	20.00	47.00	138.27	427.00	80.00	0.00	0.00	13.00	8.62	3.00
Heleniella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrobaenus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parorthocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheocricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Synorthocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	68.79	27.00	0.00	0.00	0.00
Thienemanniella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tvetenia sp.	275.40	0.00	0.00	0.00	0.00	51.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diamesa sp.	0.00	67.00	30.00	17.00	57.00	33.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Pagastia sp.	0.00	17.00	13.00	7.00	40.00	7.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00
Pseudodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potthastia longimana group	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tanypodinae	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00	0.00	0.00	0.00	0.00
Syrphidae	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stratiomyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	Hess	AS	AS
	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
SAMPLE TYPE	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	reference	reference
SAMPLE CODE	V27eH	V5aH	V5bH	V5cH	V5dH	V5eH	V8aH	V8bH	V8cH	V8dH	V8eH	V1aA	V1bA
Hemiptera (includes Corixidae ID'd)	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Collembola	0.00	7.00	3.00	7.00	7.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ostracoda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cladocera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Copepoda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oligochaeta	0.00	193.00	23.00	7.00	273.00	127.00	0.00	0.00	0.00	0.00	7.00	0.00	0.00
Nematoda	30.00	0.00	7.00	3.00	10.00	10.00	227.00	67.00	120.00	187.00	33.00	0.00	0.00
Class Turbellaria (includes triclad Polycelis coronata)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00	27.00	0.00	0.00	0.00	0.00
Pisidium sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sphaerium simile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gastropoda (includes Physa [=Physella?], Planorbidae, Valvatidae, and Gastropoda UID)	0.00	0.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mesostigmata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	268.00	87.00	34.00	46.00	17.00	13.00	306.00	320.00	279.00	267.00	106.00	7.00	0.00
Hydra	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pisicolidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS
	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
SAMPLE TYPE	reference	reference	reference	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed
SAMPLE CODE	V1cA	V1dA	V1eA	V5aA	V5bA	V5cA	V5dA	V5eA	V27aA	V27bA	V27cA	V27eA	V27dA
Ameletidae	0.00	3.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	1.00	4.00	0.00
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	16.00	25.00	368.00	0.00	24.00	0.00	4.00	32.00	24.00	36.00	41.00	9.00	370.00
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	49.00	71.00	81.00	16.00	72.00	18.00	25.00	23.00	226.00	135.00	103.00	8.00	149.00
Leptophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	0.00	6.00	0.00	24.00	0.00	0.00	0.00	0.00	3.00	9.00	3.00	1.00	0.00
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	8.48	0.00	0.00	0.00	8.47	0.00	3.26	75.36	4.51	1.49	1.09	1.01	0.00
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	19.08	6.67	4.52	0.00	0.00	1.93	4.89	2.36	3.38	2.98	1.09	0.00	3.47
Perlidae (includes Hesperoperla ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	167.48	90.00	298.29	665.93	401.07	297.95	52.21	219.02	465.50	41.69	50.11	70.96	475.53
Capniidae	16.96	26.67	27.12	127.46	307.86	201.21	13.05	414.49	24.80	10.42	4.36	2.03	0.00
Leuctridae	0.00	0.00	0.00	0.00	11.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taeniopterygidae (includes Taenionema sp. ID'd)	0.00	6.67	18.08	2.60	11.30	61.91	19.58	11.78	166.81	10.42	4.36	0.00	0.00
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	16.00	20.00	17.00	56.00	50.00	24.00	13.00	90.00	124.46	38.00	18.61	24.13	63.69
Rhyacophila sp.	4.00	3.00	19.00	176.00	152.00	177.00	36.00	339.00	134.50	30.00	10.34	11.49	47.08
Wormaldia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glossosoma sp.	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.02	63.00	29.98	13.79	33.23
Uenoidae (includes Oligophlebodes sp. ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	10.00	2.07	0.00	0.00
Hydroptilidae (includes Hydroptila sp., Oxyethira sp., Stactobiella sp., Hydroptila pupae)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Micrasema sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brachycentrus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidostoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	0.00	0.00	2.00	8.00	2.00	0.00	0.00	0.00	4.01	0.00	0.00	4.60	0.00
Coleoptera	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dytiscidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Antocha sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dicranota sp.	0.00	0.00	0.00	0.00	0.00	24.00	2.00	2.00	1.00	0.00	0.00	0.00	0.00
Hexatoma sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limnophila sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00
Rhabdomastix sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hesperoconopa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gonomyodes sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tipula sp.	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bezzia/Palpomyia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Psychodidae	8.00	0.00	8.00	10.00	26.00	136.00	6.00	176.00	2.00	0.00	0.00	0.00	0.00
Deuterophlebiidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agathon sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	0.00	0.00	8.00	8.00	0.00	16.00	0.00	32.00	2.00	4.00	2.00	4.00	26.00
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	8.00	0.00	28.00	126.00	62.00	8.00	4.00	68.00	33.00	8.00	7.00	6.00	137.00
Tanytarsini (Tribe)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cladotanytarsus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Neostempellina sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pseudochironomus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheotanytarsus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stempellinella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stempellina sp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brillia sp.	28.00	38.06	41.80	218.86	56.00	35.00	2.00	0.00	2.00	1.00	3.00	9.00	64.00
Cardiocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chaetocladius sp.	0.00	94.43	0.00	0.00	0.00	236.00	8.00	241.00	0.00	3.00	0.00	0.00	0.00
Corynoneura sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cricotopus/Orthocladius sp.	66.00	40.87	184.49	380.63	138.00	72.00	6.00	32.00	2.00	1.00	29.00	14.00	0.00
Diplocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eukiefferiella sp.	32.00	5.64	80.71	294.99	0.00	24.00	14.00	82.00	7.00	6.00	21.00	8.00	224.00
Heleniella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrobaenus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parorthocladius sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rheocricotopus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Synorthocladius sp.	0.00	0.00	0.00	0.00	48.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thienemanniella sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tvetenia sp.	0.00	0.00	0.00	9.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00
Diamesa sp.	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pagastia sp.	5.00	6.00	32.00	0.00	82.00	0.00	0.00	0.00	0.00	0.00	2.00	1.00	48.00
Pseudodiamesa sp.	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potthastia longimana group	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prodiamesa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tanypodinae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Syrphidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stratiomyidae	0.00	0.00	0.00	0.00	2.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
Lepidoptera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	AS
	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
SAMPLE TYPE	reference	reference	reference	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed	exposed
SAMPLE CODE	V1cA	V1dA	V1eA	V5aA	V5bA	V5cA	V5dA	V5eA	V27aA	V27bA	V27cA	V27eA	V27dA
Hemiptera (includes Corixidae ID'd)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Collembola	0.00	0.00	0.00	0.00	0.00	16.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00
Ostracoda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
Cladocera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Copepoda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oligochaeta	0.00	0.00	0.00	24.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00
Nematoda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Class Turbellaria (includes triclad Polycelis coronata)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pisidium sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sphaerium simile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gastropoda (includes Physa [=Physella?], Planorbidae, Valvatidae, and Gastropoda UID)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mesostigmata	0.00	0.00	0.00	0.00	0.00	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	16.00	0.00	8.00	56.00	40.00	24.00	8.00	32.00	39.00	0.00	1.00	3.00	8.00
Hydra	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pisicolidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	AS	AS	AS	AS	AS
	2007	2007	2007	2007	2007
SAMPLE TYPE	exposed	exposed	exposed	exposed	exposed
SAMPLE CODE	V8aA	V8bA	V8cA	V8eA	V8dA
Ameletidae	0.00	0.00	1.00	4.00	0.00
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	2.00	16.00	7.00	96.00	18.00
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	47.00	38.00	50.00	62.00	44.00
Leptophlebiidae	0.00	0.00	0.00	0.00	0.00
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	0.00	4.00	6.00	4.00	0.00
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	1.00	0.00	1.37	0.00	0.00
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	0.00	3.91	2.73	11.70	0.00
Perlidae (includes Hesperoperla ID'd)	0.00	0.00	0.00	0.00	0.00
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	56.00	246.62	148.84	778.20	508.93
Capniidae	2.00	18.27	39.60	114.10	101.07
Leuctridae	0.00	0.00	0.00	0.00	0.00
Taeniopterygidae (includes Taenionema sp. ID'd)	27.00	52.20	132.46	0.00	0.00
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	16.00	60.57	67.00	232.00	96.00
Rhyacophila sp.	22.00	46.43	34.00	114.00	50.00
Wormaldia sp.	0.00	0.00	0.00	0.00	0.00
Glossosoma sp.	0.00	0.00	0.00	4.00	0.00
Uenoidae (includes Oligophlebodes sp. ID'd)	0.00	0.00	3.00	0.00	0.00
Hydroptilidae (includes Hydroptila sp., Oxyethira sp., Stactobiella sp., Hydroptila pupae)	0.00	0.00	1.00	0.00	8.00
Micrasema sp.	0.00	0.00	0.00	0.00	0.00
Brachycentrus sp.	0.00	0.00	0.00	0.00	0.00
Lepidostoma sp.	0.00	0.00	0.00	0.00	0.00
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	0.00	0.00	1.00	0.00	0.00
Coleoptera	0.00	0.00	0.00	0.00	0.00
Dytiscidae	0.00	0.00	0.00	0.00	0.00
Antocha sp.	0.00	0.00	0.00	0.00	0.00
Dicranota sp.	0.00	1.00	0.00	0.00	8.00
Hexatoma sp.	0.00	0.00	0.00	0.00	0.00
Limnophila sp.	0.00	0.00	0.00	0.00	0.00
Rhabdomastix sp.	0.00	0.00	0.00	0.00	0.00
Hesperoconopa sp.	0.00	0.00	0.00	0.00	0.00
Gonomyodes sp.	0.00	0.00	0.00	0.00	0.00
Tipula sp.	0.00	0.00	0.00	0.00	0.00
Bezzia/Palpomyia sp.	0.00	0.00	0.00	0.00	0.00
Psychodidae	0.00	2.00	1.00	4.00	0.00
Deuterophlebiidae	0.00	0.00	0.00	0.00	0.00
Agathon sp.	0.00	0.00	0.00	0.00	0.00
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	0.00	2.00	0.00	4.00	16.00
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	4.00	17.00	17.00	34.00	20.00
Tanytarsini (Tribe)	0.00	0.00	0.00	2.00	0.00
Cladotanytarsus sp.	0.00	0.00	0.00	0.00	0.00
Neostempellina sp.	0.00	0.00	0.00	0.00	0.00
Pseudochironomus sp.	0.00	0.00	0.00	0.00	0.00
Rheotanytarsus sp.	0.00	0.00	0.00	0.00	0.00
Stempellinella sp.	0.00	0.00	0.00	0.00	0.00
Stempellina sp	0.00	0.00	0.00	0.00	0.00
Acricotopus sp.	0.00	0.00	0.00	0.00	0.00
Brillia sp.	0.00	42.00	19.00	60.00	110.00
Cardiocladius sp.	0.00	0.00	0.00	0.00	0.00
Chaetocladius sp.	28.00	167.00	288.00	310.00	152.00
Corynoneura sp.	0.00	0.00	0.00	0.00	2.00
Cricotopus/Orthocladius sp.	9.00	45.00	32.00	112.00	272.00
Diplocladius sp.	0.00	0.00	0.00	0.00	0.00
Eukiefferiella sp.	0.00	10.00	6.00	0.00	136.00
Heleniella sp.	0.00	0.00	0.00	0.00	0.00
Hydrobaenus sp.	0.00	0.00	0.00	0.00	0.00
Parorthocladius sp.	0.00	0.00	0.00	0.00	0.00
Rheocricotopus sp.	0.00	0.00	0.00	0.00	0.00
Synorthocladius sp.	0.00	0.00	0.00	0.00	0.00
Thienemanniella sp.	0.00	0.00	0.00	0.00	0.00
Tvetenia sp.	0.00	0.00	0.00	0.00	0.00
Diamesa sp.	0.00	0.00	0.00	0.00	0.00
Pagastia sp.	0.00	0.00	0.00	0.00	70.00
Pseudodiamesa sp.	0.00	0.00	0.00	0.00	0.00
Potthastia longimana group	0.00	0.00	0.00	0.00	0.00
Prodiamesa sp.	0.00	0.00	0.00	0.00	0.00
Tanypodinae	0.00	0.00	0.00	0.00	0.00
Syrphidae	0.00	0.00	0.00	0.00	0.00
Stratiomyidae	0.00	0.00	0.00	0.00	0.00
Lepidoptera	0.00	0.00	0.00	0.00	0.00

Table D.2: Raw benthic data after re-attributions of taxa to standardize taxon levels among samples and re-coding of sample I.Ds: combined data 2007 and 2008

	AS	AS	AS	AS	AS
	2007	2007	2007	2007	2007
SAMPLE TYPE	exposed	exposed	exposed	exposed	exposed
SAMPLE CODE	V8aA	V8bA	V8cA	V8eA	V8dA
Hemiptera (includes Corixidae ID'd)	0.00	0.00	0.00	0.00	0.00
Collembola	0.00	3.00	0.00	0.00	0.00
Ostracoda	0.00	1.00	0.00	0.00	0.00
Cladocera	0.00	0.00	0.00	0.00	0.00
Copepoda	0.00	0.00	0.00	0.00	0.00
Oligochaeta	0.00	0.00	1.00	0.00	0.00
Nematoda	0.00	0.00	0.00	0.00	0.00
Class Turbellaria (includes triclad Polycelis coronata)	0.00	0.00	0.00	0.00	0.00
Pisidium sp.	0.00	0.00	0.00	0.00	0.00
Sphaerium simile	0.00	0.00	0.00	0.00	0.00
Gastropoda (includes Physa [=Physella?], Planorbidae, Valvatidae, and Gastropoda UID)	0.00	0.00	0.00	0.00	0.00
Mesostigmata	0.00	0.00	0.00	0.00	0.00
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	9.00	27.00	18.00	20.00	64.00
Hydra	0.00	0.00	0.00	0.00	0.00
Pisicolidae	0.00	0.00	0.00	0.00	0.00

Table D.3: Benthic community metrics for all samples based on combined 2007 and 2008 data sets.

Year	Samptype	Exposure	StnSamp	indiv_after_deletions&collapse&attrib	densitym2	ntaxa_after_collapse	Ephemeroptera %	Plecoptera %	Trichoptera %	EPT%	Tipulidae%	Empididae%	Simuliidae%	Chironomidae %	Oli
2008	Hess	reference	VRH8	1703.3	1743	21	15.3	31.0	0.0	46.3	0.2	0.6	5.5	16.3	
2008	K&S	reference	VRK	502.0	502	20	25.5	36.7	0.2	62.4	0.0	0.2	17.1	11.8	
2008	Hess	exposed	X2aH	7026.7	7187	29	7.1	11.4	2.0	20.6	0.1	0.4	5.2	61.4	
2008	K&S	exposed	X2aK	1325.0	1357	30	18.6	20.1	1.9	40.7	0.1	1.4	0.9	49.7	
2008	Hess	exposed	X2bH	12693.3	13480	25	1.6	3.4	0.8	5.8	0.0	0.4	0.8	83.1	
2008	K&S	exposed	X2bK	1620.0	1652	22	3.6	7.7	1.7	13.1	0.0	0.0	3.6	69.7	
2008	Hess	exposed	X2cH	14960.0	15000	25	2.7	4.6	0.5	7.8	0.4	0.2	3.2	69.6	
2008	K&S	exposed	X2cK	3560.0	3568	21	1.8	5.6	1.1	8.5	0.0	0.7	0.2	71.7	
2008	Hess	exposed	X2dH	7786.7	8280	15	1.8	3.5	0.2	5.5	0.2	0.0	0.0	82.0	
2008	Hess	exposed	X2eH	4235.3	4335	27	4.6	6.5	0.6	11.7	0.3	0.2	0.9	58.4	
2008	Hess	reference	USFRH8	7213.3	7240	26	15.9	32.7	0.7	49.4	0.2	0.2	0.0	35.2	
2008	K&S	reference	USFRK	1969.0	1969	26	29.7	40.7	4.1	74.5	0.0	0.4	0.4	16.6	
2008	Hess	reference	NECH8	4465.7	4536	20	13.1	11.7	1.5	26.3	0.2	0.0	0.6	20.6	
2008	K&S	reference	NECK	1187.0	1187	21	46.9	28.1	1.9	76.9	0.3	0.3	0.4	18.6	
2008	Hess	exposed	R2aH	3173.7	3173	20	17.2	12.2	0.6	30.0	0.8	0.6	3.4	53.4	
2008	Hess	exposed	R2bH	5120.0	5130	19	35.0	19.2	0.5	54.6	0.0	0.1	13.8	30.9	
2008	Hess	exposed	R2cH	3643.3	3643	21	29.5	17.7	2.3	49.5	0.0	0.8	11.2	29.8	
2008	Hess	exposed	R2dH	3866.7	3873	22	18.9	14.8	0.3	34.1	0.0	0.3	0.9	53.5	
2008	Hess	exposed	R2eH	2483.3	2497	22	20.7	11.1	1.2	33.0	1.1	2.9	6.4	48.1	
2008	K&S	exposed	R2aK	503.0	506	22	46.6	19.4	0.6	66.6	0.6	0.8	1.2	23.9	
2008	K&S	exposed	R2bK	397.0	397	23	52.1	24.7	0.3	77.1	0.0	1.5	1.3	14.6	
2008	K&S	exposed	R2cK	629.0	629	26	42.3	19.9	0.5	62.6	0.2	1.3	2.4	27.2	
2008	Hess	reference	R7H	7753.3	7807	21	5.6	22.4	0.2	28.2	0.7	2.0	0.4	57.0	
2008	K&S	reference	R7aK	1205.0	1209	27	13.0	17.0	1.6	31.5	0.7	2.3	0.0	45.6	
2008	K&S	reference	R7bK	1247.3	1263	20	19.6	32.6	0.0	52.2	1.7	0.7	1.3	33.9	
2008	Hess	reference	FCH	6306.7	6360	19	3.4	20.5	1.3	25.2	1.9	0.0	0.4	56.8	
2008	K&S	reference	FCK	600.0	610	19	12.8	29.2	0.7	42.6	0.7	0.0	0.0	37.4	
2008	Hess	reference	BLCaH	9354.3	9407	25	4.3	5.3	3.2	12.8	0.4	0.1	0.0	78.0	
2008	Hess	reference	BLCbH	2853.3	2857	21	28.8	19.7	4.9	53.4	0.6	1.3	0.0	29.2	
2008	Hess	reference	BLCcH	7033.3	7033	26	5.5	8.7	0.6	14.7	0.0	0.7	0.0	79.4	
2008	Hess	reference	BLCdH	5346.3	5373	24	6.7	8.9	1.7	17.4	0.2	0.7	0.2	76.4	
2008	Hess	reference	BLCeH	5660.0	5670	25	7.5	15.5	2.1	25.0	0.5	0.9	0.0	66.7	
2008	K&S	reference	BLCaK	237.0	239	20	33.9	33.1	4.2	71.1	0.0	1.3	1.3	21.3	
2008	K&S	reference	BLCbK	885.0	887	27	19.3	26.9	1.8	48.0	0.2	0.3	0.3	43.4	
2008	K&S	reference	BLCcK	662.0	675	17	15.6	28.6	1.2	45.4	0.6	0.3	0.0	51.9	
2008	Hess	reference	STCH	8063.3	8120	19	0.5	7.1	0.0	7.6	0.1	1.8	0.0	82.8	
2008	K&S	reference	STCK	85.0	90	15	8.9	12.2	1.1	22.2	0.0	0.0	0.0	43.3	
2008	Hess	reference	BECH	19226.7	19280	20	0.3	3.3	10.3	13.9	0.0	0.0	4.4	66.0	
2008	K&S	reference	BECK	1286.0	1290	20	2.3	2.2	11.3	15.8	0.0	0.0	3.8	58.5	
2008	Hess	reference	HOCH	2140.0	2147	23	22.4	21.3	8.2	51.9	0.9	1.7	1.6	39.0	
2008	K&S	reference	HOCK	102.0	102	16	41.2	27.5	2.0	70.6	0.0	1.0	1.0	15.7	
2008	Hess	reference	GRCH	506.7	510	17	4.6	17.6	4.6	26.8	0.0	1.3	5.2	63.4	
2008	K&S	reference	GRCK	63.0	63	14	14.3	44.4	0.0	58.7	0.0	1.6	3.2	27.0	
2008	Hess	reference	BTTH	37466.7	37467	21	5.5	3.2	0.7	9.4	5.8	3.4	0.4	55.4	
2008	K&S	reference	BTTK	15750.0	15750	21	5.8	6.3	5.4	17.5	1.4	2.1	0.0	66.4	
2008	Hess	reference	BUCH	1890.0	1957	32	36.5	29.3	11.1	76.8	3.1	0.3	2.7	12.8	
2008	K&S	reference	BUCK	1820.0	1865	21	49.9	29.5	6.2	85.5	0.3	0.0	1.1	11.3	
2008	AS	exposed	X2aA	3108.0	3780	15	2.8	7.6	0.1	10.5	0.0	0.0	2.0	83.8	
2008	AS	exposed	X2bA	3424.0	4304	17	3.0	11.0	0.9	14.9	0.0	0.4	2.0	79.0	
2008	AS	exposed	X2cA	1324.0	1352	14	1.5	1.8	0.0	3.3	0.0	0.0	0.3	92.0	
2008	AS	exposed	X2dA	1272.0	1608	14	2.5	2.5	2.1	7.1	0.0	0.0	3.5	85.2	
2008	AS	exposed	X2eA	9568.0	9568	23	2.0	3.9	0.3	6.2	0.1	0.0	2.3	87.5	
2008	AS	reference	R1aA	856.0	956	15	4.0	11.7	0.2	15.9	0.0	0.0	7.9	68.2	
2008	AS	reference	R1bA	2031.0	2095	17	2.1	7.7	0.6	10.5	0.0	0.6	3.5	80.4	
2008	AS	reference	R1cA	1981.0	2026	14	4.3	13.8	0.8	19.0	0.0	0.0	5.9	72.9	
2008	AS	exposed	R2aA	631.1	783	19	12.3	13.2	1.2	26.7	0.0	0.0	3.2	45.4	
2008	AS	exposed	R2bA	303.0	304	19	18.4	5.9	0.0	24.3	0.0	0.0	4.9	62.8	
2008	AS	exposed	R2cA	437.9	442	24	15.0	6.1	1.9	23.1	0.0	0.3	2.1	69.6	
2008	AS	exposed	R2dA	2086.0	2094	27	25.3	15.9	4.6	45.7	0.2	0.0	1.4	42.5	
2008	AS	exposed	R2eA	2600.0	2600	19	30.2	12.8	1.4	44.3	0.0	0.0	5.8	39.8	

Table D.3: Benthic community metrics for all samples based on combined 2007 and 2008 data sets.

Year	Samptype	Exposure	StnSamp	indiv_after_deletions&collapse&attrib	densitym2	ntaxa_after_collapse	Ephemeroptera %	Plecoptera %	Trichoptera %	EPT%	Tipulidae%	Empididae%	Simuliidae%	Chironomidae %	Oli
2008	AS	exposed	R4aA	1082.2	1085	21	17.7	48.1	0.5	66.4	0.0	0.2	0.2	22.3	
2008	AS	exposed	R4bA	1902.0	1902	24	38.5	34.9	0.0	73.4	0.3	0.0	1.3	16.5	
2008	AS	exposed	R4cA	1396.0	1404	22	41.9	32.5	1.4	75.8	0.3	0.0	2.8	13.1	
2008	AS	exposed	R4dA	6392.0	6400	22	37.1	28.0	1.1	66.3	0.0	0.0	3.0	24.4	
2008	AS	exposed	R4eA	1724.0	1748	23	30.7	33.2	2.1	65.9	0.2	0.0	3.0	20.4	
2008	AS	exposed	R5aA	1048.0	1050	23	16.2	22.1	1.9	40.2	0.0	0.0	6.7	41.7	
2008	AS	exposed	R5bA	622.4	622	20	6.6	22.2	3.1	31.9	0.0	0.0	3.1	58.0	
2008	AS	exposed	R5cA	355.0	361	15	3.3	9.4	1.1	13.9	0.0	0.3	3.6	72.3	
2008	AS	exposed	R6aA	3630.7	3672	19	24.0	36.8	2.8	63.6	0.0	0.2	9.4	24.0	
2008	AS	exposed	R6bA	2768.0	2824	20	31.2	36.5	3.1	70.8	0.0	0.0	12.7	13.9	
2008	AS	exposed	R6cA	1015.8	1024	19	22.8	30.7	3.6	57.1	0.0	0.0	22.4	15.3	
2008	AS	reference	R7aA	5744.0	5768	20	8.5	29.5	0.6	38.6	0.0	0.0	0.0	53.4	
2008	AS	reference	R7bA	6384.0	6400	18	4.8	33.8	0.0	38.5	0.5	0.1	1.5	53.3	
2008	AS	reference	R7cA	491.0	491	19	15.3	50.1	0.2	65.6	0.0	0.4	0.2	20.0	
2008	AS	reference	R7dA	9616.0	9648	19	7.1	32.0	0.5	39.6	0.2	0.0	3.6	51.1	
2008	AS	reference	R7eA	4056.0	4072	19	6.7	35.8	0.4	42.8	0.0	0.0	0.4	43.4	
2007	Hess	reference	VRH7	2049.0	2057	17	6.5	3.0	0.3	9.8	0.0	0.6	1.3	84.9	
2007	Hess	reference	USFRH7	3020.0	3080	25	45.6	22.3	3.7	71.7	0.6	0.6	0.0	21.4	
2007	Hess	reference	NECH7	1607.0	1607	21	38.1	23.3	11.6	73.1	1.2	0.0	0.0	20.7	
2007	Hess	reference	V1aH	8806.0	8909	16	29.8	28.5	0.7	59.1	0.0	0.0	0.1	40.4	
2007	Hess	reference	V1bH	4669.0	4669	17	40.7	20.1	2.5	63.3	1.1	0.0	0.0	33.3	
2007	Hess	reference	V1cH	4633.6	4648	20	46.1	30.0	2.0	78.1	0.0	0.2	0.1	18.6	
2007	Hess	reference	V1dH	4935.0	4935	15	28.7	26.0	2.8	57.5	0.0	0.0	0.0	40.9	
2007	Hess	reference	V1eH	6582.0	6582	22	37.0	20.4	3.0	60.4	0.3	0.0	0.1	36.3	
2007	Hess	exposed	V27aH	9985.0	9985	19	42.5	26.4	11.6	80.5	0.0	15.1	0.0	2.8	
2007	Hess	exposed	V27bH	10556.0	10569	22	42.6	23.2	9.8	75.7	0.0	15.4	0.0	8.4	
2007	Hess	exposed	V27cH	4530.0	4530	15	47.1	27.7	8.2	83.0	0.0	11.8	0.0	4.7	
2007	Hess	exposed	V27dH	8144.0	8464	22	44.3	24.5	9.5	78.3	0.0	11.9	0.4	7.6	
2007	Hess	exposed	V27eH	8989.0	9042	26	40.3	23.5	14.0	77.8	0.6	10.2	0.6	7.4	
2007	Hess	exposed	V5aH	1858.0	1858	22	2.8	14.5	9.6	27.0	1.2	1.8	0.4	52.7	
2007	Hess	exposed	V5bH	933.0	956	22	8.4	31.1	9.4	48.8	0.0	1.0	0.3	42.5	
2007	Hess	exposed	V5cH	837.0	856	20	12.5	34.7	16.4	63.6	0.0	1.5	0.4	25.7	
2007	Hess	exposed	V5dH	1651.0	1704	24	7.8	26.0	14.1	47.9	1.8	0.2	0.0	30.3	
2007	Hess	exposed	V5eH	1204.0	1244	24	11.8	18.7	9.2	39.7	1.8	0.2	2.2	42.4	
2007	Hess	exposed	V8aH	7984.0	7984	22	5.8	14.8	2.7	23.4	0.0	0.8	0.5	68.6	
2007	Hess	exposed	V8bH	6225.0	6238	18	3.2	19.7	3.2	26.1	0.6	0.2	0.0	66.5	
2007	Hess	exposed	V8cH	5652.0	5652	18	4.9	25.7	4.2	34.9	0.0	3.1	0.0	54.5	
2007	Hess	exposed	V8dH	7632.0	7632	16	3.9	11.2	5.3	20.3	0.4	2.1	0.0	70.9	
2007	Hess	exposed	V8eH	2320.0	2333	21	12.8	25.5	8.0	46.3	0.3	2.9	0.0	43.4	
2007	AS	reference	V1aA	159.0	166	16	33.7	27.1	10.2	71.1	0.6	0.0	0.0	24.1	
2007	AS	reference	V1bA	78.0	81	11	71.6	9.9	2.5	84.0	0.0	0.0	0.0	16.0	
2007	AS	reference	V1cA	466.0	494	18	13.2	42.9	4.9	60.9	0.0	0.0	1.6	32.4	
2007	AS	reference	V1dA	447.0	467	16	22.5	27.8	4.9	55.2	0.0	0.0	0.0	44.8	
2007	AS	reference	V1eA	1226.0	1306	17	34.4	26.6	2.9	63.9	0.0	0.6	2.1	31.5	
2007	AS	exposed	V5aA	2204.0	2274	17	1.8	35.0	10.6	47.3	0.0	0.4	5.5	42.8	
2007	AS	exposed	V5bA	1496.0	1532	19	6.4	48.3	13.3	68.0	0.0	0.0	4.0	23.2	
2007	AS	exposed	V5cA	1401.0	1401	21	1.3	40.2	14.3	55.8	1.8	1.1	0.6	26.2	
2007	AS	exposed	V5dA	223.0	223	18	13.0	41.7	22.9	77.6	0.9	0.0	1.8	13.5	
2007	AS	exposed	V5eA	1876.0	1876	20	2.9	38.5	22.9	64.3	0.2	1.7	3.6	18.9	
2007	AS	exposed	V27aA	1278.0	1279	22	19.8	52.0	21.0	92.7	0.1	0.2	2.6	0.9	
2007	AS	exposed	V27bA	411.0	411	18	43.8	16.3	34.3	94.4	0.0	1.0	1.9	2.7	
2007	AS	exposed	V27cA	335.0	335	20	44.2	18.2	18.2	80.6	0.0	0.6	2.1	16.4	
2007	AS	exposed	V27eA	203.0	206	19	10.7	35.9	26.2	72.8	0.0	1.9	2.9	20.9	
2007	AS	exposed	V27dA	1658.0	1694	15	30.6	28.3	8.5	67.4	0.0	1.5	8.1	22.0	
2007	AS	exposed	V8aA	223.0	226	12	21.7	38.1	16.8	76.5	0.0	0.0	1.8	17.7	
2007	AS	exposed	V8bA	803.0	818	20	7.1	39.2	13.1	59.4	0.1	0.2	2.1	34.0	
2007	AS	exposed	V8cA	877.0	883	22	7.2	36.8	12.0	56.1	0.0	0.0	1.9	39.8	
2007	AS	exposed	V8eA	1966.0	1978	18	8.4	45.7	17.7	71.8	0.0	0.2	1.7	25.1	
2007	AS	exposed	V8dA	1676.0	1708	17	3.6	35.7	9.0	48.4	0.5	0.9	1.2	45.3	

indicates stations sampled by Bonnie that have no counterpart Hess or K&S data

Table D.4: Number of taxa, after proportional attribution of some taxa, and collapse to higher level of others used in Vangorda 2007 comparisons only.

a) Hess samples: Vangorda 2007

	countif	Sample ID:	UWFV	USFR	NEXC	V1-1	V1-2	V1-3	V1-4	V1-5	V27-1	V27-2	V27-3	V27-4	V27-5	V5-1	V5-2	V5-3	V5-4	V5-5	V8-1	V8-2	V8-3	V8-4	V8-5
Ameletus sp.	13		42	33	53	107	0	47	27	27	93	27	13	60	83	0	0	0	0	0	13	0	0	0	0
Baetis bicaudatus + Baetis sp.	22		69	507	7	200	270	136	63	200	800	800	493	710	1040	16	7	20	60	7	93	0	80	80	53
Acentrella sp.	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Family Heptageniidae (including identified Rhithrogena sp. Cinygmula sp. Epeorus sp.)	23		22	153	520	2266	1464	1946	1290	2077	3320	3599	1613	2970	2384	36	73	87	73	140	334	173	186	214	226
Family Ephemerellidae (including identified Drunella coloradensis, D. doddsi)	16		0	713	33	83	166	16	34	133	27	80	13	10	133	0	0	0	0	0	27	27	13	0	13
Family Chloroperlidae (including identified Sweltsa sp., Suwallia sp., Alloperla fratema, Paraperla sp.)	23		27	20	248	947	133	256	191	234	260	320	307	354	177	4	86	67	55	74	37	58	157	35	8
Family Perlodidae (including identified Megarcys sp., Skwala sp.)	11		0	75	7	7	3	0	8	3	0	0	0	3	0	0	11	4	3	0	19	0	0	0	0
Zapada spp. (including identified Z. columbiana, Z. cinctipes, Z. haysi/orogenesis	23		7	621	49	490	320	268	588	456	936	1107	226	960	1230	38	48	20	50	28	171	135	245	421	153
Taenionema sp	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	105
Family: Capniidae	23		27	20	49	1097	430	715	482	626	1044	853	680	680	677	180	108	197	314	107	710	699	525	245	280
Family: Leuctridae	18		0	7	21	0	53	47	0	20	337	173	40	77	40	0	41	0	8	12	19	77	384	70	24
Family Hydropsychidae (including identified Parapsyche sp., Hydropsyche sp.)	20		0	33	20	43	7	27	20	24	177	106	0	39	188	27	11	0	44	22	30	28	28	27	46
Rhyacophila sp.	21		0	0	160	23	3	13	77	32	161	120	109	65	99	97	44	68	74	62	105	99	140	187	106
Hydroptila sp.	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	29	42	187	8
Glossosoma sp.	16		0	20	0	0	107	53	43	114	772	667	217	627	845	13	26	63	100	29	30	0	0	0	0
Family: Limnephilidae (including identified Ecclisomyia sp.)	10		0	0	7	0	0	0	0	29	0	147	0	0	136	21	8	0	0	0	30	43	28	0	23
Family: Elmidae	1	adult	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Order: Diptera UID A	1	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Order: Diptera UID B	2	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	13	0	0	0	0	0	0
Micropsectra sp.	2	larvae	0	0	0	0	0	0	0	0	13	0	53	0	0	0	0	0	0	0	0	0	0	0	0
Neostempellina sp.	1	larvae	0	127	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudochironomus sp.	1	larvae	0	73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanytarsus sp.	4	larvae	7	0	0	0	0	13	0	0	0	27	0	0	30	0	0	0	0	0	0	0	0	0	0
Acricotopus sp.	1		0	0	0	0	0	0	0	0	0	0	0	0	41	0	0	0	0	0	0	0	0	0	0
Brillia sp.	3		0	0	0	0	0	59	0	0	0	20	0	0	171	0	0	0	0	0	0	0	0	0	0
Chaetocladius sp.	6		0	0	0	0	0	0	0	15	67	20	0	0	5	0	3	0	0	0	0	0	0	0	120
Corynoneura sp.	3		0	13	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0
Cricotopus/Orthocladius sp. A	22		0	113	40	1079	860	536	1400	1682	187	251	70	51	11	725	297	163	333	263	5000	4067	2599	5387	880
Cricotopus/Orthocladius sp. B	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	397	0	0
Eukiefferiella sp.	18		633	153	131	1882	427	166	450	531	13	126	0	0	0	165	43	20	47	137	427	80	0	0	13
Parorthocladius sp.	1		0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0
Rheocricotopus sp.	1		0	133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synorthocladius sp.	4		0	27	0	0	0	0	0	0	0	0	0	41	0	0	0	0	0	0	0	0	69	27	0
Thiennemaniella sp.	1		0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tvetenia sp.	5		0	0	89	0	0	0	0	0	0	146	0	123	202	0	0	0	0	51	0	0	0	0	0
Diamesa sp.	6	larvae	1100	0	0	0	0	0	0	0	0	0	0	0	0	67	30	17	57	33	0	0	0	0	0
Pagastia sp.	12	larvae	0	0	33	27	267	27	167	113	0	0	0	0	0	17	13	7	40	7	40	0	0	0	0
Pseudodiamesa sp.	1	larvae	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thiennemannimyia Group	4	larvae	0	13	0	0	0	0	0	0	0	0	0	27	3	0	0	0	0	0	0	0	13	0	0
Family: Syriphidae	1	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0
Pericoma sp.	9	larvae	7	0	0	0	0	0	0	0	13	0	0	0	7	20	0	7	10	3	0	0	0	27	7
Chelifera/Metachela	16	larvae	13	20	0	0	0	0	0	0	67	53	0	7	3	30	10	3	3	3	53	13	107	160	60
Oreogeton sp.	13	larvae	0	0	0	3	0	7	0	3	1440	1573	533	1003	923	3	0	3	0	0	13	0	67	0	7
Clinocera sp.	1	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0
Dicranota sp.	12	larvae	0	20	20	0	53	0	0	17	0	0	0	3	27	10	0	0	7	7	0	27	0	27	7
Rhabdomastix sp.	2	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	13	0	0	0
Hesperoconopa sp;	2	larvae	0	0	0	0	0	0	0	0	0	0	0	0	27	0	0	0	20	0	0	0	0	0	0
Gonomyodes sp.	3	larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	3	13	0	0	0	0	0
Family Simuliidae (including identified Prosimulium sp.)	11		27	0	0	13	0	3	0	7	0	0	0	34	53	7	3	3	0	27	40	0	0	0	0
Order: Hemiptera	2		0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	3	0	0	0	0	0	0	0
Order: Collembola	5		0	0	0	0	0	0	0	0	0	0	0	0	0	7	3	7	7	10	0	0	0	0	0
Phylum: Nematoda	18		7	67	13	27	0	3	0	3	40	13	0	0	30	0	7	3	10	10	227	67	120	187	33
Class: Oligochaeta	11		40	7	7	0	53	0	0	0	0	0	0	3	0	193	23	7	273	127	0	0	0	0	7
Class: Turbellaria	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	27	0	0
Class: Ostracoda	1		7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Gastropoda	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0
Aturus	14		0	40	15	0	0	97	0	0	75	13	0	107	139	14	0	0	0	13	53	236	126	118	63
Hygrobates	4		0	0	8	0	0	0	36	40	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0
Lebertia	6		0	13	15	0	0	0	0	13	15	0	0	0	0	0	0	0	0	0	13	0	14	0	0
Sperchon	19		0	47	15	0	0	36	36	40	15	13	13	30	35	29	7	3	17	0	160	70	126	88	39
Feltria	8		0	0	0	0	53	0	0	93	0	0	0	0	35	43	27	43	0	0	0	0	14	58	0
Wandesia	1		0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0	0	0	0	0	0
Torrenticola	2		0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	0	0	0	0
Order Prostigmata (including juveniles, deutonymphs, adults)	1		7																						
Number of Taxa after collapse, attribution			17	27	25	16	17	21	16	25	22	24	15	24	30	25	24	24	25	24	26	20	23	18	24

Table D.4: Number of taxa, after proportional attribution of some taxa, and collapse to higher level of others used in Vangorda 2007 comparisons only.

b) Artificial Substrate samples: Vangorda 2007

	Sample ID:		V1-A	V1-B	V1-C	V1-D	V1-E	V27-A	V27-B	V27-C	V27-D	V27-E	V5-A	V5-B	V5-C	V5-D	V5-E	V8-A	V8-B	V8-C	V8-D	V8-E
Ameletus sp.	nymph		0	22	0	3	0	0	0	1	0	4	0	2	0	0	0	0	0	1	0	4
Baetis sp.	nymph		9	1	16	25	368	24	36	41	370	9	0	24	0	4	32	2	16	7	18	96
Rhithrogena sp;	nymph		14	7	12	19	7	89	10	10	24	3	0	0	0	0	0	19	12	8	0	31
Cinygmula sp.	nymph		0	18	0	9	0	55	91	85	16	5	4	0	0	0	0	13	4	9	0	0
Epeorus sp.	nymph		31	7	37	43	74	82	34	8	110	0	12	72	18	25	23	15	22	34	44	31
Ephemerellidae (Drunella doddsi, D. coloradensis, D. spinifera, Serratella tibialis, unid. Ephemerellidae)			2	3	0	6	0	3	9	3	0	1	24	0	0	0	0	0	4	6	0	4
Family: Chloroperlidae	nymph	combine	1	1	8	0	0	5	1	1	0	1	0	8	0	3	75	1	0	1	0	0
Family: Perlodidae	nymph	combine	0	0	19	7	5	3	3	1	3	0	0	0	2	5	2	0	4	3	0	12
Zapada haysi/orogenensis	nymph		25	3	144	75	145	448	39	45	369	45	599	366	207	44	205	49	223	133	324	474
Zapada columbiana	nymph		14	0	23	15	148	18	3	5	107	24	27	35	83	8	14	7	24	16	46	124
Zapada cinctipes	nymph		0	0	0	0	5	0	0	0	0	2	40	0	8	0	0	0	0	0	139	180
Taenionema sp	nymph		1	0	0	7	18	167	10	4	0	0	3	11	62	20	12	27	52	132	0	0
Family: Capniidae	nymph		3	4	17	27	27	25	10	4	0	2	127	308	201	13	414	2	18	40	101	114
Family: Leuctridae	nymph		0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0
Family: Hydropsychidae (include Arctopsyche, Parapsyche, Hydropsyche)	larvae	combine	3	0	16	20	17	124	38	19	64	24	56	50	24	13	90	16	61	67	96	232
Rhyacophila sp.	larvae		6	0	4	3	19	135	30	10	47	11	176	152	177	36	339	22	46	34	50	114
Hydroptila sp.	larvae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8	0
Glossosoma sp.	larvae		9	2	4	0	0	5	63	30	33	14	0	0	0	0	0	0	0	0	0	4
Family: Limnephilidae (includes Ecclisomyia)		combine	0	0	0	0	2	4	0	0	0	5	8	2	0	0	0	0	0	1	0	0
Oligophleboides sp.	larvae		0	0	0	0	0	0	10	2	0	0	0	0	0	2	0	0	0	3	0	0
Order: Coleoptera	adult		0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanytarsus sp.	larvae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Brillia sp.	larvae		2	0	28	38	42	2	1	3	64	9	219	56	35	2	0	0	42	19	110	60
Chaetocladius sp.	larvae		0	0	0	94	0	0	3	0	0	0	0	0	236	8	241	28	167	288	152	310
Corynoneura sp.	larvae		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Cricotopus/Orthocladius sp. A	larvae		21	6	66	41	184	2	1	29	0	14	381	138	72	6	32	9	45	32	272	112
Eukiefferiella sp.	larvae		9	3	32	6	81	7	6	21	224	8	295	0	24	14	82	0	10	6	136	0
Synorthocladius sp.	larvae		0	0	0	0	0	0	0	0	0	0	0	48	0	0	0	0	0	0	0	0
Tvetenia sp.	larvae		0	0	0	0	0	0	0	0	0	8	10	0	0	0	0	0	0	0	0	0
Diamesa sp.	larvae		1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pagastia sp.	larvae		0	0	5	6	32	0	0	2	48	1	0	82	0	0	0	0	0	0	70	0
Pseudodiamesa sp.	larvae		0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pericoma sp.	larvae		0	0	8	0	8	2	0	0	0	0	10	26	136	6	176	0	2	1	0	4
Family: Empididae		combine	0	0	0	0	8	2	4	2	26	4	8	0	16	0	32	0	2	0	16	4
Dicranota sp.	larvae		0	0	0	0	0	1	0	0	0	0	0	0	24	2	2	0	1	0	8	0
Hesperoconopa sp;	larvae		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnophila sp.	larvae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Tipula sp.	larvae		0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Family Simuliidae (includes pupae and Simulium and Prosimulium larvae)			0	0	8	0	28	33	8	7	137	6	126	62	8	4	68	4	17	17	20	34
Family : Stratiomyiidae	larvae		0	0	0	0	0	0	0	0	0	0	0	2	1	0	1	0	0	0	0	0
Order: Collembola			0	0	0	0	0	3	0	0	0	0	0	0	16	0	0	0	3	0	0	0
Class: Oligochaeta		combine	0	0	0	0	0	0	0	0	8	0	24	0	2	0	0	0	0	1	0	0
Class: Ostracoda			0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Class : Arachnida			0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Order : Mesostigmata			0	0	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0
Aturus	adult		1	0	0	0	0	36	0	0	8	0	0	0	0	0	0	9	24	11	56	16
Hygrobates	adult		1	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebertia	adult		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Sperchon	adult		4	0	4	0	8	3	0	0	0	3	0	0	0	2	0	0	3	7	8	4
Feltria	adult		0	0	4	0	0	0	0	0	0	0	56	40	24	6	32	0	0	0	0	0
		new nind	158	78	466	447	1226	1278	411	335	1657	203	2204	1496	1401	223	1876	223	803	877	1676	1966
		new arntaxa	20	13	22	19	20	26	21	23	17	22	20	20	23	20	21	15	24	26	20	22

Table D.5: Benthic metrics for Hess and artificial substrate sampling stations based on Vangorda Creek, 2007 only.

Station	Area	Area	Hess Density (Individuals/m2)	Hess Number of Taxa	Hess Ephemeroptera (%)	Hess Plecoptera (%)	Hess Trichoptera (%)	Hess EPT (%)	Hess Chironomids (%)	Hess Simpson's D	Hess Simpson's E	Hess Simpsons E (Krebs)	Hess B-C Dist. to V-1 median	Hess Vangorda CA Axis-1 (24.4%)	Hess Vangorda CA Axis-2 (17.2%)	Hess Vangorda CA Axis-3 (14.7%)	Hess All Stations CA Axis-1 (22.4%)	Hess All Stations CA Axis-2 (15.0%)	Hess All Stations CA Axis-3 (13.3%)	Hess Reference Stations CA Axis-1 (36.6%)
UWFV	UWFV	UWFV Ref. Alternate	2057.0	17	6.5100	2.9700	0.3400	9.8200	84.9300	0.6139	0.1524	0.6523	0.8288	.	.	.	1.0582	0.3365	0.4849	-1.0485
USFR	USFR	USFR Ref. Alternate	3080.0	27	45.6500	22.3400	3.6700	71.6600	21.4000	0.8658	0.2760	0.8991	0.6881	.	.	.	-0.2553	-0.1998	-0.1772	0.0044
NEXC	NEXC	NEXC Ref. Alternate	1607.0	25	38.1500	23.2700	11.6400	73.0600	20.7200	0.8431	0.2549	0.8782	0.6540	.	.	.	-0.0817	0.0883	-0.4013	0.0746
V1-1	V1	V1 Reference	8909.0	16	29.8100	28.5200	0.7400	59.0800	40.4400	0.8220	0.3512	0.8768	0.2413	-0.0324	-0.3920	0.3887	0.0436	0.2355	-0.4374	-0.3470
V1-2	V1	V1 Reference	4669.0	17	40.6900	20.1100	2.5100	63.3100	33.2800	0.8365	0.3597	0.8888	0.1811	-0.3638	-0.2437	0.2924	0.2480	0.0379	-0.4594	0.3978
V1-3	V1	V1 Reference	4648.0	21	46.1500	29.9900	2.0000	78.1400	18.5700	0.7604	0.1987	0.7984	0.1602	0.2650	-0.4238	-0.0478	-0.1847	0.4679	0.0149	-0.0543
V1-4	V1	V1 Reference	4935.0	16	28.6500	26.0000	2.8400	57.4900	40.8700	0.8141	0.3362	0.8683	0.1626	-0.1136	-0.4392	0.6588	0.0341	0.1798	-0.7592	0.1256
V1-5	V1	V1 Reference	6582.0	25	37.0300	20.3600	3.0400	60.4200	36.3000	0.8083	0.2087	0.8420	0.0964	-0.0092	-0.2252	0.4789	-0.0563	0.0673	-0.4989	0.2097
V27-1	V27	V27 Exposure NF	9985.0	22	42.4600	26.4300	11.6200	80.5100	2.8000	0.8297	0.2669	0.8692	0.4943	0.3128	-0.0238	-0.0094	-0.2929	0.0975	0.1278	.
V27-2	V27	V27 Exposure NF	10569.0	24	42.6300	23.2100	9.8400	75.6800	8.4400	0.8223	0.2345	0.8581	0.4781	0.4297	-0.3042	-0.3288	-0.3393	0.4630	0.3013	.
V27-3	V27	V27 Exposure NF	4530.0	15	47.0600	27.6600	8.2300	82.9600	4.7000	0.8028	0.3380	0.8601	0.3643	0.2948	-0.3204	0.0045	-0.2827	0.3395	-0.0183	.
V27-4	V27	V27 Exposure NF	8464.0	24	44.3100	24.5000	9.4900	78.3000	7.6400	0.8075	0.2164	0.8426	0.4451	0.3885	-0.0303	-0.3931	-0.3462	0.1727	0.2813	.
V27-5	V27	V27 Exposure NF	9042.0	30	40.2600	23.4900	14.0200	77.7700	7.4300	0.8643	0.2457	0.8942	0.4799	0.4348	-0.2650	-0.4990	-0.3192	0.4689	0.4348	.
V5-1	V5	V5 Exposure FF	1858.0	25	2.8000	14.5300	9.6300	26.9600	52.7400	0.7972	0.1973	0.8304	0.6435	-0.8108	0.2074	-0.3201	0.7855	-0.2347	0.2520	.
V5-2	V5	V5 Exposure FF	956.0	24	8.3700	31.0700	9.4100	48.8500	42.4700	0.8572	0.2918	0.8945	0.7562	-0.5451	0.0260	0.0071	0.4869	-0.1107	-0.0430	.
V5-3	V5	V5 Exposure FF	856.0	24	12.5000	34.7000	16.3600	63.5500	25.7000	0.8682	0.3163	0.9060	0.7835	-0.6568	-0.0259	-0.0986	0.6402	-0.0540	0.0380	.
V5-4	V5	V5 Exposure FF	1704.0	25	7.8100	26.0000	14.1400	47.9500	30.3400	0.8778	0.3273	0.9144	0.6852	-0.8069	0.0326	-0.1618	0.7491	-0.1178	0.0232	.
V5-5	V5	V5 Exposure FF	1244.0	24	11.8200	18.7300	9.1600	39.7100	42.3600	0.8925	0.3876	0.9313	0.7397	-0.7270	0.0008	-0.5179	0.7447	0.0151	0.2731	.
V8-1	V8	V8 Exposure FFF	7984.0	26	5.8500	14.8300	2.6800	23.3600	68.6400	0.5683	0.0891	0.5910	0.5443	0.1051	0.1020	0.2800	-0.1449	-0.1600	-0.1537	.
V8-2	V8	V8 Exposure FFF	6238.0	20	3.2100	19.6500	3.1900	26.0500	66.4800	0.5178	0.1037	0.5450	0.5972	0.1513	0.4242	0.4054	-0.2676	-0.4912	-0.1831	.
V8-3	V8	V8 Exposure FFF	5652.0	23	4.9400	25.7100	4.2500	34.8900	54.4900	0.7510	0.1746	0.7851	0.5601	0.4451	0.6858	0.0342	-0.5034	-0.5830	0.2376	.
V8-4	V8	V8 Exposure FFF	7632.0	18	3.8500	11.2000	5.2500	20.3100	70.9400	0.4824	0.1073	0.5107	0.6625	0.1488	0.8690	0.0780	-0.2330	-0.8253	0.2669	.
V8-5	V8	V8 Exposure FFF	2333.0	24	12.8200	25.4600	8.0200	46.2900	43.4200	0.8127	0.2224	0.8480	0.5475	0.1322	0.3891	0.0388	-0.1941	-0.3409	0.1908	.

Table D.5: Benthic metrics for Hess and artificial substrate sampling stations based on Vangorda Creek, 2007 only.

Station	Area	Area	Hess Reference Stations CA Axis-2 (19.3%)	Hess Reference Stations CA Axis-3 (17.8%)	Artificial Substrate Abundance (ind./m2)	Artificial Substrate Number of Taxa	Artificial Substrate Ephemeroptera (%)	Artificial Substrate Plecoptera (%)	Artificial Substrate Trichoptera (%)	Artificial Substrate EPT (%)	Artificial Substrate Chironomids (%)	Art. Substrate Simpson's D	Art. Substrate Simpson's E	Art. Substrate Simpson's E (Krebs)	Art. Substrate B-C Dist. to V-1 median	Artificial Substrate CA-1 (23.8%)	Artificial Substrate CA-2 (13.5%)	Artificial Substrate CA-3 (12.5%)	Artificial Substrate CA-4 (9.9%)	Artificial Substrate CA-5 (8.7%)
UWFV	UWFV	UWFV Ref. Alternate	0.3270	-0.1413	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
USFR	USFR	USFR Ref. Alternate	-0.4010	-0.4375	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
NEXC	NEXC	NEXC Ref. Alternate	-0.2826	0.1137	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
V1-1	V1	V1 Reference	-0.0114	0.0659	166.0	20	33.7349	27.1084	10.2410	71.0843	24.0964	0.8906	0.4570	0.9375	0.3582	-0.3730	0.0850	0.0610	-0.1560	-0.1810
V1-2	V1	V1 Reference	0.3305	-0.2463	81.0	13	71.6049	9.8765	2.4691	83.9506	16.0494	0.8359	0.4687	0.9056	0.8054	-1.2490	0.0010	-0.6230	1.2350	-0.1970
V1-3	V1	V1 Reference	0.0496	0.1139	494.0	22	13.1579	42.9150	4.8583	60.9312	32.3887	0.8594	0.3233	0.9003	0.2426	0.0430	0.2040	-0.2030	-0.2210	-0.3760
V1-4	V1	V1 Reference	-0.1330	0.3560	467.0	19	22.4839	27.8373	4.9251	55.2463	44.7537	0.8893	0.4756	0.9387	0.2443	-0.2620	-0.1060	0.1030	0.2550	-0.2580
V1-5	V1	V1 Reference	0.1904	0.0528	1306.0	20	34.3798	26.6462	2.9096	63.9357	31.4701	0.8470	0.3268	0.8916	0.6317	0.1050	0.3430	0.1140	-0.1680	-0.2270
V27-1	V27	V27 Exposure NF	.	.	1279.0	26	19.7811	51.9937	20.9539	92.7287	0.8600	0.8265	0.2216	0.8595	0.7250	-0.2430	-0.2710	0.0480	-0.1810	0.1420
V27-2	V27	V27 Exposure NF	.	.	411.0	21	43.7956	16.3017	34.3066	94.4039	2.6764	0.8868	0.4205	0.9311	0.5724	-0.6570	-0.2590	-0.2390	-0.3110	0.2910
V27-3	V27	V27 Exposure NF	.	.	335.0	23	44.1791	18.2090	18.2090	80.5970	16.4179	0.8760	0.3507	0.9158	0.4940	-0.6280	0.0350	-0.2290	-0.1540	0.1140
V27-4	V27	V27 Exposure NF	.	.	1693.0	17	30.6556	28.2930	8.5056	67.4542	21.9728	0.8614	0.4243	0.9152	0.7718	-0.2870	0.4440	0.1080	-0.4270	0.1670
V27-5	V27	V27 Exposure NF	.	.	206.0	22	10.6796	35.9223	26.2136	72.8155	20.8738	0.9001	0.4551	0.9430	0.4610	-0.3720	0.4400	-0.0730	0.1780	0.0800
V5-1	V5	V5 Exposure FF	.	.	2274.0	20	1.7590	35.0044	10.5541	47.3175	42.8320	0.8534	0.3410	0.8983	0.8238	0.3360	0.4260	-0.2100	0.2230	0.5830
V5-2	V5	V5 Exposure FF	.	.	1532.0	20	6.3969	48.3029	13.3159	68.0157	23.2376	0.8664	0.3743	0.9120	0.7129	0.3680	0.2100	-0.4620	0.0050	-0.3730
V5-3	V5	V5 Exposure FF	.	.	1401.0	23	1.2848	40.1856	14.3469	55.8173	26.1956	0.8931	0.4066	0.9337	0.7331	0.7220	-0.2800	-0.0600	0.1690	0.2830
V5-4	V5	V5 Exposure FF	.	.	223.0	20	13.0045	41.7040	22.8700	77.5785	13.4529	0.8974	0.4874	0.9446	0.4667	0.3150	-0.3350	-0.2460	-0.1760	-0.1120
V5-5	V5	V5 Exposure FF	.	.	1876.0	21	2.9318	38.5394	22.8678	64.3390	18.9232	0.8727	0.3742	0.9164	0.8058	0.5040	-0.2470	-0.4010	-0.0720	-0.1390
V8-1	V8	V8 Exposure FFF	.	.	226.0	15	21.6814	38.0531	16.8142	76.5487	17.6991	0.8870	0.5898	0.9503	0.5386	-0.2300	-0.5450	0.2650	-0.0420	-0.0450
V8-2	V8	V8 Exposure FFF	.	.	818.0	24	7.0905	39.2421	13.0807	59.4132	33.9853	0.8564	0.2902	0.8936	0.5166	0.0370	-0.3530	0.3240	0.0060	0.0380
V8-3	V8	V8 Exposure FFF	.	.	883.0	26	7.2480	36.8063	12.0045	56.0589	39.7508	0.8324	0.2294	0.8657	0.5831	-0.1270	-0.3550	0.1520	0.0490	0.0370
V8-4	V8	V8 Exposure FFF	.	.	1708.0	20	3.6300	35.7143	9.0164	48.3607	45.3162	0.8978	0.4893	0.9451	0.7286	0.2920	0.2680	0.5700	0.0910	-0.0920
V8-5	V8	V8 Exposure FFF	.	.	1978.0	22	8.3923	45.7027	17.6946	71.7897	25.0758	0.8765	0.3679	0.9182	0.7631	0.0000	0.0640	0.4000	0.2860	-0.0890

Table D.6: Descriptive statistics for benthic metrics at Faro Vangorda Creek study areas, Hess samples (5 stations/area) 2007 only.

Variable	Area	n	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Unbiased CV (%)	Average CV (%) for Sample Method
						Lower Bound	Upper Bound				
Hess Density (Individuals/m2)	V1	5	5948.600	1838.579	822.237	3665.703	8231.497	4648.000	8909.000	32.5	
	V27	5	8518.000	2373.833	1061.610	5570.497	11465.503	4530.000	10569.000	29.3	
	V5	5	1323.600	444.523	198.797	771.652	1875.548	856.000	1858.000	35.3	
	V8	5	5967.800	2248.285	1005.463	3176.186	8759.414	2333.000	7984.000	39.6	
Hess Number of Taxa	V1	5	19.000	3.937	1.761	14.110	23.890	16.000	25.000	21.8	
	V27	5	23.000	5.385	2.408	16.310	29.690	15.000	30.000	24.6	
	V5	5	24.400	0.548	0.245	23.720	25.080	24.000	25.000	2.4	
	V8	5	22.200	3.194	1.428	18.230	26.170	18.000	26.000	15.1	
Hess EPT (%)	V1	5	63.687	8.358	3.738	53.310	74.065	57.490	78.140	13.8	
	V27	5	79.044	2.781	1.244	75.590	82.497	75.680	82.960	3.7	
	V5	5	45.404	13.417	6.000	28.745	62.064	26.960	63.550	31.0	
	V8	5	30.180	10.521	4.705	17.116	43.244	20.310	46.290	36.6	
Hess Chironomids (%)	V1	5	33.892	9.119	4.078	22.569	45.215	18.570	40.870	28.3	
	V27	5	6.204	2.366	1.058	3.266	9.142	2.800	8.440	40.0	
	V5	5	38.724	10.767	4.815	25.354	52.093	25.700	52.740	29.2	
	V8	5	60.794	11.600	5.188	46.390	75.198	43.420	70.940	20.0	
Hess Simpson's D	V1	5	0.808	0.029	0.013	0.773	0.844	0.760	0.836	3.7	
	V27	5	0.825	0.024	0.011	0.795	0.856	0.803	0.864	3.1	
	V5	5	0.859	0.037	0.016	0.813	0.904	0.797	0.893	4.5	
	V8	5	0.626	0.147	0.066	0.444	0.809	0.482	0.813	24.6	
Hess Simpson's E	V1	5	0.291	0.080	0.036	0.191	0.390	0.199	0.360	28.9	
	V27	5	0.260	0.047	0.021	0.202	0.319	0.216	0.338	19.0	
	V5	5	0.304	0.069	0.031	0.218	0.390	0.197	0.388	23.9	
	V8	5	0.139	0.057	0.025	0.069	0.210	0.089	0.222	42.9	
Hess B-C Dist. to V-1 median	V1	5	0.168	0.052	0.023	0.104	0.233	0.096	0.241	32.4	
	V27	5	0.452	0.052	0.023	0.387	0.517	0.364	0.494	12.2	
	V5	5	0.722	0.057	0.025	0.651	0.792	0.643	0.784	8.2	
	V8	5	0.582	0.049	0.022	0.521	0.644	0.544	0.662	8.9	
Hess Vangorda CA Axis-1 (24.4%)	V1	5	-0.051	0.226	0.101	-0.331	0.229	-0.364	0.265	466.7	
	V27	5	0.372	0.065	0.029	0.291	0.453	0.295	0.435	18.4	
	V5	5	-0.709	0.112	0.050	-0.848	-0.571	-0.811	-0.545	16.5	
	V8	5	0.196	0.140	0.063	0.022	0.371	0.105	0.445	74.9	
Hess Vangorda CA Axis-2 (17.2%)	V1	5	-0.345	0.102	0.046	-0.472	-0.218	-0.439	-0.225	31.2	
	V27	5	-0.189	0.149	0.067	-0.374	-0.004	-0.320	-0.024	82.9	
	V5	5	0.048	0.092	0.041	-0.066	0.162	-0.026	0.207	200.4	
	V8	5	0.494	0.295	0.132	0.128	0.860	0.102	0.869	62.6	
Hess Vangorda CA Axis-3 (14.7%)	V1	5	0.354	0.262	0.117	0.029	0.680	-0.048	0.659	77.7	
	V27	5	-0.245	0.230	0.103	-0.530	0.040	-0.499	0.004	98.4	
	V5	5	-0.218	0.205	0.092	-0.473	0.037	-0.518	0.007	98.7	
	V8	5	0.167	0.167	0.075	-0.040	0.375	0.034	0.405	104.8	48.72

Table D.7: Descriptive statistics for benthic metrics at Faro Vangorda Creek study areas, artificial substrate samples (5 stations/area) 2007 only.

Artificial Substrate Abundance	V1	5	502.800	484.210	216.546	-98.427	1104.027	81.000	1306.000	101.1	
	V27	5	784.800	660.704	295.476	-35.572	1605.172	206.000	1693.000	88.4	
	V5	5	1461.200	770.467	344.563	504.539	2417.861	223.000	2274.000	55.4	
	V8	5	1122.600	712.124	318.472	238.381	2006.819	226.000	1978.000	66.6	
Artificial Substrate Number of Taxa	V1	5	18.800	3.421	1.530	14.550	23.050	13.000	22.000	19.1	
	V27	5	21.800	3.271	1.463	17.740	25.860	17.000	26.000	15.8	
	V5	5	20.800	1.304	0.583	19.180	22.420	20.000	23.000	6.6	
	V8	5	21.400	4.219	1.887	16.160	26.640	15.000	26.000	20.7	
Artificial Substrate EPT (%)	V1	5	67.030	11.050	4.942	53.310	80.749	55.246	83.951	17.3	
	V27	5	81.600	11.896	5.320	66.829	96.371	67.454	94.404	15.3	
	V5	5	62.614	11.579	5.178	48.237	76.990	47.318	77.578	19.4	
	V8	5	62.434	11.560	5.170	48.080	76.788	48.361	76.549	19.4	
Artificial Substrate Chironomids (%)	V1	5	29.752	10.662	4.768	16.513	42.990	16.049	44.754	37.6	
	V27	5	12.560	10.089	4.512	0.033	25.088	0.860	21.973	84.3	
	V5	5	24.928	11.099	4.964	11.147	38.710	13.453	42.832	46.8	
	V8	5	32.365	11.103	4.966	18.579	46.152	17.699	45.316	36.0	
Art. Substrate Simpson's D	V1	5	0.864	0.025	0.011	0.834	0.895	0.836	0.891	3.0	
	V27	5	0.870	0.028	0.013	0.835	0.905	0.826	0.900	3.4	
	V5	5	0.877	0.018	0.008	0.854	0.900	0.853	0.897	2.2	
	V8	5	0.870	0.026	0.012	0.838	0.902	0.832	0.898	3.1	
Art. Substrate Simpson's E	V1	5	0.410	0.078	0.035	0.313	0.507	0.323	0.476	20.0	
	V27	5	0.374	0.094	0.042	0.258	0.491	0.222	0.455	26.2	
	V5	5	0.397	0.056	0.025	0.327	0.466	0.341	0.487	14.8	
	V8	5	0.393	0.147	0.066	0.211	0.575	0.229	0.590	39.1	
Art. Substrate B-C Dist. to V-1 median	V1	5	0.456	0.251	0.112	0.144	0.769	0.243	0.805	57.8	
	V27	5	0.605	0.138	0.062	0.433	0.776	0.461	0.772	24.0	
	V5	5	0.708	0.143	0.064	0.531	0.886	0.467	0.824	21.2	
	V8	5	0.626	0.113	0.050	0.486	0.766	0.517	0.763	18.9	
Artificial Substrate CA-1 (23.8%)	V1	5	-0.347	0.543	0.243	-1.021	0.327	-1.249	0.105	164.1	
	V27	5	-0.437	0.193	0.086	-0.677	-0.198	-0.657	-0.243	46.4	
	V5	5	0.449	0.169	0.076	0.239	0.659	0.315	0.722	39.6	
	V8	5	-0.006	0.197	0.088	-0.250	0.239	-0.230	0.292	3697.0	
Artificial Substrate CA-2 (13.5%)	V1	5	0.105	0.175	0.078	-0.112	0.322	-0.106	0.343	174.1	
	V27	5	0.078	0.354	0.158	-0.362	0.518	-0.271	0.444	478.2	
	V5	5	-0.045	0.342	0.153	-0.469	0.379	-0.335	0.426	793.7	
	V8	5	-0.184	0.337	0.151	-0.602	0.234	-0.545	0.268	192.0	
Artificial Substrate CA-3 (12.5%)	V1	5	-0.110	0.315	0.141	-0.501	0.281	-0.623	0.114	301.7	
	V27	5	-0.077	0.157	0.070	-0.273	0.119	-0.239	0.108	214.8	
	V5	5	-0.276	0.160	0.071	-0.474	-0.077	-0.462	-0.060	60.8	
	V8	5	0.342	0.156	0.070	0.148	0.536	0.152	0.570	48.0	177.35

Table D.8: Summary statistics for benthic community metrics, 3 Stations per Area, Vangorda 2007.

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum	CV %	Unbiased CV%
Hess Density (Individuals/m2)	V1	3	6075.333	2454.050	1416.846	-20.864	12171.531	4648.000	8909.000	40.4	43.8
	V27	3	8361.333	3330.856	1923.070	87.029	16635.638	4530.000	10569.000	39.8	43.2
	V5	3	1223.333	551.907	318.644	-147.680	2594.346	856.000	1858.000	45.1	48.9
	V8	3	6624.667	1213.132	700.402	3611.080	9638.254	5652.000	7984.000	18.3	19.8
Hess Number of Taxa	V1	3	18.000	2.646	1.528	11.430	24.570	16.000	21.000	14.7	15.9
	V27	3	20.330	4.726	2.728	8.590	32.070	15.000	24.000	23.2	25.2
	V5	3	24.330	0.577	0.333	22.900	25.770	24.000	25.000	2.4	2.6
	V8	3	23.000	3.000	1.732	15.550	30.450	20.000	26.000	13.0	14.1
Hess EPT (%)	V1	3	66.843	10.012	5.780	41.972	91.713	59.080	78.140	15.0	16.2
	V27	3	79.718	3.702	2.137	70.522	88.913	75.680	82.960	4.6	5.0
	V5	3	46.455	18.411	10.629	0.721	92.190	26.960	63.550	39.6	42.9
	V8	3	28.100	6.033	3.483	13.114	43.086	23.360	34.890	21.5	23.3
Hess Chironomids (%)	V1	3	30.764	11.153	6.439	3.059	58.470	18.570	40.440	36.3	39.3
	V27	3	5.315	2.867	1.656	-1.808	12.438	2.800	8.440	53.9	58.4
	V5	3	40.305	13.651	7.882	6.393	74.216	25.700	52.740	33.9	36.7
	V8	3	63.204	7.620	4.399	44.276	82.132	54.490	68.640	12.1	13.1
Hess Simpson's D	V1	3	0.806	0.040	0.023	0.706	0.907	0.760	0.836	5.0	5.4
	V27	3	0.818	0.014	0.008	0.784	0.853	0.803	0.830	1.7	1.8
	V5	3	0.841	0.038	0.022	0.746	0.936	0.797	0.868	4.5	4.9
	V8	3	0.612	0.123	0.071	0.308	0.917	0.518	0.751	20.0	21.7
Hess Simpson's E	V1	3	0.303	0.091	0.052	0.078	0.528	0.199	0.360	29.9	32.4
	V27	3	0.280	0.053	0.031	0.148	0.411	0.235	0.338	18.9	20.5
	V5	3	0.268	0.063	0.036	0.112	0.425	0.197	0.316	23.4	25.4
	V8	3	0.122	0.046	0.026	0.009	0.236	0.089	0.175	37.4	40.5
Artificial Substrate Density (ind./m2)	V1	3	247.000	218.089	125.914	-294.764	788.764	81.000	494.000	88.3	95.7
	V27	3	675.000	524.458	302.796	-627.825	1977.825	335.000	1279.000	77.7	84.2
	V5	3	1735.667	470.789	271.810	566.162	2905.172	1401.000	2274.000	27.1	29.4
	V8	3	642.333	362.017	209.011	-256.967	1541.634	226.000	883.000	56.4	61.1
Artificial Substrate Number of Taxa	V1	3	18.330	4.726	2.728	6.590	30.070	13.000	22.000	25.8	27.9
	V27	3	23.330	2.517	1.453	17.080	29.580	21.000	26.000	10.8	11.7
	V5	3	21.000	1.732	1.000	16.700	25.300	20.000	23.000	8.2	8.9
	V8	3	21.670	5.859	3.383	7.110	36.220	15.000	26.000	27.0	29.3
Artificial Substrate EPT (%)	V1	3	71.989	11.536	6.661	43.331	100.647	60.931	83.951	16.0	17.4
	V27	3	89.243	7.535	4.350	70.526	107.960	80.597	94.404	8.4	9.1
	V5	3	57.050	10.404	6.007	31.205	82.895	47.318	68.016	18.2	19.8
	V8	3	64.007	10.990	6.345	36.706	91.308	56.059	76.549	17.2	18.6
Artificial Substrate Chironomids (%)	V1	3	24.178	8.170	4.717	3.883	44.473	16.049	32.389	33.8	36.6
	V27	3	6.651	8.507	4.911	-14.480	27.783	0.860	16.418	127.9	138.5
	V5	3	30.755	10.563	6.099	4.515	56.995	23.238	42.832	34.3	37.2
	V8	3	30.478	11.436	6.603	2.069	58.888	17.699	39.751	37.5	40.7
Art. Substrate Simpson's D	V1	3	0.862	0.027	0.016	0.794	0.930	0.836	0.891	3.2	3.4
	V27	3	0.863	0.032	0.019	0.783	0.943	0.826	0.887	3.7	4.0
	V5	3	0.871	0.020	0.012	0.821	0.921	0.853	0.893	2.3	2.5
	V8	3	0.859	0.027	0.016	0.791	0.927	0.832	0.887	3.2	3.5
Art. Substrate Simpson's E	V1	3	0.416	0.081	0.047	0.216	0.617	0.323	0.469	19.4	21.0
	V27	3	0.331	0.101	0.058	0.080	0.582	0.222	0.421	30.5	33.0
	V5	3	0.374	0.033	0.019	0.292	0.456	0.341	0.407	8.8	9.5
	V8	3	0.370	0.193	0.111	-0.109	0.849	0.229	0.590	52.2	56.5

Table D.9: Summary statistics for benthic community metrics based on artificial subtrates, Rose Creek 2008.

Five Stations per Area

						95% C. I. of Mean					Average CV
		n	Mean	Std. Deviation	Std. Error	lower	upper	Minimum	Maximum	CV %	for Method
Abundance	R2	5	1244.6000	1036.8977	463.7148	-42.8786	2532.0786	304.0000	2600.0000	83.3	
	R7	5	5275.8000	3352.8221	1499.4276	1112.7215	9438.8785	491.0000	9648.0000	63.6	
	X2	5	4122.4000	3309.1577	1479.9003	13.5380	8231.2620	1352.0000	9568.0000	80.3	
Number of Taxa	R2	5	21.6000	3.7150	1.6610	16.9900	26.2100	19.0000	27.0000	17.2	
	R7	5	19.0000	0.7070	0.3160	18.1200	19.8800	18.0000	20.0000	3.7	
	X2	5	16.6000	3.7820	1.6910	11.9000	21.3000	14.0000	23.0000	22.8	
Simpson's D (Krebs)	R2	5	0.8713	0.0071	0.0032	0.8625	0.8800	0.8635	0.8817	0.8	
	R7	5	0.7991	0.0430	0.0192	0.7457	0.8526	0.7400	0.8465	5.4	
	X2	5	0.7517	0.0813	0.0364	0.6507	0.8526	0.6174	0.8126	10.8	
Simpson's E (Smith & Wilson 1996)	R2	5	0.3665	0.0463	0.0207	0.3090	0.4241	0.3131	0.4177	12.6	
	R7	5	0.2706	0.0489	0.0219	0.2099	0.3314	0.2024	0.3258	18.1	
	X2	5	0.2697	0.0907	0.0406	0.1571	0.3823	0.1644	0.3777	33.6	
EPT (%)	R2	5	32.8219	11.2289	5.0217	18.8794	46.7644	23.0595	45.7498	34.2	
	R7	5	45.0204	11.6276	5.2000	30.5829	59.4580	38.5000	65.5804	25.8	
	X2	5	8.3755	4.4513	1.9907	2.8484	13.9025	3.2544	14.8699	53.1	
Chironomidae (%)	R2	5	52.0351	13.2924	5.9445	35.5304	68.5398	39.8462	69.5632	25.5	
	R7	5	44.2207	14.1601	6.3326	26.6387	61.8028	19.9593	53.3981	32.0	
	X2	5	85.4950	4.7824	2.1388	79.5568	91.4331	78.9963	92.0118	5.6	29.4

Three Stations per Area

						95% C. I. of Mean					Average CV
		n	Mean	Std. Deviation	Std. Error	lower	upper	Minimum	Maximum	CV %	for Method
Abundance	R2	3	509.6667	246.6342	142.3943	-103.0067	1122.3401	304.0000	783.1000	48.4	
	R7	3	4219.6667	3244.5450	1873.2389	-3840.2300	12279.5633	491.0000	6400.0000	76.9	
	X2	3	3145.3333	1575.0166	909.3363	-767.2248	7057.8915	1352.0000	4304.0000	50.1	
Number of Taxa	R2	3	20.6700	2.8870	1.6670	13.5000	27.8400	19.0000	24.0000	14.0	
	R7	3	19.0000	1.0000	0.5770	16.5200	21.4800	18.0000	20.0000	5.3	
	X2	3	15.3300	1.5280	0.8820	11.5400	19.1300	14.0000	17.0000	10.0	
Simpson's D (Krebs)	R2	3	0.8669	0.0036	0.0021	0.8579	0.8758	0.8635	0.8707	0.4	
	R7	3	0.8145	0.0390	0.0225	0.7176	0.9114	0.7711	0.8465	4.8	
	X2	3	0.7373	0.1050	0.0606	0.4765	0.9981	0.6174	0.8126	14.2	
Simpson's E (Smith & Wilson 1996)	R2	3	0.3673	0.0394	0.0227	0.2695	0.4651	0.3221	0.3943	10.7	
	R7	3	0.2903	0.0429	0.0247	0.1838	0.3967	0.2427	0.3258	14.8	
	X2	3	0.2687	0.0712	0.0411	0.0919	0.4456	0.1867	0.3140	26.5	
EPT (%)	R2	3	24.6840	1.8197	1.0506	20.1635	29.2045	23.0595	26.6505	7.4	
	R7	3	47.5460	15.6183	9.0172	8.7480	86.3440	38.5000	65.5804	32.8	
	X2	3	9.5335	5.8648	3.3861	-5.0355	24.1025	3.2544	14.8699	61.5	
Chironomidae (%)	R2	3	59.2757	12.4505	7.1883	28.3469	90.2044	45.4348	69.5632	21.0	
	R7	3	42.2024	19.2633	11.1217	-5.6502	90.0551	19.9593	53.3981	45.6	
	X2	3	84.9392	6.5809	3.7995	68.5913	101.2871	78.9963	92.0118	7.7	25.1

Table D.10: Summary statistics for benthic community metrics based on Hess samples, Rose Creek 2008.

Five Stations/Area

						95% C. I. of Mean					Average CV
		n	Mean	Std. Deviation	Std. Error	lower	upper	Minimum	Maximum	CV %	for Method
Density (individuals/m2)	BLC	5	6068.0000	2399.5933	1073.1307	3088.5114	9047.4886	2856.6667	9406.6667	39.5	
	R2	5	3663.3333	974.2718	435.7076	2453.6151	4873.0516	2496.6667	5130.0000	26.6	
	X2	5	9656.3333	4457.7274	1993.5563	4121.3337	15191.3330	4335.0000	15000.0000	46.2	
Number of Taxa	BLC	5	24.2000	1.9240	0.8600	21.8100	26.5900	21.0000	26.0000	8.0	
	R2	5	20.8000	1.3040	0.5830	19.1800	22.4200	19.0000	22.0000	6.3	
	X2	5	24.2000	5.4040	2.4170	17.4900	30.9100	15.0000	29.0000	22.3	
Simpson's D (Krebs)	BLC	5	0.5646	0.1703	0.0762	0.3531	0.7761	0.3863	0.8359	30.2	
	R2	5	0.8535	0.0501	0.0224	0.7912	0.9157	0.7877	0.8986	5.9	
	X2	5	0.7494	0.0451	0.0202	0.6934	0.8055	0.6997	0.8140	6.0	
Simpson's E (Smith & Wilson 1996)	BLC	5	0.1233	0.0942	0.0421	0.0063	0.2403	0.0627	0.2901	76.4	
	R2	5	0.3614	0.1216	0.0544	0.2104	0.5123	0.2141	0.4909	33.6	
	X2	5	0.1751	0.0420	0.0188	0.1230	0.2273	0.1332	0.2365	24.0	
EPT (%)	BLC	5	24.6705	16.7468	7.4894	3.8766	45.4643	12.7569	53.4422	67.9	
	R2	5	40.2352	11.0233	4.9298	26.5480	53.9224	30.0420	54.5809	27.4	
	X2	5	10.2854	6.2703	2.8042	2.4997	18.0710	5.4750	20.5937	61.0	
Chironomidae (%)	BLC	5	65.9428	21.1482	9.4577	39.6839	92.2017	29.1715	79.4313	32.1	
	R2	5	43.1288	11.8806	5.3132	28.3771	57.8805	29.8262	53.5284	27.5	
	X2	5	70.9020	11.4032	5.0997	56.7431	85.0610	58.4000	83.1355	16.1	30.9

Three Stations/Area

						95% C. I. of Mean					Average CV
		n	Mean	Std. Deviation	Std. Error	lower	upper	Minimum	Maximum	CV %	for Method
Density (individuals/m2)	BLC	3	6432.2222	3316.1161	1914.5605	-1805.4668	14669.9113	2856.6667	9406.6667	51.6	
	R2	3	3982.2222	1021.4061	589.7091	1444.9089	6519.5356	3173.3333	5130.0000	25.6	
	X2	3	11888.8889	4142.5560	2391.7058	1598.2093	22179.5685	7186.6667	15000.0000	34.8	
Number of Taxa	BLC	3	24.0000	2.6460	1.5280	17.4300	30.5700	21.0000	26.0000	11.0	
	R2	3	20.0000	1.0000	0.5770	17.5200	22.4800	19.0000	21.0000	5.0	
	X2	3	26.3300	2.3090	1.3330	20.6000	32.0700	25.0000	29.0000	8.8	
Simpson's D (Krebs)	BLC	3	0.5806	0.2309	0.1333	0.0071	1.1542	0.3863	0.8359	39.8	
	R2	3	0.8681	0.0480	0.0277	0.7489	0.9872	0.8128	0.8986	5.5	
	X2	3	0.7383	0.0363	0.0209	0.6482	0.8284	0.6997	0.7716	4.9	
Simpson's E (Smith & Wilson 1996)	BLC	3	0.1454	0.1258	0.0726	-0.1671	0.4578	0.0627	0.2901	86.5	
	R2	3	0.4092	0.1236	0.0714	0.1022	0.7163	0.2670	0.4909	30.2	
	X2	3	0.1467	0.0120	0.0069	0.1169	0.1765	0.1332	0.1560	8.2	
EPT (%)	BLC	3	26.9795	22.9388	13.2437	-30.0037	83.9627	12.7569	53.4422	85.0	
	R2	3	44.7066	12.9518	7.4777	12.5325	76.8806	30.0420	54.5809	29.0	
	X2	3	11.4172	8.0089	4.6239	-8.4779	31.3124	5.8358	20.5937	70.1	
Chironomidae (%)	BLC	3	62.1872	28.6019	16.5133	-8.8639	133.2383	29.1715	79.4313	46.0	
	R2	3	38.0172	13.2985	7.6779	4.9819	71.0526	29.8262	53.3613	35.0	
	X2	3	71.3818	10.9718	6.3346	44.1264	98.6373	61.4100	83.1355	15.4	32.9

Table D.11: Summary statistics for benthic community metrics based on three Hess versus kick samples per area, Rose Creek 2008

Hess

						95% C. I. of Mean					Average CV
		n	**Mean**	**Std. Deviation**	**Std. Error**	**lower**	**upper**	**Minimum**	**Maximum**	**CV %**	**for Method**
Density (individuals/m2)	BLC	3	6432.2222	3316.1161	1914.5605	-1805.4668	14669.9113	2856.6667	9406.6667	51.6	
	R2	3	3982.2222	1021.4061	589.7091	1444.9089	6519.5356	3173.3333	5130.0000	25.6	
	X2	3	11888.8889	4142.5560	2391.7058	1598.2093	22179.5685	7186.6667	15000.0000	34.8	
Number of Taxa	BLC	3	24.0000	2.6460	1.5280	17.4300	30.5700	21.0000	26.0000	11.0	
	R2	3	20.0000	1.0000	0.5770	17.5200	22.4800	19.0000	21.0000	5.0	
	X2	3	26.3300	2.3090	1.3330	20.6000	32.0700	25.0000	29.0000	8.8	
Simpson's D (Krebs)	BLC	3	0.5806	0.2309	0.1333	0.0071	1.1542	0.3863	0.8359	39.8	
	R2	3	0.8681	0.0480	0.0277	0.7489	0.9872	0.8128	0.8986	5.5	
	X2	3	0.7383	0.0363	0.0209	0.6482	0.8284	0.6997	0.7716	4.9	
Simpson's E (Smith & Wilson 1996)	BLC	3	0.1454	0.1258	0.0726	-0.1671	0.4578	0.0627	0.2901	86.5	
	R2	3	0.4092	0.1236	0.0714	0.1022	0.7163	0.2670	0.4909	30.2	
	X2	3	0.1467	0.0120	0.0069	0.1169	0.1765	0.1332	0.1560	8.2	
EPT (%)	BLC	3	26.9795	22.9388	13.2437	-30.0037	83.9627	12.7569	53.4422	85.0	
	R2	3	44.7066	12.9518	7.4777	12.5325	76.8806	30.0420	54.5809	29.0	
	X2	3	11.4172	8.0089	4.6239	-8.4779	31.3124	5.8358	20.5937	70.1	
Chironomidae (%)	BLC	3	62.1872	28.6019	16.5133	-8.8639	133.2383	29.1715	79.4313	46.0	
	R2	3	38.0172	13.2985	7.6779	4.9819	71.0526	29.8262	53.3613	35.0	
	X2	3	71.3818	10.9718	6.3346	44.1264	98.6373	61.4100	83.1355	15.4	
Hess 3 rep 2008 CA-1 (37.6%)	BLC	3	-0.5336	0.1102	0.0636	-0.8073	-0.2598	-0.6597	-0.4560	20.7	
	R2	3	-0.0700	0.0372	0.0215	-0.1624	0.0225	-0.1053	-0.0311	53.2	
	X2	3	0.4425	0.1098	0.0634	0.1697	0.7154	0.3237	0.5403	24.8	
Hess 3 rep 2008 CA-2 (23.9%)	BLC	3	0.2535	0.0936	0.0540	0.0211	0.4859	0.1510	0.3343	36.9	
	R2	3	-0.4681	0.2335	0.1348	-1.0482	0.1120	-0.6841	-0.2203	49.9	
	X2	3	0.1628	0.0711	0.0410	-0.0138	0.3394	0.0819	0.2153	43.7	
Hess 3 rep 2008 CA-3 (11.4%)	BLC	3	0.0212	0.4546	0.2625	-1.1081	1.1505	-0.3426	0.5308	2147.7	
	R2	3	0.0205	0.0681	0.0393	-0.1487	0.1897	-0.0202	0.0991	332.8	
	X2	3	-0.0115	0.2093	0.1208	-0.5314	0.5083	-0.1944	0.2167	1814.5	189.5

Kick and Sweep

						95% C. I. of Mean					Average CV
		n	Mean	Std. Deviation	Std. Error	lower	upper	Minimum	Maximum	CV %	for Method
Density (individuals/m2)	BLC	3	600.3333	330.3897	190.7506	-220.4001	1421.0668	239.0000	887.0000	55.0	
	R2	3	510.6667	116.0704	67.0133	222.3319	799.0015	397.0000	629.0000	22.7	
	X2	3	2192.3333	1200.4584	693.0850	-789.7706	5174.4373	1357.0000	3568.0000	54.8	
Number of Taxa	BLC	3	21.3300	5.1320	2.9630	8.5900	34.0800	17.0000	27.0000	24.1	
	R2	3	23.6700	2.0820	1.2020	18.5000	28.8400	22.0000	26.0000	8.8	
	X2	3	24.3300	4.9330	2.8480	12.0800	36.5900	21.0000	30.0000	20.3	
Simpson's D (Krebs)	BLC	3	0.7825	0.0439	0.0253	0.6735	0.8915	0.7548	0.8331	5.6	
	R2	3	0.8693	0.0237	0.0137	0.8104	0.9282	0.8420	0.8849	2.7	
	X2	3	0.7813	0.0783	0.0452	0.5867	0.9758	0.6962	0.8504	10.0	
Simpson's E (Smith & Wilson 1996)	BLC	3	0.2317	0.0751	0.0433	0.0453	0.4182	0.1511	0.2995	32.4	
	R2	3	0.3311	0.0602	0.0347	0.1816	0.4805	0.2752	0.3948	18.2	
	X2	3	0.2012	0.0385	0.0223	0.1055	0.2970	0.1568	0.2242	19.2	
EPT (%)	BLC	3	54.8597	14.1503	8.1697	19.7083	90.0111	45.4222	71.1297	25.8	
	R2	3	68.7727	7.4605	4.3073	50.2398	87.3055	62.6391	77.0781	10.8	
	X2	3	20.7577	17.4011	10.0465	-22.4690	63.9845	8.5202	40.6780	83.8	
Chironomidae (%)	BLC	3	38.8849	15.7793	9.1102	-0.3130	78.0829	21.3389	51.9111	40.6	
	R2	3	21.9029	6.5247	3.7671	5.6945	38.1112	14.6096	27.1860	29.8	
	X2	3	63.7415	12.1657	7.0239	33.5203	93.9628	49.7421	71.7489	19.1	
KS 3 rep 2008 CA-1 (42.4%)	BLC	3	-0.4817	0.0351	0.0203	-0.5689	-0.3945	-0.5211	-0.4538	7.3	
	R2	3	-0.0703	0.1474	0.0851	-0.4364	0.2959	-0.2400	0.0260	209.8	
	X2	3	0.3572	0.1534	0.0885	-0.0238	0.7382	0.1866	0.4837	42.9	
KS 3 rep 2008 CA-2 (19.7%)	BLC	3	0.1619	0.3182	0.1837	-0.6285	0.9523	-0.2052	0.3585	196.6	
	R2	3	-0.2715	0.0639	0.0369	-0.4302	-0.1128	-0.3439	-0.2230	23.5	
	X2	3	0.0843	0.1781	0.1028	-0.3581	0.5267	-0.0425	0.2879	211.3	
KS 3 rep 2008 CA-3 (13.9%)	BLC	3	-0.0685	0.3498	0.2020	-0.9375	0.8006	-0.4718	0.1530	510.9	
	R2	3	0.1303	0.1862	0.1075	-0.3323	0.5929	0.0018	0.3438	142.9	
	X2	3	-0.0360	0.1641	0.0948	-0.4438	0.3717	-0.2135	0.1104	455.5	84.6

Table D.12: Summary statistics for exposure (5 stations/area) versus reference (single station in each of 6 areas) comparisons based on Hess samples

						95% C. I. of Mean					Average CV
		n	Mean	Std. Deviation	Std. Error	lower	upper	Minimum	Maximum	CV %	for Method
Density (individuals/m2)	Reference	6	4634.3333	3041.8845	1241.8442	1442.0713	7826.5954	1607.0000	8120.0000	65.6	
	V27 Exposure	5	8518.0000	2373.8327	1061.6102	5570.4974	11465.5026	4530.0000	10569.0000	27.9	
	V5 Exposure	5	1323.6000	444.5231	198.7968	771.6517	1875.5483	856.0000	1858.0000	33.6	
	V8 Exposure	5	5967.8000	2248.2845	1005.4634	3176.1861	8759.4139	2333.0000	7984.0000	37.7	
Number of Taxa	Reference	6	20.8667	2.6128	1.0667	18.1247	23.6086	17.0000	24.2000	12.5	
	V27 Exposure	5	20.8000	4.0866	1.8276	15.7259	25.8741	15.0000	26.0000	19.6	
	V5 Exposure	5	22.4000	1.6733	0.7483	20.3223	24.4777	20.0000	24.0000	7.5	
	V8 Exposure	5	19.0000	2.4495	1.0955	15.9586	22.0414	16.0000	22.0000	12.9	
Simpson's D	Reference	6	0.6830	0.1823	0.0744	0.4917	0.8743	0.4140	0.8840	26.7	
	V27 Exposure	5	0.8306	0.0227	0.0101	0.8024	0.8587	0.8127	0.8683	2.7	
	V5 Exposure	5	0.8595	0.0338	0.0151	0.8175	0.9015	0.8040	0.8931	3.9	
	V8 Exposure	5	0.6270	0.1280	0.0572	0.4681	0.7859	0.4922	0.8145	20.4	
Simpson's E (Smith & Wilson 1996)	Reference	6	0.2100	0.1113	0.0454	0.0932	0.3268	0.0900	0.3760	53.0	
	V27 Exposure	5	0.2933	0.0431	0.0193	0.2397	0.3468	0.2431	0.3558	14.7	
	V5 Exposure	5	0.3304	0.0620	0.0277	0.2535	0.4074	0.2320	0.3896	18.8	
	V8 Exposure	5	0.1588	0.0612	0.0274	0.0827	0.2348	0.1102	0.2567	38.6	
EPT (%)	Reference	6	32.5433	25.4557	10.3923	5.8292	59.2575	7.6000	73.1000	78.2	
	V27 Exposure	5	79.0438	2.7814	1.2439	75.5903	82.4974	75.6800	82.9600	3.5	
	V5 Exposure	5	45.4044	13.4173	6.0004	28.7446	62.0641	26.9600	63.5500	29.6	
	V8 Exposure	5	30.1802	10.5215	4.7054	17.1161	43.2444	20.3100	46.2900	34.9	
Chironomidae (%)	Reference	6	58.3900	25.1160	10.2536	32.0324	84.7476	20.7000	84.9000	43.0	
	V27 Exposure	5	6.2044	2.3662	1.0582	3.2664	9.1424	2.8000	8.4400	38.1	
	V5 Exposure	5	38.7236	10.7673	4.8153	25.3543	52.0930	25.7000	52.7400	27.8	
	V8 Exposure	5	60.7939	11.6004	5.1879	46.3901	75.1977	43.4200	70.9400	19.1	27.9
VC Hess RCA C/I CA-1 (21.6%)	Reference	6	0.3409	0.2548	0.1040	0.0735	0.6083	-0.0995	0.6645	74.7	
	V27 Exposure	5	-0.4491	0.0197	0.0088	-0.4735	-0.4246	-0.4805	-0.4275	4.4	
	V5 Exposure	5	0.4365	0.1206	0.0539	0.2868	0.5863	0.2574	0.5796	27.6	
	V8 Exposure	5	-0.2535	0.1616	0.0723	-0.4542	-0.0528	-0.5015	-0.0706	63.8	
VC Hess RCA C/I CA-2 (15.9%)	Reference	6	0.1222	0.4679	0.1910	-0.3688	0.6132	-0.7543	0.4426	382.9	
	V27 Exposure	5	-0.2793	0.0525	0.0235	-0.3445	-0.2141	-0.3451	-0.2115	18.8	
	V5 Exposure	5	-0.2695	0.0838	0.0375	-0.3736	-0.1655	-0.3736	-0.1452	31.1	
	V8 Exposure	5	0.3498	0.1159	0.0518	0.2059	0.4937	0.1533	0.4373	33.1	
VC Hess RCA C/I CA-3 (10.8%)	Reference	6	-0.2541	0.1885	0.0769	-0.4519	-0.0563	-0.5930	-0.0978	74.2	
	V27 Exposure	5	-0.1574	0.0612	0.0274	-0.2334	-0.0813	-0.2059	-0.0611	38.9	
	V5 Exposure	5	0.2598	0.1078	0.0482	0.1259	0.3937	0.1429	0.3947	41.5	
	V8 Exposure	5	0.2704	0.2676	0.1197	-0.0619	0.6027	-0.0372	0.5577	99.0	
VC Hess RCA C/I CA-4 (8.4%)	Reference	6	-0.0641	0.1526	0.0623	-0.2242	0.0960	-0.3102	0.1122	238.0	
	V27 Exposure	5	-0.0338	0.3765	0.1684	-0.5013	0.4336	-0.6542	0.3262	1112.5	
	V5 Exposure	5	0.0303	0.1025	0.0458	-0.0969	0.1575	-0.1304	0.1237	338.2	
	V8 Exposure	5	0.1125	0.3171	0.1418	-0.2812	0.5063	-0.2701	0.5919	281.8	88.3

Table D.13: Summary statistics for exposure (5 stations/area) versus reference (single station in each of 10 areas) comparisons based on Hess samples

						95% C. I. of Mean					Average CV
		n	Mean	Std. Deviation	Std. Error	lower	upper	Minimum	Maximum	CV %	for Method
Density (individuals/m2)	Reference	10	4648.8000	2843.5299	899.2031	2614.6612	6682.9388	510.0000	8120.0000	61.2	
	X2 Exposure	5	9656.3333	4457.7274	1993.5563	4121.3337	15191.3330	4335.0000	15000.0000	46.2	
	R2 Exposure	5	3663.3333	974.2718	435.7076	2453.6151	4873.0516	2496.6700	5130.0000	26.6	
Number of Taxa	Reference	10	22.2200	4.3507	1.3758	19.1077	25.3323	17.0000	32.0000	19.6	
	X2 Exposure	5	24.2000	5.4037	2.4166	17.4904	30.9096	15.0000	29.0000	22.3	
	R2 Exposure	5	20.8000	1.3038	0.5831	19.1811	22.4189	19.0000	22.0000	6.3	
Simpson's D	Reference	10	0.7539	0.1541	0.0487	0.6436	0.8642	0.4140	0.9080	20.4	
	X2 Exposure	5	0.7494	0.0451	0.0202	0.6934	0.8055	0.6997	0.8140	6.0	
	R2 Exposure	5	0.8535	0.0501	0.0224	0.7912	0.9157	0.7877	0.8986	5.9	
Simpson's E (Smith & Wilson 1996)	Reference	10	0.2407	0.0906	0.0287	0.1759	0.3055	0.0900	0.3760	37.7	
	X2 Exposure	5	0.1751	0.0420	0.0188	0.1230	0.2273	0.1332	0.2365	24.0	
	R2 Exposure	5	0.3614	0.1216	0.0544	0.2104	0.5123	0.2142	0.4909	33.6	
EPT (%)	Reference	10	36.3160	19.7019	6.2303	22.2221	50.4099	7.6000	76.8000	54.3	
	X2 Exposure	5	10.2854	6.2703	2.8042	2.4997	18.0710	5.4800	20.5900	61.0	
	R2 Exposure	5	40.2352	11.0233	4.9298	26.5480	53.9224	30.0400	54.5800	27.4	
Chironomidae (%)	Reference	10	44.9840	23.7511	7.5108	27.9935	61.9745	12.8000	82.8000	52.8	
	X2 Exposure	5	70.9020	11.4032	5.0997	56.7431	85.0610	58.4000	83.1400	16.1	
	R2 Exposure	5	43.1288	11.8806	5.3132	28.3771	57.8805	29.8300	53.5300	27.5	30.5
URC Hess RCA C/I CA-1 (18.5%)	Reference	10	0.1869	0.2703	0.0855	-0.0065	0.3803	-0.3730	0.6477	144.6	
	X2 Exposure	5	-0.3849	0.2662	0.1190	-0.7154	-0.0544	-0.6965	-0.0172	69.1	
	R2 Exposure	5	0.1148	0.0946	0.0423	-0.0026	0.2322	-0.0386	0.2024	82.4	
URC Hess RCA C/I CA-2 (14.5%)	Reference	10	0.0917	0.3164	0.1000	-0.1346	0.3180	-0.3078	0.7185	345.0	
	X2 Exposure	5	0.0903	0.1224	0.0547	-0.0616	0.2422	-0.0956	0.2176	135.5	
	R2 Exposure	5	-0.3715	0.1512	0.0676	-0.5593	-0.1838	-0.5357	-0.1341	40.7	
URC Hess RCA C/I CA-3 (11.6%)	Reference	10	-0.0587	0.4611	0.1458	-0.3885	0.2712	-1.0455	0.2721	786.1	
	X2 Exposure	5	0.0907	0.1636	0.0731	-0.1123	0.2938	-0.0782	0.2966	180.2	
	R2 Exposure	5	-0.0600	0.0822	0.0367	-0.1620	0.0420	-0.1477	0.0442	136.9	
URC Hess RCA C/I CA-4 (10.3%)	Reference	10	-0.1118	0.3560	0.1126	-0.3664	0.1429	-0.7155	0.3649	318.5	
	X2 Exposure	5	0.0270	0.2289	0.1024	-0.2572	0.3112	-0.2215	0.3030	848.4	
	R2 Exposure	5	0.1624	0.1151	0.0515	0.0195	0.3053	-0.0288	0.2413	70.9	123.6

Table D.14: Summary statistics for exposure (3 stations/area) versus reference (single station in each of 10 areas) comparisons based on Kick samples

						95% C. I. of Mean					Average CV
		n	Mean	Std. Deviation	Std. Error	lower	upper	Minimum	Maximum	CV %	for Method
Density (individuals/m2)	Reference	10	822.4300	709.8417	224.4717	314.6398	1330.2202	63.0000	1969.0000	86.3	
	X2 Exposure	3	2192.3333	1200.4584	693.0850	-789.7706	5174.4373	1357.0000	3568.0000	54.8	
	R2 Exposure	3	510.6667	116.0704	67.0133	222.3319	799.0015	397.0000	629.0000	22.7	
Number of Taxa	Reference	10	19.6800	3.7847	1.1968	16.9726	22.3874	14.0000	26.0000	19.2	
	X2 Exposure	3	24.3333	4.9329	2.8480	12.0794	36.5873	21.0000	30.0000	20.3	
	R2 Exposure	3	23.6667	2.0817	1.2019	18.4955	28.8378	22.0000	26.0000	8.8	
Simpson's D	Reference	10	0.8390	0.0312	0.0099	0.8167	0.8613	0.7830	0.8770	3.7	
	X2 Exposure	3	0.7813	0.0783	0.0452	0.5867	0.9758	0.6962	0.8504	10.0	
	R2 Exposure	3	0.8693	0.0237	0.0137	0.8104	0.9282	0.8420	0.8849	2.7	
Simpson's E (Smith & Wilson 1996)	Reference	10	0.3469	0.1154	0.0365	0.2644	0.4294	0.1910	0.5830	33.3	
	X2 Exposure	3	0.2012	0.0385	0.0223	0.1055	0.2970	0.1568	0.2242	19.2	
	R2 Exposure	3	0.3311	0.0602	0.0347	0.1816	0.4805	0.2752	0.3948	18.2	
EPT (%)	Reference	10	59.0080	19.2753	6.0954	45.2193	72.7967	22.2000	85.5000	32.7	
	X2 Exposure	3	20.7577	17.4011	10.0465	-22.4690	63.9845	8.5200	40.6800	83.8	
	R2 Exposure	3	68.7727	7.4605	4.3073	50.2398	87.3055	62.6400	77.0800	10.8	
Chironomidae (%)	Reference	10	26.0320	12.7012	4.0165	16.9461	35.1179	11.3000	43.3000	48.8	
	X2 Exposure	3	63.7415	12.1657	7.0239	33.5203	93.9628	49.7400	71.7500	19.1	
	R2 Exposure	3	21.9029	6.5247	3.7671	5.6945	38.1112	14.6100	27.1900	29.8	29.1
URC K&S RCA C/I CA-1 (26.2%)	Reference	10	-0.2122	0.2046	0.0647	-0.3585	-0.0658	-0.5098	0.0724	96.5	
	X2 Exposure	3	0.4846	0.1677	0.0968	0.0679	0.9013	0.2960	0.6171	34.6	
	R2 Exposure	3	0.1325	0.2263	0.1307	-0.4297	0.6946	-0.0949	0.3577	170.8	
URC K&S RCA C/I CA-2 (15.7%)	Reference	10	0.0375	0.3932	0.1243	-0.2438	0.3188	-0.5667	0.5110	1049.1	
	X2 Exposure	3	-0.0434	0.1060	0.0612	-0.3068	0.2200	-0.1658	0.0206	244.3	
	R2 Exposure	3	0.0555	0.0947	0.0546	-0.1796	0.2906	-0.0079	0.1643	170.5	
URC K&S RCA C/I CA-3 (13.7%)	Reference	10	-0.0906	0.3027	0.0957	-0.3072	0.1259	-0.6601	0.4833	334.0	
	X2 Exposure	3	0.1917	0.1354	0.0782	-0.1446	0.5280	0.0986	0.3470	70.6	
	R2 Exposure	3	-0.2152	0.0732	0.0423	-0.3971	-0.0333	-0.2774	-0.1345	34.0	
URC K&S RCA C/I CA-4 (8.9%)	Reference	10	-0.1198	0.2799	0.0885	-0.3200	0.0804	-0.5795	0.4012	233.6	
	X2 Exposure	3	0.0263	0.2118	0.1223	-0.4998	0.5523	-0.1492	0.2615	806.2	
	R2 Exposure	3	0.0531	0.0771	0.0445	-0.1384	0.2445	-0.0328	0.1162	145.2	130.5

Table D.15: Scores for benthic taxa from CA of Hess samples at Vangorda Creek study areas (V1, V27, V5, V8), 2007 (5 stations/area).

Taxon	Hess Sampler CA Axis-1 (24.4%)	Hess Sampler CA Axis-2 (17.2%)	Hess Sampler CA Axis-3 (14.7%)	Hess Sampler CA Axis-4 (8.5%)
Ameletus sp.	0.507	-0.664	0.100	-0.174
Baetis bicaudatus + Baetis sp.	0.113	-0.164	-0.019	-0.153
Family Heptageniidae (including identified Rhithrogena sp. Cinygmula sp. Epeorus sp.)	0.055	-0.139	0.075	-0.073
Family Ephemerellidae (including identified Drunella coloradensis, D. doddsi)	0.350	-0.329	0.326	0.060
Family Chloroperlidae (including identified Sweltsa sp., Suwallia sp., Alloperla fratema, Paraperla sp.)	0.011	-0.150	0.082	-0.149
Family Perlodidae (including identified Megarcys sp., Skwala sp.)	-0.497	-0.347	0.582	-0.431
Zapada spp. (including identified Z. columbiana, Z. cinctipes, Z. haysi/orogenesis	0.077	-0.052	0.080	-0.054
Family: Capniidae	-0.026	-0.033	0.078	-0.046
Family: Leuctridae	0.262	0.181	-0.061	-0.013
Family Hydropsychidae (including identified Parapsyche sp., Hydropsyche sp.)	0.035	0.037	-0.029	0.126
Rhyacophila sp.	-0.058	0.116	-0.010	-0.023
Hydroptila sp.	0.485	1.578	0.487	0.206
Glossosoma sp.	-0.059	-0.415	-0.213	-0.160
Family: Limnephilidae (including identified Ecclisomyia sp.)	0.250	0.228	-0.068	0.613
Tanytarsus sp.	0.913	-0.912	-0.952	0.957
Brillia sp.	0.893	-0.923	-0.936	0.927
Chaetocladius sp.	0.427	-0.033	-0.065	0.775
Cricotopus/Orthocladius sp. A	-0.128	0.127	0.211	0.011
Eukiefferiella sp.	-0.399	-0.293	0.352	0.169
Synorthocladius sp.	0.803	1.418	-0.288	-1.324
Tvetenia sp.	0.429	-0.454	-1.317	-0.075
Diamesa sp.	-1.703	0.159	-0.689	-0.023
Pagastia sp.	-0.673	-0.452	0.518	-0.083
Thiennemannimyia Group	0.989	0.514	-0.792	-1.404
Pericoma sp.	-0.532	0.555	-0.482	0.260
Chelifera/Metachela	0.085	0.655	-0.153	0.142
Oreogeton sp.	0.640	-0.218	-0.423	-0.235
Dicranota sp.	-0.295	0.329	-0.017	0.292
Gonomyodes sp.	-1.840	0.252	-1.115	0.202
Family Simuliidae (including identified Prosimulium sp.)	-0.186	-0.270	-0.348	-0.192
Order: Collembola	-1.708	0.136	-0.742	-0.069
Phylum: Nematoda	0.145	0.455	0.094	0.211
Class: Oligochaeta	-1.338	0.109	-0.492	-0.043
Aturus	0.391	0.458	-0.223	0.196
Hygrobates	-0.009	-0.363	1.599	0.350
Lebertia	0.510	0.381	0.589	-0.213
Sperchon	0.144	0.246	0.110	0.052
Feltria	-0.438	0.305	0.041	-0.049

Table D.16: Scores for benthic taxa from CA of artificial substrate samples at Vangorda Creek study areas (V1, V27, V5, V8), 2007 (5 stations/area).

Taxon	Artificial Substrate CA-1 (23.8%)	Artificial Substrate CA-2 (13.5%)	Artificial Substrate CA-3 (12.5%)	Artificial Substrate CA-4 (9.9%)
Ameletus sp.	-1.217	0.219	-0.619	1.854
Baetis sp.	-0.268	0.145	0.049	-0.247
Rhithrogena sp;	-0.701	-0.153	0.146	-0.010
Cinygmula sp.	-1.029	-0.257	-0.233	0.116
Epeorus sp.	-0.116	-0.060	-0.025	-0.066
Ephemerellidae (Drunella doddsi, D. coloradensis, D. spinifera, Serratella tibialis, unid. Ephemerellidae)	-0.635	-0.092	-0.123	0.471
Family: Chloroperlidae	0.059	-0.307	-0.794	-0.197
Family: Perlodidae	-0.064	-0.178	0.045	-0.234
Zapada haysi/orogenensis	-0.009	0.015	0.002	-0.025
Zapada columbiana	0.069	0.123	0.109	-0.078
Zapada cinctipes	0.522	0.659	0.739	0.615
Taenionema sp	0.057	-0.633	-0.055	-0.155
Family: Capniidae	0.213	-0.077	-0.130	0.187
Family: Hydropsychidae (include Arctopsyche, Parapsyche, Hydropsyche)	-0.007	-0.039	0.062	-0.082
Rhyacophila sp.	0.138	-0.084	-0.041	-0.087
Glossosoma sp.	-1.065	0.288	-0.269	-0.360
Family: Limnephilidae (includes Ecclisomyia)	0.041	0.635	-0.321	0.165
Oligophleboides sp.	-0.876	-0.795	-0.509	-0.672
Brillia sp.	0.137	0.325	0.172	0.058
Chaetocladius sp.	0.309	-0.632	0.440	0.276
Cricotopus/Orthocladius sp. A	0.089	0.107	-0.009	0.235
Eukiefferiella sp.	0.002	0.243	-0.086	-0.107
Pagastia sp.	0.085	0.842	0.118	-0.320
Pericoma sp.	0.823	-0.152	-0.504	0.016
Family: Empididae	0.208	0.265	0.067	-0.142
Dicranota sp.	1.030	-0.509	0.232	0.150
Family Simuliidae (includes pupae and Simulium and Prosimulium larvae)	0.114	0.132	-0.047	-0.164
Family : Stratiomyiidae	1.257	-0.180	-1.142	0.112
Order: Collembola	0.782	-0.980	0.213	0.162
Class: Oligochaeta	0.400	0.823	-0.190	0.000
Aturus	-0.153	-0.302	0.950	-0.086
Sperchon	-0.057	0.110	0.493	-0.094
Feltria	1.035	0.076	-0.945	0.110

Table D.17: Taxon scores from Correspondence Analysis (CA) of means of 47 Areas, all sample types, at Faro Mine Site, 2007 - 2008 combined.

Taxa	ASY Mean CA-1 (18.6%)	ASY Mean CA-2 (11.0%)	ASY Mean CA-3 (9.8%)	ASY Mean CA-4 (8.8%)	ASY Mean CA-5 (7.7%)
Ameletidae	0.1084	-0.2915	0.4670	-0.2664	0.5855
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	-0.0294	-0.0353	0.0238	-0.0809	-0.2770
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	0.2804	-0.0891	0.0584	0.0133	0.0665
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	0.2582	0.0700	0.1453	0.2323	0.0921
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	0.2795	-0.1678	0.3055	0.0705	0.2465
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	0.1062	0.1698	-0.1753	0.1481	-0.0309
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	0.0548	-0.0465	-0.0281	0.0254	-0.0533
Capniidae	0.2713	-0.0553	0.0878	0.0179	-0.1008
Leuctridae	0.3261	-0.3545	-0.0272	0.2325	0.8119
Taeniopterygidae (includes Taenionema sp. ID'd)	0.4204	0.1543	-0.4297	0.1436	-0.3468
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	0.2885	-0.1207	-0.4186	0.0246	-0.0104
Rhyacophila sp.	0.4723	-0.1831	0.0010	-0.2328	0.0351
Glossosoma sp.	-0.1057	0.2050	-0.4801	0.0538	0.2876
Micrasema sp.	-1.7086	0.7757	-0.2148	-1.2268	0.3072
Brachycentrus sp.	-1.3949	1.0698	-1.2106	0.1108	-0.3110
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	-0.3640	-0.6875	0.4127	-0.3582	0.2340
Dicranota sp.	-0.0927	-0.3254	0.1327	0.0945	0.4603
Bezzia/Palpomyia sp.	0.1880	0.6968	0.3068	0.0932	0.0302
Psychodidae	0.3242	-0.0286	-0.1869	-0.0330	-0.4153
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	-0.0481	-0.2132	0.0248	-0.0818	0.1336
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	-0.0151	0.1914	-0.0929	-0.0365	-0.3992
Tanytarsini (Tribe)	-1.0433	0.1376	-0.1382	-0.9929	0.1732
Rheotanytarsus sp.	-0.6109	-0.3794	-0.1516	1.1258	-0.5559
Brillia sp.	1.0931	-1.0855	-1.3839	-1.2941	-0.2333
Chaetocladius sp.	0.9836	-0.9438	-0.8876	-1.1435	-0.4351
Corynoneura sp.	0.4392	-0.2780	1.4548	-0.1293	-0.2133
Cricotopus/Orthocladius sp.	0.0681	0.1384	-0.1360	0.0746	0.1468
Eukiefferiella sp.	0.0217	0.1732	-0.0796	0.0270	-0.1105
Synorthocladius sp.	0.4298	0.2067	-0.0430	-0.2026	0.7627
Thienemanniella sp.	0.1338	1.2967	0.3671	-0.3168	0.2437
Tvetenia sp.	-0.5817	-0.7353	0.2590	0.0937	-0.3801
Diamesa sp.	0.2401	0.7163	1.2490	-0.8044	-0.8338
Pagastia sp.	0.2079	0.2518	-0.0252	0.1850	-0.0140
Tanypodinae	-0.9569	0.5092	-0.2281	-0.4750	0.4491
Collembola	0.2557	0.0208	-0.0366	0.3922	0.2122
Ostracoda	-0.6977	0.5092	-0.2339	0.1450	0.0931
Copepoda	-2.0197	-0.8610	0.0684	-0.2349	-0.1309
Oligochaeta	-0.3315	0.1002	0.0727	0.0805	-0.0253
Nematoda	-0.2982	-0.0330	0.1617	0.1496	0.2138
Gastropoda (includes Physa [=Physella?], Planorbidae, Valvatidae, and Gastropoda UID)	-2.0927	-1.1757	0.1330	0.1790	-0.3225
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	-0.0779	0.0344	0.0212	0.0705	0.0447

Table D.18: Taxon scores from Correspondence Analysis (CA) of X2, R2, BLC stations (3 stations/area), kick samples taken at Faro Mine.

Taxa	KS 3 rep 2008 CA-1 (42.4%)	KS 3 rep 2008 CA-2 (19.7%)	KS 3 rep 2008 CA-3 (13.9%)	KS 3 rep 2008 CA-4 (10.4%)
Ameletidae	-0.9735	1.1205	0.5873	0.3894
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	-0.0887	-0.2567	0.1070	-0.1374
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	-0.3601	-0.0970	0.1611	-0.0894
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	-0.1442	-0.0787	-0.0218	-0.0033
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	-0.5696	-0.2900	0.2478	-0.1270
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	-0.1892	-0.1955	-0.2493	-0.1303
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	0.0287	-0.0145	-0.1209	-0.0304
Capniidae	-0.2096	-0.0094	0.0387	0.0107
Taeniopterygidae (includes Taenionema sp. ID'd)	-0.6135	0.1663	-0.0754	0.4540
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	-0.1139	1.0621	0.0213	-0.2182
Rhyacophila sp.	-0.0774	0.2616	-0.1564	0.2393
Glossosoma sp.	0.5876	-0.3584	0.3597	0.7566
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	-1.3764	0.4065	-0.7487	0.4130
Dicranota sp.	-0.6044	-0.9010	-0.7166	0.0795
Bezzia/Palpomyia sp.	0.4097	0.1402	0.1093	-0.2965
Psychodidae	-0.8074	0.3299	0.5555	-0.0055
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	-0.0604	0.0384	0.0812	-0.3531
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	0.2415	-0.0716	0.2419	0.0433
Cricotopus/Orthocladius sp.	-0.0606	0.0927	-0.1177	0.0420
Eukiefferiella sp.	0.0866	0.0318	-0.1579	0.0743
Thienemanniella sp.	0.9578	0.3081	-0.1263	0.1174
Diamesa sp.	0.5264	-0.4723	0.4239	0.3866
Pagastia sp.	0.2646	-0.1729	-0.3359	-0.0324
Tanypodinae	0.6880	-0.0827	0.2185	-0.1721
Ostracoda	0.3959	0.4493	0.0739	0.0210
Oligochaeta	0.3479	0.2238	0.0638	-0.1283
Nematoda	0.0876	-0.0270	-0.2555	-0.0135
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	0.1464	0.1123	-0.0139	-0.0218

Table D.19: Taxon scores from Correspondence Analysis (CA) of X2, R2, BLC stations (3 stations/area), Hess samples taken at Faro Mine.

Taxa	Hess 3 rep 2008 CA-1 (37.6%)	Hess 3 rep 2008 CA-2 (23.9%)	Hess 3 rep 2008 CA-3 (11.4%)
Ameletidae	0.5395	0.4376	0.0757
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	-0.0506	-0.3603	0.1223
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	-0.1909	-0.0848	0.1291
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	-0.1237	-0.1563	0.0145
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	-0.3162	-0.3147	0.1391
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	-0.4177	-0.1121	0.1965
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	0.0194	-0.0314	0.0500
Capniidae	-0.2046	-0.0632	0.0335
Leuctridae	-0.3217	-1.4379	-0.1604
Taeniopterygidae (includes Taenionema sp. ID'd)	0.2169	0.6153	1.1394
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	-0.5068	-0.3148	-0.3268
Rhyacophila sp.	-0.0844	0.0017	0.1537
Glossosoma sp.	0.8854	0.3769	0.3603
Hydroptilidae (includes Hydroptila sp., Oxyethira sp., Stactobiella sp., Hydroptila pupae)	-1.3239	0.8348	0.1328
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	-0.0444	0.5536	0.1656
Dicranota sp.	0.6588	0.0631	0.2532
Bezzia/Palpomyia sp.	-0.0699	-0.1152	-0.3621
Psychodidae	-0.9271	0.7843	0.1117
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	-0.1022	0.0957	0.0732
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	0.4398	-0.5173	0.0320
Rheotanytarsus sp.	-1.4119	0.6765	-1.1079
Cricotopus/Orthocladius sp.	-0.0999	0.0470	-0.0332
Eukiefferiella sp.	0.3375	-0.0180	0.0760
Synorthocladius sp.	1.2003	0.6124	-0.5572
Thienemanniella sp.	1.1176	0.5424	-0.2723
Diamesa sp.	1.0778	0.5009	-0.0929
Pagastia sp.	0.1581	-0.2544	-0.2348
Tanypodinae	0.6538	-0.3417	-0.1364
Ostracoda	-0.0530	0.5056	-0.1673
Oligochaeta	-0.0402	0.2940	0.1322
Nematoda	-0.0341	-0.0029	0.0189
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	0.0204	0.1464	-0.1153

Table D.20: Taxon scores in CA for Hess samples in RCA (X2, R2 means versus reference areas)

Taxa	URC Hess RCA CA-1 (25.8%)	URC Hess RCA CA-2 (14.7%)	URC Hess RCA CA-3 (12.8%)
Ameletidae	0.4082	-0.6793	0.0434
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	0.4016	0.2741	-0.0966
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	0.1004	-0.0231	-0.0545
Leptophlebiidae	2.7368	0.3061	-0.2166
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	0.1092	-0.0945	-0.0383
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	0.2556	-0.1230	0.0006
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	-0.2367	0.1802	-0.2005
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	0.0838	-0.1143	0.0368
Capniidae	0.0925	0.0909	0.0544
Leuctridae	-0.2801	-0.3349	-0.4548
Taeniopterygidae (includes Taenionema sp. ID'd)	-0.2638	0.8184	-0.0171
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	-0.2268	0.4646	-0.3343
Rhyacophila sp.	0.4737	0.1371	-0.0590
Glossosoma sp.	-0.2667	0.1210	-0.1815
Brachycentrus sp.	-0.3579	0.9175	0.4769
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	0.6082	-0.2559	0.3225
Antocha sp.	1.6391	0.6310	-0.9946
Dicranota sp.	-0.2189	-0.3571	0.1536
Hexatoma sp.	0.0861	0.9491	-1.4725
Limnophila sp.	-0.4554	1.3742	0.0545
Rhabdomastix sp.	-0.2863	0.5698	-0.6423
Bezzia/Palpomyia sp.	0.2369	0.5706	-0.0244
Psychodidae	-0.3372	0.6403	-0.3102
Deuterophlebiidae	-0.4010	0.1144	0.4108
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	-0.3004	0.1556	0.1098
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	0.1776	0.1388	0.2803
Tanytarsini (Tribe)	-0.1765	0.9235	-1.2045
Rheotanytarsus sp.	-0.2374	-0.3849	-1.4620
Cricotopus/Orthocladius sp.	-0.3582	0.0813	0.0521
Eukiefferiella sp.	-0.2919	-0.0247	0.1902
Synorthocladius sp.	-0.3403	0.0769	0.5605
Thienemanniella sp.	-0.0643	0.7663	0.3728
Tvetenia sp.	0.2456	-0.8779	-0.9373
Diamesa sp.	1.6537	-0.2009	0.6334
Pagastia sp.	-0.3560	-0.0547	0.4864
Tanypodinae	-0.1194	-0.2186	-0.2557
Lepidoptera	-0.1798	0.4278	0.3375
Hemiptera (includes Corixidae ID'd)	2.6718	-0.3577	0.3957
Collembola	-0.3064	-1.1885	-0.1234
Ostracoda	-0.2600	-0.2326	-0.1705
Oligochaeta	-0.2562	-0.2523	0.2270
Nematoda	-0.2830	-0.3617	-0.0521
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	-0.0290	-0.1068	0.0791

Table D.21: Taxon scores in CA for kick samples in RCA (X2, R2 means versus reference areas)

Taxa	URC K&S RCA CA-1 (25.6%)	URC K&S RCA CA-2 (17.6%)	URC K&S RCA CA-3 (13.3%)
Ameletidae	0.0993	0.9258	0.1336
Baetidae (includes Acentrella, Baetis tricaudatus, B. bicaudatus, Fallceon, Baetis sp., Baetidae UID)	0.0813	-0.2981	-0.3151
Heptageniidae (includes Cinygmula, Rhithrogena, Epeorus, Heptageniidae UID)	0.0731	0.0774	-0.0677
Ephemerellidae (includes various Drunella sp, also Serratella, Ephemerella sp., Ephemerellidae UID)	0.0888	0.1065	-0.0417
Chloroperlidae (includes Alloperla fratema, Paraperla sp., Suwalia sp., Sweltsa sp., Chloroperlidae UID)	-0.0512	0.1756	-0.1812
Perlodidae (includes Cultus sp., Isoperla sp., Kogotus sp., Megarcys sp., Rickeri sp., Skwala sp., Perlodidae UID)	0.0302	-0.1605	-0.1004
Nemouridae (includes Podmosta sp., Visoka sp., Zapada sp., Z. cinctipes, Z. columbiana, Z. oregonensis/haysi, Nemouridae UID)	0.1266	0.0989	-0.0782
Capniidae	-0.2187	-0.0095	-0.2357
Leuctridae	0.8937	0.1696	0.3097
Taeniopterygidae (includes Taenionema sp. ID'd)	0.1851	0.0153	-0.2561
Hydropsychidae (includes Arctopsyche sp., Hydropsyche sp., Parapsyche sp., Hydropsychidae juv/dam)	0.8818	-0.0770	0.3115
Rhyacophila sp.	-0.1024	0.2303	0.1495
Glossosoma sp.	0.6462	-0.2248	0.5752
Limnephilidae (includes Dicosmoecus sp., Ecclisomyia sp., Limnephilidae larvae juv/dam)	-0.3475	0.8436	-0.5525
Dicranota sp.	-0.1800	0.6711	0.0728
Bezzia/Palpomyia sp.	-0.6626	-0.1883	0.5500
Psychodidae	-0.0787	0.2105	0.0901
Deuterophlebiidae	-0.6575	0.0153	-0.4847
Empididae (includes Chelifera/Metachela, Clinocera, Oreogeton, Empididae UID)	-0.0850	-0.1566	0.2177
Simuliidae (includes Prosimulium, Simulium, Simuliidae pupae)	0.0108	-0.4659	-0.2515
Tanytarsini (Tribe)	-0.5941	1.5492	0.1292
Rheotanytarsus sp.	1.7941	-0.1391	0.3628
Stempellinella sp.	1.9550	-0.2487	0.6380
Stempellina sp	-0.4162	0.1025	-0.3549
Cricotopus/Orthocladius sp.	-0.1352	0.1551	0.0627
Eukiefferiella sp.	-0.3501	-0.0540	-0.2771
Synorthocladius sp.	-0.5683	-0.2728	0.4447
Thienemanniella sp.	-1.0015	-1.1536	1.4565
Tvetenia sp.	1.0114	-0.9637	-0.8615
Diamesa sp.	-0.6100	-1.1848	-0.2105
Pagastia sp.	-0.4218	0.3659	0.3342
Tanypodinae	-0.8459	-0.9750	1.0796
Collembola	-0.6774	-0.1763	0.9447
Ostracoda	-0.2362	-0.4483	0.1512
Copepoda	1.3459	-0.3470	0.1885
Oligochaeta	0.0056	-0.2859	-0.2951
Nematoda	0.0288	0.2333	0.2537
Prostigmata (many ID'd taxa, plus deutonymphs, juveniles, and UID adults)	-0.0884	0.1807	0.1217

Report of Benthic Invertebrate Analysis – Van Gorda (Faro) Mine Yukon, for Minow Environmental
Analysis by Cordillera Consulting, March 31 2008

Methods

In November of 2007, 31 samples were received from Faro, Yukon. In the raw samples, the organic and inorganic matter was separated by elutriation. The inorganic elutriate was examined under low power to check for missed trichopterans, molluscs or any other heavy organisms. The remaining sample was sieved in a 300 µ to remove preservative and clay particles. Each sample was evaluated for total numbers and need for subsampling. The following samples Ref 1, Ref. 2, Nexc 1, V8-01, V8-02, V8-03, V8-04, V8-05, V27-01, V27-02, V27-03, were relatively uniform in the size of detrital material and further fractionation was not needed. The subsampling method used for these samples was by area (Caton Tray) and not less than one quarter of the sample was sorted (exception being V8-04). A minimum number of 300 was used for the subsampling criteria.

The balance of the samples was fractioned into either 2 or 3 size fractions depending on the quantity of large organic detrital material. The sieves used were 4 mm, 2 mm and 300 µ. In most cases the whole of the course and very course fraction was sorted and the fine portion was subsampled with 300 organisms as a minimum number. The exceptions to this was V5-01, V5-02, V5-03, V5-05, V27-E, V27-D, V1-A where the fractions were all sorted in their entirety. Another exception was in V1-E, V5-A, V5-B, V8-E and V8-D where the quantity of the course and very course fraction was very large and the invertebrates too few to sort through 100 %. In these cases a minimum number of 300 organisms was the target for the whole sample.

Invertebrates were divided into orders or classes and stored in individual vials in 80% ethanol.

Following the sorting process the invertebrates were identified to the lowest practical level. The following texts were used in the identifications:

Clifford, Hugh F. 1991. Aquatic Invertebrates of Alberta. University of Alberta Press Edmonton, Alberta.

Epler, John. 2001 The Larval Chironomids of North and South Carolina. http://home.earthlink.net/~johnepler/

Epler, John. Identification Manual for the Water Beetles of Florida. http://home.earthlink.net/~johnepler/

Epler, John. Identification Manual for the Aquatic and Semi-aquatic Heteroptera of Florida. http://home.earthlink.net/~johnepler/

Jacobus, Luke and Pat Randolph. 2005. Northwest Ephemeroptera Nymphs. Manual from Northwest Biological Assessment Working Group. Moscow Idaho 2005. Not Published.

Kathman,R.D., R.O. Brinkhurst. 1999. Guide to the Freshwater Oligochaetes of North America. Aquatic Resources Center, College Grove, Tennessee.

Larson, D.J., Y. Alarie, R.E. Roughly.2005. Predaceous Diving Beetles (Coleoptera: Dytiscidae) of the Neararctic Region. NRC-CNRC Research Press. Ottawa.

Mackie, G. Sphaeriidae of North America http://www.collegeofidaho.edu/campus/community/museum/CorbiculaceaOfNorthAmerica-GLMackie/Sphaeriidae/SphaeriidaeIndex.htm

Merritt, R.W., K.W. Cummins and M. Berg. (eds.). 2008. An introduction to the aquatic insects of North America, 4th. Kendall/Hunt, Dubuque, IA.

Needham, James, M. May, M. Westfall Jr. 2000. Dragonflies of North America. Scientific Publishers. Gainsville FL.

Westfall, Minter J. Jr. and May, Michael L. 1996. Damselflies of North America. Scientific Publishers, Gainesville, FL.

Needham, K. 1996. An Identification Guide to the Nymphal Mayflies of British Columbia. Publication #046 Resource Inventory Committee, Government of British Columbia.

Oliver, Donald R. and Mary E. Roussel. 1983. The Insects and Arachnids of Canada Part 11. The Genera of larval midges of Canada. Biosystematics Research Institute. Ottawa, Ontario. Research Branch, Agriculture Canada. Publication 1746.

Proctor, H. The ‘Top 18’ Water Mite Families in Alberta. Zoology 351.

Stewart, Kenneth W. and Bill Stark. 2002. The Nymphs of North American Stonefly Genera (Plecoptera). The Caddis Press. Columbus Ohio.

Stewart, Kenneth W. and Mark W. Oswood. 2006. The Stoneflies of Alaska and Western Canada. The Caddis Press.Columbus Ohio. 43221-0039.

Wiggins, Glenn B. 1998. Larvae of the North American Caddisfly Genera (Tricoptera) 2nd ed. University of Toronto Press. Toronto Ontario.

QA/QC

Sorting Efficiency

As the project was being sorted every ten samples was resorted by the lab manager to evaluate sorting efficiency. All resorted samples (4 were resorted) achieved > 95% sorting efficiency.

Taxonomic Efficiency

Four samples have been selected to send to another taxonomist to evaluate taxonomic efficiency. Report Pending.

Report of QA/QC Analysis of 12 Samples from Laberge Environmental Services By Cordillera Consulting, March 2008

As requested by Minnow Environmental 12 benthic samples analyzed by another laboratory were received by Cordillera Consulting in January 2008. Contained in the shipment were:

- 12 vials of sorted invertebrates
- 12 one litre Nalgene bottles labelled V1B, V1C, V1D, V5C, V5D, V5E, V8A, V8B, V8C, V27A, V27B and V27C containing the original detritus from which the invertebrates in the vials were sorted
- 6 containers of unsorted fines labelled V1C unsorted 3/4s, V5C unsorted 7/8, V5D unsorted ½, V5E unsorted 16/16ths, V8B unsorted 9/16ths and V27A unsorted 3/4s. One container was broken in transit from the previous laboratory and it was labelled V1D unsorted 3/4s. It was discarded.

Cordillera Consulting contacted the previous laboratory and found the methods for analysis to be as follows:

- The samples were elutriated and sieved using 180 µ and 1 mm sieves.
- The whole of the course portion was sorted, identified and enumerated.
- The fine portion was subsampled in 7 out of 12 samples to portions between 1/16th and one half.
- The fine and course fractions of the sorted invertebrates were stored together in one vial
- The fine and course portions of the sorted debris were stored together in one vial

Two issues emerged as problems right away in the QA/QC process.

1. Minnow Environmental had requested that the finest sieve size be 300µ. However an 180µ sieve was used by the previous lab. There will be higher numbers of very small organisms accounted for in the data as a result.
2. The subsampled fine fraction and whole course fraction of the sorted invertebrates and the sorted debris being stored together makes it impossible to accurately perform a quality control analysis on each portion. No records were kept by the previous lab indicating how many organisms were found in the fractions. Only those sites which have not had subsampling can be analysed for sorting efficiency and taxonomic efficiency accurately.

Sorting Efficiency

Three samples were randomly chosen to resort, V8-B, V8-A and V27-C.

	Original Sorted Numbers	Cordillera Consulting Resort	% Efficiency
V8-B	~2000 ? X 0.3125* = 625	62	~90%
V8-A	262	39	85.10%
V27-C	409	31	92.40%

* 0.3125 is the subsampled portion the sorted 'fine'numbers were multiplied by to get the totals. Cordillera Consulting estimated that 75 organisms were found in the course portion and 625 were found in the 5/16ths of the fine portion.

Sorting efficiency was found to be acceptable in V8-B and V27-C but not acceptable in V8-A. (EEM Guidelines Chapter 5, page 5-109) Organisms found in V8-A were added back to the original numbers.

Taxonomic Efficiency

The invertebrates in V8-A, V8-B and V27-C were reidentified by Sue Salter at Cordillera Consulting.

The absolute total numbers in the three samples number differed by 15.9% in V27-C, 12.9% in V8-A and approximately 26.4% in V8-B.
The % disagreements including both disagreement in numbers and disagreements in taxa identifications was 47% in V27-C, 57.6 % in V8-A and 73.9% in V8-B. V8-B is likely falsely high due to the very rough estimate in total numbers due to subsampling. The acceptable disagreement level of 10% however is very much exceeded and all twelve of these samples need to be re-identified and re-counted.

The errors range from

- **minor** i.e. placing immature larvae at the genus level instead of family or order, not using up to date nomenclature and reference texts
- **major** misidentification of common taxa with unambiguous characteristics (Parapsyche sp., Taeniopterygidae), miscounts of greater than 10%.

Others taxonomic errors suggest the taxonomist has not taken specialized training currently available within the taxonomic community and has not maintained a current collection of reference texts.

The following disagreements in taxa and numbers were recorded:

V27-C

	V27-C	Re ID	Disagreement	Comments
PHYLUM ARTHROPODA				
Class Insecta				
Order Ephemeroptera				
Family Siphlonuridae				
Ameletus sp	1	1		Ameletus is now in the Family Ameletidae
Family Baetidae				
Baetis sp	62	41	21	numbers disagreement
Family Heptageniidae		62		I can see the rationale for putting the immature Heptageniids into Cinymula sp. and I accept this designation. I differ only in the number of Epeorus sp.
Cinygmula sp	95	34		
Epeorus sp	4	3	1	
Rhithrogena sp	4	4		
Family Ephemereliidae				
Drunella doddsi	3	3		
Order Plecoptera juvenile		5		
Family Capniidae		4		It is very difficult to identify even mature Capniids and these Capniids are immature
Capnia sp	7		7	

Family Perlodidae				
Megarcys sp	1	1		
Sweltsa sp group	1			
Family Nemouridae				
Zapada sp	87	46	41	disagreement in numbers
Podmosta sp	4		4	I think the previous lab has misidentified Taeniopterygidae as Podmosta sp.
Family Chloroperlidae				
Sweltsa group		1		Sweltsa sp. belongs in the family Chloroperlidae not Perlodidae
Family Taeniopterygidae		4		Likely mistaken for Podmosta sp.
Order Trichoptera				
Trichoptera Unid J	3	2	1	2 of the Trichoptera Unid J were identified as Oligophlebodes sp.
Trichoptera P				
Family Uenoidae				
Oligophlebodes sp.		2	2	
Family Hydropsychidae juvenile		17	4	
Arctopsyche sp	22		22	Parapsyche sp. has been misidentified as Arctopsyche sp. throughout this project
Parapsyche sp.		1		
Family Glossosomatidae				
Glossosoma sp	29	29		
Family Rhyacophilidae				I did not identify Rhyacophilidae to the species level, and I don't disagree with the identifications; I only disagree with the number found. Rhyacophila acropedes is no longer a valid name. R. brunnea is now used.
Rhyacophila sp.		10	6	
Rhyacophila acropedes or vao				
Rhyacophila angelita				
Rhyacophila hyalinata	4			
Order Diptera				
Family Chironomidae				
Chironomidae P	9	9		
Chironomidae L	48			
Sub Family Orthocladinae				
Brillia sp		3	3	these taxa were found but not recorded by previous lab
Cricotopus sp	3			
Cricotopus/Orthocladius sp.		29	26	It is recommended in current keys that most Cricotopus sp. be referred to as Cricotopus/Orthocladius sp. unless there is pupal association. There is also a disagreement in number
Eukiefferiella sp	8	21	13	numbers disagreement.
Family Diamesinae				
Diamesa sp	2		2	misidentification
Pagastia sp.		2		
Family Empididae				
Weidemannia sp	3		3	misidentification
Oreogeton sp.		2		
Family Psychodidae				

Pericoma sp				
Family Simulidae		7		
Prosimulium L	3		4	
Order Hydracarina				
Lebertia sp.		1	1	misidentification
Sperchon sp	1		1	
Unioncola sp	2		2	misidentification
Total per sample	**409**	**344**	**164**	47.6 % disagreement

V8-A

	V8a	Resort	Disagreement	Comments
PHYLUM ARTHROPODA				
Class Insecta				
Order Ephemeroptera				
Family Siphlonuridae				
Ameletus sp				Ameletus is now in the Family Ameletidae
Family Baetidae				
Baetis sp	3	2	1	
Family Heptageniidae		10		I can see the rationale for putting the immature Heptageniids into Cinymula sp. and I accept this designation. I differ only in the number of Rhithrogena sp. sp.
Cinygmula sp	21	10		
Epeorus sp	12	12		
Rhithrogena sp	16	15	1	
Order Plecoptera				It is very difficult to identify mature Capniids and these Capniids are immature
Family Capniidae		2		
Capnia sp	2		2	
Family Chloroperlidae				
Sweltsa sp group	1	1		
Family Nemouridae				
Zapada sp	73	56	27	disagreement in numbers
Podmosta sp				disagreement in numbers and identification
Family Taeniopterygidae		27		
Order Trichoptera				
Family Hydropsychidae juvenile		13	19	Parapsyche sp. has been misidentified as Arctopsyche throughout this project
Arctopsyche sp	19			
Parapsyche sp.		3		
Family Rhyacophilidae		22	34	disagreement in numbers
Rhyacophila acropedes or vao	44			
Rhyacophila angelita	1			

Rhyacophila hyalinata	11			
Order Diptera				
Family Chironomidae				
Chironomidae P	4	3	1	
Chironomidae L	3		4	
Sub Family Orthocladinae				
Cardiocladius sp	1			
Chaetocladius sp.		29	29	misidentification
Cricotopus sp	16			
Cricotopus/Orthocladius sp.		9		
Eukiefferiella sp	23		23	misidentification
Thienemanniella sp	1		1	misidentification
Family Simulidae				
Simulium sp L	3	4		
Order Hydracarina				
Unioncola sp	7			
Aturus sp.		9	9	misidentification
Total per sample	**262**	**228**	**151**	**57.6 % disagreement**

V8-B

Please note V8-B was a sub-sampled site and the actual numbers for the previous lab are only a very rough estimate because the records of the original numbers were never kept. The numbers in the disagreement column here are not reliable.

	V8-B	V8-B x 5/16	Re ID	Disagreement	Comments
PHYLUM ARTHROPODA					
Class Insecta					
Order Ephemeroptera					
Family Baetidae					
Baetis sp	157	49	16	33	disagreement in numbers
Family Heptageniidae juvenile or dam.			10		
Cinygmula sp	26	8	3		I can see the rationale for putting the immature Heptageniids into Cinymula sp. and I accept this designation. I differ only in the number of Epeorus sp.
Epeorus sp	9	3	16		
Rhithrogena sp	1		9		
Family Ephemereliidae					
Drunella doddsi	3	1	2	1	disagreement in numbers
Drunella grandis	1			1	disagreement in numbers
Drunella spinifera sp.			1	1	disagreement in identification
Serratella tibialis			1	1	disagreement in

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					identification
Ephemerella flavilinea	28	9			
Order Plecoptera juvenile			75	75	these juvenile larvae cannot be distinguished to genus or family level
Family Capniidae juvenile			14		It is very difficult to identify mature Capniids and these Capniids are immature; disagreement in number also
Capnia sp	51	16		16	
Family Perlodidae					
Megarcys sp	4	1	3	2	disagreement in number
Family Nemouridae					
Zapada sp	398	124	189		I think the previous lab has misidentified Taeniopterygidae as Podmosta sp.
Podmosta sp	298	93		46	
Family Taeniopterygidae juvenile			40		disagreement in total numbers including immatures
Order Trichoptera					
Trichoptera Unid J	3	1	1		
Family Hydropsychidae Juvenile			47		Parapsyche sp. has been missidentified as Arctopsyche throughout this project; juvenile larvae cannot be identified to genus; disagreement in numbers also
Arctopsyche sp	138	43		17	
Parapsyche			13		
Family Rhyacophilidae					
Rhyacophila sp.			46	27	disagreement in numbers
Rhyacophila acropedes or vao	41	13			
Rhyacophila angelita					
Rhyacophila hyalinata	21	7			
Order Diptera					
Diptera Unid A	1		1		
Diptera Unid L	4	1	1		
Family Chironomidae				51	disagreement in total numbers of Chironomidae
Chironomidae P	27	8	14		
Chironomidae L	250	78			
Sub Family Orthocladinae					
Brillia sp	47	15	42		
Cardiocladius sp	11	3	0		disagreement in identification
Chaetocladius sp.			167		
Cricotopus sp	151	47			
Cricotopus/Orthocladius sp.			45		
Eukiefferiella sp	174	54	10		

Family Diamesinae					
Diamesa sp	23	7	0		diagreement in identification
Family Empididae					
Chelifera sp	4	1	2	2	disagreement in numbers
Family Psychodidae					
Pericoma sp	4	1	2	2	disagreement in numbers
Family Simulidae P			4		
Prosimulium L	16	5	0	16	disagreement in numbers and identification
Prosimulium sp P					
Simulium sp L	18	6	13	5	
Simulium sp P	4	1			
Family Tipulidae					
Dicranota sp	3	1	1	2	disagreement in numbers
Order Collembola			3	12	disagreement in numbers
Isotomurus sp	7	2			
Podura sp	8	3		8	disagreement with identification
Class Arachnida					
Order Aranaea	3	1			
Order Hydracarina					
Hydracarina Unid J	6	2		6	disagreement in numbers and identification
Sperchon sp	7	2	3	4	
Aturus sp.			24	24	
Unioncola sp	115	36	0	115	
Sub Class Ostracoda					
Cypria sp	3	1	1	2	disagreement with numbers
PHYLUM NEMATODA	10	3	0	10	disagreement with numbers
Total per sample	**2075**	**648**	**819**	**479**	73.9 % disagreement

Report on the re-Identification of 12 Vangorda Samples

The first three samples examined in the QA/QC were left unchanged.

Of the remaining 9 samples, the sites which had not had subsampling applied were sieved through 300µ and 210µ sieves. The number of organisms in the 210µ fraction were recorded and preserved but the individuals were not identified. The organisms in the 300µ fraction were all reidentified and the results recorded and sent to the client.

The sites which did have subsampling applied were sieved through 1 mm, 300µ and 210µ sieves. The 210µ fraction was counted and preserved and the other 2 fractions were identified and counted and preserved separately. The results were recorded and sent to the client.

The table below is a record of total numbers from the previous labs identifications, the current identifications and the number of organisms in the 210µ fraction.

	V1b	V1c	V1d	V5c	V5d	V5e	V8b	V8c	V8a	V27a	V27b	V27c
Subsample	all	1/4	1/4	1/8	1/2	1/16	5/16	all	all	1/4	all	all
Previous #s	147	1348	1423	2770	747	3962	2075	1048	262	1502	427	409
Current #s	81	494	467	1401	225	1877	819	885	226	1280	411	335
# in 210µ fraction	9	127	87	65	75	57		71		38	42	

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Report on Benthic Invertebrate Analysis
Faro Mine Samples Collected Summer 2008

for

Minnow Environmental

by

Cordillera Consulting – Taxonomist Sue Salter

December 15, 2008

Hess and Kick-net samples from the Faro, Yukon area were received in September 2008. The forty-seven samples were examined on arrival for adequate preservation and completeness.

Each sample was elutriated to remove sand or gravel. The elutriate was examined for molluscs or trichopteran cases which were removed if found. The remaining organic material was washed through two nested sieves (2 mm on top of 300 microns). The contents of the two sieves were sorted and identified separately under low power dissecting microscopes. If numbers of invertebrates appeared to be high (> 400) the sample was split by surface area within a 300 micron sieve. The fractions were subsampled to achieve a total of more than 325 organisms from the sample.

There were two samples (BTT Hess and BTT K&S) with a large proportion of filamentous algae which could not be subsampled with the above method because even distribution of the sample was not achievable. In these cases the whole sample was rinsed, pressed to a point where no water was dripping and then weighed. A subsample was removed by weight using scissors. This subsample was sorted and subsequent subsamples were removed until 325 organisms had been removed from the whole.

See separate document for a record of subsampling numbers and proportions.

Ten percent of the sorted debris was resorted to test sorting efficiency. The sorting efficiency was found to be >95%.

We await instructions for what to do with the sorted debris, unsorted subsamples, vials of invertebrates. The project will remain on site until we receive your instructions.

	Sample ID:	**VR-Hess**	**VR-Hess**	**VR-K&S**	**VR-K&S**	**X2-1 Hess**	**X2-1 Hess**	**X2-1 K&S**	**X2-1 K&S**	**X2-2 Hess**	**X2-2 Hess**
	CC:	080280	080280	080281	080281	080282	080282	080283	080283	080284	080284
	subsample	coarse, all	fine, all	coarse, all	fine, all	coarse, 1/2	fine, 1/2	coarse, all	fine, all	coarse, 1/4	fine, 1/2
	Subsample #	**36**	**487**	**59**	**442**	**156**	**922**	**94**	**1263**	**67**	**1888**

X2-2 K&S	**X2-2 K&S**	**X2-3 Hess**	**X2-3 Hess**	**X2-3 K&S**	**X2-3 K&S**	**X2-4 Hess**	**X2-4 Hess**	**X2-5 Hess**	**X2-5 Hess**	**USFR-Hess**	**USFR-Hess**
080285	080285	080286	080286	080287	080287	080288	080288	080289	080289	080290	080290
coarse, 1/8	fine, 1/4	coarse, 1/4	fine, 1/4	coarse, 1/8	fine, 1/8	coarse, 1/4	fine, 1/4	coarse, 1/2	fine, 1/2	coarse, 1/2	fine, 1/4
33	**347**	**123**	**1002**	**215**	**231**	**140**	**481**	**55**	**595**	**48**	**519**

USFR-K&S	**USFR-K&S**	**NXT-Hess**	**NXT-Hess**	**NXT-K&S**	**NXT-K&S**	**R2-1 Hess**	**R2-1 Hess**	**R2-2 Hess**	**R2-2 Hess**	**R2-3 Hess**	**R2-3 Hess**
080291	080291	080292	080292	080293	080293	080294	080294	080295	080295	080296	080296
coarse, all	fine, 1/4	coarse, 1/8	fine, 3/8	coarse, all	fine, 1/4	coarse, 1/2	fine, 1/4	coarse all	fine 1/16	coarse all	fine 1/4
114	**464**	**9**	**234**	**87**	**276**	**184**	**146**	**355**	**74**	**113**	**245**

R2-4 Hess	**R2-5 Hess**	**R2-5 Hess**	**R2-1 K&S**	**R2-2 K&S**	**R2-3 K&S**	**R7 Hess**	**R7 Hess**	**R7-1 K&S**	**R7-1 K&S**	**R7-2 K&S**	**R7-2 K&S**
080297	080298	080298	080299	080300	080301	080302	080302	080303	080303	080304	080304
1/2	coarse all	fine 1/8	all	all	all	coarse, 1/2	fine, 1/8	coarse, all	fine, 1/4	coarse, 3/4	fine, 1/8
581	**261**	**61**	**515**	**397**	**631**	**99**	**268**	**42**	**292**	**222**	**122**

FC1 Hess 080305 coarse, 1/4 **157**	**FC1 Hess** 080305 fine, 1/8 **161**	**FC1 K&S** 080306 coarse, 1/2 **13**	**FC1 K&S** 080306 fine, 1/2 **292**	**BLC1 Hess** 080307 coarse, 1/2 **219**	**BLC1 Hess** 080307 fine, 1/16 **149**	**BLC2 Hess** 080308 coarse, all **169**	**BLC2 Hess** 080308 fine, 1/4 **172**	**BLC-3 Hess** 080309 coarse, all **182**	**BLC-3 Hess** 080309 fine, 1/4 **482**	**BLC-4 Hess** 080310 1/4 **403**	
BLC-5 Hess 080311 coarse all **213**	**BLC-5 Hess** 080311 fine 1/8 **186**	**BLC-1 K&S** 080312 all **239**	**BLC-2 K&S** 080313 1/2 **324**	**BLC-3 K&S** 080314 coarse, 1/2 **149**	**BLC-3 K&S** 080314 fine, 3/8 **176**	**STC Hess** 080315 coarse, all **164**	**STC Hess** 080315 fine, 1/16 **142**	**STC K&S** 080316 all **90**	**BEC Hess** 080317 coarse, 1/2 **454**	**BEC Hess** 080317 fine, 1/16 **324**	**BEC K&S** 080318 coarse all **266**
BEC K&S 080318 Fine 1/16 **63**	**HOC Hess** 080319 coarse, all **43**	**HOC Hess** 080319 fine, 1/2 **301**	**HOC K&S** 080320 all **102**	**GRC Hess** 080321 all **153**	**GRC K&S** 080322 all **64**	**BTT Hess** 080323 10% 73/733 **~3090**	**BTT K&S** 080324 0.67% coarse **45**	**BTT K&S** 080324 fine, 1/32 **278**	**BUC Hess** 080325 coarse, all **97**	**BUC Hess** 080325 fine, 1/2 **258**	**BUC K&S** 080326 1/5 **373**

Benthic Invertebrate Sub Sampling Report for Minnow Environmental Project 2254 Faro Mines

Cordillera Consulting February 2009

The subsampling procedure chosen for the project was an area based method recommended in the EEM Guidance document found at : <http://www.ec.gc.ca/eem/English/Publications/web_publication/Sub_Sampling/default.cfm >.

The samples were sieved into fine (F) and course (C) portions using 2mm and 300 µ sieves.

<u>Determination of subsampling accuracy and precision:</u>

The effects of subsampling on abundance estimates should be examined on a minimum of 10% of the samples. If the error exceeds 20% for any group of samples, all samples within that group of samples should be completely sorted to assure the subsampling process is not compromising data integrity. This requires that 10% of samples which have been subsampled are randomly selected and the remaining unsorted material is sorted in its entirety. The estimates (calculated as above) are then compared to the actual counts from the sample and the accuracy of the estimates and the precision between subsamples can calculated as below:

Accuracy of the subsampling estimate

% Error in the estimate = [1-(estimated # in sample/actual # in sample)]x100

Example (repeated from Section 3.2)

1. a count in subsample A = 289, representing 15% of the sample by volume, for an estimate of the total in the sample of 1927
2. a count in subsample B = 316, representing 15% of the sample by volume, for an estimate of the total in the sample of 2106
3. the count in the remainder of the sample = 1359, for a actual total of 1964
4. the reported precision would be the same as in the first example, 8.5 % the reported accuracy would be -1.9% and +7.2% for sample A and B respectively.

Precision between subsamples

% Difference between two subsamples (A& B) = [1- (count in subsample A / count in subsample B)] x 100

Example (repeated from Section 3.2)

1. a count in subsample A = 289
2. a count in subsample B = 316
3. the reported precision between theses two subsamples would be 8.5% (1-(289/316))x100.

From EEM Guidance < http://www.ec.gc.ca/eem/English/Publications/web_publication/Sub_Sampling/default.cfm >

In the Minnow Project # 2254, there were 47 samples. Five samples were randomly selected from the project to test subsampling efficiency. Two of the samples had been tested during the course of the work and the remaining three were tested after the project was completed as part of the QA/QC for the project. The samples chosen were: VR-K&S, USFR-K&S, X2-3 Hess, R2-3 Hess and R7-1 K&S.

Sample #		Subsample Portion	Actual Subsample #	Expected Subsample #	%accuracy	%precision
VR-K&S	F	1/4	96	110	14.58	
VR-K&S	F	1/4	117	110	5.98	17.95
VR-K&S	F	1/4	102	110	7.84	5.88
VR-K&S	F	1/4	128	110	14.06	25.00
VR-K&S	C	1/4	10	15	50.00	
VR-K&S	C	1/4	14	15	7.14	28.57
VR-K&S	C	1/4	17	15	11.76	41.18
VR-K&S	C	1/4	18	15	16.67	44.44
USFR-K&S	F	1/4	464	455	1.94	
USFR-K&S	F	1/4	543	455	16.21	14.55
USFR-K&S	F	1/4	424	455	7.31	9.43
USFR-K&S	F	1/4	389	455	16.97	19.28
USFR-K&S	C	1/4	25	29	16.00	
USFR-K&S	C	1/4	30	29	3.33	16.67
USFR-K&S	C	1/4	26	29	11.54	3.85
USFR-K&S	C	1/4	33	29	12.12	24.24
X2-3 Hess	F	1/4	1002	1023	2.10	
X2-3 Hess	F	1/4	975	1023	4.92	2.77
X2-3 Hess	F	1/4	1065	1023	3.94	5.92
X2-3 Hess	F	1/4	1104	1023	7.34	9.24
X2-3 Hess	C	1/4	123	133	8.13	
X2-3 Hess	C	1/4	139	133	4.32	11.51
X2-3 Hess	C	1/4	120	133	10.83	2.50
X2-3 Hess	C	1/4	150	133	11.33	18.00
R2-3 Hess	F	1/4	245	252	2.86	
R2-3 Hess	F	1/4	254	252	0.79	3.54
R2-3 Hess	F	1/4	272	252	7.35	9.93
R2-3 Hess	F	1/4	239	252	5.44	2.51
R7-1 K&S	F	1/4	291	322	10.65	
R7-1 K&S	F	1/4	386	322	16.58	24.61
R7-1 K&S	F	1/4	276	322	16.67	5.43
R7-1 K&S	F	1/4	288	322	11.81	1.04

The sample portions highlighted are the portions which were used for total numbers and reported on. The course and fine parts of VR-K&S and the course portions of USFR-K&S were subsampled during the course of working on the project and so the reported numbers are the actual numbers for the whole sample and not generated from subsample numbers.

The average subsampling error is 10.58%, which is considered acceptable by EEM Guidance. The subsampling precision is calculated for samples compared to the first subsample in the group. The average precision is 14.5%.

APPENDIX E

Habitat Matching

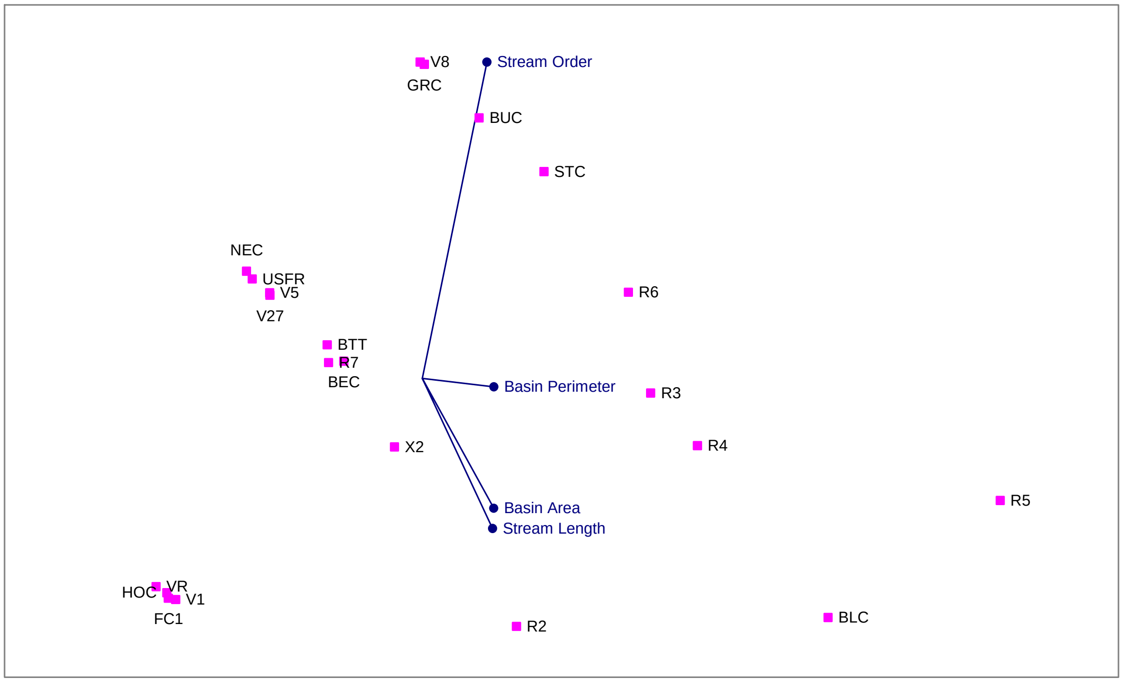
Table E.1: Habitat Characteristics Taken from GIS

Area	Basin Perimeter (km)	Basin Area (km2)	Basin Area (ha)	Stream Order	Total Stream Length (m)	Drainage Density (m/km2)	Station Elevation (m)	Source Elevation (m)	Distance to Source (m)	Avegerage Stream Gradient	% of Basin Area In Bedrock Types						% of Basin Area in Land Cover Types				% of Basin Area in Active Claims		Road Density (km/km2)	% Area Builtup	% Area Logged (In Last 30 Years)
											Metamorphic	Sedimentary	Volcanic	Plutonic	Unconsolidated	Ultramafic	Coniferous	Tundra	Barren	Water	HardRock	Placer			
BEC	74.73	89.08	8908.23	2	32469.40	364.49	823	1335	19145.75	0.0267	0.0075	0.8119	0.1805	0.0000	0.0000	0.0000	0.7373	0.2627	0.0000	0.0000	0.0500	0.0000	0.040	0.0000	0.0000
BLC	178.54	580.43	58043.16	3	190619.56	328.41	657	1455	72371.16	0.0110	0.0127	0.7978	0.0624	0.1271	0.0000	0.0000	0.5789	0.3866	0.0131	0.0215	0.1529	0.0000	0.025	0.0000	0.0046
BTT	67.14	81.78	8178.48	2	26082.25	318.91	962	1198	16865.20	0.0140	0.0000	0.0000	0.3985	0.6015	0.0000	0.0000	0.2021	0.7610	0.0369	0.0000	0.0000	0.0000	0.164	0.0000	0.0000
BUC	95.99	145.78	14577.87	3	61542.61	422.16	708	1246	28932.64	0.0186	0.0000	0.0303	0.0000	0.3550	0.0000	0.0000	0.9009	0.0991	0.0000	0.0000	0.0052	0.0000	0.012	0.0000	0.0000
FC	21.32	13.31	1331.13	1	9260.62	695.70	1314	1524	9260.62	0.0227	0.0000	0.0270	0.0000	0.9730	0.0000	0.0000	0.5774	0.4225	0.0000	0.0000	0.2625	0.0000	0.000	0.0000	0.0000
GRC	71.08	109.84	10983.82	3	45208.32	411.59	739	1292	14382.54	0.0384	0.0000	0.9470	0.0523	0.0007	0.0000	0.0000	0.7730	0.2270	0.0000	0.0000	0.0751	0.0040	0.003	0.0000	0.0000
HOC	22.40	12.07	1206.52	1	6479.96	537.08	819	884	4103.77	0.0158	0.0000	0.0000	0.0877	0.0000	0.9123	0.0000	0.9939	0.0061	0.0000	0.0000	0.0346	0.0000	0.417	0.0000	0.0000
NEXC	28.79	21.26	2125.81	2	8085.83	380.36	1031	1480	6263.05	0.0717	0.0000	0.4254	0.0000	0.5746	0.0000	0.0000	0.1261	0.8738	0.0001	0.0000	0.5203	0.0000	0.000	0.0000	0.0000
R2	111.58	228.80	22880.07	2	134446.00	587.61	1027	1499	5437.02	0.0868	0.0000	0.4586	0.0500	0.4914	0.0000	0.0000	0.4251	0.4220	0.1529	0.0000	0.4246	0.0000	0.074	0.0000	0.0000
R3	126.99	295.76	29576.05	3	166196.65	561.93	975	1499	32399.42	0.0162	0.0000	0.5132	0.0559	0.4309	0.0000	0.0000	0.4485	0.4318	0.1197	0.0000	0.4642	0.0000	0.058	0.0000	0.0001
R4	145.03	334.87	33487.02	3	181310.77	541.44	946	1499	41211.86	0.0134	0.0000	0.5303	0.0731	0.3965	0.0000	0.0000	0.5006	0.3937	0.1057	0.0000	0.4281	0.0000	0.051	0.0000	0.0001
R5	178.36	665.25	66525.27	4	285447.20	429.08	909	1471	44992.98	0.0125	0.0000	0.0009	0.1848	0.3723	0.0000	0.0000	0.4694	0.4694	0.0613	0.0000	0.2451	0.0000	0.026	0.0000	0.0001
R6	148.08	323.20	32320.01	3	95346.59	295.01	935	1471	42593.16	0.0126	0.0000	0.0018	0.3046	0.3425	0.0000	0.0000	0.4277	0.5557	0.0166	0.0000	0.0596	0.0000	0.000	0.0000	0.0000
R7	60.45	93.10	9309.63	2	33040.47	354.91	1121	1499	16617.78	0.0227	0.0000	0.2792	0.0611	0.6597	0.0000	0.0000	0.4067	0.4717	0.1216	0.0000	0.0919	0.0000	0.000	0.0000	0.0000
STC	128.19	215.35	21535.38	3	65147.61	302.51	833	1361	33098.51	0.0160	0.0827	0.0055	0.0263	0.0000	0.3183	0.0000	0.6249	0.1765	0.1985	0.0000	0.0000	0.0000	0.003	0.0000	0.0000
USFR	30.40	24.93	2493.14	2	11125.79	446.26	1289	1461	6642.79	0.0259	0.0000	0.0119	0.0000	0.9881	0.0000	0.0000	0.0000	0.7065	0.2935	0.0000	0.0215	0.0000	0.000	0.0000	0.0000
UWFV (VR)	15.53	7.73	773.27	1	5031.21	650.64	1219	1282	773.94	0.0814	0.0000	0.3059	0.0000	0.6941	0.0000	0.0000	0.0000	0.9117	0.0882	0.0000	0.5221	0.0000	0.026	0.0000	0.0000
V1	27.18	18.06	1806.03	1	7817.30	432.84	1155	1463	5968.79	0.0516	0.0000	0.1266	0.0000	0.8734	0.0000	0.0000	0.0478	0.5624	0.3898	0.0000	0.1856	0.0000	0.000	0.0000	0.0000
V27	39.18	30.63	3063.22	2	17912.48	584.76	987	1463	9453.30	0.0504	0.0000	0.4065	0.0331	0.5604	0.0000	0.0000	0.0282	0.7420	0.2298	0.0000	0.5182	0.0000	0.014	0.0000	0.0000
V5	39.90	32.58	3258.12	2	15636.19	479.91	825	1282	8314.67	0.0550	0.0460	0.5812	0.1619	0.1848	0.0000	0.0261	0.4492	0.5299	0.0209	0.0000	0.7356	0.0000	0.318	0.0000	0.0000
V8	69.35	89.68	8967.81	3	51244.40	571.43	694	1463	17561.13	0.0438	0.0717	0.4711	0.1847	0.2586	0.0000	0.0139	0.2280	0.6859	0.0861	0.0000	0.6537	0.0000	0.222	0.0056	0.0028
X2	82.79	117.70	11770.12	2	71704.86	609.21	1075	1499	19729.42	0.0215	0.0000	0.3091	0.0483	0.6426	0.0000	0.0000	0.4552	0.4426	0.1022	0.0000	0.1940	0.0000	0.000	0.0000	0.0000

E.1.1 Basin Characteristics

E.1.1.1 Size

Not surprisingly, stream size in control areas was smaller than in impact areas (e.g., R7 vs. R2 or V1 vs. V27). Only basin area was used in further analyses because it explained variation among areas in the PCA and was highly correlated (r > 0.7) with other size measures.

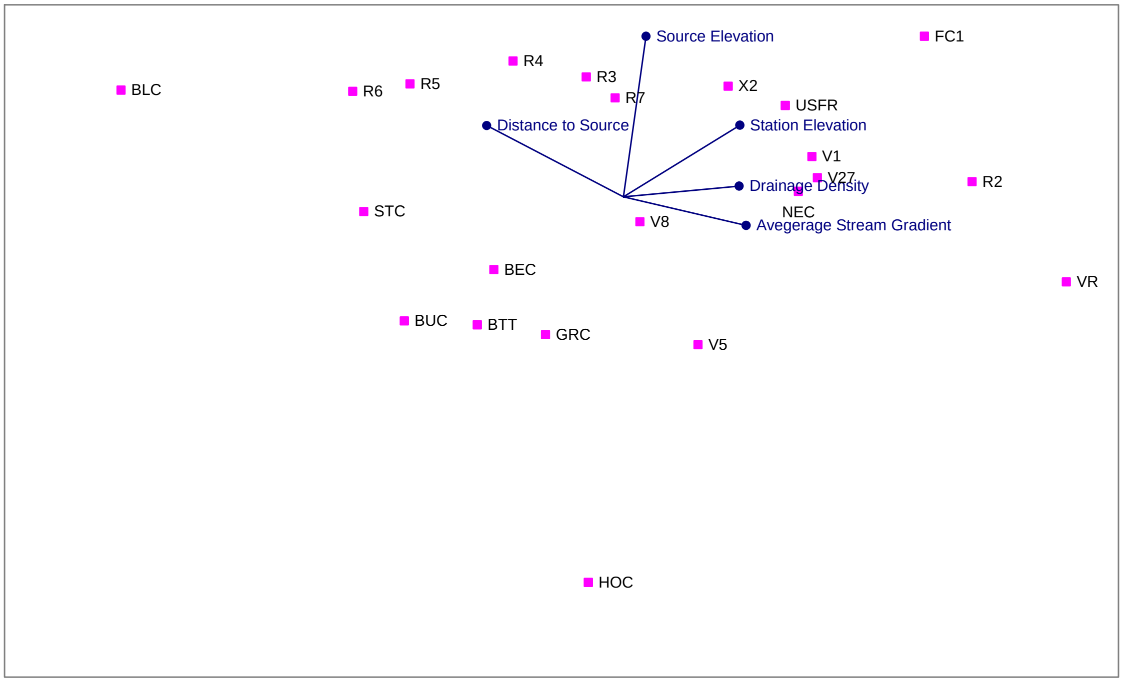


	PCA 1	PCA 2	PCA 3
Basin Perimeter	0.51	-0.02	0.77
Basin Area	0.51	-0.35	0.04
Stream Order	0.46	0.85	-0.25
Stream Length	0.51	-0.40	-0.59

	Basin Perimeter	*Basin Area*	*Stream Order*	*Stream Length*
Basin Perimeter	1.00			
Basin Area	0.94	1.00		
Stream Order	0.83	0.76	1.00	
Stream Length	0.90	0.96	0.74	1.00

E.1.1.2 Drainage Characteristics

Drainage characteristics were each important in explaining variability among areas in the PCA and were not highly correlated so all were used in further analyses with the exception of distance to source which was negatively correlated to average stream gradient.

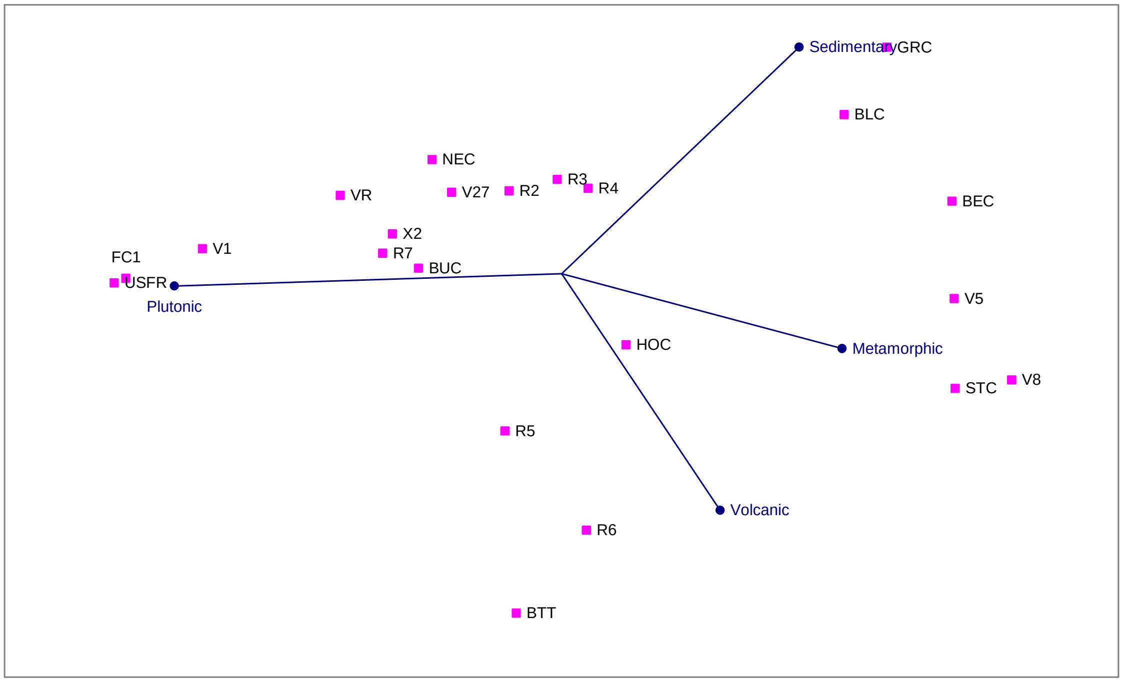


	PCA 1	PCA 2	PCA 3
Drainage Density	0.47	0.06	-0.43
Station Elevation	0.47	0.37	-0.39
Source Elevation	0.09	0.84	0.32
Distance to Source	-0.55	0.37	0.02
Average Upstream Gradient	0.50	-0.15	0.74

	Drainage Density	*Station Elevation*	*Source Elevation*	*Distance to Source*	*Avegerage Stream Gradient*
Drainage Density	1.00				
Station Elevation	0.39	1.00			
Source Elevation	0.10	0.36	1.00		
Distance to Source	-0.43	-0.50	0.26	1.00	
Average Stream Gradient	0.37	0.26	0.09	-0.63	1.00

E.1.1.3 Bedrock

The bedrock geology at V1 (primarily plutonic) was distinct from V5, V8, and V27 (primarily sedimentary and volcanic). Bedrock types were important in distinguishing areas in the PCA and were uncorrelated but percent metamorphic was removed because its presence was rare in the study area.

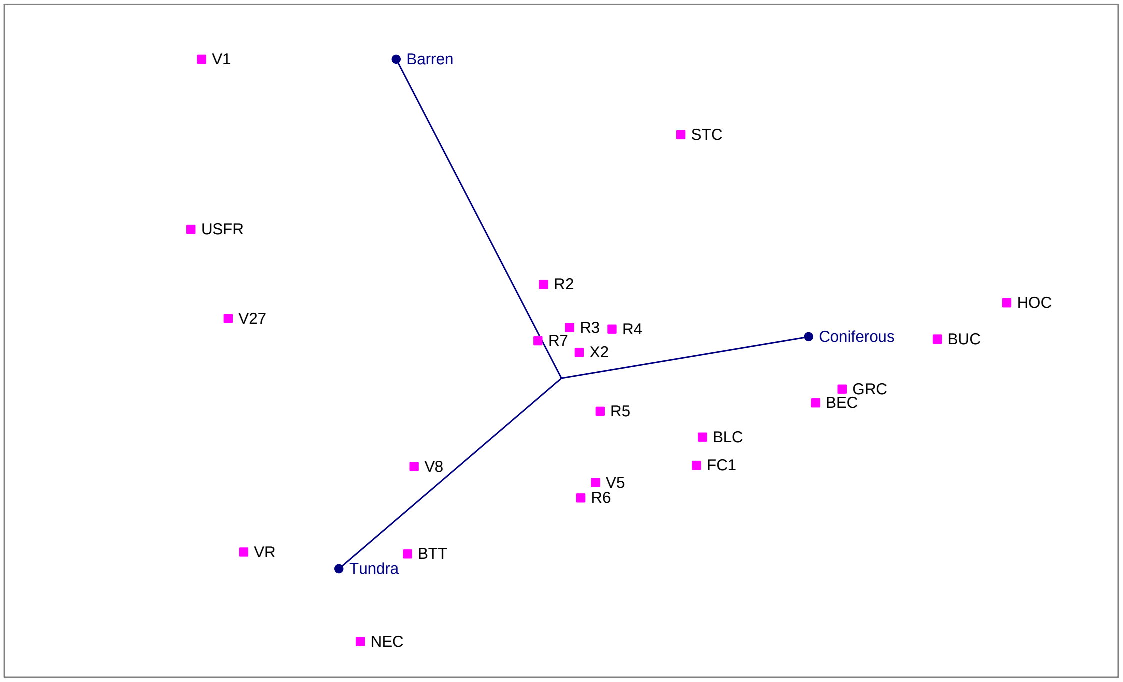


	PCA 1	PCA 2	PCA 3
Metamorphic	0.50	-0.22	-0.74
Sedimentary	0.43	0.67	0.35
Volcanic	0.28	-0.70	0.57
Plutonic	-0.69	-0.04	-0.08

	Metamorphic	*Sedimentary*	*Volcanic*	*Plutonic*
Metamorphic	1.00			
Sedimentary	0.04	1.00		
Volcanic	0.10	-0.10	1.00	
Plutonic	-0.43	-0.43	-0.27	1.00

E.1.1.4 Land cover

Coniferous was the only land cover category retained in further analyses as it was important in the PCA and was correlated with the other land cover types.

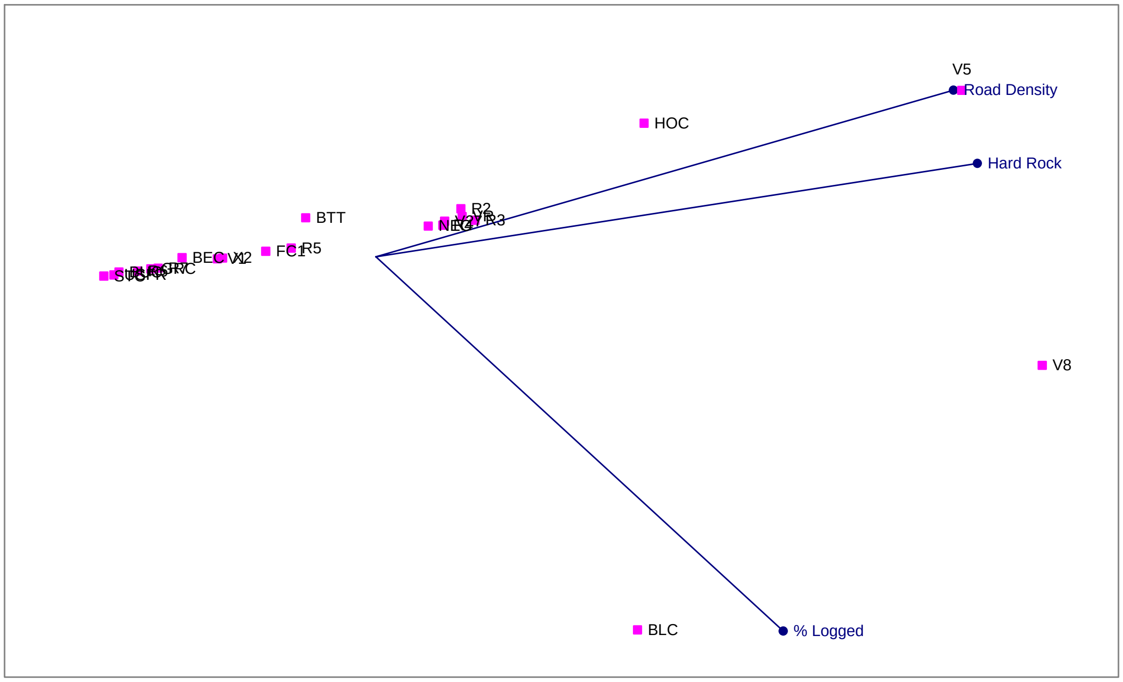


	PCA 1	PCA 2	PCA 3
Coniferous	0.67	0.11	0.74
Tundra	-0.60	-0.51	0.62
Barren	-0.44	0.85	0.27

	Coniferous	*Tundra*	*Barren*
Coniferous	1.00		
Tundra	-0.93	1.00	
Barren	-0.59	0.26	1.00

E.1.1.5 Human land use

The area downstream of Faro (i.e., V8) had the most but still relatively little human land use in its basin. Also, area estimates based on hard rock mining land claims did not likely accurately depict actual area disturbed by mining. Estimates of percent area logged were dated. None of these variables were included in later stages of evaluation.



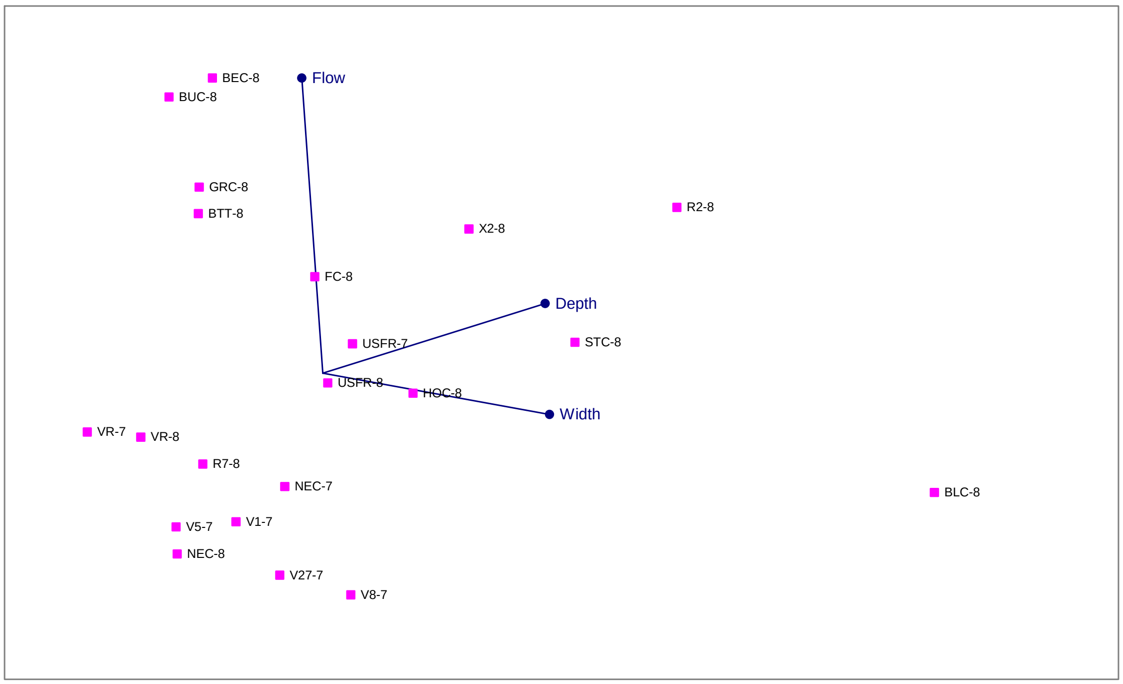
	PCA 1	PCA 2	PCA 3
Hard Rock	0.65	0.22	-0.73
Road Density	0.62	0.40	0.68
% Logged	0.44	-0.89	0.12

	Hard Rock	*Road Density*	*% Logged*
Hard Rock	1.00		
Road Density	0.24	1.00	
% Logged	0.12	0.09	1.00

E.1.2 Habitat Characteristics Based on Field Measurements

Gradient, percent cobble & gravel, and amount of partially open canopy were potentially important in distinguishing areas but were not used in further analyses because of the subjectivity in measuring them (i.e., the values at areas sampled in both 2007 and 2008 varied between years) and because the variability in habitat among areas was largely captured using basin characteristics derived from mapping.

Areas varied with respect to mean bottom velocity and wetted width. Mean depth was eliminated from further analyses because it was correlated with wetted width.



	PCA 1	PCA 2	PCA 3
Flow Velocity	-0.07	0.96	0.26
Depth	0.70	0.23	-0.68
Wetted Width	0.71	-0.13	0.69

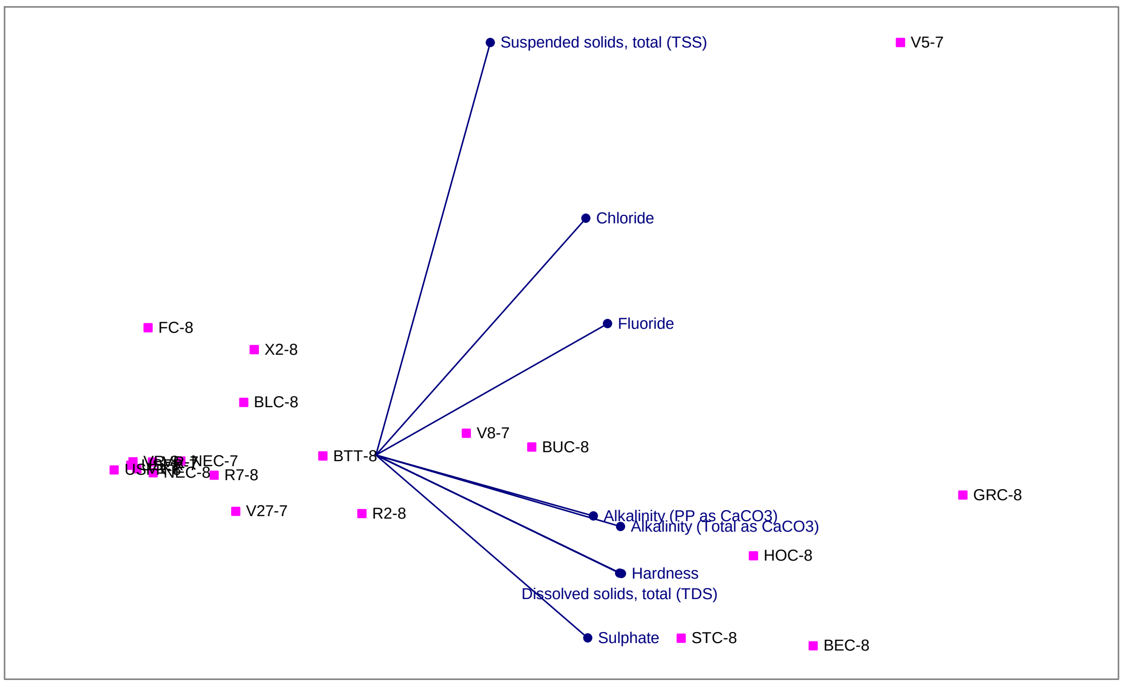
	Flow	*Depth*	*Width*
Flow Velocity	1.00		
Depth	0.09	1.00	
Wetted Width	-0.15	0.59	1.00

E.1.3 Water Chemistry

Correlations between water chemistry variables were evaluated but not used in later stages of habitat evaluation because such variables are influenced by mine activity and thus not good predictors of expected habitat conditions at a given location.

E.1.3.1 General water chemistry

Hardness and correlated variables were relatively high (total hardness > 200 mg/L) in several tributaries of the Pelly River (areas BEC, BUC, GRC, HOC, and STC) and in downstream sections of Vangorda Creek (V5 and V8). Of the inorganic chemistry variables, hardness gradient explained the most variability among areas. TSS also explained variability among areas and was not highly correlated with hardness.

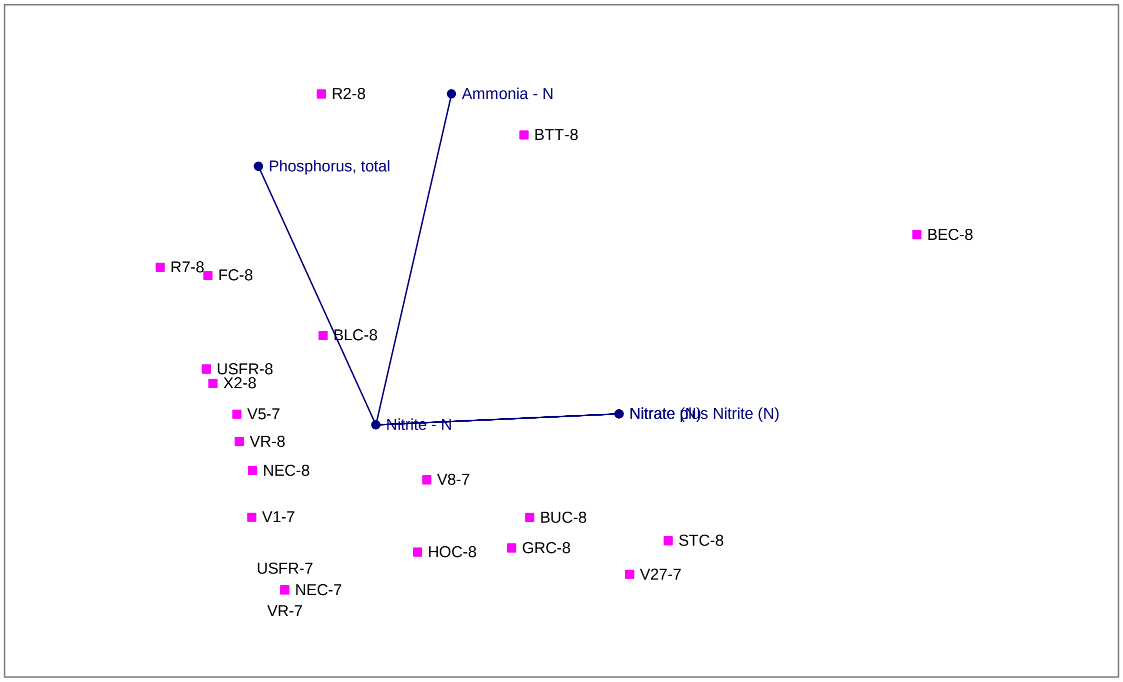


	PCA 1	PCA 2	PCA 3
Fluoride	0.37	0.23	-0.23
Alkalinity (Total as CaCO3)	0.40	-0.13	-0.26
Alkalinity (PP as CaCO3)	0.35	-0.11	-0.64
Sulphate	0.34	-0.33	0.58
Chloride	0.34	0.42	0.10
Suspended solids, total (TSS)	0.19	0.74	0.24
Dissolved solids, total (TDS)	0.39	-0.21	0.22
Hardness	0.40	-0.21	0.13

	Fluoride	*Alkalinity*	*Alkalinity*	*Sulphate*	*Chloride*	*TSS*	*TDS*	*Hardness*
Fluoride	1.00							
Alkalinity (Total as CaCO3)	0.87	1.00						
Alkalinity (PP as CaCO3)	0.76	0.89	1.00					
Sulphate	0.58	0.77	0.61	1.00				
Chloride	0.87	0.71	0.59	0.52	1.00			
Suspended solids, total (TSS)	0.57	0.28	0.25	0.14	0.73	1.00		
Dissolved solids, total (TDS)	0.78	0.93	0.78	0.94	0.68	0.25	1.00	
Hardness	0.80	0.95	0.82	0.93	0.67	0.25	1.00	1.00

E.1.3.2 Nutrient Chemistry

Although nutrient concentrations at all areas were low, nitrate, ammonia, and total phosphorus concentrations were important in explaining variability among areas.

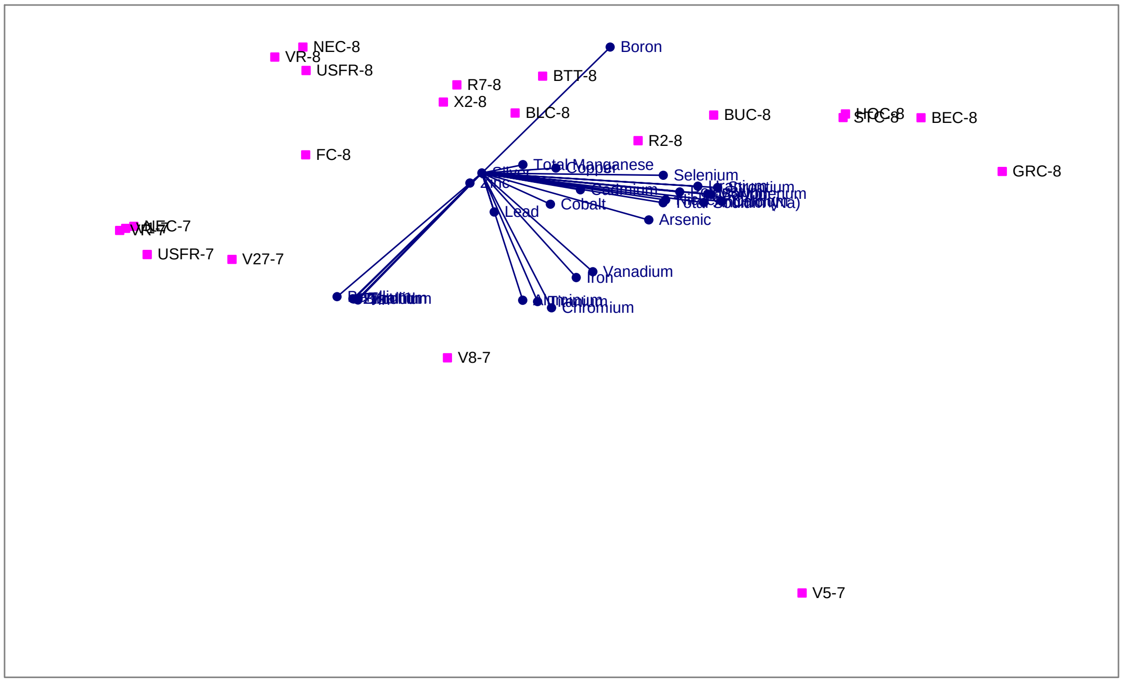


	PCA 1	PCA 2	PCA 3
Ammonia - N	0.20	0.79	-0.58
Nitrite - N	0.00	0.00	0.00
Nitrate (N)	0.66	0.03	0.26
Nitrate plus Nitrite (N)	0.66	0.03	0.26
Phosphorus, total	-0.32	0.62	0.72

	Ammonia	*Nitrite*	*Nitrate*	*N03+NO2*	*TP*
Ammonia - N	1.00				
Nitrite - N	0.00	1.00			
Nitrate (N)	0.21	0.00	1.00		
Nitrate plus Nitrite (N)	0.21	0.00	1.00	1.00	
Phosphorus, total	0.08	0.00	-0.30	-0.30	1.00

E.1.3.3 Metals

There were high correlations among several metals but no distinct gradients in metal concentrations among areas. Area V5 had the highest concentrations of aluminum, arsenic, chromium, iron, and titanium.



	PCA 1	PCA 2	PCA 3		PCA 1	PCA 2	PCA 3
Aluminum	0.104629	0.410242	-0.256425	Total Manganese	0.04234	0.124861	0.558344
Antimony	0.309373	-0.115371	-0.004142	Molybdenum	0.304389	-0.110492	-0.07672
Arsenic	0.220495	0.212645	-0.018648	Nickel	0.254567	-0.037039	0.18991
Barium	0.304916	-0.061857	-0.023467	Potassium	0.263864	0.005981	0.096388
Cadmium	0.143877	-0.111802	0.007705	Selenium	0.247897	-0.242388	-0.075746
Calcium	0.329696	-0.101121	0.013926	Total Sodium (Na)	0.249219	0.037672	0.081974
Chromium	0.162675	0.289055	-0.269877	Strontium	0.318292	-0.152605	0.010105
Cobalt	0.09639	0.223309	0.482788	Titanium	0.124788	0.406052	-0.251855
Copper	0.074876	0.135411	-0.041754	Uranium	0.293318	-0.167716	-0.048452
Iron	0.158957	0.407231	0.016888	Zinc	-0.007677	0.129464	0.420983
Lead	0.017568	0.32649	0.081085				

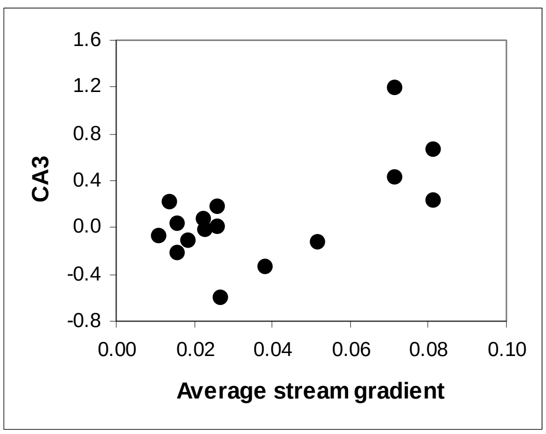
	Aluminum	*Antimony*	*Arsenic*	*Barium*	*Cadmium*	*Calcium*	*Chromium*	*Cobalt*	*Copper*	*Iron*	*Lead*	*Manganese*	*Molybdenum*	*Nickel*	*Potassium*	*Selenium*	*Sodium*	*Strontium*	*Titanium*	*Uranium*	*Zinc*
Aluminum	1.00																				
Antimony	0.11	1.00																			
Arsenic	0.44	0.58	1.00																		
Barium	0.18	0.79	0.57	1.00																	
Cadmium	0.08	0.40	-0.05	0.54	1.00																
Calcium	0.14	0.92	0.50	0.89	0.49	1.00															
Chromium	0.83	0.28	0.38	0.30	0.17	0.37	1.00														
Cobalt	0.19	0.13	0.25	0.15	0.07	0.20	0.13	1.00													
Copper	0.18	0.03	0.36	0.21	-0.16	0.16	0.06	0.00	1.00												
Iron	0.79	0.27	0.69	0.36	0.04	0.28	0.66	0.55	0.12	1.00											
Lead	0.43	-0.05	0.28	-0.06	0.02	-0.05	0.29	0.21	0.35	0.43	1.00										
Total Manganese	-0.10	0.02	0.09	0.03	-0.02	0.09	-0.12	0.95	-0.04	0.32	0.09	1.00									
Molybdenum	0.11	0.87	0.56	0.86	0.34	0.89	0.32	0.06	0.13	0.26	-0.12	-0.05	1.00								
Nickel	0.14	0.81	0.40	0.55	0.37	0.75	0.16	0.45	0.05	0.30	0.06	0.35	0.56	1.00							
Potassium	0.12	0.58	0.50	0.78	0.08	0.77	0.26	0.30	0.47	0.31	-0.02	0.23	0.67	0.46	1.00						
Selenium	-0.07	0.76	0.16	0.70	0.69	0.82	0.29	-0.05	-0.16	-0.01	-0.20	-0.10	0.72	0.55	0.39	1.00					
Total Sodium (Na)	0.14	0.52	0.51	0.72	0.06	0.70	0.29	0.32	0.53	0.31	0.00	0.24	0.72	0.35	0.92	0.32	1.00				
Strontium	0.04	0.95	0.47	0.82	0.41	0.98	0.30	0.14	0.09	0.19	-0.10	0.05	0.90	0.77	0.70	0.84	0.62	1.00			
Titanium	0.99	0.17	0.51	0.23	0.07	0.19	0.84	0.20	0.19	0.82	0.40	-0.08	0.19	0.17	0.17	-0.04	0.21	0.10	1.00		
Uranium	0.03	0.93	0.44	0.69	0.31	0.92	0.30	0.03	0.07	0.12	-0.09	-0.06	0.83	0.76	0.59	0.81	0.49	0.97	0.09	1.00	
Zinc	-0.09	-0.03	0.09	-0.06	0.19	-0.03	-0.10	0.46	-0.12	0.16	0.57	0.46	-0.17	0.12	-0.02	-0.12	-0.04	-0.07	-0.09	-0.13	1.00

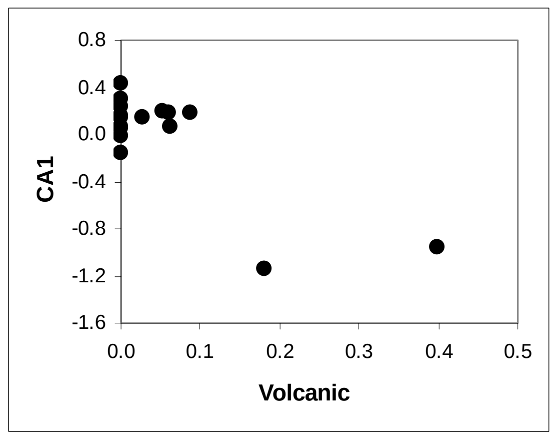
Appendix E.2 Biological-habitat relationships at reference areas

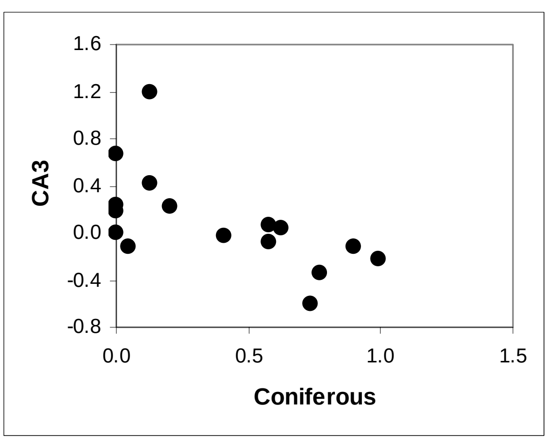
Based on correlation analyses of habitat characteristics the following variables were included in correlations with benthic community metrics:

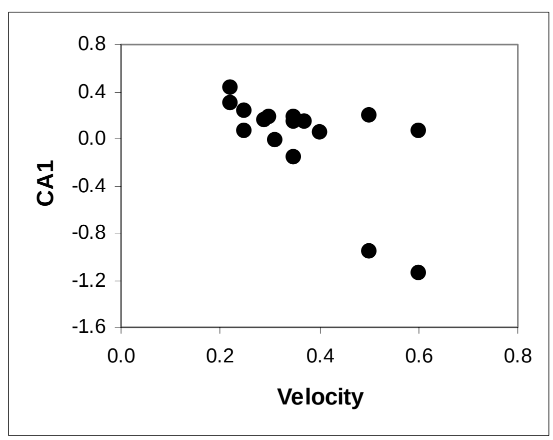
E.2.1 Hess sampling method

	CA1	*CA2*	*CA3*	*Abun*	*Rich*	*%EPT*	*%Chir*	*Diversity*	*E*	*Basin Area*	*Drainage Density*	*Station Elevation*	*Source Elevation*	*Average Stream Gradient*	*Sedimentary*	*Volcanic*	*Plutonic*	*Coniferous*	*Velocity*	*Wetted Width*
CA1	1.00																			
CA2	-0.02	1.00																		
CA3	0.37	-0.37	1.00																	
Abun	-0.83	-0.38	-0.13	1.00																
Rich	0.00	-0.05	-0.16	-0.09	1.00															
%EPT	0.43	-0.19	-0.06	-0.48	0.58	1.00														
%Chir	-0.33	0.35	-0.24	0.28	-0.54	-0.83	1.00													
Diversity	-0.03	-0.15	-0.17	-0.08	0.41	0.69	-0.73	1.00												
E	0.14	-0.08	-0.28	-0.25	0.36	0.78	-0.69	0.92	1.00											
Basin Area	-0.03	0.11	-0.25	0.06	0.22	-0.25	0.36	-0.56	-0.53	1.00										
Drainage Density	0.22	0.13	0.15	-0.40	-0.16	0.09	-0.09	0.28	0.34	-0.48	1.00									
Station Elevation	0.15	-0.30	0.40	-0.10	-0.20	0.15	-0.22	0.26	0.14	-0.64	0.56	1.00								
Source Elevation	0.20	-0.21	0.25	-0.12	-0.12	0.03	-0.04	-0.17	-0.34	0.12	-0.16	0.42	1.00							
Avegerage Stream Gradient	0.33	-0.11	0.63	-0.38	-0.41	0.11	-0.26	0.05	0.02	-0.46	0.41	0.41	0.16	1.00						
Sedimentary	-0.12	0.40	-0.18	-0.10	-0.32	-0.29	0.27	-0.21	-0.28	0.41	-0.24	-0.46	0.15	0.20	1.00					
Volcanic	-0.80	-0.26	-0.22	0.93	-0.09	-0.45	0.29	-0.01	-0.13	0.10	-0.39	-0.30	-0.38	-0.40	0.04	1.00				
Plutonic	0.17	-0.51	0.42	-0.03	0.05	0.32	-0.39	0.37	0.21	-0.49	0.41	0.91	0.52	0.30	-0.50	-0.26	1.00			
Coniferous	-0.12	0.53	-0.61	-0.03	0.20	-0.12	0.26	-0.04	0.12	0.36	-0.16	-0.76	-0.48	-0.61	0.20	0.16	-0.77	1.00		
Velocity	-0.65	0.27	-0.55	0.40	0.29	-0.11	0.13	0.25	0.20	-0.02	-0.11	-0.39	-0.36	-0.47	0.07	0.46	-0.35	0.56	1.00	
Wetted Width	0.14	0.06	-0.14	-0.04	0.28	-0.07	0.20	-0.44	-0.36	0.83	-0.42	-0.43	0.04	-0.49	0.12	0.01	-0.34	0.24	-0.32	1.00



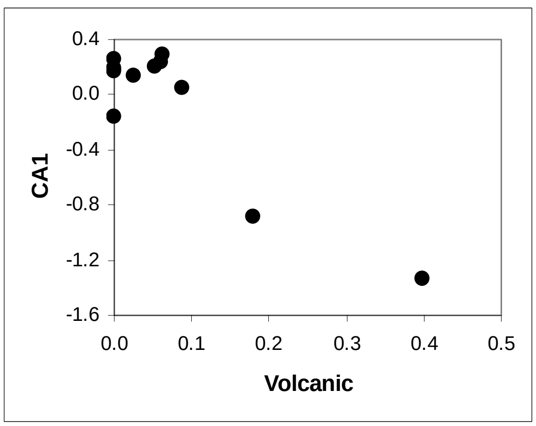


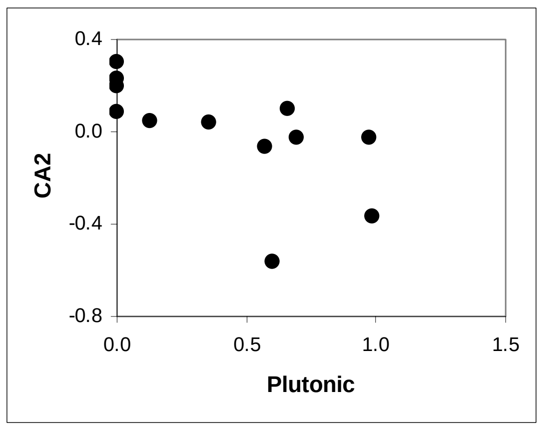


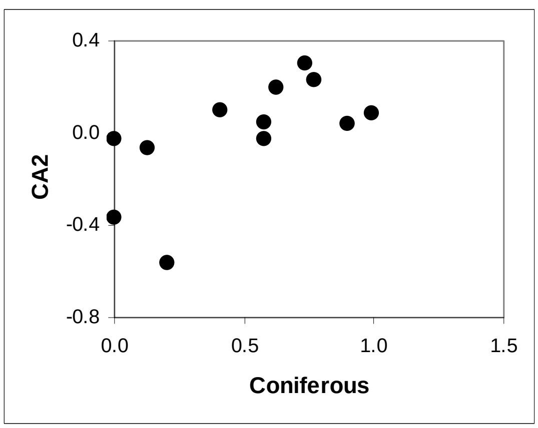


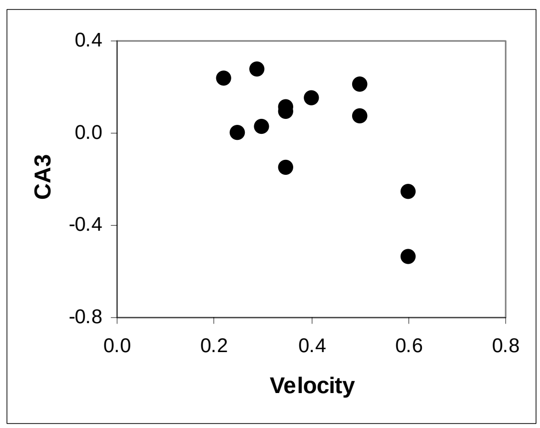
E.2.2 Kick-and-sweep sampling method

	CA1	CA2	CA3	Abun	Rich	%EPT	%Chir	Diversity	E	Basin Area	Drainage Density	Station Elevation	Source Elevation	Avegerage Stream Gradient	Sedimentary	Volcanic	Plutonic	Coniferous	Velocity	Wetted Width
CA1	1.00																			
CA2	0.46	1.00																		
CA3	0.24	-0.51	1.00																	
Abun	-0.80	-0.76	0.21	1.00																
Rich	-0.16	-0.55	0.04	0.23	1.00															
%EPT	0.62	-0.06	0.12	-0.40	0.19	1.00														
%Chir	-0.71	-0.09	-0.17	0.56	-0.03	-0.93	1.00													
Diversity	0.55	0.83	-0.22	-0.81	-0.39	0.07	-0.31	1.00												
E	0.35	0.77	-0.09	-0.55	-0.81	-0.14	-0.08	0.80	1.00											
Basin Area	0.18	0.20	-0.13	-0.09	-0.01	-0.11	0.24	-0.25	-0.13	1.00										
Drainage Density	0.30	-0.01	0.21	-0.30	-0.08	0.32	-0.48	0.34	0.16	-0.50	1.00									
Station Elevation	0.02	-0.45	0.51	0.04	0.47	0.04	-0.14	0.08	-0.22	-0.61	0.57	1.00								
Source Elevation	0.25	-0.01	0.27	-0.19	0.47	-0.10	0.15	0.15	-0.12	0.21	-0.10	0.41	1.00							
Avegerage Stream Gradient	0.26	0.03	0.43	-0.23	0.03	0.34	-0.46	0.35	0.17	-0.42	0.37	0.38	0.15	1.00						
Sedimentary	0.07	0.52	-0.27	-0.29	-0.18	-0.09	0.16	0.30	0.38	0.41	-0.26	-0.43	0.21	0.21	1.00					
Volcanic	-0.90	-0.43	-0.12	0.87	0.01	-0.64	0.77	-0.63	-0.31	0.01	-0.40	-0.20	-0.34	-0.35	0.00	1.00				
Plutonic	0.00	-0.65	0.53	0.23	0.68	0.19	-0.17	-0.20	-0.51	-0.43	0.45	0.89	0.49	0.27	-0.47	-0.15	1.00			
Coniferous	0.13	0.64	-0.67	-0.31	-0.60	-0.03	0.04	0.29	0.46	0.23	-0.07	-0.70	-0.46	-0.55	0.15	-0.02	-0.72	1.00		
Velocity	-0.54	0.11	-0.62	0.29	-0.18	-0.26	0.31	0.00	0.15	-0.16	-0.11	-0.35	-0.30	-0.36	0.06	0.40	-0.27	0.49	1.00	
Wetted Width	0.24	0.05	-0.04	-0.15	0.06	0.03	0.08	-0.34	-0.27	0.83	-0.38	-0.41	0.04	-0.46	0.13	-0.05	-0.33	0.16	-0.47	1.00



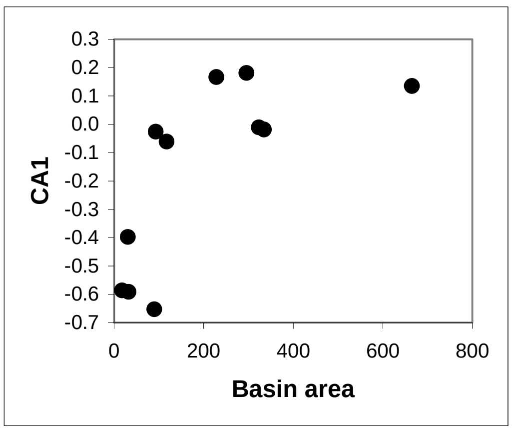


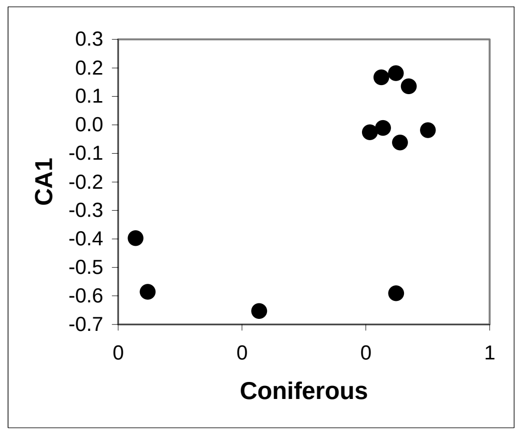


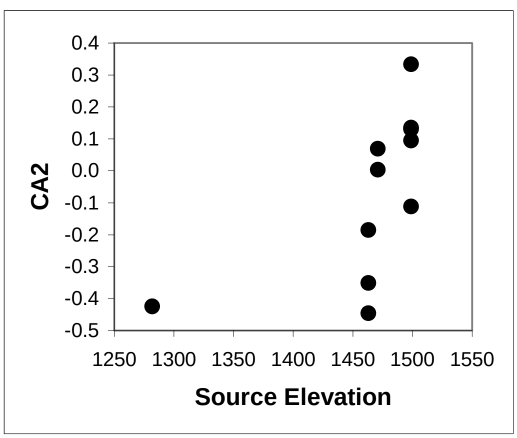


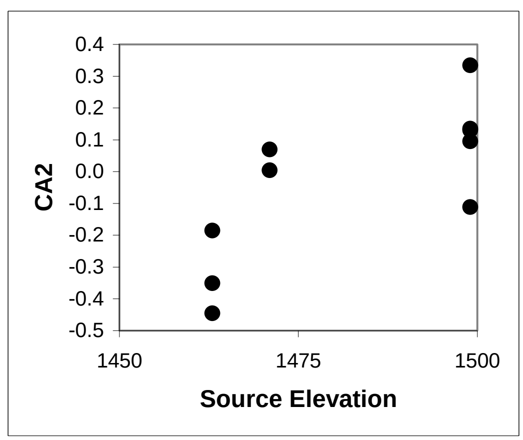
E.2.3 Artificial substrate sampling method – reference and exposure areas (due to low number of reference areas)

	CA1	*CA2*	*CA3*	*Abun*	*Richness*	*%EPT*	*%Chir*	*Diversity*	*Evenness*	*Basin Area*	*Drainage Density*	*Station Elevation*	*Source Elevation*	*Average Stream Gradient*	*Sedimentary*	*Volcanic*	*Plutonic*	*Coniferous*
CA1	1.00																	
CA2	-0.70	1.00																
CA3	-0.81	0.86	1.00															
Abun	-0.38	0.34	0.66	1.00														
Richness	-0.46	-0.03	0.15	0.07	1.00													
%EPT	0.56	-0.75	-0.75	-0.34	0.29	1.00												
%Chir	-0.46	0.72	0.71	0.34	-0.42	-0.99	1.00											
Diversity	0.01	-0.50	-0.37	-0.33	0.79	0.60	-0.68	1.00										
Evenness	0.32	-0.61	-0.60	-0.63	0.41	0.51	-0.56	0.86	1.00									
Basin Area	-0.70	0.36	0.37	-0.14	0.30	-0.43	0.34	0.08	0.00	1.00								
Drainage Density	0.04	0.06	-0.05	-0.10	0.43	0.25	-0.24	0.48	0.36	-0.22	1.00							
Station Elevation	-0.33	0.34	0.50	0.39	-0.13	-0.18	0.21	-0.24	-0.35	-0.16	-0.16	1.00						
Source Elevation	-0.59	0.52	0.53	0.30	0.10	-0.29	0.31	-0.23	-0.49	0.31	0.11	0.44	1.00					
Average Stream Gradient	0.36	-0.31	-0.38	-0.42	0.15	0.29	-0.29	0.44	0.56	-0.51	0.37	0.01	-0.30	1.00				
Sedimentary	0.17	-0.21	-0.20	0.12	0.61	0.51	-0.55	0.61	0.39	-0.42	0.69	-0.31	-0.27	0.37	1.00			
Volcanic	0.04	0.07	-0.08	-0.21	-0.29	-0.38	0.34	-0.38	-0.19	0.41	-0.52	-0.65	-0.29	-0.33	-0.36	1.00		
Plutonic	-0.03	0.10	0.22	0.23	-0.30	0.00	0.08	-0.24	-0.25	-0.33	-0.04	0.90	0.48	0.09	-0.32	-0.72	1.00	
Coniferous	-0.66	0.49	0.66	0.46	0.41	-0.58	0.47	0.02	-0.15	0.57	-0.11	-0.14	0.01	-0.41	0.09	0.34	-0.47	1.00









Appendix E.3 Reference-area selection

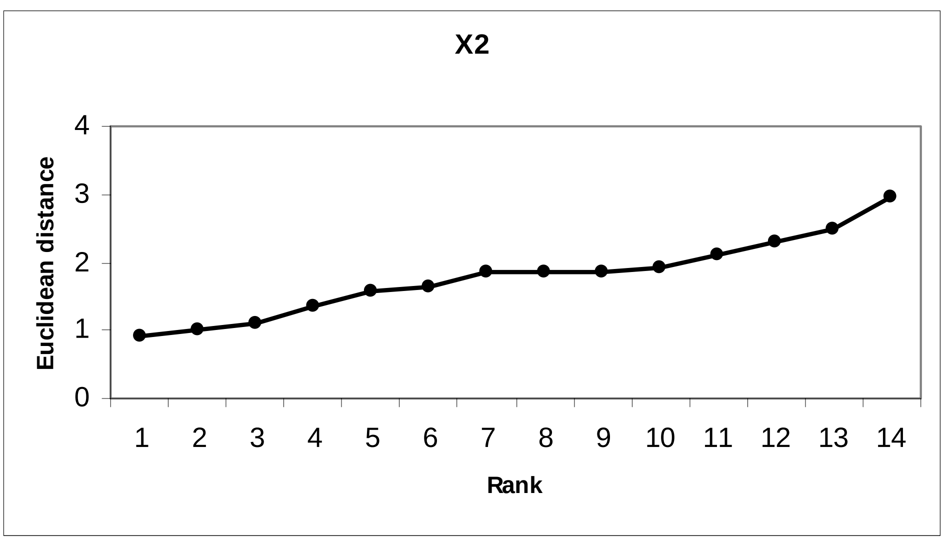
E.3.1 Reference-site selection for exposure area X2

Exposure Area	Rank [1]	Reference Areas	Euclidean Distance	ncP [2]	P [3]
X2	1	R7	0.917127302		
	2	FC	1.002777842		
	3	USFR	1.097126975	0.59	0.19
	4	NEXC	1.361997341	0.23	0.02
	5	VR	1.574266864	0.40	0.02
	6	BUC	1.626468796	0.74	0.02
	7	STC	1.852122383	0.57	0.00
	8	GRC	1.864997976	0.84	0.01
	9	HOC	1.87168781	0.95	0.01
	10	BLC	1.9182478	0.96	0.01
	11	V1	2.10883355	0.83	0.00
	12	R6	2.296825432	0.68	0.00
	13	BEC	2.483550508	0.57	0.00
	14	BTT	2.953954154	0.17	0.00

[1] Rank from most to least suitable reference area for a given exposure area based on habitat similarity

[2] Probability habitat at the exposure site is outside the normal range of habitat (i.e., 2 SDs) at the first x number of reference sites

[3] Probability habitat at the exposure site is different than the average habitat at the first x number of reference sites



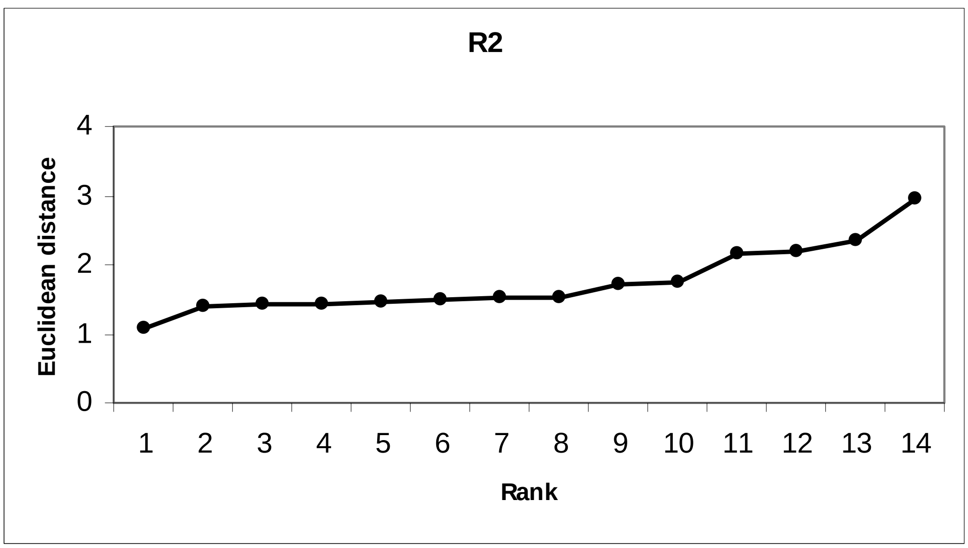
E.3.2 Reference-site selection for exposure area R2

Exposure Area	Rank[1]	Reference Areas	Euclidean Distance	ncP[2]	P[3]
R2	1	R7	1.092653413		
	2	BUC	1.402918828		
	3	FC	1.41623041	0.94	0.47
	4	NEXC	1.44178742	0.97	0.32
	5	GRC	1.46057992	0.99	0.23
	6	STC	1.504042815	0.97	0.11
	7	USFR	1.508143604	0.99	0.10
	8	HOC	1.5234193	0.99	0.07
	9	BLC	1.698914223	0.52	0.00
	10	VR	1.735340961	0.67	0.00
	11	BEC	2.161508331	0.02	0.00
	12	R6	2.183753551	0.26	0.00
	13	V1	2.33821228	0.27	0.00
	14	BTT	2.939796047	0.02	0.00

[1] Rank from most to least suitable reference area for a given exposure area based on habitat similarity

[2] Probability habitat at the exposure site is outside the normal range of habitat (i.e., 2 SDs) at the first x number of reference sites

[3] Probability habitat at the exposure site is different than the average habitat at the first x number of reference sites



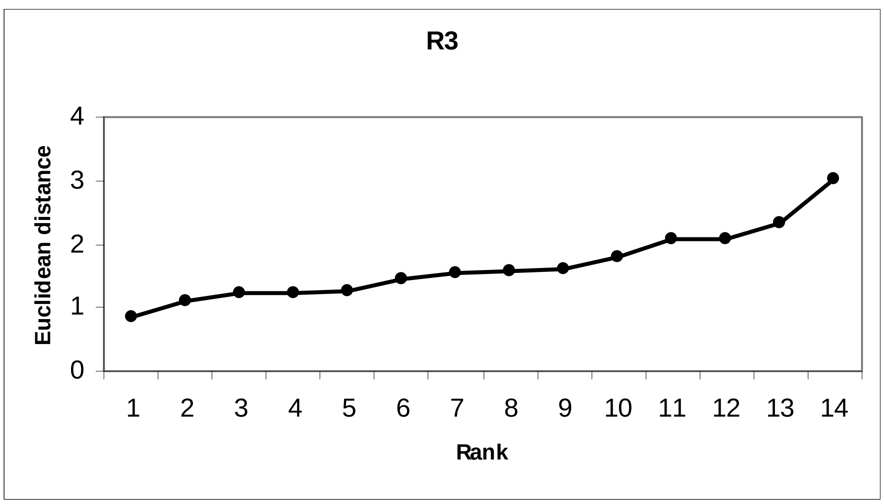
E.3.3 Reference-site selection for exposure area R3

Exposure Area	Rank [1]	Reference Areas	Euclidean Distance	ncP [2]	P [3]
R3	1	R7	0.84491557		
	2	NEXC	1.117747408		
	3	STC	1.23304797	0.81	0.32
	4	HOC	1.236824054	0.95	0.27
	5	BLC	1.261215581	0.98	0.19
	6	VR	1.450428943	0.65	0.02
	7	GRC	1.536728413	0.69	0.01
	8	FC	1.586918304	0.80	0.01
	9	USFR	1.614009635	0.90	0.01
	10	BUC	1.801401655	0.58	0.00
	11	R6	2.068134888	0.25	0.00
	12	V1	2.086081431	0.57	0.00
	13	BEC	2.340208039	0.33	0.00
	14	BTT	3.027094098	0.03	0.00

[1] Rank from most to least suitable reference area for a given exposure area based on habitat similarity

[2] Probability habitat at the exposure site is outside the normal range of habitat (i.e., 2 SDs) at the first x number of reference sites

[3] Probability habitat at the exposure site is different than the average habitat at the first x number of reference sites



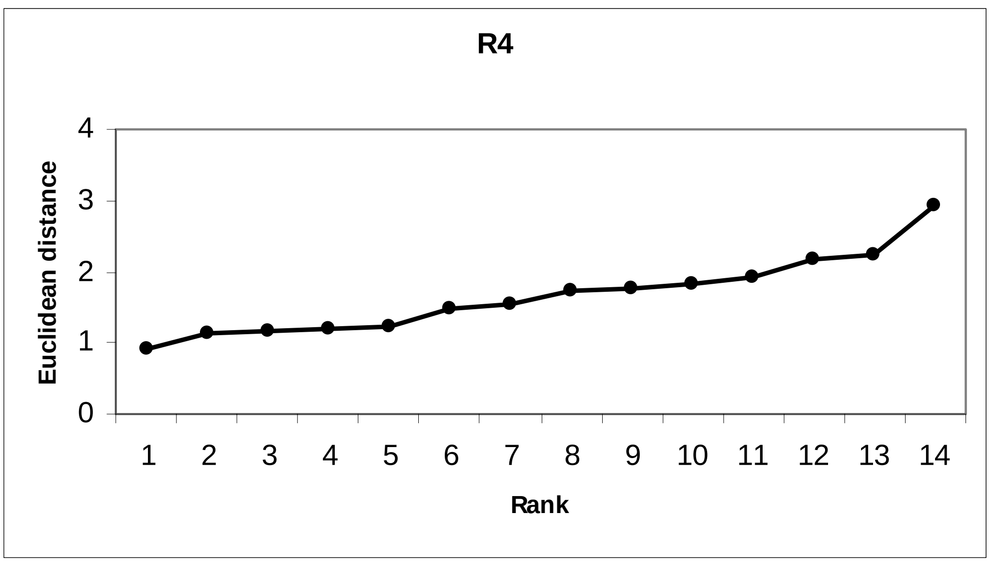
E.3.4 Reference-site selection for exposure area R4

Exposure Area	Rank [1]	Reference Areas	Euclidean Distance	ncP [2]	P [3]
R4	1	R7	0.922846087		
	2	HOC	1.120305616		
	3	STC	1.179056997	0.86	0.36
	4	BLC	1.201400424	0.93	0.24
	5	NEXC	1.219291775	0.97	0.17
	6	GRC	1.473226149	0.26	0.00
	7	VR	1.550440048	0.52	0.00
	8	FC	1.721683264	0.40	0.00
	9	USFR	1.748944514	0.70	0.00
	10	BUC	1.834757328	0.73	0.00
	11	R6	1.920296357	0.74	0.00
	12	V1	2.178472096	0.38	0.00
	13	BEC	2.233077875	0.59	0.00
	14	BTT	2.915642093	0.04	0.00

[1] Rank from most to least suitable reference area for a given exposure area based on habitat similarity

[2] Probability habitat at the exposure site is outside the normal range of habitat (i.e., 2 SDs) at the first x number of reference sites

[3] Probability habitat at the exposure site is different than the average habitat at the first x number of reference sites



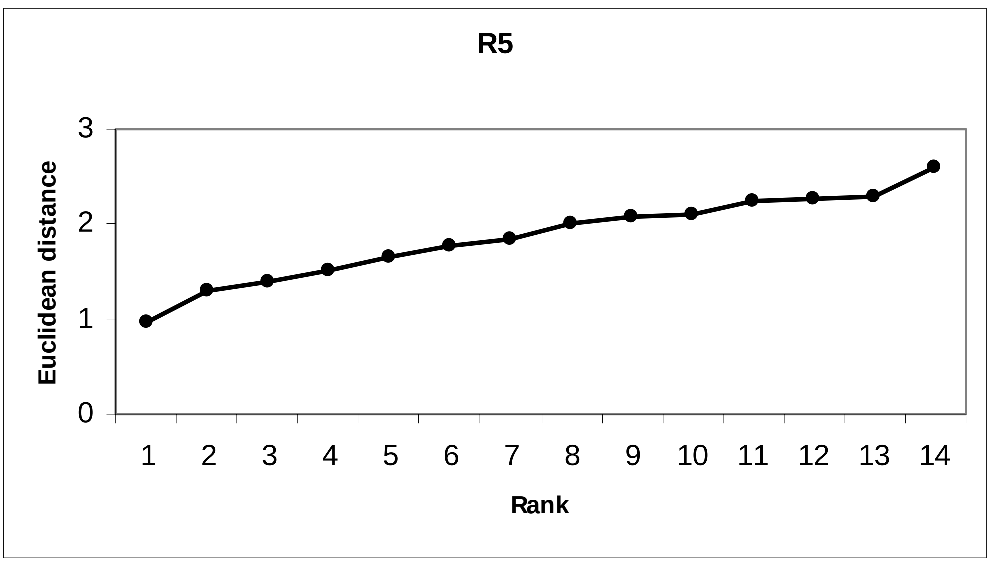
E.3.5 Reference-site selection for exposure area R5

Exposure Area	Rank [1]	Reference Areas	Euclidean Distance	ncP [2]	P [3]
R5	1	R6	0.972369745		
	2	HOC	1.308204433		
	3	R7	1.394347335	0.87	0.37
	4	BLC	1.522590357	0.82	0.15
	5	STC	1.654530599	0.77	0.06
	6	GRC	1.773100936	0.77	0.03
	7	NEXC	1.850510819	0.83	0.02
	8	BEC	2.013328719	0.71	0.00
	9	BTT	2.079892078	0.81	0.00
	10	VR	2.094149407	0.92	0.00
	11	FC	2.24655298	0.81	0.00
	12	USFR	2.26871579	0.91	0.00
	13	BUC	2.285294626	0.96	0.00
	14	V1	2.606266956	0.56	0.00

[1] Rank from most to least suitable reference area for a given exposure area based on habitat similarity

[2] Probability habitat at the exposure site is outside the normal range of habitat (i.e., 2 SDs) at the first x number of reference sites

[3] Probability habitat at the exposure site is different than the average habitat at the first x number of reference sites



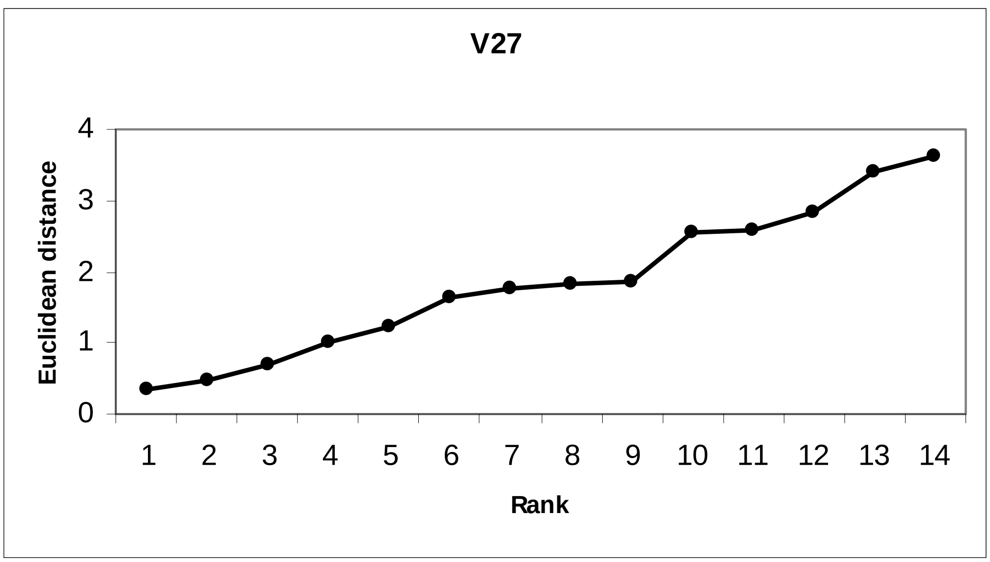
E.3.6 Reference-site selection for exposure area V27

Exposure Area	Rank [1]	Reference Areas	Euclidean Distance	ncP [2]	P [3]
V27	1	NEXC	0.351240987		
	2	VR	0.458980825		
	3	R7	0.684632851	0.40	0.12
	4	V1	1.007384656	0.35	0.04
	5	BLC	1.24151516	0.52	0.02
	6	USFR	1.633813098	0.40	0.01
	7	FC	1.760153993	0.67	0.01
	8	STC	1.817378482	0.85	0.01
	9	HOC	1.871335439	0.93	0.01
	10	GRC	2.566799097	0.37	0.00
	11	R6	2.567887476	0.72	0.00
	12	BUC	2.84132274	0.66	0.00
	13	BEC	3.398362606	0.38	0.00
	14	BTT	3.635136347	0.49	0.00

[1] Rank from most to least suitable reference area for a given exposure area based on habitat similarity

[2] Probability habitat at the exposure site is outside the normal range of habitat (i.e., 2 SDs) at the first x number of reference sites

[3] Probability habitat at the exposure site is different than the average habitat at the first x number of reference sites



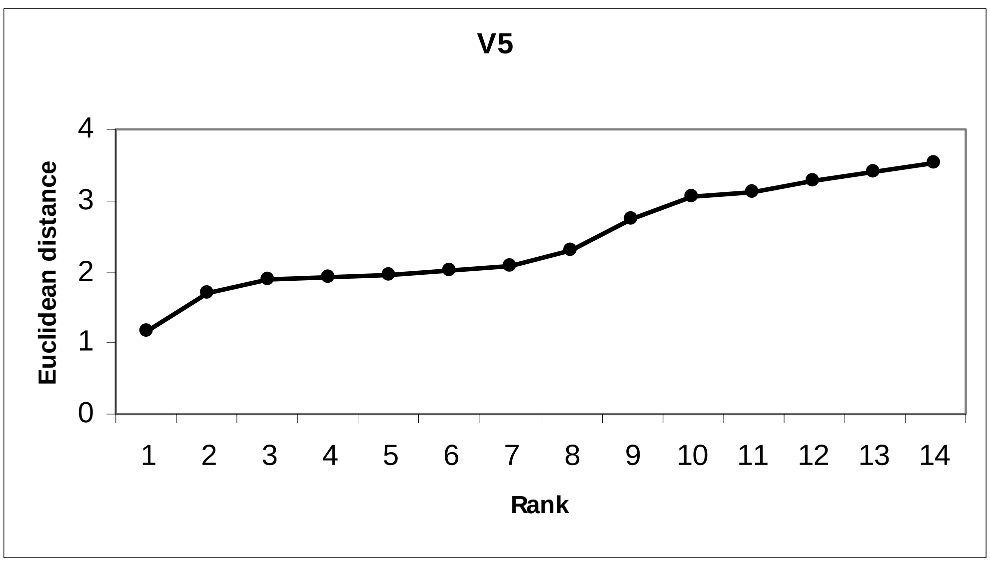
E.3.7 Reference-site selection for exposure area V5

Exposure Area	Rank [1]	Reference Areas	Euclidean Distance	ncP [2]	P [3]
V5	1	BLC	1.167467714		
	2	HOC	1.704292396		
	3	NEXC	1.885607267	0.85	0.34
	4	R7	1.928683303	0.94	0.25
	5	STC	1.939546308	0.98	0.22
	6	VR	2.014492443	0.98	0.12
	7	R6	2.080611168	0.98	0.06
	8	V1	2.30623929	0.78	0.01
	9	GRC	2.74101792	0.25	0.00
	10	USFR	3.044581636	0.25	0.00
	11	FC	3.132369337	0.52	0.00
	12	BEC	3.271665536	0.62	0.00
	13	BTT	3.388791908	0.72	0.00
	14	BUC	3.519372541	0.76	0.00

[1] Rank from most to least suitable reference area for a given exposure area based on habitat similarity

[2] Probability habitat at the exposure site is outside the normal range of habitat (i.e., 2 SDs) at the first x number of reference sites

[3] Probability habitat at the exposure site is different than the average habitat at the first x number of reference sites



E.3.8 Reference-site selection for exposure area V8

Exposure Area	Rank [1]	Reference Areas	Euclidean Distance	ncP [2]	P [3]
V8	1	HOC	1.101120168		
	2	R6	1.104525697		
	3	BLC	1.146543976	0.09	0.02
	4	R7	1.491098499	0.02	0.00
	5	STC	1.495988866	0.77	0.06
	6	NEXC	1.786850146	0.36	0.00
	7	GRC	1.926478369	0.53	0.00
	8	VR	2.03212536	0.67	0.00
	9	BEC	2.30419111	0.46	0.00
	10	BTT	2.437451791	0.59	0.00
	11	V1	2.525497493	0.72	0.00
	12	USFR	2.542917679	0.88	0.00
	13	FC	2.560760206	0.95	0.00
	14	BUC	2.665235441	0.94	0.00

[1] Rank from most to least suitable reference area for a given exposure area based on habitat similarity

[2] Probability habitat at the exposure site is outside the normal range of habitat (i.e., 2 SDs) at the first x number of reference sites

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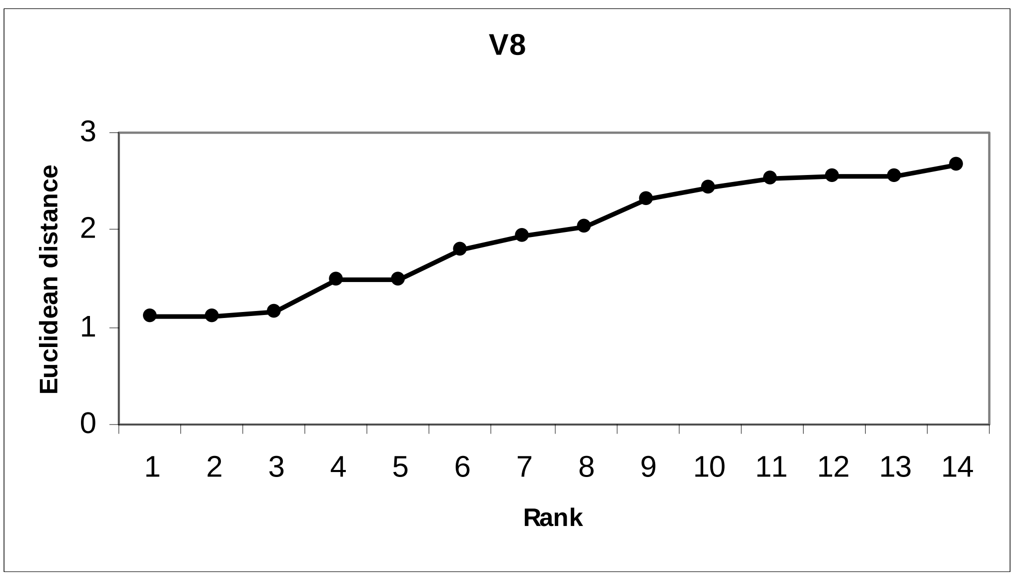

APPENDIX F

Reference – Exposure Comparisons by ANOVA

Table F.1: ANOVA results for five Hess versus artificial substrates per area; V27, V5, V8 versus V1, 2007

	Dependent Variable	Mean Square	F (ANOVA)	p-value	Observed Power
Hess	Hess Density (Individuals/m2)	44926797.9333	12.5953	0.000176	0.9979
	Hess Number of Taxa	26.1833	1.9042	0.169622	0.3998
	Hess EPT (%)	2268.2760	24.6339	0.000003	1.0000
	Hess Chironomids (%)	2515.9451	29.6642	0.000001	1.0000
	Hess Simpson's D	0.0544	8.9478	0.001032	0.9797
	Hess Simpson's E	0.0282	6.7590	0.003725	0.9305
	Hess B-C Dist. to V-1 median	0.2779	100.2708	0.000000	1.0000
	Hess Vangorda CA Axis-1 (24.4%)	1.1227	51.4445	0.000000	1.0000
	Hess Vangorda CA Axis-2 (17.2%)	0.6681	20.8981	0.000009	1.0000
	Hess Vangorda CA Axis-3 (14.7%)	0.4339	9.0614	0.000971	0.9810
Artificial Substrate	Artificial Substrate Abundance	861867.6500	1.9458	0.162926	0.4078
	Artificial Substrate Number of Taxa	8.8667	0.8465	0.488476	0.1929
	Artificial Substrate EPT (%)	408.6436	3.0764	0.057557	0.6058
	Artificial Substrate Chironomids (%)	385.9055	3.3416	0.045792	0.6454
	Art. Substrate Simpson's D	0.0001	0.2035	0.892459	0.0801
	Art. Substrate Simpson's E	0.0011	0.1106	0.952624	0.0659
	Art. Substrate B-C Dist. to V-1 median	0.0551	1.9094	0.168782	0.4008
	Artificial Substrate CA-1 (23.8%)	0.8073	8.0859	0.001671	0.9666
	Artificial Substrate CA-2 (13.5%)	0.0877	0.9077	0.459195	0.2046
	Artificial Substrate CA-3 (12.5%)	0.3458	7.9540	0.001803	0.9640

Table F.2: Summary of ANOVA, and user-defined contrasts (V27, V5, V8 vs. V1) for Vangorda Creek sampling areas (5 stations/are

	1-way ANOVA						Contrast Statistics		
Dependent Variable	p-value	Power	Contrast Type[a]	(I) Area	(J) Area	Value of Contrast (J-I)	Standard Error	t-statistic	p-value[b]
Hess Density (Individuals/m2)			Assume equal variances	V1 Reference	V27 Exposure	2569.400	1194.481	2.151	0.047
	0.00018	0.99786		V1 Reference	V5 Exposure	-4625.000	1194.481	-3.872	0.001
				V1 Reference	V8 Exposure	19.200	1194.481	0.016	0.987
Hess Number of Taxa			Assume equal variances	V1 Reference	V27 Exposure	4.000	2.345	1.706	0.107
	0.16962	0.39979		V1 Reference	V5 Exposure	5.400	2.345	2.303	0.035
				V1 Reference	V8 Exposure	3.200	2.345	1.364	0.191
Hess EPT (%)			Assume equal variances	V1 Reference	V27 Exposure	15.356	6.069	2.530	0.022
	0.00000	1.00000		V1 Reference	V5 Exposure	-18.283	6.069	-3.013	0.008
				V1 Reference	V8 Exposure	-33.507	6.069	-5.521	0.000
Hess Chironomids (%)			Assume equal variances	V1 Reference	V27 Exposure	-27.688	5.825	-4.754	0.000
	0.00000	1.00000		V1 Reference	V5 Exposure	4.832	5.825	0.830	0.419
				V1 Reference	V8 Exposure	26.902	5.825	4.619	0.000
Hess Simpson's D			Does not assume equal variances	V1 Reference	V27 Exposure	0.017	0.017	1.012	0.342
	0.00103	0.97967		V1 Reference	V5 Exposure	0.050	0.021	2.414	0.044
				V1 Reference	V8 Exposure	-0.182	0.067	-2.719	0.049
Hess Simpson's E			Assume equal variances	V1 Reference	V27 Exposure	-0.031	0.041	-0.749	0.465
	0.00373	0.93053		V1 Reference	V5 Exposure	0.013	0.041	0.322	0.752
				V1 Reference	V8 Exposure	-0.151	0.041	-3.708	0.002
Hess B-C Dist. to V-1 median			Assume equal variances	V1 Reference	V27 Exposure	0.284	0.033	8.530	0.000
	0.00000	1.00000		V1 Reference	V5 Exposure	0.553	0.033	16.617	0.000
				V1 Reference	V8 Exposure	0.414	0.033	12.434	0.000
Hess Vangorda CA Axis-1 (24.4%)			Assume equal variances	V1 Reference	V27 Exposure	0.423	0.093	4.526	0.000
	0.00000	1.00000		V1 Reference	V5 Exposure	-0.659	0.093	-7.049	0.000
				V1 Reference	V8 Exposure	0.247	0.093	2.646	0.018
Hess Vangorda CA Axis-2 (17.2%)			Does not assume equal variances	V1 Reference	V27 Exposure	0.156	0.081	1.930	0.094
	0.00001	0.99999		V1 Reference	V5 Exposure	0.393	0.062	6.386	0.000
				V1 Reference	V8 Exposure	0.839	0.139	6.015	0.002
Hess Vangorda CA Axis-3 (14.7%)			Assume equal variances	V1 Reference	V27 Exposure	-0.599	0.138	-4.331	0.001
	0.00097	0.98098		V1 Reference	V5 Exposure	-0.572	0.138	-4.136	0.001
				V1 Reference	V8 Exposure	-0.187	0.138	-1.351	0.196
Artificial Substrate Abundance			Assume equal variances	V1 Reference	V27 Exposure	282.000	420.919	0.670	0.512
	0.16293	0.40778		V1 Reference	V5 Exposure	958.400	420.919	2.277	0.037
				V1 Reference	V8 Exposure	619.800	420.919	1.472	0.160
Artificial Substrate Number of Taxa			Assume equal variances	V1 Reference	V27 Exposure	3.000	2.047	1.466	0.162
	0.48848	0.19291		V1 Reference	V5 Exposure	2.000	2.047	0.977	0.343
				V1 Reference	V8 Exposure	2.600	2.047	1.270	0.222
Artificial Substrate EPT (%)			Assume equal variances	V1 Reference	V27 Exposure	14.570	7.289	1.999	0.063
	0.05756	0.60576		V1 Reference	V5 Exposure	-4.416	7.289	-0.606	0.553
				V1 Reference	V8 Exposure	-4.595	7.289	-0.630	0.537
Artificial Substrate Chironomids (%)			Assume equal variances	V1 Reference	V27 Exposure	-17.191	6.797	-2.529	0.022
	0.04579	0.64543		V1 Reference	V5 Exposure	-4.823	6.797	-0.710	0.488
				V1 Reference	V8 Exposure	2.614	6.797	0.385	0.706
Art. Substrate Simpson's D			Assume equal variances	V1 Reference	V27 Exposure	0.006	0.016	0.366	0.719
	0.89246	0.08012		V1 Reference	V5 Exposure	0.012	0.016	0.780	0.447
				V1 Reference	V8 Exposure	0.006	0.016	0.357	0.726
Art. Substrate Simpson's E			Assume equal variances	V1 Reference	V27 Exposure	-0.036	0.063	-0.571	0.576
	0.95262	0.06595		V1 Reference	V5 Exposure	-0.014	0.063	-0.216	0.831
				V1 Reference	V8 Exposure	-0.017	0.063	-0.270	0.790
Art. Substrate B-C Dist. to V-1 median			Assume equal variances	V1 Reference	V27 Exposure	0.148	0.107	1.381	0.186
	0.16878	0.40077		V1 Reference	V5 Exposure	0.252	0.107	2.345	0.032
				V1 Reference	V8 Exposure	0.170	0.107	1.578	0.134
Artificial Substrate CA-1 (23.8%)			Assume equal variances	V1 Reference	V27 Exposure	-0.090	0.200	-0.451	0.658
	0.00167	0.96657		V1 Reference	V5 Exposure	0.796	0.200	3.984	0.001
				V1 Reference	V8 Exposure	0.342	0.200	1.709	0.107
Artificial Substrate CA-2 (13.5%)			Assume equal variances	V1 Reference	V27 Exposure	-0.028	0.197	-0.140	0.890
	0.45920	0.20459		V1 Reference	V5 Exposure	-0.151	0.197	-0.766	0.455
				V1 Reference	V8 Exposure	-0.290	0.197	-1.473	0.160
Artificial Substrate CA-3 (12.5%)			Assume equal variances	V1 Reference	V27 Exposure	0.033	0.132	0.247	0.808
	0.00180	0.96398		V1 Reference	V5 Exposure	-0.166	0.132	-1.260	0.226
				V1 Reference	V8 Exposure	0.452	0.132	3.426	0.003

(shaded) significant at p = 0.1

[a] Contrast test used is dependent upon results of Levene's Test for homogeneity of variances.

[b] User-defined contrasts are *a priori* tests with each test p = 0.10

Table F.3: User-defined contrast tests based on 3 stations per area, Vangorda Creek, 2007.

		Contrast	(I) Area	(J) Area	Value of Contrast	Std. Error	t	df	p-value
Hess Density (Individuals/m2)	Does not assume equal variances	V1 vs. V27	V1 Reference	V27 Exposure	2286.0000	2388.6510	0.9570	3.68	0.397
		V1 vs. V5	V1 Reference	V5 Exposure	-4852.0000	1452.2353	-3.3410	2.20	0.069
		V1 vs. V8	V1 Reference	V8 Exposure	549.3333	1580.5115	0.3480	2.92	0.752
Hess Number of Taxa	Assume equal variances	V1 vs. V27	V1 Reference	V27 Exposure	2.3300	2.5390	0.9190	8.00	0.385
		V1 vs. V5	V1 Reference	V5 Exposure	6.3300	2.5390	2.4950	8.00	0.037
		V1 vs. V8	V1 Reference	V8 Exposure	5.0000	2.5390	1.9700	8.00	0.084
Hess EPT (%)	Assume equal variances	V1 vs. V27	V1 Reference	V27 Exposure	12.8750	9.0303	1.4260	8.00	0.192
		V1 vs. V5	V1 Reference	V5 Exposure	-20.3874	9.0303	-2.2580	8.00	0.054
		V1 vs. V8	V1 Reference	V8 Exposure	-38.7426	9.0303	-4.2900	8.00	0.003
Hess Chironomids (%)	Assume equal variances	V1 vs. V27	V1 Reference	V27 Exposure	-25.4489	7.9270	-3.2100	8.00	0.012
		V1 vs. V5	V1 Reference	V5 Exposure	9.5406	7.9270	1.2040	8.00	0.263
		V1 vs. V8	V1 Reference	V8 Exposure	32.4394	7.9270	4.0920	8.00	0.003
Hess Simpson's D	Does not assume equal variances	V1 vs. V27	V1 Reference	V27 Exposure	0.0120	0.0247	0.4850	2.47	0.667
		V1 vs. V5	V1 Reference	V5 Exposure	0.0346	0.0321	1.0770	3.99	0.342
		V1 vs. V8	V1 Reference	V8 Exposure	-0.1939	0.0746	-2.6000	2.43	0.100
Hess Simpson's E	Assume equal variances	V1 vs. V27	V1 Reference	V27 Exposure	-0.0234	0.0533	-0.4390	8.00	0.673
		V1 vs. V5	V1 Reference	V5 Exposure	-0.0348	0.0533	-0.6520	8.00	0.532
		V1 vs. V8	V1 Reference	V8 Exposure	-0.1807	0.0533	-3.3910	8.00	0.009
Artificial Substrate Abundance	Assume equal variances	V1 vs. V27	V1 Reference	V27 Exposure	428.0000	335.4891	1.2760	8.00	0.238
		V1 vs. V5	V1 Reference	V5 Exposure	1488.6670	335.4891	4.4370	8.00	0.002
		V1 vs. V8	V1 Reference	V8 Exposure	395.3330	335.4891	1.1780	8.00	0.273
Artificial Substrate Number of Taxa	Assume equal variances	V1 vs. V27	V1 Reference	V27 Exposure	5.0000	3.3170	1.5080	8.00	0.170
		V1 vs. V5	V1 Reference	V5 Exposure	2.6700	3.3170	0.8040	8.00	0.445
		V1 vs. V8	V1 Reference	V8 Exposure	3.3300	3.3170	1.0050	8.00	0.344
Artificial Substrate EPT (%)	Assume equal variances	V1 vs. V27	V1 Reference	V27 Exposure	17.2545	8.3555	2.0650	8.00	0.073
		V1 vs. V5	V1 Reference	V5 Exposure	-14.9386	8.3555	-1.7880	8.00	0.112
		V1 vs. V8	V1 Reference	V8 Exposure	-7.9818	8.3555	-0.9550	8.00	0.367
Artificial Substrate Chironomids (%)	Assume equal variances	V1 vs. V27	V1 Reference	V27 Exposure	-17.5267	7.9737	-2.1980	8.00	0.059
		V1 vs. V5	V1 Reference	V5 Exposure	6.5769	7.9737	0.8250	8.00	0.433
		V1 vs. V8	V1 Reference	V8 Exposure	6.3003	7.9737	0.7900	8.00	0.452
Art. Substrate Simpson's D	Assume equal variances	V1 vs. V27	V1 Reference	V27 Exposure	0.0011	0.0222	0.0500	8.00	0.961
		V1 vs. V5	V1 Reference	V5 Exposure	0.0090	0.0222	0.4060	8.00	0.696
		V1 vs. V8	V1 Reference	V8 Exposure	-0.0034	0.0222	-0.1530	8.00	0.882
Art. Substrate Simpson's E	Does not assume equal variances	V1 vs. V27	V1 Reference	V27 Exposure	-0.0854	0.0746	-1.1440	3.82	0.319
		V1 vs. V5	V1 Reference	V5 Exposure	-0.0424	0.0504	-0.8420	2.64	0.469
		V1 vs. V8	V1 Reference	V8 Exposure	-0.0466	0.1208	-0.3860	2.68	0.728

Table F.4: Summary of ANOVA results for three vs. five Hess stations per area, X2 and R2 versus BLC, 2008.

Five Stations/Area

Dependent Variable	Mean Square	F (ANOVA)	Sig. (p value)	Observed Power
Density (individuals/m2)	45478839.0741	5.1333	0.0245	0.7135
Number of Taxa	19.2667	1.6705	0.2291	0.2838
Simpson's D (Krebs)	0.1071	9.5699	0.0033	0.9390
Simpson's E (Smith & Wilson 1996)	0.0784	9.2514	0.0037	0.9312
EPT (%)	1121.8244	7.6266	0.0073	0.8753
Chironomidae (%)	1097.0167	4.5809	0.0332	0.6612

Three StationsArea

Dependent Variable	Mean Square	F (ANOVA)	Sig. (p value)	Observed Power
Density (individuals/m2)	49146544.4440	5.0490	0.0520	0.5840
Number of Taxa	30.7780	6.9250	0.0280	0.7240
Simpson's D (Krebs)	0.0622	3.2760	0.1090	0.4110
Simpson's E (Smith & Wilson 1996)	0.0693	6.6520	0.0300	0.7060
EPT (%)	832.3060	3.2940	0.1080	0.4130
Chironomidae (%)	890.9630	2.3970	0.1720	0.3130

Table F.5: User-defined contrasts for Hess samples: X2, R2 versus BLC, Rose Creek 2008 (5 vs. 3 stations/ area).

Five Stations/Area		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
Density (individuals/m2)	Does not assume equal variances	BLC vs R2	-2404.667	1158.210	-2.076	5.284	0.089
		BLC vs X2	3588.333	2264.040	1.585	6.139	0.163
Number of Taxa	Assume equal variances	BLC vs R2	-3.400	2.148	-1.583	12	0.139
		BLC vs X2	0.000	2.148	0.000	12	1.000
Simpson's D (Krebs)	Assume equal variances	BLC vs R2	0.289	0.067	4.319	12	0.001
		BLC vs X2	0.185	0.067	2.763	12	0.017
Simpson's E (Smith & Wilson 1996)	Assume equal variances	BLC vs R2	0.238	0.058	4.090	12	0.001
		BLC vs X2	0.052	0.058	0.891	12	0.391
EPT (%)	Assume equal variances	BLC vs R2	15.565	7.671	2.029	12	0.065
		BLC vs X2	-14.385	7.671	-1.875	12	0.085
Chironomidae (%)	Assume equal variances	BLC vs R2	-22.814	9.787	-2.331	12	0.038
		BLC vs X2	4.959	9.787	0.507	12	0.622

Three Stations/Area		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
Density (individuals/m2)	Assume equal variances	BLC vs R2	-2450.000	2547.359	-0.962	6	0.373
		BLC vs X2	5456.667	2547.359	2.142	6	0.076
Number of Taxa	Assume equal variances	BLC vs R2	-4.000	1.721	-2.324	6	0.059
		BLC vs X2	2.330	1.721	1.356	6	0.224
Simpson's D (Krebs)	Does not assume equal variances	BLC vs R2	0.287	0.136	2.111	2.172	0.159
		BLC vs X2	0.158	0.135	1.169	2.099	0.358
Simpson's E (Smith & Wilson 1996)	Does not assume equal variances	BLC vs R2	0.264	0.102	2.592	3.999	0.061
		BLC vs X2	0.001	0.073	0.019	2.036	0.987
EPT (%)	Assume equal variances	BLC vs R2	17.727	12.979	1.366	6	0.221
		BLC vs X2	-15.562	12.979	-1.199	6	0.276
Chironomidae (%)	Assume equal variances	BLC vs R2	-24.170	15.743	-1.535	6	0.176
		BLC vs X2	9.195	15.743	0.584	6	0.580

Table F.6: ANOVA results for artificial substrates: X2, R2 versus R7, 2008 (5 vs. 3 stations/area)

Five Stations per Area

Dependent Variable	Mean Square	F (ANOVA)	Sig. (p value)	Observed Power
Density (individuals/m2)	21552198.2000	2.7790	0.1020	0.4440
Number of Taxa	31.2670	3.2800	0.0730	0.5110
Simpson's D (Krebs)	0.0181	6.3920	0.0130	0.8090
Simpson's E (Smith & Wilson 1996)	0.0155	3.6400	0.0580	0.5560
EPT (%)	1741.0730	18.5810	0.0000	0.9990
Chironomidae (%)	2403.4900	18.0230	0.0000	0.9980

Three Stations per Area

Dependent Variable	Mean Square	F (ANOVA)	Sig. (p value)	Observed Power
Density (individuals/m2)	10932515.4440	2.5100	0.1610	0.3260
Number of Taxa	22.3330	5.7430	0.0400	0.6410
Simpson's D (Krebs)	0.0128	3.0470	0.1220	0.3860
Simpson's E (Smith & Wilson 1996)	0.0081	2.8590	0.1340	0.3650
EPT (%)	1098.5790	11.7020	0.0080	0.9160
Chironomidae (%)	1388.2720	7.3140	0.0250	0.7480

Table F.7: User -defined contrast tests (X2, R2 vs. R7) based on artificial substrates, 2008 (5 vs 3 stations/area).

Five Stations per Area		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
Density (individuals/m2)	Assume equal variances	R2 vs. R7	4031.200	1761.329	2.289	12	0.041
		R7 vs. X2	-1153.400	1761.329	-0.655	12	0.525
Number of Taxa	Does not assume equal variances	R2 vs. R7	-2.600	1.691	-1.537	4.289	0.194
		R7 vs. X2	-2.400	1.720	-1.395	4.279	0.231
Simpson's D (Krebs)	Does not assume equal variances	R2 vs. R7	-0.072	0.020	-3.699	4.216	0.019
		R7 vs. X2	-0.047	0.041	-1.153	6.079	0.292
Simpson's E (Smith & Wilson 1996)	Assume equal variances	R2 vs. R7	-0.096	0.041	-2.325	12	0.038
		R7 vs. X2	-0.001	0.041	-0.023	12	0.982
EPT (%)	Assume equal variances	R2 vs. R7	12.199	6.122	1.993	12	0.070
		R7 vs. X2	-36.645	6.122	-5.986	12	0.000
Chironomidae (%)	Assume equal variances	R2 vs. R7	-7.814	7.304	-1.070	12	0.306
		R7 vs. X2	41.274	7.304	5.651	12	0.000

Three Stations per Area		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
Density (individuals/m2)	Does not assume equal variances	R2 vs. R7	3710.000	1878.643	1.975	2.023	0.186
		R7 vs. X2	-1074.333	2082.286	-0.516	2.893	0.643
Number of Taxa	Assume equal variances	R2 vs. R7	-1.670	1.610	-1.035	6	0.341
		R7 vs. X2	-3.670	1.610	-2.277	6	0.063
Simpson's D (Krebs)	Does not assume equal variances	R2 vs. R7	-0.052	0.023	-2.316	2.034	0.144
		R7 vs. X2	-0.077	0.065	-1.194	2.542	0.332
Simpson's E (Smith & Wilson 1996)	Assume equal variances	R2 vs. R7	-0.077	0.043	-1.777	6	0.126
		R7 vs. X2	-0.022	0.043	-0.497	6	0.637
EPT (%)	Does not assume equal variances	R2 vs. R7	22.862	9.078	2.518	2.054	0.125
		R7 vs. X2	-38.012	9.632	-3.946	2.553	0.039
Chironomidae (%)	Assume equal variances	R2 vs. R7	-17.073	11.249	-1.518	6	0.180
		R7 vs. X2	42.737	11.249	3.799	6	0.009

Table F.8: ANOVA results for three Hess vs. kick stations per area: X2, R2 versus BLC, 2008

Hess Three Stations per Area

Dependent Variable	Mean Square	F (ANOVA)	Sig. (p value)	Observed Power
Density (individuals/m2)	49146544.4440	5.0490	0.0520	0.5840
Number of Taxa	30.7780	6.9250	0.0280	0.7240
Simpson's D (Krebs)	0.0622	3.2760	0.1090	0.4110
Simpson's E (Smith & Wilson 1996)	0.0693	6.6520	0.0300	0.7060
EPT (%)	832.3060	3.2940	0.1080	0.4130
Chironomidae (%)	890.9630	2.3970	0.1720	0.3130
Hess 3 rep 2008 CA-1 (37.6%)	0.7150	83.8430	0.0000	1.0000
Hess 3 rep 2008 CA-2 (23.9%)	0.4630	20.3450	0.0020	0.9930
Hess 3 rep 2008 CA-3 (11.4%)	0.0010	0.0120	0.9880	0.0510

Kick and Sweep Three Stations per Area

Dependent Variable	Mean Square	F (ANOVA)	Sig. (p value)	Observed Power
Density (individuals/m2)	2685253.4440	5.1520	0.0500	0.5930
Number of Taxa	7.4440	0.4060	0.6830	0.0900
Simpson's D (Krebs)	0.0076	2.6600	0.1490	0.3430
Simpson's E (Smith & Wilson 1996)	0.0138	3.8630	0.0840	0.4720
EPT (%)	1830.9730	9.8320	0.0130	0.8630
Chironomidae (%)	1328.3580	9.0660	0.0150	0.8350
KS 3 rep 2008 CA-1 (42.4%)	0.5280	34.0710	0.0010	1.0000
KS 3 rep 2008 CA-2 (19.7%)	0.1600	3.5070	0.0980	0.4350
KS 3 rep 2008 CA-3 (13.9%)	0.0341	0.5560	0.6000	0.1060

Table F.9: User-defined contrast tests (X2, R2 vs BLC) based on three Hess versus kick samples, 2008.

Three Hess/Area		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
Density (individuals/m2)	Assume equal variances	BLC vs R2	-2450.000	2547.359	-0.962	6	0.373
		BLC vs X2	5456.667	2547.359	2.142	6	0.076
Number of Taxa	Assume equal variances	BLC vs R2	-4.000	1.721	-2.324	6	0.059
		BLC vs X2	2.330	1.721	1.356	6	0.224
Simpson's D (Krebs)	Does not assume equal variances	BLC vs R2	0.287	0.136	2.111	2.172	0.159
		BLC vs X2	0.158	0.135	1.169	2.099	0.358
Simpson's E (Smith & Wilson 1996)	Does not assume equal variances	BLC vs R2	0.264	0.102	2.592	3.999	0.061
		BLC vs X2	0.001	0.073	0.019	2.036	0.987
EPT (%)	Assume equal variances	BLC vs R2	17.727	12.979	1.366	6	0.221
		BLC vs X2	-15.562	12.979	-1.199	6	0.276
Chironomidae (%)	Assume equal variances	BLC vs R2	-24.170	15.743	-1.535	6	0.176
		BLC vs X2	9.195	15.743	0.584	6	0.580
Hess 3 rep 2008 CA-1 (37.6%)	Assume equal variances	BLC vs R2	0.464	0.075	6.148	6	0.001
		BLC vs X2	0.976	0.075	12.944	6	0.000
Hess 3 rep 2008 CA-2 (23.9%)	Assume equal variances	BLC vs R2	-0.722	0.123	-5.855	6	0.001
		BLC vs X2	-0.091	0.123	-0.736	6	0.490
Hess 3 rep 2008 CA-3 (11.4%)	Assume equal variances	BLC vs R2	-0.001	0.238	-0.003	6	0.998
		BLC vs X2	-0.033	0.238	-0.137	6	0.895

Three Kick Samples/Area		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
Density (individuals/m2)	Does not assume equal variances	BLC vs R2	-89.667	202.180	-0.444	2.486	0.693
		BLC vs X2	1592.000	718.855	2.215	2.301	0.140
Number of Taxa	Assume equal variances	BLC vs R2	2.330	3.496	0.667	6	0.529
		BLC vs X2	3.000	3.496	0.858	6	0.424
Simpson's D (Krebs)	Assume equal variances	BLC vs R2	0.087	0.044	1.984	6	0.095
		BLC vs X2	-0.001	0.044	-0.027	6	0.979
Simpson's E (Smith & Wilson 1996)	Assume equal variances	BLC vs R2	0.099	0.049	2.034	6	0.088
		BLC vs X2	-0.030	0.049	-0.624	6	0.556
EPT (%)	Assume equal variances	BLC vs R2	13.913	11.142	1.249	6	0.258
		BLC vs X2	-34.102	11.142	-3.061	6	0.022
Chironomidae (%)	Assume equal variances	BLC vs R2	-16.982	9.883	-1.718	6	0.137
		BLC vs X2	24.857	9.883	2.515	6	0.046
KS 3 rep 2008 CA-1 (42.4%)	Assume equal variances	BLC vs R2	0.411	0.102	4.048	6	0.007
		BLC vs X2	0.839	0.102	8.254	6	0.000
KS 3 rep 2008 CA-2 (19.7%)	Does not assume equal variances	BLC vs R2	-0.433	0.187	-2.313	2.161	0.137
		BLC vs X2	-0.078	0.211	-0.369	3.141	0.736
KS 3 rep 2008 CA-3 (13.9%)	Assume equal variances	BLC vs R2	0.199	0.202	0.983	6	0.364
		BLC vs X2	0.032	0.202	0.160	6	0.878

Table F.10: ANOVA results for exposure (5 stations/area) versus reference (single stations in each of 6 areas) comparisons based on Hess samples.

Dependent Variable	Mean Square	F	Sig.	Observed Power
Density (individuals/m2)	44927718.8254	8.5038	0.0011	0.9756
Number of Taxa	9.6698	1.2075	0.3371	0.2662
Simpson's D	0.0649	4.6295	0.0153	0.8043
Simpson's E (Smith & Wilson 1996)	0.0309	5.2636	0.0094	0.8563
EPT (%)	2599.5970	9.9673	0.0005	0.9899
Chironomidae (%)	3279.2319	13.3414	0.0001	0.9989
VC Hess RCA C/I CA-1 (21.6%)	0.9851	34.2548	0.0000	1.0000
VC Hess RCA C/I CA-2 (15.9%)	0.4838	6.9275	0.0030	0.9401
VC Hess RCA C/I CA-3 (10.8%)	0.4030	13.0328	0.0001	0.9986
VC Hess RCA C/I CA-4 (8.4%)	0.0324	0.4879	0.6952	0.1284

Table F.11: User-defined exposure (5 stations/area) versus reference (single station in each of 6 areas) contrasts based on Hess samples.

		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
Density (individuals/m2)	Does not assume equal variances	Reference vs. V27	-3883.667	1633.767	-2.377	8.98205	0.041
		Reference vs. V5	3310.733	1257.655	2.632	5.255232	0.044
		Reference vs. V8	-1333.467	1597.853	-0.835	8.915148	0.426
Number of Taxa	Assume equal variances	Reference vs. V27	0.067	1.714	0.039	17	0.969
		Reference vs. V5	-1.533	1.714	-0.895	17	0.383
		Reference vs. V8	1.867	1.714	1.089	17	0.291
Simpson's D	Does not assume equal variances	Reference vs. V27	-0.148	0.075	-1.965	5.185181	0.105
		Reference vs. V5	-0.176	0.076	-2.323	5.410204	0.064
		Reference vs. V8	0.056	0.094	0.596	8.810373	0.566
Simpson's E (Smith & Wilson 1996)	Assume equal variances	Reference vs. V27	-0.083	0.046	-1.795	17	0.090
		Reference vs. V5	-0.120	0.046	-2.597	17	0.019
		Reference vs. V8	0.051	0.046	1.105	17	0.285
EPT (%)	Does not assume equal variances	Reference vs. V27	-46.500	10.466	-4.443	5.14297	0.006
		Reference vs. V5	-12.861	12.000	-1.072	7.805153	0.316
		Reference vs. V8	2.363	11.408	0.207	6.897817	0.842
Chironomidae (%)	Does not assume equal variances	Reference vs. V27	52.186	10.308	5.063	5.10635	0.004
		Reference vs. V5	19.666	11.328	1.736	7.021708	0.126
		Reference vs. V8	-2.404	11.491	-0.209	7.290383	0.840
VC Hess RCA C/I CA-1 (21.6%)	Assume equal variances	Reference vs. V27	0.790	0.103	7.693	17	0.000
		Reference vs. V5	-0.096	0.103	-0.931	17	0.365
		Reference vs. V8	0.594	0.103	5.788	17	0.000
VC Hess RCA C/I CA-2 (15.9%)	Does not assume equal variances	Reference vs. V27	0.401	0.192	2.086	5.150777	0.090
		Reference vs. V5	0.392	0.195	2.012	5.382438	0.096
		Reference vs. V8	-0.228	0.198	-1.150	5.724642	0.296
VC Hess RCA C/I CA-3 (10.8%)	Does not assume equal variances	Reference vs. V27	-0.097	0.082	-1.184	6.22231	0.280
		Reference vs. V5	-0.514	0.091	-5.659	8.131452	0.000
		Reference vs. V8	-0.525	0.142	-3.686	7.029701	0.008
VC Hess RCA C/I CA-4 (8.4%)	Assume equal variances	Reference vs. V27	-0.030	0.156	-0.194	17	0.848
		Reference vs. V5	-0.094	0.156	-0.605	17	0.553
		Reference vs. V8	-0.177	0.156	-1.133	17	0.273

Table F.12: ANOVA results for exposure (5 stations/area) versus reference (single station in each of 10 areas) comparison based on Hess samples.

Dependent Variable	Mean Square	F	Sig.	Observed Power
Density (individuals/m2)	55005698.9194	5.9922	0.0107	0.8151
Number of Taxa	14.6460	0.8470	0.4460	0.1712
Simpson's D	0.0192	1.4061	0.2722	0.2601
Simpson's E (Smith & Wilson 1996)	0.0452	5.4911	0.0145	0.7784
EPT (%)	1426.8161	5.8635	0.0116	0.8062
Chironomidae (%)	1326.0753	3.6586	0.0477	0.5929
URC Hess RCA C/I CA-1 (18.5%)	0.5713	9.9430	0.0014	0.9621
URC Hess RCA C/I CA-2 (14.5%)	0.4016	6.4878	0.0081	0.8461
URC Hess RCA C/I CA-3 (11.6%)	0.0421	0.3496	0.7099	0.0970
URC Hess RCA C/I CA-4 (10.3%)	0.1295	1.5683	0.2371	0.2862

Table F.13: User-defined exposure (5 stations/area) versus reference (single station in each of 10 areas) contrasts based on Hess samples.

		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
Density (individuals/m2)	Does not assume equal variances	Reference vs. X2	-5007.533	2186.969	-2.290	5.688523	0.064
		Reference vs. R2	985.467	999.203	0.986	12.208108	0.343
Number of Taxa	Assume equal variances	Reference vs. X2	-1.980	2.278	-0.869	17	0.397
		Reference vs. R2	1.420	2.278	0.623	17	0.541
Simpson's D	Assume equal variances	Reference vs. X2	0.004	0.064	0.070	17	0.945
		Reference vs. R2	-0.100	0.064	-1.556	17	0.138
Simpson's E (Smith & Wilson 1996)	Assume equal variances	Reference vs. X2	0.066	0.050	1.318	17	0.205
		Reference vs. R2	-0.121	0.050	-2.427	17	0.027
EPT (%)	Assume equal variances	Reference vs. X2	26.031	8.544	3.047	17	0.007
		Reference vs. R2	-3.919	8.544	-0.459	17	0.652
Chironomidae (%)	Does not assume equal variances	Reference vs. X2	-25.918	9.078	-2.855	12.996239	0.014
		Reference vs. R2	1.855	9.200	0.202	12.959413	0.843
URC Hess RCA C/I CA-1 (18.5%)	Assume equal variances	Reference vs. X2	0.572	0.131	4.355	17	0.000
		Reference vs. R2	0.072	0.131	0.549	17	0.590
URC Hess RCA C/I CA-2 (14.5%)	Assume equal variances	Reference vs. X2	0.001	0.136	0.010	17	0.992
		Reference vs. R2	0.463	0.136	3.400	17	0.003
URC Hess RCA C/I CA-3 (11.6%)	Assume equal variances	Reference vs. X2	-0.149	0.190	-0.786	17	0.443
		Reference vs. R2	0.001	0.190	0.007	17	0.994
URC Hess RCA C/I CA-4 (10.3%)	Assume equal variances	Reference vs. X2	-0.139	0.157	-0.882	17	0.390
		Reference vs. R2	-0.274	0.157	-1.742	17	0.100

Table F.14: ANOVA results for exposure (3 stations/area) versus reference (single station in each of 10 areas) comparisons based on kick samples.

Dependent Variable	Mean Square	F	Sig.	Observed Power
Density (individuals/m2)	2645842.8300	4.6206	0.0305	0.6745
Number of Taxa	35.3253	2.4657	0.1236	0.4073
Simpson's D	0.0062	3.6173	0.0564	0.5625
Simpson's E (Smith & Wilson 1996)	0.0249	2.4862	0.1218	0.4102
EPT (%)	2109.4325	6.7531	0.0097	0.8391
Chironomidae (%)	1841.4385	13.0596	0.0008	0.9866
URC K&S RCA C/I CA-1 (26.2%)	0.6013	14.5963	0.0005	0.9931
URC K&S RCA C/I CA-2 (15.7%)	0.0092	0.0834	0.9205	0.0602
URC K&S RCA C/I CA-3 (13.7%)	0.1358	2.0247	0.1716	0.3421
URC K&S RCA C/I CA-4 (8.9%)	0.0482	0.7775	0.4798	0.1544

Table F.15: User-defined exposure (3 stations/area) versus reference (single station in each of 10 areas) contrasts based on kick samples.

		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
Density (individuals/m2)	Does not assume equal variances	Reference vs. X2	-1369.903	728.529	-1.880	2.435626	0.178
		Reference vs. R2	311.763	234.261	1.331	10.307306	0.212
Number of Taxa	Assume equal variances	Reference vs. X2	-4.653	2.492	-1.868	13	0.085
		Reference vs. R2	-3.987	2.492	-1.600	13	0.134
Simpson's D	Assume equal variances	Reference vs. X2	0.058	0.027	2.124	13	0.053
		Reference vs. R2	-0.030	0.027	-1.115	13	0.285
Simpson's E (Smith & Wilson 1996)	Assume equal variances	Reference vs. X2	0.146	0.066	2.213	13	0.045
		Reference vs. R2	0.016	0.066	0.240	13	0.814
EPT (%)	Assume equal variances	Reference vs. X2	38.250	11.634	3.288	13	0.006
		Reference vs. R2	-9.765	11.634	-0.839	13	0.416
Chironomidae (%)	Assume equal variances	Reference vs. X2	-37.710	7.817	-4.824	13	0.000
		Reference vs. R2	4.129	7.817	0.528	13	0.606
URC K&S RCA C/I CA-1 (26.2%)	Assume equal variances	Reference vs. X2	-0.697	0.134	-5.215	13	0.000
		Reference vs. R2	-0.345	0.134	-2.579	13	0.023
URC K&S RCA C/I CA-2 (15.7%)	Does not assume equal variances	Reference vs. X2	0.081	0.139	0.584	10.986928	0.571
		Reference vs. R2	-0.018	0.136	-0.133	10.970706	0.897
URC K&S RCA C/I CA-3 (13.7%)	Assume equal variances	Reference vs. X2	-0.282	0.171	-1.656	13	0.122
		Reference vs. R2	0.125	0.171	0.731	13	0.478
URC K&S RCA C/I CA-4 (8.9%)	Assume equal variances	Reference vs. X2	-0.146	0.164	-0.891	13	0.389
		Reference vs. R2	-0.173	0.164	-1.054	13	0.311

Table F.16: Benthic community characteristics of each reference area in comparison to the group of reference areas having similar habitat characteristics based on Hess (2007) samples. Results are presented for traditional central (cP) t-tests and non-central (ncP) t-tests (Test Site Analysis).

Hess 2007		CA1	CA2	CA3	Density	No. Taxa	%EPT	%Chir.	Simpson's Diversity	Simpson's Evenness
Reference										
BLCH-8		-0.17	0.24	0.40	6068	24.2	24.7	65.9	0.565	0.123
HOCH-8		-0.32	0.37	0.02	2147	23.0	51.9	39.0	0.884	0.376
NEXH-7		-0.03	-0.52	-0.59	1607	21.0	73.1	20.7	0.844	0.305
R7H-8		-0.22	0.39	-0.30	7807	21.0	28.2	57.0	0.777	0.214
STCH-8		-0.18	0.34	-0.15	8120	19.0	7.6	82.8	0.414	0.090
VRH-7		1.34	0.38	0.03	2057	17.0	9.8	84.9	0.614	0.152
Mean		**0.07**	**0.20**	**-0.10**	**4634**	**20.9**	**32.5**	**58.4**	**0.68**	**0.21**
SD		**0.63**	**0.35**	**0.34**	**3042**	**2.6**	**25.5**	**25.1**	**0.18**	**0.11**
Exposure										
BLCH-8		-0.17	0.24	0.40	6068	24.2	24.7	65.9	0.565	0.123
	t	-0.85	0.25	3.32	1	2.9	-0.7	0.7	-1.45	-1.75
	cP	0.43	0.81	0.02	0.34	0.04	0.52	0.53	0.21	0.14
	ncP	1.00	1.00	0.73	1.00	0.84	1.00	1.00	0.99	0.98
HOCH-8		-0.32	0.37	0.02	2147	23.0	51.9	39.0	0.884	0.376
	t	-1.40	1.06	0.80	-2	1.8	1.7	-1.7	2.47	3.34
	cP	0.22	0.34	0.46	0.13	0.13	0.15	0.14	0.06	0.02
	ncP	0.99	1.00	1.00	0.98	0.98	0.98	0.98	0.91	0.73
NEXH-7		-0.03	-0.52	-0.59	1607	21.0	73.1	20.7	0.844	0.305
	t	-0.34	-4.51	-3.28	-2	0.1	3.6	-3.4	1.97	1.91
	cP	0.74	0.01	0.02	0.08	0.91	0.02	0.02	0.11	0.11
	ncP	1.00	0.45	0.74	0.94	1.00	0.67	0.72	0.97	0.97
R7H-8		-0.22	0.39	-0.30	7807	21.0	28.2	57.0	0.777	0.214
	t	-1.02	1.20	-1.33	2	0.1	-0.4	-0.1	1.15	0.08
	cP	0.35	0.28	0.24	0.07	0.91	0.72	0.91	0.30	0.94
	ncP	1.00	1.00	0.99	0.93	1.00	1.00	1.00	1.00	1.00
STCH-8		-0.18	0.34	-0.15	8120	19.0	7.6	82.8	0.414	0.090
	t	-0.89	0.87	-0.35	3	-1.6	-2.2	2.2	-3.30	-2.41
	cP	0.41	0.42	0.74	0.05	0.17	0.08	0.08	0.02	0.06
	ncP	1.00	1.00	1.00	0.89	0.99	0.94	0.95	0.74	0.92
VRH-7		1.34	0.38	0.03	2057	17.0	9.8	84.9	0.614	0.152
	t	4.51	1.13	0.84	-2	-3.3	-2.0	2.4	-0.85	-1.17
	cP	0.01	0.31	0.44	0.12	0.02	0.10	0.06	0.44	0.30
	ncP	0.45	1.00	1.00	0.97	0.74	0.96	0.92	1.00	1.00

cP - probability metric value at exposure area is the same as the mean for reference areas.
ncP - probability metric value at exposure area is inside the range of reference values
Different from exposure mean (cP < 0.1) or range (ncP < 0.1).
Uncertain with respect to being similar to or different from reference (0.1 > p < 0.9).
Similar to reference mean (cP > 0.9) or within reference range (ncP < 0.9).

Table F.17: Benthic community characteristics of each reference area in comparison to the group of reference areas having similar habitat characteristics based on Hess (2008) samples. Results are presented for traditional central (cP) t-tests and non-central (ncP) t-tests (Test Site Analysis).

Hess 2008		CA1	CA2	CA3	Density	No. Taxa	%EPT	%Chir.	Simpson's Diversity	Simpson's Evenness
Reference										
BLCH-8		-0.21	0.30	-0.29	6068	24.2	24.7	65.9	0.56	0.12
BUCH-8		0.20	0.33	-0.58	1957	32.0	76.8	12.8	0.91	0.34
FC1H-8		-0.20	-0.47	0.19	6360	19.0	25.2	56.8	0.80	0.27
GRCH-8		-0.25	0.43	0.07	510	17.0	26.8	63.4	0.78	0.27
HOCH-8		-0.20	0.55	0.18	2147	23.0	51.9	39.0	0.88	0.38
NEXH-8		1.62	0.01	0.13	4536	20.0	26.3	20.6	0.72	0.18
VRH-8		0.34	-0.39	0.11	7807	21.0	28.2	57.0	0.78	0.21
R7H-8		-0.27	-0.17	0.29	8120	19.0	7.6	82.8	0.41	0.09
STCH-8		-0.29	-0.01	0.15	7240	26.0	49.4	35.2	0.85	0.26
USFRH-8		-0.15	-0.55	-0.52	1743	21.0	46.3	16.3	0.84	0.29
Mean		**0.06**	**0.00**	**-0.03**	**4649**	**22.2**	**36.3**	**45.0**	**0.75**	**0.24**
SD		**0.59**	**0.39**	**0.32**	**2844**	**4.4**	**19.7**	**23.8**	**0.15**	**0.09**
Exposure										
BLCH-8		-0.21	0.30	-0.29	6068	24.2	24.7	65.9	0.56	0.12
	t	-1.41	2.40	-2.63	1.58	1.44	-1.87	2.79	-3.88	-4.10
	cP	0.19	0.04	0.03	0.15	0.18	0.09	0.02	0.00	0.00
	ncP	1.00	0.99	0.99	1.00	1.00	1.00	0.98	0.85	0.81
BUCH-8		0.20	0.33	-0.58	1957	32.0	76.8	12.8	0.91	0.34
	t	0.76	2.64	-5.55	-2.99	7.11	6.50	-4.29	3.16	3.43
	cP	0.47	0.03	0.00	0.02	0.00	0.00	0.00	0.01	0.01
	ncP	1.00	0.99	0.46	0.97	0.19	0.27	0.77	0.96	0.93
FC1H-8		-0.20	-0.47	0.19	6360	19.0	25.2	56.8	0.80	0.27
	t	-1.40	-3.81	2.15	1.90	-2.34	-1.78	1.57	1.01	0.92
	cP	0.19	0.00	0.06	0.09	0.04	0.11	0.15	0.34	0.38
	ncP	1.00	0.87	1.00	1.00	0.99	1.00	1.00	1.00	1.00
GRCH-8		-0.25	0.43	0.07	510	17.0	26.8	63.4	0.78	0.27
	t	-1.67	3.44	0.99	-4.60	-3.79	-1.53	2.45	0.58	1.02
	cP	0.13	0.01	0.35	0.00	0.00	0.16	0.04	0.58	0.33
	ncP	1.00	0.93	1.00	0.69	0.87	1.00	0.99	1.00	1.00
HOCH-8		-0.20	0.55	0.18	2147	23.0	51.9	39.0	0.88	0.38
	t	-1.40	4.40	2.09	-2.78	0.57	2.50	-0.80	2.67	4.72
	cP	0.20	0.00	0.07	0.02	0.58	0.03	0.45	0.03	0.00
	ncP	1.00	0.74	1.00	0.98	1.00	0.99	1.00	0.99	0.66
NEXH-8		1.62	0.01	0.13	4536	20.0	26.3	20.6	0.72	0.18
	t	8.39	0.08	1.58	-0.13	-1.61	-1.61	-3.25	-0.78	-2.26
	cP	0.00	0.94	0.15	0.90	0.14	0.14	0.01	0.46	0.05
	ncP	0.08	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00
VRH-8		0.34	-0.39	0.11	7807	21.0	28.2	57.0	0.78	0.21
	t	1.52	-3.14	1.37	3.51	-0.89	-1.30	1.60	0.47	-0.93
	cP	0.16	0.01	0.21	0.01	0.40	0.23	0.14	0.65	0.38
	ncP	1.00	0.96	1.00	0.92	1.00	1.00	1.00	1.00	1.00
R7H-8		-0.27	-0.17	0.29	8120	19.0	7.6	82.8	0.41	0.09
	t	-1.78	-1.41	3.19	3.86	-2.34	-4.61	5.03	-6.97	-5.26
	cP	0.11	0.19	0.01	0.00	0.04	0.00	0.00	0.00	0.00
	ncP	1.00	1.00	0.95	0.86	0.99	0.69	0.59	0.21	0.53
STCH-8		-0.29	-0.01	0.15	7240	26.0	49.4	35.2	0.85	0.26
	t	-1.86	-0.14	1.77	2.88	2.75	2.10	-1.30	2.03	0.71
	cP	0.10	0.89	0.11	0.02	0.02	0.07	0.23	0.07	0.50
	ncP	1.00	1.00	1.00	0.98	0.98	1.00	1.00	1.00	1.00
USFRH-8		-0.15	-0.55	-0.52	1743	21.0	46.3	16.3	0.84	0.29
	t	-1.14	-4.45	-4.96	-3.23	-0.89	1.60	-3.82	1.71	1.75
	cP	0.28	0.00	0.00	0.01	0.40	0.14	0.00	0.12	0.11
	ncP	1.00	0.73	0.60	0.95	1.00	1.00	0.87	1.00	1.00

cP - probability metric value at exposure area is the same as the mean for reference areas.
ncP - probability metric value at exposure area is inside the range of reference values
Different from exposure mean (cP < 0.1) or range (ncP < 0.1).
Uncertain with respect to being similar to or different from reference (0.1 > p < 0.9).
Similar to reference mean (cP > 0.9) or within reference range (ncP < 0.9).

Table F.18: Benthic community characteristics of each reference area in comparison to the group of reference areas having similar habitat characteristics based on kick and sweep samples. Results are presented for traditional central (cP) t-tests and non-central (ncP) t-tests (Test Site Analysis).

K&S 2008		CA1	CA2	CA3	Density	No. Taxa	%EPT	%Chir.	Simpson's Diversity	Simpson's Evenness
Reference										
BLCK-8		-0.13	0.24	-0.13	600	21.3	54.8	38.9	0.78	0.23
BUCK-8		0.38	-0.02	-0.05	1865	21.0	85.5	11.3	0.83	0.27
FC1K-8		-0.21	0.71	-0.04	610	19.0	42.6	37.4	0.86	0.37
GRCK-8		-0.19	-0.25	-0.49	63	14.0	58.7	27.0	0.88	0.58
HOCK-8		0.04	-0.20	-0.46	102	16.0	70.6	15.7	0.83	0.37
NEXK-8		-0.14	0.41	-0.06	1187	21.0	76.9	18.6	0.83	0.28
R7K-8		-0.16	0.22	0.14	1236	23.5	41.9	39.8	0.87	0.33
STCK-8		-0.30	0.10	-0.25	90	15.0	22.2	43.3	0.86	0.47
USFRK-8		0.98	-0.07	0.21	1969	26.0	74.5	16.6	0.80	0.19
VRK-8		-0.07	-0.57	-0.67	502	20.0	62.4	11.8	0.87	0.37
Mean		**0.02**	**0.06**	**-0.18**	**822**	**19.7**	**59.0**	**26.0**	**0.84**	**0.35**
SD		**0.39**	**0.36**	**0.28**	**710**	**3.8**	**19.3**	**12.7**	**0.03**	**0.12**
Exposure										
BLCK-8		-0.13	0.24	-0.13	600	21.3	54.8	38.9	0.78	0.23
	t	-1.21	1.55	0.56	-0.99	1.38	-0.68	3.20	-5.70	-3.15
	cP	0.26	0.16	0.59	0.35	0.20	0.51	0.01	0.00	0.01
	ncP	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.43	0.96
BUCK-8		0.38	-0.02	-0.05	1865	21.0	85.5	11.3	0.83	0.27
	t	2.98	-0.66	1.48	4.64	1.10	4.35	-3.67	-1.31	-2.03
	cP	0.02	0.53	0.17	0.00	0.30	0.00	0.01	0.22	0.07
	ncP	0.97	1.00	1.00	0.68	1.00	0.76	0.89	1.00	1.00
FC1K-8		-0.21	0.71	-0.04	610	19.0	42.6	37.4	0.86	0.37
	t	-1.92	5.68	1.57	-0.95	-0.57	-2.69	2.83	1.83	0.58
	cP	0.09	0.00	0.15	0.37	0.58	0.02	0.02	0.10	0.58
	ncP	1.00	0.43	1.00	1.00	1.00	0.98	0.98	1.00	1.00
GRCK-8		-0.19	-0.25	-0.49	63	14.0	58.7	27.0	0.88	0.58
	t	-1.75	-2.69	-3.46	-3.38	-4.75	-0.05	0.24	3.86	6.47
	cP	0.11	0.02	0.01	0.01	0.00	0.96	0.81	0.00	0.00
	ncP	1.00	0.99	0.92	0.93	0.66	1.00	1.00	0.86	0.28
HOCK-8		0.04	-0.20	-0.46	102	16.0	70.6	15.7	0.83	0.37
	t	0.15	-2.20	-3.13	-3.21	-3.08	1.90	-2.57	-0.90	0.58
	cP	0.88	0.06	0.01	0.01	0.01	0.09	0.03	0.39	0.58
	ncP	1.00	1.00	0.96	0.95	0.96	1.00	0.99	1.00	1.00
NEXK-8		-0.14	0.41	-0.06	1187	21.0	76.9	18.6	0.83	0.28
	t	-1.33	3.11	1.38	1.62	1.10	2.94	-1.85	-1.00	-1.86
	cP	0.22	0.01	0.20	0.14	0.30	0.02	0.10	0.34	0.10
	ncP	1.00	0.96	1.00	1.00	1.00	0.97	1.00	1.00	1.00
R7K-8		-0.16	0.22	0.14	1236	23.5	41.9	39.8	0.87	0.33
	t	-1.49	1.39	3.52	1.84	3.19	-2.81	3.42	2.69	-0.38
	cP	0.17	0.20	0.01	0.10	0.01	0.02	0.01	0.02	0.71
	ncP	1.00	1.00	0.91	1.00	0.95	0.98	0.93	0.98	1.00
STCK-8		-0.30	0.10	-0.25	90	15.0	22.2	43.3	0.86	0.47
	t	-2.58	0.35	-0.76	-3.26	-3.91	-6.04	4.30	1.93	3.32
	cP	0.03	0.73	0.46	0.01	0.00	0.00	0.00	0.09	0.01
	ncP	0.99	1.00	1.00	0.95	0.85	0.36	0.77	1.00	0.94
USFRK-8		0.98	-0.07	0.21	1969	26.0	74.5	16.6	0.80	0.19
	t	7.86	-1.07	4.30	5.11	5.28	2.54	-2.35	-4.15	-4.27
	cP	0.00	0.31	0.00	0.00	0.00	0.03	0.04	0.00	0.00
	ncP	0.12	1.00	0.77	0.57	0.53	0.99	0.99	0.80	0.77
VRK-8		-0.07	-0.57	-0.67	502	20.0	62.4	11.8	0.87	0.37
	t	-0.71	-5.47	-5.46	-1.43	0.26	0.56	-3.54	2.74	0.74
	cP	0.49	0.00	0.00	0.19	0.80	0.59	0.01	0.02	0.48
	ncP	1.00	0.48	0.48	1.00	1.00	1.00	0.91	0.98	1.00

cP - probability metric value at exposure area is the same as the mean for reference areas.
ncP - probability metric value at exposure area is inside the range of reference values
Different from exposure mean (cP < 0.1) or range (ncP < 0.1).
Uncertain with respect to being similar to or different from reference (0.1 > p < 0.9).
Similar to reference mean (cP > 0.9) or within reference range (ncP < 0.9).