Assessment of 2009 Aquatic Data for Clinton Creek Mine, Yukon

Report Prepared for:

Assessment and Abandoned Mines Branch
Energy, Mines and Resources
Government of Yukon
Whitehorse, Yukon

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EXECUTIVE SUMMARY

Water and sediment chemistry, as well as benthic macroinvertebrate and fish community structure, were assessed in reference and mine-exposed areas near the Clinton Creek Mine in the summer and fall of 2009. The data contributed to previously identified information gaps.

Water samples collected under relatively high and low summer flow conditions showed that numerous substances occur at concentrations above background levels downstream of the mine, but guidelines for protection of aquatic life were rarely exceeded. Method detection limits for some variables measured in one of the sets of water samples (collected August 11th) were above background concentrations and/or guidelines, precluding assessment of potential effects on biota on that date. Also, laboratory analyses of asbestos in water and sediment samples were not yet complete when this report was prepared, so the asbsestos concentration data will be provided in a future addendum to this report.

A benthic macroinvertebrate survey in Clinton Creek revealed a mine-related influence on downstream community composition that included higher relative proportions of chironomid (midge) taxa and lower relative proportions of stoneflies compared to local reference streams. Of the mine-exposed areas sampled in Clinton Creek and Wolverine Creek, the benthic invertebrate community in Wolverine Creek downstream of the tailings area was most different from reference communities. Preliminary results suggest that effects on invertebrate communities do not carry over into the Fortymile River.

The 2009 fish surveys confirmed that populations of arctic grayling, Chinook salmon, and slimy sculpin utilize Clinton Creek, but it should be noted that many of the Chinook salmon have been manually re-located to upstream reaches of Clinton Creek in annual surveys, because beaver dams along much of the creek hamper movement from lower to upper reaches (e.g., Smart 2007). In addition, the 2009 fish survey concluded that local tributaries to Clinton Creek and the Fortymile River are unsuitable for use as reference streams in evaluations of the Clinton Creek fish community due to limited fish habitat in reference tributaries to Clinton Creek and placer mining in the other Fortymile River tributaries. Irrespective of any effects of asbestos or altered water chemistry on the health of downstream receiving environments, past mining activities in the Clinton Creek area have resulted in obvious alterations to the surrounding aquatic habitat (e.g., formation of Hudgeon Lake).

Characterizing seasonal and annual variability in chemical conditions and collecting evidence that directly links (or disconnects) changes in biological community structure to asbestos and/or chemical exposure (e.g., toxicity tests) are data gaps that still need to be addressed.

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1.0 INTRODUCTION

1.1 Mine Background

The former Clinton Creek Asbestos Mine is located 100 km northwest of Dawson City, Yukon (Figure 1.1). The mine site is located on Clinton Creek, a tributary of the Forty-mile River which flows into the Yukon River (Figure 1.2). The mine was operated by Cassiar Asbestos Corporation Ltd. from 1967 to 1978 when it was shut down due to poor economic circumstances (Minnow 2009a). A waste rock dump failure in 1974 impounded Clinton Creek and resulted in the formation of Hudgeon Lake upstream of the mine. The same year, the south lobe of the tailings deposit slid into Wolverine Creek, a tributary to Clinton Creek. Channel reconstruction and reinforcement in the early 1980s were unsuccessful; in 1984 Clinton Creek escaped the reinforced channel and undercut the north valley wall, and in 1985, the north lobe of the tailings area slide also slid into Wolverine Creek. In 1986, Cassiar submitted a rehabilitation and abandonment plan for the site, which was not immediately accepted by regulatory authorities. Negotiations with regulators continued through 1991 when Princeton Mining Corp. purchased Cassiar and continued with remediation activities. In 1992, the Government of Canada assumed responsibility for the site. After a flood destroyed channel reinforcements and weir structures in Clinton Creek in 1997, the government began to investigate environmental risks (1999). Attempts to stabilize the Clinton Creek channel included installation of gabion structures in 2002-2004. The Yukon Government assumed a project management role for the site in 2003 and, since then, has overseen various additional site clean-up and stabilization efforts to move towards official site closure.

1.2 Project Objectives

In support of closure planning, Minnow Environmental Inc. was asked to analyze and interpret the data collected in 2009 that were relevant to the aquatic environment near the former Clinton Creek Mine. The 2009 data collection was based on a study design (Minnow 2009b, Appendix A) that was developed to fill gaps in existing information previously identified by Minnow (2009a) and included the characterization of habitat and biological quality. This report summarizes the analyses of the 2009 data and identifies on-going information gaps pertinent to closure plans for the Clinton Creek Mine site.

1.3 Document Organization

The methods used for sample collection and for the analysis of samples and data are outlined in Section 2.0. The results of water and sediment chemistry characterization are

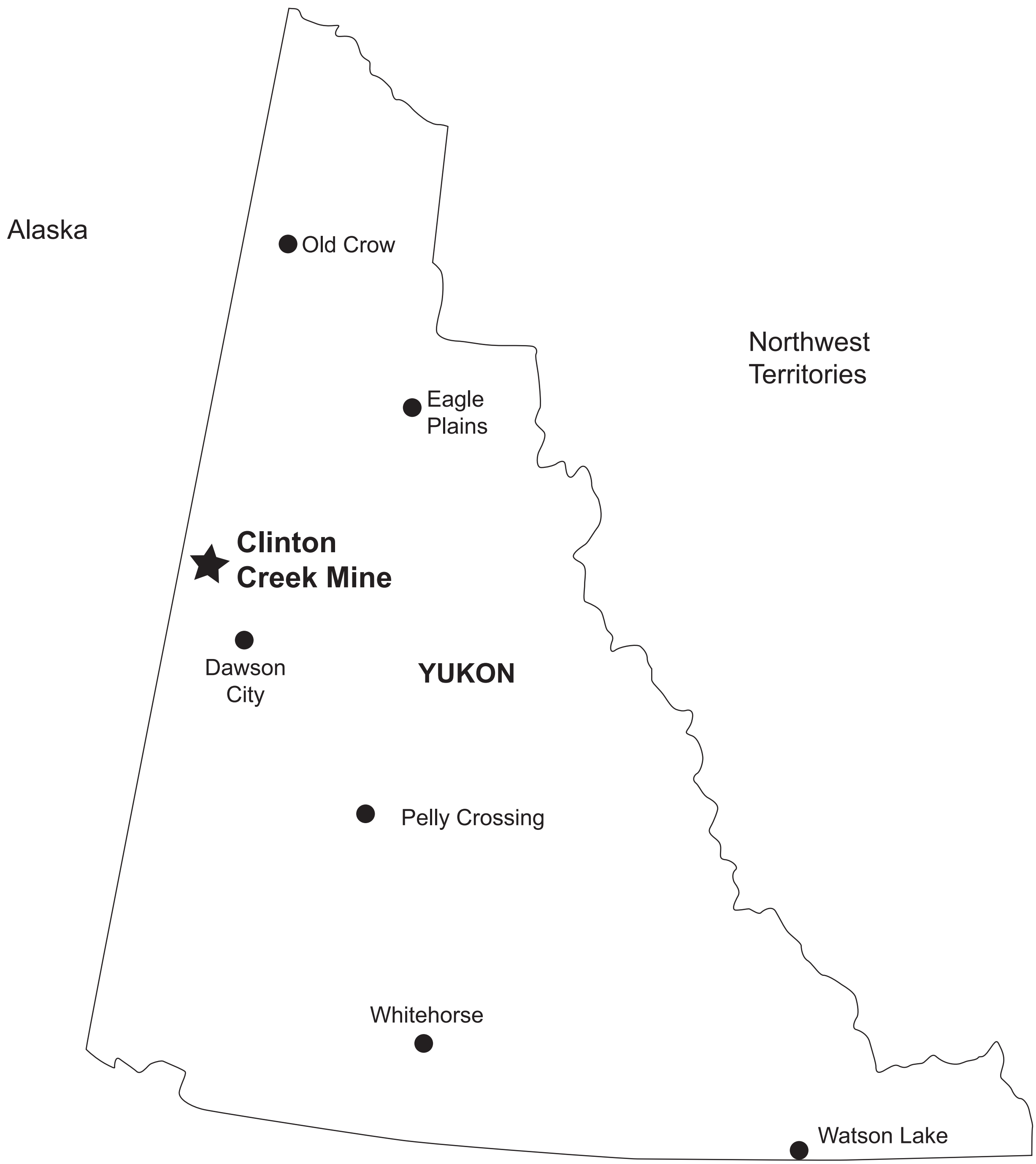
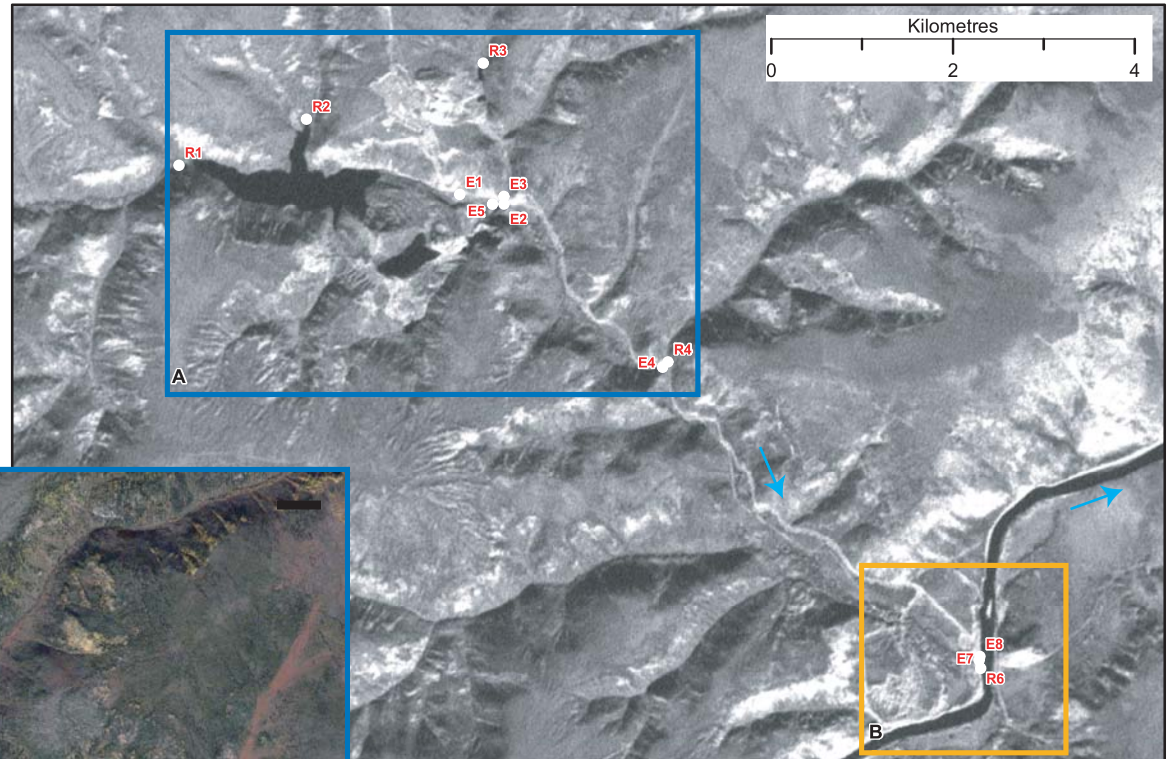


Figure 1.1

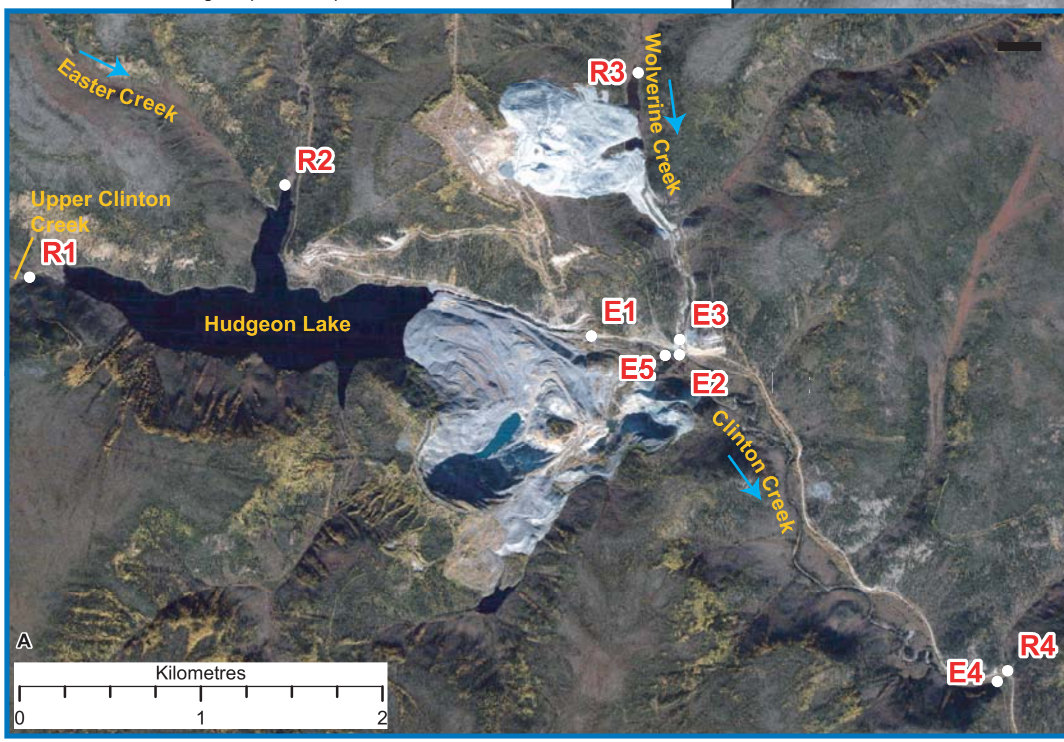
minnow

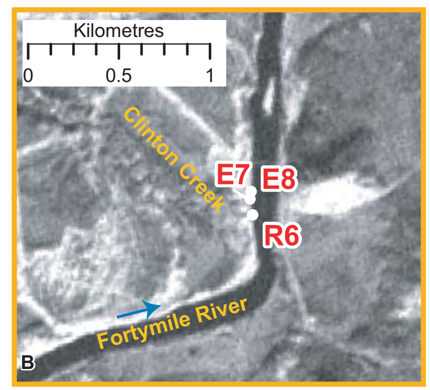
Location of Clinton Creek Mine

Ref: 2315
Date: July 2010



Quickbird Satellite image captured September, 2008.





Landsat 7 Satellite image captured May 2002.

Figure 1.2

minnow environmental inc.

Sampling Areas Near Clinton Creek Mine Site

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presented in Section 3.0. Benthic macroinvertebrate and fish community data are discussed in Section 4.0. The conclusions and recommendations of the study are presented in Sections 5.0 and 6.0, respectively. The references cited throughout this document are listed in Section 7.0.

2.0 METHODS

Studies of the aquatic environments near Clinton Creek Mine were conducted by various groups during the summer of 2009 (Environment Canada 2009, Laberge 2010, WMEC 2009). Samples of water, sediment, benthic macroinvertebrate and fish were collected in reference and mine-exposed areas (Table 2.1, Figure 1.2). The results have been compiled and assessed by Minnow for this report.

2.1 Sample Collection and Analyses

Water samples collected August 11th by Environment Canada were analyzed at Environment Canada's Pacific and Yukon Laboratory for Environmental Testing in North Vancouver, BC (Appendix D). LaBerge Environmental Services (LaBerge) also collected grab samples of water in August (18-19) and September (2-3, 20) and sent them for analyses of nutrients, metals, and asbsestos to Exova in Surrey, BC (LaBerge 2010; Appendix B). After receipt of the first set of samples in August, Exova reported lack of capacity to measure short asbestos fibres, which comprise the majority of the asbestos content of environmental samples at Clinton Creek. Therefore, subsequent sets of samples collected by Laberge for asbestos analysis were re-directed to the Occupational and Environmental Health Laboratory at McMaster University for analysis. Water samples were also collected by the Yukon Government in late September (30th) and sent to Exova for analyses of nutrients and metals, and to McMaster for analysis of asbestos. Laboratory results were not available for all samples at the time this report was prepared, so the data will be provided as an addendum or update to this report once available.

Two sediment samples were collected by Environment Canada on August 11th from lower Wolverine Creek (E3; Figure 1.2; no methods reported) and sent to the Pacific and Yukon Laboratory for Environmental Testing for analysis of metals (Appendix D). Sediment samples were also collected by Laberge on September 20th from depositional habitats at locations E3 to E5 (Figure 1.2) using a steel trowel. Sample collection from additional areas was precluded at that time by high water flows. The Laberge samples were sent to Exova for analyses of nutrients, metals (Appendix B). Although asbestos concentrations were also reported by Exova, the data are have not been presented and discussed in this report based on concerns regarding the laboratory's ability to measure short asbestos fibres (see above).

Three benthic macroinvertebrate samples (two in the Fortymile River) were collected by Laberge in each sampling area using kick sampling methods of the Canadian Aquatic Biomonitoring Network (CABIN). Supporting habitat information was also collected (Appendix B). Sample processing was done by Cordillera Consulting in Summerland, BC.

Table 2.1: Summary of samples collected near Clinton Creek, 2009.

Area Type	Minnow Site Code	Description	Yukon Government Site Code	Water Quality[a]	Sediment Quality[b]	Benthic Invertebrates[c]	Fish[d]
Reference	R1	Clinton Creek u/s of Hudgeon Lake	-	✓		✓	
	R2	Easter Creek u/s of Hudgeon Lake	HL-03	✓		✓	
	R3	Wolverine Creek u/s tailings	WC-01	✓		✓	
	R4	Eagle Creek u/s of culvert	EC-01	✓		✓	✓
	R5	Mickey Creek (tributary to Fortymile River)	MC-01				✓
	R6	Fortymile River u/s of Clinton Creek	FM-01	✓		✓	
	R7	Maiden Creek (tributary to Fortymile River)	-				✓
	R8	Marten Creek (tributary to Fortymile River)	-				✓
Exposed	E1	Clinton Creek d/s gabions (u/s Porcupine Creek)	CC-03	✓		✓	✓
	E2	Clinton Creek d/s Porcupine Creek (u/s Wolverine Creek)	CC-01	✓		✓	✓
	E3	Wolverine Creek u/s culvert	WC-05 [e]	✓	✓	✓	✓
	E4	Clinton Creek d/s Wolverine Creek (u/s Eagle Creek)	CC-04	✓	✓	✓	
	E5	Porcupine Beaver Pond	PC-04 [f]	✓	✓		✓
	E6	Clinton Creek u/s townsite ford	CC-06	✓			✓
	E7	Clinton Creek u/s of mouth	CC-07	✓		✓	
	E8	Fortymile River d/s of Clinton Creek	FM-02	✓		✓	

[a] Samples collected by Environment Canada (11 August), Laberge (18-19 August, 2-3 and 20 September), and Yukon Government (30 September)
[b] Samples collected by Environment Canada (11 August; Wolverine Creek only) and Laberge (20 September, E3 to E5).
[c] Samples collected by Minnow (August 18-19) and Laberge (August 18-19, 2-3 September)
[d] Samples collected by White Mountain Environmental Consulting (September 7-13).
[e] Samples collected at this location by Environment Canada in 2009 were labelled WC-01
[f] Sample collected at this location by Environment Canada in 2009 was labelled PC-01

Three sampling techniques were used to characterize fish communities: minnow trapping, electrofishing, and angling (White Mountain Environmental Consulting (WMEC 2009; Appendix C). Fish were identified, inspected for abnormalities, and released where they were caught. Lengths and weights of slimy sculpin and fish habitat conditions were also recorded.

2.2 Data Analyses

Water and sediment chemistry, as well as benthic invertebrate and fish communities, were evaluated in mine exposed areas relative to reference locations (Table 2.1, Figure 1.2).

To characterize mine influence on surface water chemistry downstream of the mine reference benchmarks were first computed. These were set at the 95th percentile (for substances that might increase as a result of mine exposure, e.g., metals) or the 5th percentile (for a few substances for which a decrease would have greater environmental impact, e.g., oxygen, alkalinity) using the available (pooled) reference area data for each variable. Values above the 95th percentile (or below the 5th percentile for selected substances) were considered to be outside of background conditions and indicative of a mine influence. The influence on the reference benchmarks of data collected during a particularly high-flow event (i.e., September 20th) was also considered.

To assess the potential effects of mine-related substances on aquatic biota, variables that were outside the range of reference conditions in one or more downstream areas were also compared to water quality guidelines (Appendix Table E.1, E.2). Federal guidelines for the protection of aquatic life were applied if available, otherwise a provincial criterion (B.C. preferentially, or else Ontario) was used (Appendix Table E.1). Drinking water criteria were used in the absence of guidelines for the protection of aquatic life.

Sediment samples were not collected from reference areas so sediment data were compared only to sediment quality guidelines (Appendix Table E.3).

Benthic macroinvertebrate communities in mine-influenced areas were compared to communities in reference locations with comparable habitat (e.g., stream size, substrate type, water depth). More specifically, mine-exposed areas in the Wolverine Creek tributary (E3) and Clinton Creek (E1, E2, E4, E7) were compared to conditions in Clinton Creek upstream of Hudgeon Lake (R1) and other tributaries to Clinton Creek which have not been affected by mining (R2-R4, Figure 1.2). Communities in the Fortymile River downstream of Clinton Creek (E8) were compared to communities in the Fortymile River upstream of Clinton Creek (R6).

The overall composition of benthic macroinvertebrate communities was summarized using Correspondence Analysis (CA). CA was used to calculate axes, which can be thought of as new variables explaining the variation in benthic community data among locations. 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 taxa were eliminated from the analysis if they occurred in fewer than five samples or fewer than 10 individuals in total were found.

Additional benthic community metrics were compared between mine-exposed and reference areas to assess potential mine impacts on benthic community health: mean benthic invertebrate abundance, number of taxa (richness) % Plecoptera (stoneflies), and % chironomids (midges). Abundance and richness are conventional measures of benthic community health. Percent Plecoptera and percent chironomids were selected as descriptive metrics because most EPT taxa (Ephemeroptera-mayflies, Plecoptera-stoneflies, Trichoptera-caddisflies) present were stoneflies and most Diptera taxa (true flies) were chironomids. Stoneflies (and EPT in general) are typically intolerant of human disturbances, so reductions in mine-exposed compared to reference communities would suggest a mine effect on benthic community health. Conversely, the percentage of chironomids is often increased in disturbed areas, particularly those associated with accumulation of fine particulates (affecting sediment composition compared to reference areas) and/or nutrients.

One-sample t-tests, based on mean community metrics for each area (mean of n=3 samples per area), were used to determine if the benthic community in each mine-exposed area was significantly different (i.e., $P<0.1$) than that of the reference areas based on each community metric. The traditional central P (cP) indicates the probability that the mean value for an exposure area is different than the *mean* value for reference areas. The non-central probability value (ncP) indicates the likelihood an exposure area is within ($ncP>0.90$) 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 of each metric was used to define the reference condition range.

Reference-exposure area comparisons were planned for evaluation of fish community composition in the Clinton Creek watershed but suitable reference areas could not be found locally (WMEC 2009, Appendix C). Thus, the number of fish caught and catch per unit effort were qualitatively compared to data from previous fish surveys in Clinton Creek. In addition, the condition of slimy sculpin in Clinton Creek was qualitatively compared to the condition of slimy sculpin in other tributaries to the Fortymile River.

Collectively, the water, sediment, and biological quality data were evaluated with respect to implications for site closure. Information gaps were identified and recommendations for follow up studies were developed.

3.0 WATER AND SEDIMENT QUALITY

As noted in Section 2.0, water samples were collected on five occasions by three different field crews during August and September 2009. The set of stations sampled varied among sampling occasions. Water discharge (flow) also varied substantially among sampling events, ranging from low in mid-August to very high in late September (see discharge data presented in Table 2 of Appendix B).

3.1 Asbestos

Sample analyses for asbestos, one of the key contaminants at the Clinton Creek Mine, were not completed by the time this report was prepared, due to extenuating circumstances at the laboratory (Occupational and Environmental Health Laboratory, Department of Chemistry and Chemical Biology, McMaster University). The data will be provided as an addendum this report, once available.

3.2 Water Chemistry

Numerous water quality variables were above background levels in one or more samples collected in mine-exposed areas. In Clinton Creek samples collected in 2009 and previous years, boron, manganese, and nickel were the substances most consistently elevated relative to background levels (yellow highlighted concentrations in Table 3.1). In Wolverine Creek, antimony, boron, and nickel were the substances most often elevated relative to background levels (Table 3.2). These results are consistent with the observation of Schreier et al. (1987) that metals such as nickel, cobalt, chromium, and manganese are often released from materials rich in chrysotile asbestos.

Water concentrations of sulphate, cadmium, and chromium were above both background levels and water quality guidelines for protection of aquatic life in only occasional samples collected in either Clinton Creek or Wolverine Creek (orange highlight; Tables. 3.1 and 3.2), suggesting limited potential for adverse effects to biota, at least in terms of the substances for which guidelines have been developed and the flow conditions that were sampled.

Data for the August 11, 2009, samples collected and analyzed by Environment Canada Analytical (Appendix Table E.5) were not included in Tables 3.1 or 3.2 because method detection limits (MDLs) for some variables were higher than background and/or guideline concentrations, precluding definitive interpretation of data for those substances (e.g., boron, arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, selenium, silver, vanadium, zinc). In addition, detectable concentrations of some parameters reported for the same

Table 3.1: Water quality in Clinton Creek.

Variables	Units	Water Quality Guideline [d]		Upper Background (95th percentile)[a]	E1 (CC-03) Clinton Creek d/s of gabions u/s of Porcupine Creek			E2 (CC-01) Clinton Creek d/s of Porcupine Creek u/s of Wolverine Creek						E4 (CC-04) Clinton Creek d/s of Wolverine Creek u/s of Eagle Creek					
		Source	Value		18-Aug-09[c]	2-Sept-09[c]	20-Sept-09[c]	21-Sept-07[b]	2-Oct-08[b]	18-Aug-09[c]	2-Sept-09[c]	20-Sept-09[c]	30-Sept-09[b]	16-Sep-04[b]	21-Sept-07[b]	18-Aug-09[c]	3-Sept-09[c]	20-Sept-09[c]	30-Sept-09[b]
Non-metals																			
Total Phosphorus (colourimetric method)	mg/L	PWQO	0.03	-	<0.05	<0.05	<0.05			<0.05	<0.05	<0.05	-			<0.05	<0.05	<0.05	-
Dissolved Orthophosphate-P	mg/L	-	-	0.06	0.03	0.04	0.04			0.03	0.04	0.04	-			0.03	0.04	0.04	-
Dissolved Organic Carbon	mg/L	-	-	21	15.4	18.3	17.1			14	17	15	-			10.1	14.5	16.5	-
Total Ammonia (N)	mg/L	CWQG	0.19	<0.05	<0.05	<0.05	<0.05			<0.05	<0.05	<0.05	-			<0.05	<0.05	<0.05	-
Kjeldahl Nitrogen	mg/L	-	-	0.5	0.49	0.47	0.48			0.36	0.42	0.5	-			0.28	0.36	0.5	-
Nitrate and Nitrite - N	mg/L	CWQG	-	0.32	0.04	<0.01	0.13			0.04	<0.01	0.11	-			0.06	0.02	0.1	-
Bicarbonate	mg/L	-	-	74	160	140	130			240	160	130	-			310	200	140	-
Carbonate	mg/L	-	-	<6	<6	<6	<6			<6	<6	<6	-			<6	<6	<6	-
Hydroxide	mg/L	-	-	<5	<5	<5	<5			<5	<5	<5	-			<5	<5	<5	-
Total Alkalinity[c]	mg/L as CaCO3	PWQO	16	63	136	111	106			196	128	107	-			251	164	115	-
Dissolved Sulfate (SO4)	mg/L	BCWQG	50	260	157	126	117			294	162	120	-			416	246	136	-
Total Suspended Solids	mg/L	CWQG	107	102	<2	<2	12			4	2	20	-			3	2	21	-
Total Hardness	mg CaCO3/L	-	-	516	311	281	263	280	377	584	346	265	-	757	334	819	472	296	-
pH (lab)	pH units	CWQG	6.5-9.0	7.66	7.77	7.91	7.92			7.84	7.86	7.93	-			7.97	7.84	7.85	-
Conductivity (field)	µS/cm	-	-	-	506	-	-			901	-	-	-			1191	-	-	-
Electrical Conductivity (lab)	µS/cm at 25 C	-	-	804	548	468	457			886	561	467	-			1180	770	516	-
Dissolved Oxygen	mg/L	CWQG	6.5	-	8.08[e]	-	-			7.49[e]	-	-	-			8.83[e]	-	-	-
Dissolved Oxygen	%	-	-	-	82	-	-			73.5	-	-	-			83.7	-	-	-
Temperature (field)	°C	-	-	-	13.5	11.0	7.9			12.2	10.7	8.1	-			10.7	7.0	7.9	-
Total Metals																			
Aluminum	mg/L	CWQG	0.1	1.2	0.022	0.041	0.206	0.078	0.0302	0.014	0.035	0.177	0.105	< 0.005	0.091	0.014	0.026	0.206	0.052
Antimony	mg/L	PWQO	0.02	0.0006	0.0003	0.0003	0.0003	0.0004	0.00037	0.0003	0.0003	0.0004	0.0003	0.0006	0.0004	0.0007	0.0004	0.0004	0.0004
Arsenic	mg/L	CWQG	0.005	0.0022	0.0016	0.0013	0.0012	0.0011	0.00129	0.0034	0.0017	0.0013	0.0008	0.0014	0.0011	0.0021	0.0018	0.0015	0.0013
Barium	mg/L	CDWQG	1.0	0.091	0.038	0.039	0.047	0.049	0.0357	0.063	0.041	0.045	0.04	0.062	0.049	0.059	0.046	0.045	0.04
Beryllium	mg/L	PWQO	1.1	0.00005	<0.00004	<0.00004	<0.00004	< 0.0001	< 0.00050	<0.00004	<0.00004	0.00004	<0.00004	< 0.0001	< 0.0001	<0.00004	<0.00004	0.00006	0.00004
Bismuth	mg/L	-	-	<0.001	<0.001	<0.001	<0.001	< 0.0005	< 0.00050	<0.001	<0.001	<0.001	<0.001	< 0.0005	< 0.0005	<0.001	<0.001	<0.001	<0.001
Boron	mg/L	BCWQG	1.2	0.017	0.014	0.01	0.012	0.014	0.038	0.074	0.026	0.015	0.021	0.134	0.039	0.166	0.071	0.026	0.068
Cadmium	mg/L	CWQG	0.00003	0.00021	0.00005	0.00004	0.00004	0.00004	< 0.000050	0.00005	0.00003	0.00006	0.00003	0.00005	0.00005	0.00005	0.00374	0.00006	0.00003
Calcium	mg/L	-	-	88.0	63.5	55.7	51.6	55.6	68.3	97	64.7	51.8	58.1	117	60.6	107	75.5	53.7	71.4
Chromium	mg/L	CWQG	0.001	0.003	0.0007	0.0008	0.0024	0.0023	0.00159	0.0008	0.0009	0.0029	0.0014	0.0008	0.0021	0.0009	0.0009	0.0047	0.0011
Cobalt	mg/L	BCWQG	0.004	0.0010	0.00042	0.00034	0.00062	0.0006	0.00056	0.002	0.0006	0.00075	0.00038	0.0012	0.0007	0.00134	0.00074	0.00088	0.00084
Copper	mg/L	CWQG	0.002	0.006	0.002	0.003	0.004	0.003	0.00259	0.001	0.002	0.003	0.003	< 0.001	0.003	0.001	0.003	0.004	0.002
Iron	mg/L	CWQG	0.3	2.12	0.262	0.226	0.635	0.3	0.318	1.04	0.363	0.643	0.376	0.4	0.4	0.48	0.376	0.778	0.423
Lead	mg/L	CWQG	0.002	0.002	<0.0001	<0.0001	0.0008	< 0.0001	0.000085	<0.0001	<0.0001	0.0008	0.0002	< 0.0001	0.0002	<0.0001	0.0007	0.0008	0.0001
Lithium	mg/L	-	-	0.008	0.005	0.004	0.003	0.006	0.0099	0.014	0.007	0.004	0.005	0.033	0.012	0.029	0.015	0.006	0.014
Magnesium	mg/L	-	-	72	37.1	34.4	32.6	34.2	50.1	82.9	44.8	33	34.7	113	44.3	134	68.8	39.3	65.7
Manganese	mg/L	BCWQG	1	0.099	0.0586	0.0612	0.0988	0.11	0.114	0.536	0.138	0.116	0.0534	0.335	0.14	0.365	0.17	0.131	0.18
Molybdenum	mg/L	CWQG	0.073	0.0012	0.0011	0.0009	0.001	0.001	0.00129	0.0019	0.0012	0.001	0.001	0.003	0.001	0.002	0.0014	0.0011	0.0014
Nickel	mg/L	CWQG	0.065	0.008	0.009	0.006	0.008	0.0084	0.0115	0.023	0.01	0.01	0.006	0.0278	0.0139	0.028	0.016	0.014	0.016
Phosphorus (ICP scan)	mg/L	PWQO	0.03	0.087	<0.01	<0.01	<0.01		< 0.30	0.018	0.015	0.017	0.014			<0.01	0.023	0.02	0.013
Potassium	mg/L	-	-	1	0.8	0.7	0.8	0.6	< 2.0	1.2	0.8	0.8	0.6	1.3	0.8	1.5	1	0.8	0.9
Selenium	mg/L	CWQG	0.001	0.0020	0.0007	<0.0006	0.0007	0.0003	0.0016	<0.0006	<0.0006	0.0007	0.0011	0.0012	0.0009	<0.0006	<0.0006	0.001	<0.0006
Silicon	mg/L	-	-	7.21	3.66	3.89	4.31	4.46	4.89	5	4.18	4.25	4.48	4.82	4.73	4.78	4.3	4.62	4.71
Silver	mg/L	CWQG	0.0001	0.00004	<0.00001	<0.00001	0.00003	< 0.0001	< 0.000010	<0.00001	<0.00001	0.00003	<0.00001	< 0.0001	< 0.0001	<0.00001	<0.00001	0.00002	<0.00001
Sodium	mg/L	CDWQG	200	4.7	2.95	2.78	2.65	3.1	4.1	5.46	3.37	2.68	3.06	8.3	4	8.81	5	3.14	5.4
Strontium	mg/L	-	-	0.432	0.329	0.271	0.26	0.308	0.335	0.599	0.33	0.264	0.284	0.882	0.393	0.858	0.464	0.286	0.44
Sulfur	mg/L	-	-	86.1	50.4	46.4	42.8			101	58.7	43.8	50.9			141	84.7	49.8	79.1
Tellurium	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.0001			<0.0001	<0.0001	<0.0001	<0.0001			<0.0001	<0.0001	<0.0001	<0.0001
Thallium	mg/L	CWQG	0.0008	<0.00001	0.00001	<0.00001	<0.00001	< 0.00005	< 0.00010	0.00001	<0.00001	<0.00001	<0.00001	< 0.00005	< 0.00005	<0.00001	<0.00001	<0.00001	<0.00001
Thorium	mg/L	-	-	<0.0004	<0.0004	<0.0004	<0.0004			<0.0004	<0.0004	<0.0004	<0.0004			<0.0004	<0.0004	<0.0004	<0.0004
Tin	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.0001	< 0.001	< 0.00010	<0.0001	<0.0001	<0.0001	<0.0001	< 0.001	< 0.001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium	mg/L	-	-	0.03	0.0007	0.0008	0.0066	0.0045	< 0.010	0.0008	0.0009	0.005	0.0039	0.0141	0.0065	0.0008	0.0009	0.007	0.0033
Uranium	mg/L	SKWQG	0.015	0.0067	0.002	0.002	0.0019	0.0022	0.00187	0.002	0.0019	0.0018	0.0019	0.0038	0.0022	0.003	0.0019	0.0017	0.0019
Vanadium	mg/L	PWQO	0.006	0.0038	0.0002	0.0002	0.001	0.0005	< 0.0010	0.0004	0.0003	0.0011	0.0005	0.0002	0.0006	0.0003	0.0003	0.0012	0.0004
Zinc	mg/L	CWQG	0.030	0.0195	0.008	0.004	0.005	0.007	0.0012	0.004	0.004	0.008	0.007	0.004	0.006	0.005	0.015	0.008	0.006
Zirconium	mg/L	PWQO	0.004	0.0015	0.0007	0.0008	0.0014			0.0006	0.0007	0.0012	0.001			0.001	0.0008	0.0012	0.0011

(yellow) value is greater than the 95th percentile of reference or is less than the 5th percentile of reference

(orange) value is greater than the 95th percentile of reference and guideline or is less than the 5th percentile of reference and guideline (or method detection limit is above guideline)

Note: Station identifiers are those used by Minnow and, in parentheses, those used by the Yukon Territory Government

[a] variables were screened for values exceeding the 95th percentile of reference except total alkalinity, bicarbonate, carbonate, hydroxide, and pH which were screened for values below the 5th percentile of reference.

[b] water quality data provided by the Yukon Territory Government

[c] water quality data provided by Laberge Environmental Services

[d] see Table E.1 for supporting information

[e] value exceeds the CWQG guideline for early life stages of coldwater aquatic biota (9.5 mg/L)

Table 3.2: Water quality in Wolverine Creek (E3, WC-05) relative to background levels (yellow) and water quality guidelines (orange).

	Variables	Units	Water Quality Guideline [a]		Upper Background (95th percentile)[b]	Yukon Government		Laberge Environmental Services			Yukon Government
			Source	Value		21-Sep-07	2-Oct-08	18-Aug-09	2-Sep-09	20-Sep-09	30-Sep-09
Non-metals	Total Phosphorus (colourimetric method)	mg/L	PWQO	0.03	-	-	-	<0.05	<0.05	<0.05	-
	Dissolved Orthophosphate-P	mg/L	-	-	0.06	-	-	0.03	0.05	0.05	-
	Dissolved Organic Carbon	mg/L	-	-	21	-	-	9.1	12.6	19.4	-
	Total Ammonia (N)	mg/L	CWQG	0.19	<0.05	-	-	<0.05	<0.05	<0.05	-
	Kjeldahl Nitrogen	mg/L	-	-	0.5	-	-	0.28	0.31	0.57	-
	Nitrate and Nitrite - N	mg/L	CWQG	-	0.32	-	-	0.15	0.09	0.08	-
	Bicarbonate	mg/L	-	-	74	-	-	260	220	100	-
	Carbonate	mg/L	-	-	<6	-	-	<6	<6	<6	-
	Hydroxide	mg/L	-	-	<5	-	-	<5	<5	<5	-
	Total Alkalinity[c]	mg/L as CaCO3	PWQO	16	63	-	-	218	182	88	-
	Dissolved Sulfate (SO4)	mg/L	BCWQG	50	260	-	-	279	221	112	-
	Total Suspended Solids	mg/L	CWQG	107	102	-	-	2	<2	28	-
	Total Hardness	mg CaCO3/L	-	-	516	274	362	565	497	244	-
	pH (lab)	pH units	CWQG	6.5-9.0	7.66	-	-	8.36	8.2	7.87	-
	Conductivity (field)	µS/cm	-	-	-	-	-	865	-	-	-
	Electrical Conductivity (lab)	µS/cm at 25 C	-	-	804	-	-	862	742	421	-
	Dissolved Oxygen	mg/L	CWQG	6.5	-	-	-	10.31	-	-	-
	Dissolved Oxygen	%	-	-	-	-	-	94.5	-	-	-
	Temperature (field)	°C	-	-	-	-	-	9.1	6.1	3.4	-
Total Metals	Aluminum	mg/L	CWQG	0.1	1.2	0.347	0.0116	0.02	0.019	0.47	0.042
	Antimony	mg/L	PWQO	0.02	0.0006	0.0008	0.00055	0.0021	0.0016	0.0007	0.0013
	Arsenic	mg/L	CWQG	0.005	0.0022	0.0013	0.00074	0.0023	0.0023	0.0017	0.0018
	Barium	mg/L	CDWQG	1.0	0.091	0.051	0.022	0.051	0.049	0.057	0.046
	Beryllium	mg/L	PWQO	1.1	0.00005	< 0.0001	< 0.00050	<0.00004	<0.00004	0.00007	<0.00004
	Bismuth	mg/L	-	-	<0.001	< 0.0005	< 0.00050	<0.001	<0.001	<0.001	<0.001
	Boron	mg/L	BCWQG	1.2	0.017	0.096	0.051	0.199	0.169	0.054	0.136
	Cadmium	mg/L	CWQG	0.00003	0.00021	0.00002	< 0.00050	<0.00001	0.00007	0.00002	<0.00001
	Calcium	mg/L	-	-	88.0	44.8	56.9	69	67.8	38.6	53.9
	Chromium	mg/L	CWQG	0.001	0.003	0.0038	0.0009	0.0014	0.0014	0.0056	0.0014
	Cobalt	mg/L	BCWQG	0.004	0.0010	0.0003	< 0.00010	0.00018	0.00016	0.00068	0.00017
	Copper	mg/L	CWQG	0.002	0.006	0.003	0.00083	<0.001	0.002	0.004	0.002
	Iron	mg/L	CWQG	0.3	2.12	0.5	0.102	0.064	0.089	1.25	0.122
	Lead	mg/L	CWQG	0.002	0.002	0.0002	< 0.000050	0.0001	<0.0001	0.001	<0.0001
	Lithium	mg/L	-	-	0.008	0.006	< 0.0050	0.006	0.007	0.003	0.006
	Magnesium	mg/L	-	-	72	39.4	53.4	95.3	79.5	35.8	61.9
	Manganese	mg/L	BCWQG	1	0.099	0.039	0.0124	0.0242	0.0248	0.0702	0.0227
	Molybdenum	mg/L	CWQG	0.073	0.0012	< 0.001	0.000557	0.0014	0.0013	0.0009	0.0011
	Nickel	mg/L	CWQG	0.065	0.008	0.0112	0.00538	0.016	0.015	0.013	0.014
	Phosphorus (ICP scan)	mg/L	PWQO	0.03	0.087	-	< 0.30	0.017	0.011	0.023	0.014
	Potassium	mg/L	-	-	1	0.7	< 2.0	1.1	1	0.7	0.8
	Selenium	mg/L	CWQG	0.001	0.0020	0.001	< 0.0010	<0.0006	<0.0006	0.0008	<0.0006
	Silicon	mg/L	-	-	7.21	6.12	5.5	4.13	5.17	6.26	5.33
	Silver	mg/L	CWQG	0.0001	0.00004	< 0.0001	< 0.000010	<0.00001	<0.00001	0.00002	<0.00001
	Sodium	mg/L	CDWQG	200	4.7	3.4	4.4	5.29	4.87	3.14	4.42
	Strontium	mg/L	-	-	0.432	0.269	0.125	0.36	0.358	0.195	0.289
	Sulfur	mg/L	-	-	86.1	-	-	89	80.3	39.3	65.7
	Tellurium	mg/L	-	-	<0.0001	-	-	<0.0001	<0.0001	<0.0001	<0.0001
	Thallium	mg/L	CWQG	0.0008	<0.00001	< 0.00005	< 0.00010	<0.00001	<0.00001	<0.00001	<0.00001
	Thorium	mg/L	-	-	<0.0004	-	-	<0.0004	<0.0004	<0.0004	<0.0004
	Tin	mg/L	-	-	<0.0001	< 0.001	< 0.00010	<0.0001	<0.0001	<0.0001	<0.0001
	Titanium	mg/L	-	-	0.03	0.0216	< 0.010	0.0015	0.0008	0.0128	0.0021
	Uranium	mg/L	SKWQG	0.015	0.0067	0.0017	0.000879	0.0022	0.002	0.0014	0.0014
	Vanadium	mg/L	PWQO	0.006	0.0038	0.0015	< 0.0010	0.0003	0.0004	0.0019	0.0004
	Zinc	mg/L	CWQG	0.030	0.0195	0.007	< 0.0010	0.003	0.003	0.005	0.003
	Zirconium	mg/L	PWQO	0.004	0.0015	-	-	0.0002	0.0004	0.001	0.0005

(yellow) value is greater than the 95th percentile of reference or is less than the 5th percentile of reference

(orange) value is greater than the 95th percentile of reference and guideline or is less than the 5th percentile of reference and guideline (or method detection limit is above guideline)

[a] see Table E.1 for supporting information

[b] In the case of total alkalinity, bicarbonate, carbonate, hydroxide, and pH concentrations were compared to the 5th percentile of reference to identify values below, rather than above, background levels.

samples were well above those observed on other samples dates (e.g., arsenic, phosphorus, silver) and are thus suspect.

In both Clinton and Wolverine Creeks, concentrations of various substances (e.g. sulphate, hardness, conductivity, calcium, magnesium, sodium, sulphur) measured in 2009 were generally highest in samples collected Aug 18th, when water flow was low (flow conditions during sample dates in previous years are unknown). Exceptions were total suspended solids, aluminum, and chromium, which were found at higher concentrations in samples collected in late September 2009 when flows were higher.

Overall, water samples collected in the summer of 2009 and previous years (2007-08) showed that a wide range of substances occur at concentrations above background levels, but guidelines for protection of aquatic life were rarely exceeded. Water quality data are lacking for other seasons.

3.3 Sediment Chemistry

Sediment quality was evaluated on one or two occasions in each of three mine-exposed areas (Table 3.3). Most notably, chromium and nickel concentrations were >12-times and >20-times respective Canadian Sediment Quality Guideline (CSQG) Probable Effect Levels (PEL). Arsenic levels were above the Canadian Interim Sediment Quality Guideline (ISQG) but only exceed the PEL in Porcupine Creek. Similar concentrations of these metals were reported for sediments in Wolverine Creek in 1998 (Minnow 2009, Royal Roads University 1999). There are no sediment data for other reference or exposure areas of the watershed to provide regional context.

Table 3.3: Sediment quality data for samples collected in the vicinity of the Clinton Creek Mine, 2009. Highlighted values were above sediment quality guidelines.

Parameter	Units (dry weight)	Guideline Source	Interim Sediment Quality Guideline (ISQG[a])	Probably Effect Level (PEL[a])	E3 (WC-05) Wolverine Creek u/s of culvert		E4 Clinton Creek just d/s of Wolverine Creek	E5 (PC-04) Porcupine Creek Beaver Pond
					11-Aug-09[b]	20-Sep-09	20-Sep-09	20-Sep-09
Particle Size								
2.0 mm sieve	%	-	-	-	-	19.9	3.0	11.6
850 micron sieve	%	-	-	-	-	7.4	9.8	18.9
425 micron sieve	%	-	-	-	-	8.1	32.5	19.2
250 micron sieve	%	-	-	-	-	19.1	32.4	12.8
150 micron sieve	%	-	-	-	-	22.4	12.0	10.3
106 micron sieve	%	-	-	-	-	12.7	4.2	8.2
53 micron sieve	%	-	-	-	-	7.4	3.6	10.6
Pan	%					3.0	2.4	8.1
Total Kjeldahl Nitrogen	mg/kg	OMOE	550[f]	4800[g]	-	0.04	0.02	0.11
Metals								
Aluminum	mg/kg	-	-	-	4,320	-	-	-
Antimony	mg/kg	-	-	-	14.5	1.3	1.6	3.5
Arsenic	mg/kg	CSQG[c]	5.9	17.0	11.9	8.6	11.6	28.4
Barium	mg/kg	-	-	-	30.5	132	202	370
Beryllium	mg/kg	-	-	-	< 0.1	<0.1	0.1	0.4
Boron	mg/kg	-	-	-	111	-	-	-
Cadmium	mg/kg	CSQG	0.6	3.5	< 0.5	0.15	0.19	2.28
Calcium	mg/kg	-	-	-	5,450	-	-	
Chromium	mg/kg	CSQG	37.3	90.0	1,105	1,180	1,170	331
Cobalt	mg/kg	-	-	-	47.2	69.5	77.2	38.2
Copper	mg/kg	CSQG	35.7	197	6.15	8	8	45
Iron	mg/kg	BCSQG[d]	21,200[f]	43,766[g]	28,250	-	-	
Lead	mg/kg	CSQG	35.0	91.3	< 5	3.6	3	11.1
Magnesium	mg/kg	-	-	-	200,500	-	-	
Manganese	mg/kg	PSQG[e]	460[f]	1,100[g]	639	-	-	
Mercury	mg/kg	BCSQG	0.17	0.486	0.028	0.02	0.03	0.24
Molybdenum	mg/kg	-	-	-	< 1	<1	1	5
Nickel	mg/kg	BCSQG	16	75	1,540	1,660	1,600	590
Phosphorus	mg/kg	PSQG	600[f]	2,000[g]	168	0.14	0.05	0.14
Potassium	mg/kg	-	-	-	78.5	-	-	
Selenium	mg/kg	BCSQG	2		0.7	0.6	0.6	6.7
Silicon	mg/kg	-	-	-	246.5	-	-	
Silver	mg/kg	-	-	-	< 1	0.1	<0.1	0.6
Sodium	mg/kg	-	-	-	13.5	-	-	
Strontium	mg/kg	-	-	-	23.6	-	-	
Sulfur	mg/kg	-	-	-	345.5	-	-	
Thallium	mg/kg	-	-	-		<0.05	<0.05	0.26
Tin	mg/kg	-	-	-	13	<1	<1	<1
Titanium	mg/kg	-	-	-	16.4	-	-	
Uranium	mg/kg	-	-	-		2.3	2.2	2.6
Vanadium	mg/kg	-	-	-	18	4	<0.1	22.7
Zinc	mg/kg	CSQG	123	315	30.55	35	39	148

value exceeds ISQG (or LEL)

value exceeds PEL (or SEL)

[a] see Appendix E.3 for additional details

[b] values represent the mean of two sediment samples

[c] Canadian Sediment Quality Guideline

[d] British Columbia Sediment Quality Guideline

[e] Provincial Sediment Quality Guideline for Ontario

[f] LEL - lowest effect level guideline rather than an ISQG

[g] SEL - severe effect level guideline rather than a PEL

4.0 BIOLOGICAL COMMUNITIES

4.1 Benthic Macroinvertebrate Surveys

Benthic macroinvertebrate communities are indicative of localized water quality conditions, they are important components of aquatic food webs, and there are standardized methods for their collection and evaluation. Therefore, they are useful for monitoring the effects of anthropogenic disturbances on aquatic ecosystems.

Correspondence Analysis (CA) showed benthic invertebrate communities in most mine-exposed areas (E1, E2, E3, E4, E7) were distinct from the reference communities sampled (R1, R2, R3, R4, R6; Figure 4.1). This was evident as statistical differences between most mine exposed areas (except E3) and the average reference community data with respect to the first CA axis (i.e., cP<0.1 for CA1 in Table 4.1). CA1 contrasted reference stations with higher relative abundance of taxa such as the mayfly *Cinygmula* sp., Neumouirid stoneflies including *Podmosta* sp. and the blackfly *Prosimulium* sp. against mine-exposed areas with lower relative abundance of those same taxa and higher relative abundance of chironomid (midge) taxa such as *Euryhapsis* sp. and *Hydrobaenus* sp. None of the exposure areas along Clinton Creek were conclusively outside of the reference area range (ncP<0.9) for CA1, but low ncP values (e.g., <0.5) indicated a low probability (<50%) that these areas were in reference condition.

Unlike mine-exposed Clinton Creek sampling areas, Wolverine Creek (E3) had a benthic invertebrate community that was significantly different from both the pooled (R1-R4) reference mean (cP<0.1) and the reference community range (ncP<0.1) based on CA2 score (Table 4.1). CA2 contrasted the higher relative abundance of unspecified Plecoptera and the chironomid *Diamesa* sp. at E3 compared to higher relative abundance of taxa such as unspecified Perlodidae, *Ameletus* sp., and *Hydrobaenus* sp. at the other areas (Appendix Table F.4).

Benthic communities in the mine-exposed areas of the Clinton Creek watershed also differed from the average reference community based on percent chironomids (midges) and percent Plecoptera (stoneflies) (Table 4.1). Chironomids represented a higher proportion and Plecoptera a lower proportion of the communities in mine-exposed areas compared to the reference areas (Figure 4.2). This is consistent with the separation of areas identified by CA (particularly CA1). Neither, percent chironomids or percent Plecoptera for mine-exposed areas were conclusively within or outside of the reference area range (0.1<ncP<0.9), except at E4 which was within the reference range (ncP>0.9) for % chironomids. But, as with the CA metrics, low ncP suggested less reference-like conditions in most mine-exposed areas.

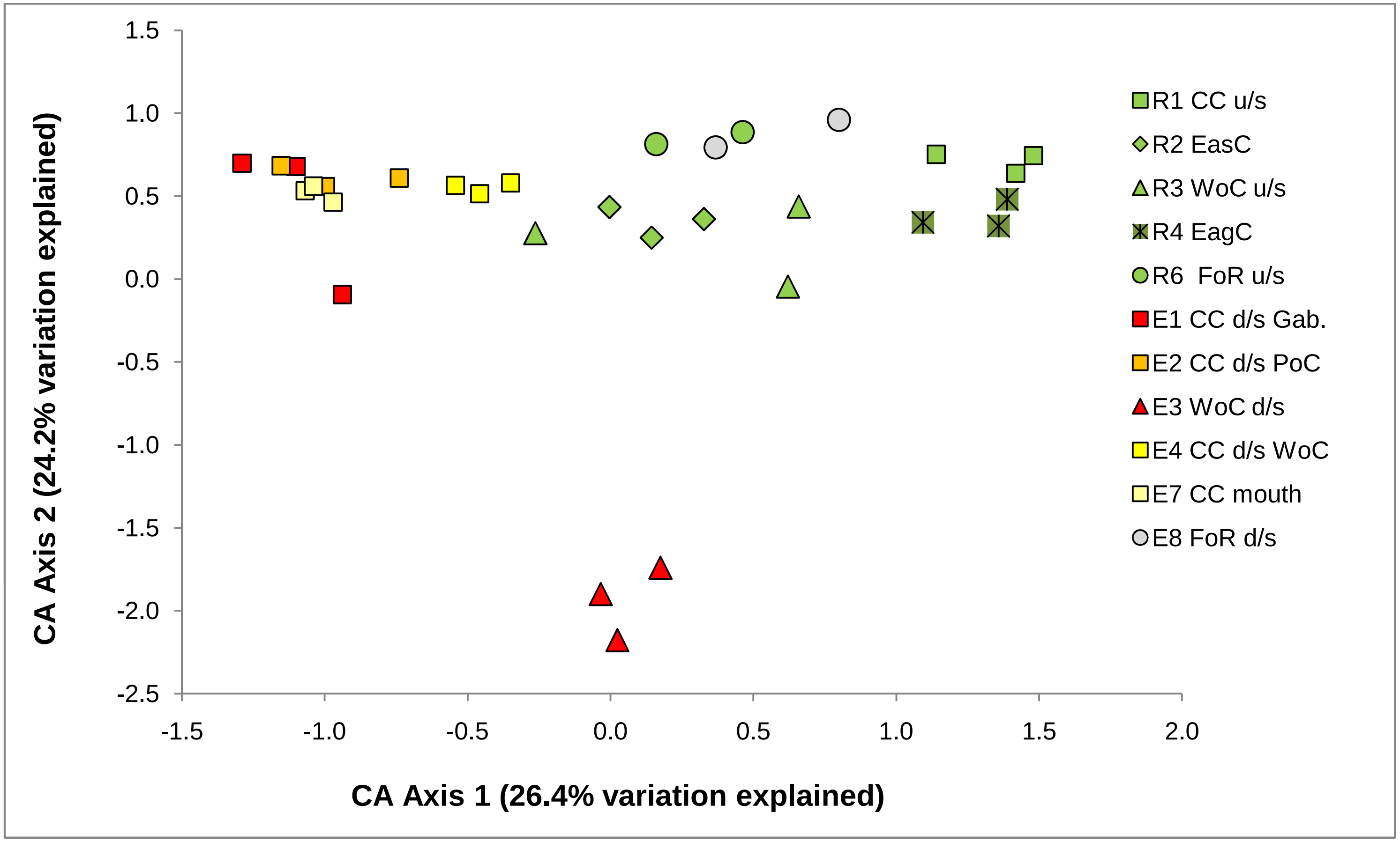

Figure 4.1. Correspondence Analysis ordination of benthic macroinvertebrate communities in streams near the Clinton Creek mine in August 2009.

Table 4.1 Central (cP) and non-central (ncP) t-test results for reference versus mine-exposed stream benthic macroinvertebrate communities (based on mean of n=3 samples per area).

Sampling Areas	Statistic	Correspondence Analysis		Organism Abundance	Taxon Richness	Dominant Taxa	
		CA1	CA2			% Chironomids	% Plecoptera
R1-R4, Reference Areas	mean	0.8	0.4	1246	18.2	22.3	53.3
	sd	0.6	0.2	854	4.4	21.4	21.9
E1, Clinton Creek d/s gabion structures and u/s Porcupine Creek	mean	-1.11	0.43	4335	20	82	0
	sd	0.18	0.45	2154	1.0	2	0
	cP	0.00	0.96	0.16	0.53	0.01	0.01
	ncP	0.19	1.00	0.13	0.99	0.23	0.31
E2, Clinton Creek d/s Porcupine Creek and u/s of Wolverine Creek	mean	-0.96	0.62	2146	25	68	2
	sd	0.21	0.06	694	0.7	4	0
	cP	0.01	0.17	0.29	0.06	0.02	0.01
	ncP	0.22	0.88	0.85	0.66	0.39	0.33
E3, Wolverine Creek u/s of culvert	mean	0.05	-1.94	2852	13	82	8
	sd	0.11	0.22	649	1.0	6	2
	cP	0.11	0.00	0.08	0.12	0.01	0.02
	ncP	0.80	0.01	0.48	0.80	0.23	0.41
E4, Clinton Creek d/s of Wolverine Creek and u/s of Eagle Creek	mean	-0.45	0.55	214	19	38	4
	sd	0.10	0.03	60	2.2	3	2
	cP	0.02	0.32	0.10	0.88	0.29	0.01
	ncP	0.44	0.97	0.78	1.00	0.96	0.35
E7, Clinton Creek upstream of mouth	mean	-1.03	0.52	451	21	75	4
	sd	0.05	0.05	47	0.0	1	1
	cP	0.00	0.45	0.18	0.32	0.01	0.01
	ncP	0.21	0.99	0.90	0.97	0.30	0.36

Different from reference mean (cP < 0.1) .

Similar to reference mean (cP > 0.9).

Different from (outside of) reference range (ncP < 0.1).

Similar to (within) reference range (ncP > 0.9).

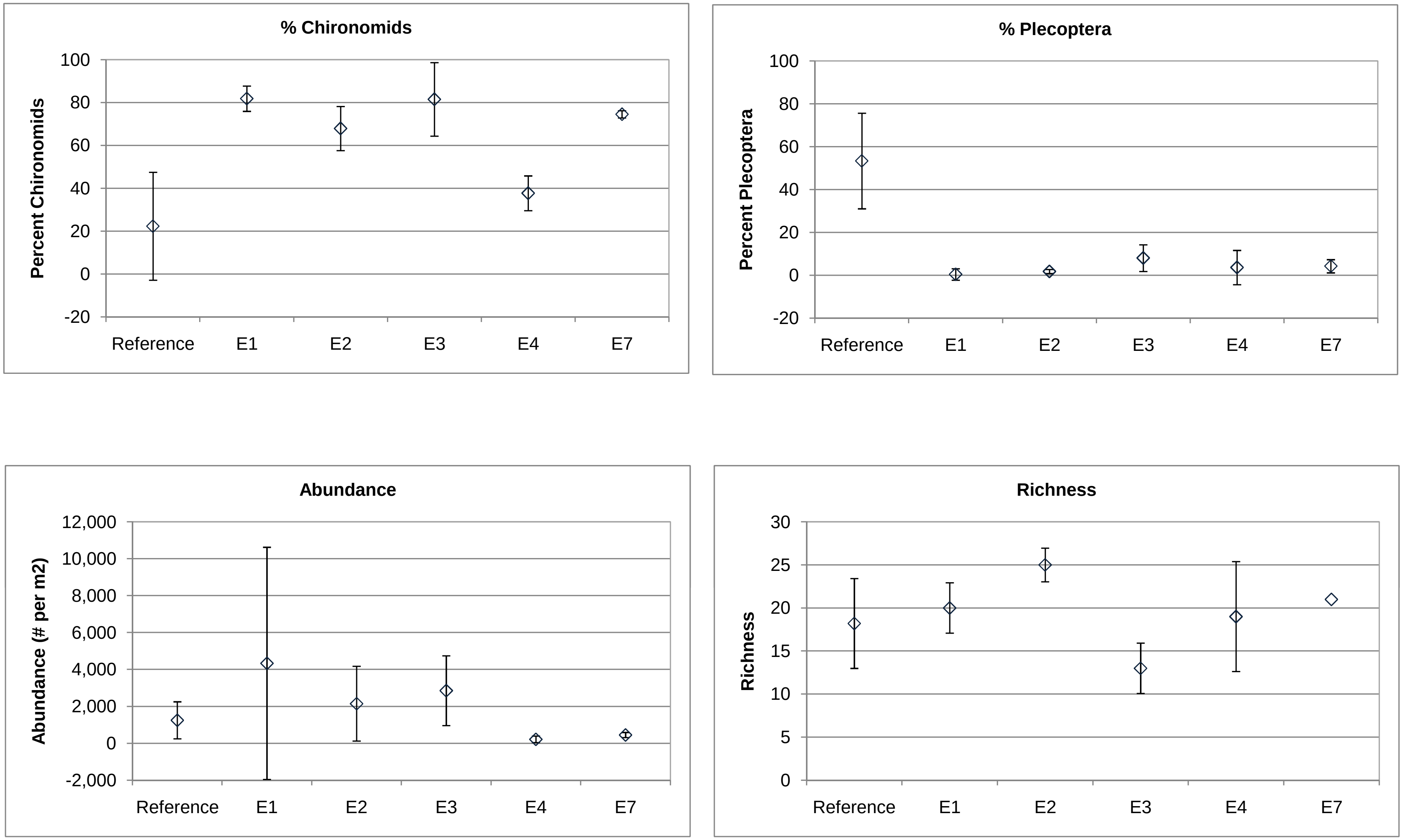

Figure 4.2: Benthic invertebrate abundance, richness, percent chironomids and percent plecoptera (mean ± 95% confidence interval) at mine-exposed areas compared to the pooled reference areas.

Table 4.2 Central and non-central t-tests results for reference versus exposure riverine benthic macroinvertebrate communities (n=2)

Site	CA1	CA2	Organism Abundance	Taxon Richness	% Chironomids	% Plecoptera
Forty Mile River u/s Clinton Creek						
R6-A	0.16	0.81	113	16	17.7	41.6
R6-B	0.46	0.89	397	17	10.1	59.9
mean	**0.31**	**0.85**	**255.0**	**16.5**	**13.9**	**50.8**
sd	**0.15**	**0.04**	**142.0**	**0.5**	**3.8**	**9.2**
Forty Mile River d/s Clinton Creek						
E8-A	0.37	0.79	65	14	12.3	56.9
E8-B	0.80	0.96	396	22	3.5	56.1
mean	**0.58**	**0.88**	**230.5**	**18.0**	**7.9**	**56.5**
sd	**0.22**	**0.08**	**165.5**	**4.0**	**4.4**	**0.4**
cP value	0.41	0.79	0.92	0.75	0.41	0.60

(yellow)	Different from reference mean (cP < 0.1).
(green)	Similar to reference mean (cP > 0.9).

In other words, individual exposure areas (E1, E2, E3, E4, E7) had only a 31-41% chance of being in reference condition (i.e., 0.31<ncP<0.41) based on percent Plecoptera relative to 77-100% for individual reference areas (Appendix Table F.1). Similarly, individual exposure areas had a 22-61% chance of being in reference condition based on percent chironomids compared to 89-94% for individual reference areas.

Fewer differences between mine-exposed and reference areas were evident in measures of organism abundance and taxon richness (Figure 4.2), with several areas being within the reference range for the latter metric (ncP for taxon richness of >0.9 in Table 4.1).

Despite the differences in benthic invertebrate community structure evident within Clinton Creek, the community in the Fortymile River downstream of Clinton Creek (E8) was similar to the reference communities, the most relevant comparison being relative to the community in the Fortymile River upstream of Clinton Creek (Figure 4.1; Table 4.2). However, the certainty of this conclusion is limited by small sample sizes (i.e., n=2 samples per area) and some uncertainty as to the sample locations relative to the Clinton Creek plume within the Fortymile River.

Overall, the data indicated that there were mine-related effects on the benthic macroinvertebrate communities downstream of the Clinton Creek Mine but, except in the case of Wolverine Creek, the communities were not definitively outside the range of conditions found in reference streams. Mine influence was most evident in Wolverine Creek based on a CA2 score outside the reference range, as well relatively lower taxon richness compared to all other areas. There was no evidence of mine-related effects in the Fortymile River based on limited sampling effort.

4.2 Fish Surveys

Numerous fish surveys have been conducted near the Clinton Creek mine site and consistently showed that various fish species typical of Yukon streams utilize Clinton Creek and the Fortymile River; particularly arctic grayling, Chinook salmon, and slimy sculpin (Minnow 2009a). Limiting factors appear to be barriers to fish movement and a lack of sufficiently deep, over-winter habitat (WMEC 2008, 2009). For example, natural immigration into Clinton Creek from the Fortymile River is hampered by numerous beaver dams located along much of the creek. The tributaries to Clinton Creek offer a limited amount of shallow-water, well-oxygenated habitat suitable for seasonal fish utilization, but perched culverts restrict access into Wolverine Creek and Eagle Creek. Also, gabion structures at the outlet of Hudgeon Lake into Clinton Creek represent a barrier to upstream migration under most flow conditions. Furthermore, Hudgeon Lake is anoxic below five metres depth (UMA 2008) and thus offers limited usable habitat for fish even in the ice-free season.

The fish survey conducted in 2009 confirmed a lack of streams near Clinton Creek that could serve in a reference-exposure evaluation of the Clinton Creek fish community (WMEC 2009, Appendix C). Fish do not appear to utilize Clinton Creek or East Creek upstream of Hudgeon Lake. Both Eagle and Wolverine tributaries to Clinton Creek contain limited fish habitat, have low summer flows, and have hanging culverts at their confluences with Clinton Creek (WMEC 2009). Other regional tributaries to the Fortymile River (Mickey, Maiden, and Marten) have suitable fish habitat (Table 4.3) but have been affected by placer mining.

The 2009 fish survey again confirmed that populations of arctic grayling, Chinook salmon, and slimy sculpin utilize Clinton Creek (Table 4.3, Appendix C). A program managed by Dawson District Renewable Resources Council since 2006 has moved Chinook salmon from the mouth of Clinton Creek to the upper reaches (e.g., Smart 2007), so it is not known whether any Chinook naturally colonize these upstream areas.

No external abnormalities were observed among any of the fish caught in 2009 (WMEC 2009). In addition, there were no obvious differences in the condition of slimy sculpin in Clinton Creek compared to those in other tributaries to the Fortymile River (Figure 4.3). Clinton Creek appears to have a stable and healthy fish population relative to other creeks of its size in the Yukon drainage and has been recognized as an important rearing habitat for juvenile salmon (WMEC 2009).

Irrespective of any effects of asbestos or altered water chemistry on the health of downstream receiving environments, past mining activities in the Clinton Creek area have resulted in obvious alterations to the surrounding fish habitat (e.g., formation of Hudgeon Lake, hanging culverts). Also, the formation of Hudgeon Lake has resulted in increased temperatures and flow attenuation in downstream areas of Clinton Creek.

Table 4.3: Catch-per-unit-effort for the Fish Community Survey, Clinton Creek, September 2009 (WMEC 2009, Appendix C).

Method	Area	Effort[1]	Arctic Grayling		Chinook Salmon		Slimy Sculpin	
			# Caught	CPUE	# Caught	CPUE	# Caught	CPUE
Angling[2]	R4	-	-	-	-	-	-	-
	R5	45	1	1.33				
	R7	45						
	R8	45						
	E1	45	7	9.33				
	E2	45	6	8.00	1	1.33		
	E3	-	-	-	-	-	-	-
	E4	45						
	E5	10						
	E6	45						
Electrofishing[3]	R4	163						
	R5	567	1	0.18			6	1.06
	R7	685						
	R8	716	3	0.42			19	2.65
	E1	766	8	1.04				
	E2	813	2	0.25	4	0.49	136	16.73
	E3	435						
	E4	868					24	2.76
	E6	1,052					88	8.37
Minnow Trapping[4]	R4	-	-	-	-	-	-	-
	R5	196	1	0.005	23	0.117	2	0.010
	R7	180	1	0.006				
	R8	20					1	0.050
	E1	180						
	E2	215			41	0.191	22	0.102
	E3	-	-	-	-	-	-	-
	E4	280	1	0.004			4	0.014
	E6	170	2	0.012	3	0.018	5	0.029

[1] Angling (minutes), electrofishing (seconds), minnow traps (hours * # of traps)
[2] CPUE- # fish/hour
[3] CPUE- # fish/100 seconds
[4] CPUE- # fish/hour

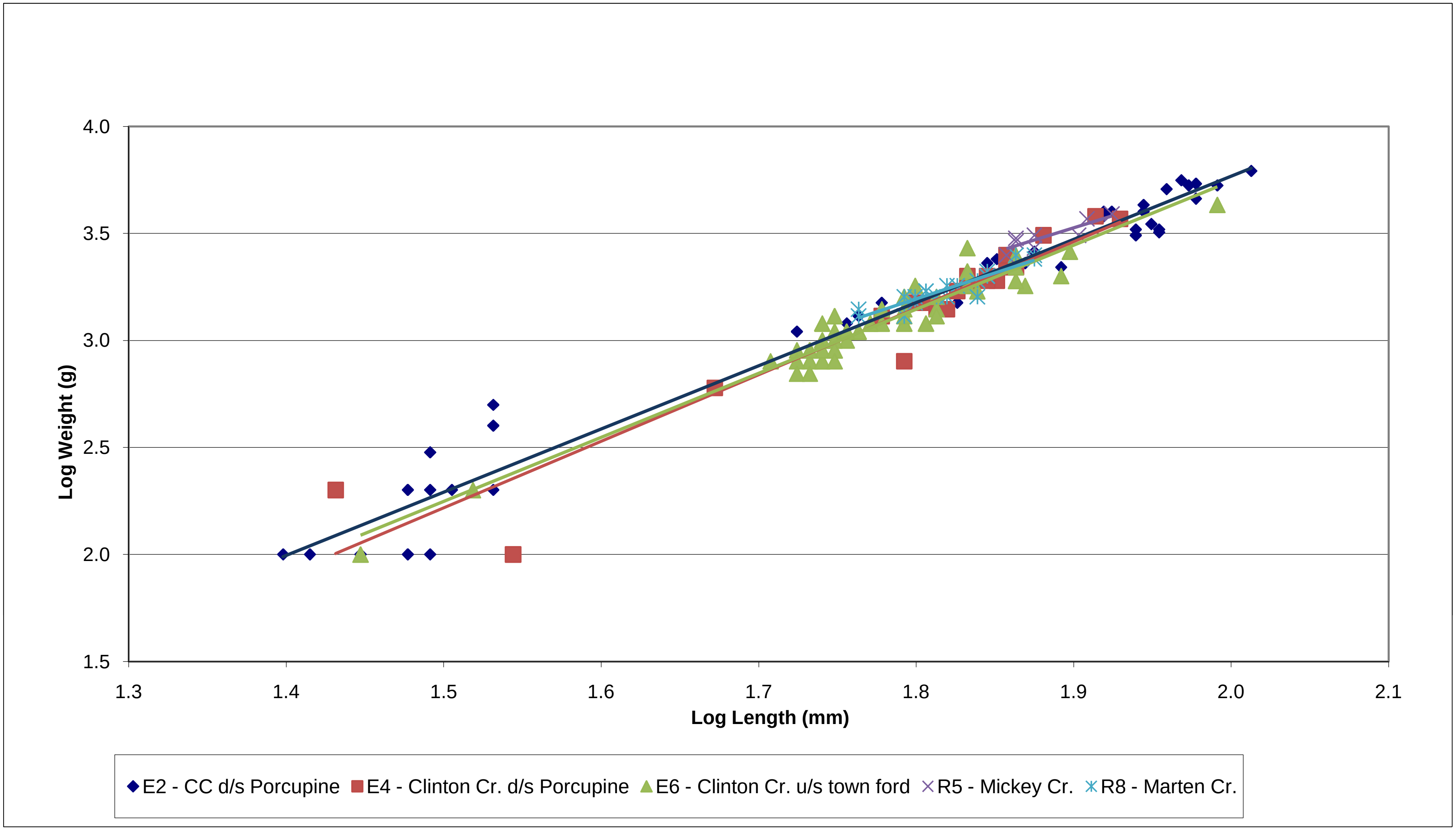

Figure 4.3: Comparison of weight-length relationships for slimy sculpin collected at various areas in Clinton Creek and other regional streams (from WMEC 2009)

5.0 CONCLUSIONS

1. Analyses of 2009 samples for asbestos content were not complete when this report was prepared, so all asbestos data will be summarized in a future report addendum.

2. Limited data for water samples collected under relatively high and low summer flow conditions indicate that numerous substances occur at concentrations above background levels downstream of the mine, but guidelines for protection of aquatic life are rarely exceeded.

3. Method detection limits for some substances measured in water and sediment samples were above background concentrations and/or guidelines, precluding definitive conclusions regarding the potential for such substances to be affecting biota.

4. Benthic macroinvertebrate surveys in Clinton Creek showed mine-related influence on community composition that included lower relative proportions of stoneflies and higher relative proportions of chironomid taxa compared to reference areas. The precise cause (e.g., chemical or physical) of these changes is not clear. Preliminary results suggest that these effects do not carry over into the Fortymile River.

5. The 2009 fish surveys confirmed that populations of arctic grayling, Chinook salmon, and slimy sculpin utilize Clinton Creek. The relative proportions of Chinook salmon that naturally colonize upper Clinton Creek, relative to those that are manually transferred from lower reaches in annual surveys by Fisheries and Oceans Canada, is unknown. The 2009 study concluded that tributaries to Clinton Creek and the Fortymile River investigated to date are unsuitable reference streams for comparison with Clinton Creek due to lack of fish habitat and the effects of placer mining, respectively. Also, the formation of Hudgeon Lake represents a confounding influence on fish habitat in Clinton Creek as similar impoundments are rare in headwaters of Yukon streams.

6. There remains insufficient information to make conclusions regarding the effects of elevated asbestos and metals on the health of aquatic ecosystems downstream of the Clinton Creek Mine. In particular, there is little known about water quality and flow conditions other than in summer. In addition, there is little information with which to

assess the effects of a possible future breach of the waste rock by Hudgeon Lake or the potential positive and negative effects of various closure options.

6.0 RECOMMENDATIONS

The following recommendations are pertinent to deciding among various options for closure of the Clinton Creek mine (i.e., status quo or some level of remediation).

1. Continue the routine water quality monitoring program to characterize concentrations of asbestos and other contaminants in different seasons and flow scenarios. These data are necessary for accurately assessing any current or potential future effects of the mine on biota in downstream receiving environments.

2. Collect water samples for the purpose of conducting laboratory toxicity tests, particularly in a high flow event when suspension of asbestos fibres is likely to be maximal. Histological analysis (e.g., in partnership with a university) of the tissues of exposed biota may also be valuable in characterizing the extent of contamination by asbestos fibres.

3. Collect sediment samples from reference and mine-exposed areas to characterize the concentrations of asbestos and other contaminants.

4. Collect sediment samples for laboratory toxicity testing. As in #2, this information will identify whether current concentrations, particularly of asbestos, are sufficient to be toxic to aquatic biota and may assist in explaining mine-related influences observed among benthic invertebrate communities downstream of the mine.

5. Conduct a desk-top evaluation of the uniqueness of the Clinton Creek with respect to supporting regional fisheries resources using existing habitat (e.g., temperature) and biological (e.g., benthic macroinvertebrate and fish community composition) data. This would confirm the importance of Clinton Creek to the sustainability of regional fisheries, particularly with respect to juvenile Chinook salmon rearing.

6. Summarize new and existing site-specific data on the importance of groundwater seeps for maintaining the temperature of Clinton Creek below the upper thermal tolerance of resident fish species and as a potential source of nutrients. There is concern that potential site reconfiguration could alter groundwater flow paths which may in turn alter the quality and/or quantity of Clinton Creek fish habitat.

7. Collect additional baseline information in the Fortymile River to assess any current impacts of the Clinton Creek mine on this downstream receiving environment before any remediation activities begin.

8. Combine breach model predictions with the results of toxicity testing to qualitatively evaluate the range of potential impacts in Clinton Creek that could extend into the Fortymile River should a breach occur in the future.

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APPENDIX A

Minnow Study Design Recommendations for 2009

Project Memorandum

Date: July 15, 2009

To: Rachel Pugh

Cc: Patti Orr (Minnow), Cynthia Russel (Minnow)

From: Michelle Bowman, Minnow

RE: 2009 Study Design Recommendations

We've scanned the existing asbestos literature and Clinton Creek Mine reports for information relevant to 2009 sampling recommendations. As you previously noted, historical asbestos concentrations in Clinton Creek are at or above levels (i.e., $>10^6$ fibres/L) shown in the literature to have adverse effects on aquatic biota (macrophytes, algae, zooplankton, and fish). Habitat characteristics for streams in the vicinity of the Clinton Creek mine site, as well as perceived information gaps, were considered in developing recommendations for sample collection for 2009 to support the closure planning process.

Sampling Areas

Based on the information compiled to date, we have identified a number of potential reference and mine-exposed sampling areas, listed below. Final determination of appropriate sampling areas should be made in the field based on priorities discussed below, while also taking into account ease of access, habitat comparability, and approved project budgets.

R1 – Clinton Creek upstream of Hudgeon Lake
R2 – Easter Creek upstream of Hudgeon Lake
R3 – Upper Wolverine Creek (above tailings)
R4 – Easter Creek
R5- Mickey Creek (nearby tributary to Fortymile River)
R6- Fortymile River upstream of Clinton Creek
E1 – Clinton Creek downstream of gabion baskets/ upstream of Porcupine Creek
E2 – Clinton Creek downstream of Porcupine Creek/ upstream of Wolverine Creek
E3 – Wolverine Creek upstream of hanging culvert
E4 – Clinton Creek downstream of Wolverine Creek/ upstream of Eagle Creek
E5 - Porcupine Creek upstream of Clinton Creek confluence (if possible/ no habitat/access information)
E6- Clinton Creek downstream of Eagle Creek
E7- Clinton Creek near mouth
E8 - Fortymile River downstream of Clinton Creek

Available habitat information suggests all these areas are characterized by predominantly erosional habitat (riffles with gravel/ cobble). It will be important for field personnel to match habitat characteristics (e.g., substrate type, depth, velocity) among sampling areas as closely as possible so habitat-related effects on biota do not confound the identification of mine-related effects. Photos and GPS coordinates should be collected at all areas, in addition to habitat information (see below).

If all the above areas can be sampled, the resulting information will provide a good indication of the magnitude and spatial extent of any mine-related influence on near-field areas. However, it is unlikely that there is sufficient time remaining in the 2009 field season to accomplish this level of effort (i.e., for you in terms of soliciting proposals and awarding contracts and also for planning and mobilization by contractors). Therefore, we have identified the priority areas as those closest to the mine (E1-E5), along with at least two reference areas that closely match the habitat characteristics of the exposure areas. This will allow for reference-exposure area comparisons to be made as part of the assessment of mine-related effects. If the data suggest effects are evident, this may leave unanswered questions about the spatial extent of influence that would need to be answered in a future survey.

Water sampling

It appears that some water quality data exist for recent years but method detection limits have been too high (above water quality guidelines) for some substances to allow for meaningful data interpretation (e.g., cadmium, chromium, phosphorus, selenium, silver, thallium). Furthermore, it appears that asbestos levels in water have not been measured since 1998, so this is an important data gap with respect to closure planning. Therefore, we recommend the collection of water samples for the purpose of analyzing asbestos, as well as ICP metals (with low detection limits), nutrients (nitrate, nitrite, TKN, ammonia, total P), sulphate, and DOC. If possible, you should also collect flow data when water samples are collected so contaminant loads from the different sources can be computed under the different flow scenarios (downstream loads minus upstream loads equal mine contributions of asbestos and other contaminants).

Consistent with our previous recommendations (email June 18th), water sampling should aim to capture a range of conditions (e.g., from prolonged dry, low flow to just after a sizable precipitation event) at both reference and mine-exposed areas (particularly E4). We suggest that the lack of data characterizing within-year concentration variability would likely be perceived as a large data gap relative to normal expectations for a closure plan Environmental Assessment. Strategically capturing a range of flow conditions will be more effective than simply increasing sampling frequency given the limited window of time over which to collect data this year. I am aware that you will be visiting the site at pre-determined intervals, so it may not be possible for you to personally collect such samples, but perhaps arrangements could be made with other contractors or regulatory agencies that expect to visit the site this summer and/or with local residents.

Benthic Macroinvertebrate Sampling and Habitat Characterization

The surveys conducted to date did not adequately quantify the spatial extent or magnitude of mine-related effects on benthic invertebrate communities. You have indicated that Laberge may be available to conduct a benthic invertebrate survey this summer. We recommend that they be contracted to complete the field work, the taxonomic analysis and enumeration (preferably as a subcontract to Sue Salter's lab, Cordillera, in Summerland, BC), and a written summary of the field methods and supporting information (e.g., habitat information and field measurements). Minnow will develop a separate cost estimate in August for your review to complete the statistical analysis and reporting of benthic community data.

We recommend collection of invertebrate samples from three stations per area, using Environment Canada's CABIN (kick-and sweep) protocol, in late summer (August or September). This represents a control-impact sampling design that will allow for quantification of mine influence on the downstream benthic communities. While five stations per area would provide better statistical power, three stations per area will likely be adequate to detect any substantive mine influence and is more manageable considering the short notice being given to Laberge for planning and implementation. As noted above, if it is not possible to sample all areas listed above, at least those closest to the mine (E1-E5) should be sampled, along with at least two reference areas.

Habitat characteristics (substrate type, depth, velocity) should be kept as consistent as possible among all sample stations. Characteristics to be recorded in the field should include wetted and bankful stream widths, average and maximum stream depth, flow (discharge), velocity, general morphology (% pond/pool, riffle, run for 200 m upstream), substrate type (% areal coverage of bedrock, boulder, cobble, gravel, sand or finer), aquatic vegetation (type and qualitative abundance), and any other observations that may be relevant to benthic community characteristics. Also, measurements should be made of water temperature, pH, dissolved oxygen, and specific conductance. Water samples should be collected and sent for laboratory analysis of the parameters listed in the previous section.

Fish Survey

It appears that annual fish surveys have been conducted by Fisheries and Oceans in recent years, involving deployment of minnow traps. Based on this, it appears that arctic grayling, slimy sculpin, and juvenile Chinook salmon are present in the vicinity of the mine site (the latter likely being the result of manual transfers from the mouth of Clinton Creek (2007?). These surveys will be useful in summarizing recent fish presence/absence patterns in selected areas downstream of Hudgeon Lake. However, reference area data are lacking and different downstream areas were sampled among surveys. To provide a more complete data set, we recommend conducting a broader fish community survey in 2009, including the same seven priority areas listed above (E1-E5, plus two reference areas). Reference areas should be located far (200-300m) enough from exposure areas to avoid capturing sculpin that routinely use mine-impacted habitat. Community surveys should be conducted using minnow traps and electrofishing (and possibly seine nets). Fishing effort should be standardized among areas to provide a rough estimate of relative abundance based on catch-per-unit-effort (CPUE). All fish should be identified, enumerated, inspected for any external lesions, tumors, other abnormalities or fin clips (all documented), and then released alive in the areas where they were caught. In addition, the lengths and weights of at least 20 sculpin per area should be recorded.

If possible, it would also be useful to more precisely estimate relative abundance of each fish species (by repeated pass electrofishing at closed stations in each area) at two of the locations (e.g., one upstream reference area and one downstream area below Wolverine Creek).

It is recommended that Fisheries and Oceans (DFO) be approached to determine if they are planning to conduct another survey in 2009, in which case the feasibility of expanding the program to include the components listed above should be explored. If DFO plans to conduct a survey but will not be able to expand the scope of work, perhaps the recommended scope of work could be accomplished by White Mountain Environmental Consulting (Paul Sparling) or through a collaborative effort between DFO and WMEC.

The recommended sampling design will assist in identifying any substantive influence of mine exposure on the health of downstream fish populations. However, it is important to note that the toxicological literature suggests that detailed histological data is required to directly link changes in fish health to asbestos exposure. We have concluded that there is insufficient time to plan for this type of specialized analyses in 2009. This may result in a data gap that will need to be addressed in the future.

Other Considerations

I will be in Whitehorse for another project at the end of August and could be available to visit the site in order to assist with selecting appropriate sampling locations, particularly for the benthic invertebrate survey. In addition to ensuring the sampling design will be adequate to support statistical analyses, the interpretation of site data would be improved by first-hand site knowledge. We estimate that the costs associated with travel to the site by road (travel time, truck rental, and mileage), one full day of field reconnaissance at the site, and subsistence and accommodation for three days, would represent an additional [redacted], although this could be reduced if transportation could be shared (e.g., if the timing coincided with one of your monthly visits).

We are concerned about the health and safety associated with handing field samples containing elevated asbestos levels. We recommend that all field and laboratory personnel be informed about potential exposure risks in advance so they can take appropriate safety precautions.

Let us know if you have any questions or concerns regarding the above.

APPENDIX B

LES (2010) Report

SUMMARY OF ENVIRONMENTAL MONITORING ACTIVITIES AT THE ABANDONED CLINTON CREEK ASBESTOS MINE, 2009

FOR

Yukon

ASSESSMENT AND ABANDONED MINES

ENERGY MINES AND RESOURCES

BY

Laberge ENVIRONMENTAL SERVICES

January 2010

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1.0 BACKGROUND

The former Clinton Creek Asbestos Mine is located approximately 100 km northwest of Dawson City, Yukon, and nine km upstream of the confluence of Clinton Creek and the Forty Mile River. The mine operated from 1967 to 1978. The site encompasses three open pits (Porcupine, Snowshoe and Creek), two waste rock piles (Clinton Creek Dump and Porcupine Creek Dump), and a tailings pile.

In 1974, 60 million tonnes of the Clinton Creek waste rock pile slumped across the Clinton Creek valley creating the formation of Hudgeon Lake. During the 1980s various weirs were constructed to reinforce the Clinton Creek channel in attempts to stabilize and control the outflow from Hudgeon Lake, with limited success. The structures were washed out during a high flow event in 1997. The Federal Government (DIAND) assumed responsibility for the site in 1999; following Devolution in 2003, the Government of Yukon (YG) assumed responsibility for site management. In a series of stages from 2002 to 2004, gabion drop structures were constructed within the channel downstream of the Hudgeon Lake outlet. YG continues to monitor these structures and conducts repairs as necessary.

In the early summer of 2009, Minnow Environmental Inc (Minnow) was contracted by YG to review all existing environmental data pertaining to the Clinton Creek site and make recommendations for any data gaps.

1.1 Scope of Work

Laberge Environmental Services (Laberge) was contracted by YG to conduct various environmental monitoring surveys on Clinton Creek and several of its tributaries during the late summer of 2009, based on the recommendations by Minnow. Methods and the results of each of the three field trips are summarized in this report.

2.0 METHODS

Three separate field trips were made to the site in an attempt to capture conditions under varying flow regimes. Due to the lateness of the contract, the three field trips were conducted; August 17th to 20th, September 1st to 4th and September 19th to 21st, 2009. Although this only covered a period of five weeks, a low water event was sampled during August and a very high flow event was captured during September 20th.

Michelle Bowman, an employee with Minnow, accompanied a field crew of two from Laberge to establish exposure sites on Clinton Creek and reference sites on appropriate tributaries. Water samples, stream sediment samples and benthic invertebrate samples were collected. Habitat assessments were also conducted at each site.

2.1 Water Quality Sampling

Exova, formerly Bodycote Analytical, supplied Laberge with the necessary sample kits prior to each field trip. Each sample bottle was rinsed three times with the sample waters and then filled and preserved as specified by the laboratory's protocols. Samples were kept cool then shipped as soon as possible to Exova in Surrey, BC.

In situ measurements of pH, conductivity, water temperature and dissolved oxygen were made. Discharge measurements were also conducted where possible on each visit.

2.2 Benthic Invertebrate Sampling

Benthic invertebrates were collected with a D-net equipped with a 400 micron mesh net using the kick and sweep method following CABIN protocols. Triplicates were collected per site for three minutes each and the number of transects was noted. Note that only duplicates were collected on the Forty Mile River due to the lack of appropriate sampling habitat. Samples were treated with 10% formalin and sent to Cordillera Consulting in Summerland, BC for sorting, identification and enumeration. Due to the high number of invertebrates in many of the samples, fractions were sub sampled as necessary.

Various habitat conditions were noted and recorded on CABIN field sheets.

2.3 Stream Sediment Geochemistry

Composite stream sediment samples were collected with a steel trowel from three sites during the final field trip. Fine grained material from recently deposited areas were chosen and placed into ziplock bags, kept cool, and shipped to Exova with the water samples.

3.0 RESULTS

3.1 Established Sites

A total of eleven sites were eventually established, five reference sites and six exposure sites. These are listed below in Table 1 along with the sampling matrices and frequencies.

TABLE 1 SAMPLING FREQUENCY AND MATRIX

Site #	Site Description	Sampling Event, 2009		
		Aug 18, 19	Sept 2, 3	Sept 20
Reference Sites:				
R1	Clinton Cr u/s Hudgeon Lake	WQ, BI	WQ	
R2	Easter Cr u/s Hudgeon Lake	WQ, BI	WQ	
R3	Wolverine Cr u/s tailings		WQ, BI	
R4	Eagle Creek u/s culverts at road crossing	WQ, BI	WQ	WQ
R6	Forty Mile River u/s Clinton Creek		WQ, BI	
Exposed Sites:				
E1	Clinton Cr d/s gabions, u/s Porcupine Cr	WQ, BI	WQ	WQ
E2	Clinton Cr d/s Porcupine Cr, u/s Wolverine Cr	WQ, BI	WQ	WQ
E3	Wolverine Cr u/s culverts at road crossing	WQ, BI	WQ	WQ, SS
E4	Clinton Cr d/s Wolverine Cr, u/s Eagle Cr	WQ, BI	WQ	WQ, SS
E7	Clinton Cr near mouth	WQ, BI	WQ	WQ
E8	Forty Mile River d/s Clinton Creek		WQ, BI	WQ
	Porcupine Beaver Ponds			SS
WQ = water quality BI = benthic invertebrates SS = stream sediments				

3.2 Water Quality

Water quality samples were not collected at all sites on all sampling events. During the initial trip in August, eight sample locations were established; three reference sites and five exposed sites. Upon review, Minnow recommended that samples should also be collected upstream on Wolverine Creek as well as on the Forty Mile River, upstream and downstream of the confluence of Clinton Creek. These three sites were sampled for the first time during the second field trip in early September. Due to a high rainfall event proceeding and during the third field trip, flood conditions prevented access (fording) across Clinton Creek to sample upstream on the Forty Mile River. Since the boat for collecting samples upstream of Hudgeon Lake was located at the resident's location situated on the other side of Clinton Creek, samples could not be collected from R1 and

R2 in late September. These flood conditions also prevented safe access to R3, Wolverine Creek upstream of the sloughed tailings.

Table 2 summarizes the data collected from all sites for all occasions. Only metals where the CCME guidelines were exceeded have been included in the table. Although the guideline was slightly exceeded for selenium at R4 on September 20th only, selenium has not been included in Table 2.

All waters in the study area were slightly alkaline and ranged in pH from 7.66 to 8.36. All sampled waters had high conductivity especially during the undiluted state during the August sampling when flows were the lowest measured. In August, conductivity values ranged from 548 uS/cm at R4 and E1, to 1180 uS/cm at E4. In September, the Forty Mile River was sampled and conductivity values were lower here, however the same general trend was followed during the other sampling events. Note that E8, Forty Mile River downstream of Clinton Creek, was not sampled sufficiently downstream of the influence of Clinton Creek to ensure that full mixing had taken place, and this is reflected in the conductivity values. The hardness levels followed the same general trend as conductivity. All waters in the study area were hard or very hard.

Discharge varied significantly over the study period. Flows were higher in early September than during mid August, and in late September flows were almost a magnitude greater than those recorded in early September. The increase in flow created greater turbidity with higher total suspended solids readings documented at most sites during the third sampling event. Eagle Creek was very turbid and had a TSS value of 164 mg/L. The waters in the study area were generally clear during the other sampling events.

Some of the metals at some of the sites exceeded the CCME recommended guidelines for the protection of freshwater aquatic life. Since all the waters within the study area were hard or very hard, the appropriate guidelines for hard waters were used for the metals where the guidelines vary with hardness. The guideline for cadmium is very conservative but since the flows in the study area were hard or very hard, the

TABLE 2 **Clinton Creek Water Quality Sampling Program - Analytical Summary**

Site #	Site Description	Date (2009)	pH (Lab)	Conductivity (uS/cm@25^{o}C) (Lab)	TSS mg/L	Discharge (cms)	Cadmium mg/L	Chromium mg/L	Copper mg/L	Iron mg/L	Hardness mg $CaCO_3$/L
DL	*Detection Limit*			*1*	*1*		*0.00001*	*0.0004*	*0.001*	*0.01*	*1*
CCME	*CCME Guidelines*							*0.001*	*0.004*	*0.3*	
R1	Clinton Creek u/s Hudgeon Lake	Aug. 18, 19	7.88	785	3	0.1737	0.00004	0.0004	0.002	0.294	491
		Sept. 2, 3	7.73	457	7	0.5063	0.00004	0.0009	0.004	**0.504**	273
R2	Easter Creek u/s Hudgeon Lake	Aug. 18, 19	8.05	816	<2	0.0429	0.00001	<0.0004	<0.001	0.205	532
		Sept. 2, 3	7.94	635	2	0.0842	0.00007	0.0009	0.002	0.226	396
R3	Wolverine Cr u/s Tailings Upstream of beaver pond u/s of tailings	Sept. 2, 3	7.96	703	9	0.062	**0.00024**	**0.0011**	0.002	**0.502**	444
R4	Eagle Creek u/s culvert	Aug. 18, 19	8.09	548	<2	0.047	0.00004	0.0006	0.003	0.216	323
		Sept. 2, 3	7.94	438	10	0.0576	0.00003	**0.0011**	0.003	**0.393**	251
		Sept. 20	7.66	226	164	0.426	**0.00018**	**0.0052**	**0.008**	**3.45**	130
R6	Forty Mile River u/s Clinton Ck	Sept. 2, 3	7.66	191	<2	N/A	<0.00001	0.0005	0.003	0.208	94.9
E1	Clinton Creek d/s gabions and u/s Porcupine Creek	Aug. 18, 19	7.77	548	<2	0.2605	0.00005	0.0007	0.002	0.262	311
		Sept. 2, 3	7.91	468	<2	0.5051	0.00004	0.0008	0.003	0.226	281
		Sept. 20	7.92	457	12	4 (e)	0.00004	**0.0024**	0.004	**0.635**	263
E2	Clinton Creek d/s Porcupine and u/s Wolverine Cr	Aug. 18, 19	7.84	886	4	0.0925	0.00005	0.0008	0.001	**1.04**	584
		Sept. 2, 3	7.86	561	2	0.4085	0.00003	0.0009	0.002	**0.363**	346
		Sept. 20	7.93	467	20	4 (e)	0.00006	**0.0029**	0.003	**0.643**	265
E3	Wolverine Cr u/s culvert d/s tailings	Aug. 18, 19	8.36	862	2	0.063	<0.00001	**0.0014**	<0.001	0.064	565
		Sept. 2, 3	8.2	742	<2	0.0557	0.00007	**0.0014**	0.002	0.089	497
		Sept. 20	7.87	421	28	0.3972	0.00002	**0.0056**	0.004	**1.25**	244
E4	Clinton Creek d/s Wolverine Cr and u/s Eagle Creek	Aug. 18, 19	7.97	1180	3	0.2534	0.00005	0.0009	0.001	**0.48**	819
		Sept. 2, 3	7.84	770	2	0.6920	**0.00374**	0.0009	0.003	**0.376**	472
		Sept. 20	7.85	516	21	7 (e)	0.00006	**0.0047**	0.004	**0.778**	296
E7	Clinton Creek near mouth	Aug. 18, 19	7.95	1080	<2	0.2758	0.00003	0.0009	0.001	0.148	713
		Sept. 2, 3	7.84	771	<2	0.8625	0.00002	0.001	0.002	0.255	484
		Sept. 20	7.8	483	58		**0.0001**	**0.0059**	**0.005**	**1.61**	284
E8	Forty Mile River d/s Clinton Ck	Sept. 2, 3	7.77	504	<2	N/A	0.00001	0.0008	0.002	0.244	289
		Sept. 20	7.79	441	58		0.00007	**0.0059**	**0.005**	**1.87**	259

Note: (e) = estimated flow

calculation, using the formula 10{0.86[log(hardness)]-3.2}, was used to determine the site specific guideline for each site. The guideline for cadmium was exceeded at the reference sites R3 (Sept 3) and R4 (Sept 20) and at the exposed sites E4 (Sept 3) and E7 (Sept 20), with the highest concentration documented at E4.

The recommended guideline for chromium was exceeded at the reference sites R3 (Sept 3) and R4 (Sept 3 and 20), and at the exposed sites E1 (Sept 20), E2 (Sept 20), E3 (all three sampling dates), E4 (Sept 20), E7 (Sept 20) and E8 (Sept 20).

The recommended guideline for copper was exceeded at the reference site R4 (Sept 20) and at the exposed sites E7 (Sept 20) and E8 (Sept 20).

The recommended guideline for iron was exceeded on at least one occasion at all of the sites with the exception of R2 (Easter Creek). The guideline was exceeded on all sampling dates at E2 and E4.

The majority of these exceedences occurred during the September 20th sampling event. All sampled waters were turbid at this time due to runoff from the heavy rains. The higher suspended sediment load documented during this field trip created greater concentrations of many of the metals in Table 2 since analysis was performed on 'total metals'. Thus the data represents concentrations contained within the mobilized sediment as well as within the water column. The toxicity of most metals is more toxic to aquatic life in the dissolved phase. Future sampling should also include the analysis of dissolved metals to get an indication of the presence of the more toxic phase, especially during turbid events.

Several significant parameters had greater concentrations at the upstream site on Wolverine Creek (R3) than downstream at E3, consequently R3 may not represent a very effective reference site for impacts at E3. The reference site R4, Eagle Creek, also had higher concentrations of some metals than E3 and it appears that R2, Easter Creek, may be the best reference site for water chemistry for Wolverine Creek.

3.3 Benthic Macro-Invertebrates

Three phyla were found in the study area: Arthropoda, Mollusca and Annelida. A total of 45,914 individual invertebrates, representing 103 different taxonomic groups, were identified within the study area. These data are presented in Appendix A.

The kick and sweep method is not a quantifiable approach and densities cannot be calculated. However, as the time taken to complete sampling was consistent at each site (with the exception of the two sites on the Forty Mile River), some general comparisons and observations on the benthic populations have been suggested below. Minnow will be doing a detailed analysis of the habitat and benthic communities which will be submitted in a separate report (Minnow, 2010, in preparation).

3.3.1 Habitat Descriptions

Using CABIN field sheets, habitat data was collected at each site and is summarized in Appendix B. Similar characteristics were targeted at each site in attempts to allow realistic comparisons between reference and exposed sites.

3.3.2 Abundance and Diversity

Three sweeps of three minutes duration each were made at all of the sites except on the Forty Mile River where only two sweeps were made. The objective was not to compare the Clinton Creek sites with the Forty Mile River sites since the habitat characteristics of large rivers are very different to those of creeks.

To enable a snapshot of the general characteristics of the benthic communities, the total number of invertebrates captured at each site is presented in Table 3. Excluding the Forty Mile River sites, population numbers ranged from 641 individuals collected from E4 (Clinton Creek d/s Wolverine Cr and u/s Eagle Creek) to 13,005 individuals collected at E1 (Clinton Creek d/s gabions and u/s Porcupine Creek). Population numbers on the Forty Mile River were low and similar to each other.

As a measure of community diversity, the number of taxonomic groups identified from species to phylum at each site was tallied (Table 3). The benthic community at Easter Creek (R2) was the most diverse with 40 different taxa identified. The community at R1, Clinton Creek u/s Hudgeon Lake was the least diverse in the study area with 22 different taxa present.

To further characterize the taxonomic wealth of each community, the diversity was related to the population size using the formula: (Diversity –1) divided by the natural log of the population (Table 3) resulting in a similar trend for the extremes, but E8 and E4 now show greater richness.

TABLE 3
ABUNDANCE, DIVERSITY AND TAXONOMIC RICHNESS IN THE WATERSHEDS AT CLINTON CREEK, 2009

SITE	LOCATION	ABUNDANCE	DIVERSITY	TAXONOMIC RICHNESS INDEX
REFERENCE SITES:				
R1		6,456	22	2.4
R2		1,807	40	5.2
R3		1,312	35	4.7
R4		5,375	23	2.6
R6		510	23	3.5
EXPOSED SITES:				
E1		13,005	34	3.5
E2		6,437	35	3.9
E3		8,557	24	2.5
E4		641	32	4.8
E7		1,354	33	4.4
E8		461	32	5.1

3.3.3 Distribution

The composition of the benthos communities was displayed as a percentage of the major taxonomic groups for each station (Figure 1). Based on this, taxa were classified with respect to their dominance within the community (Table 4).

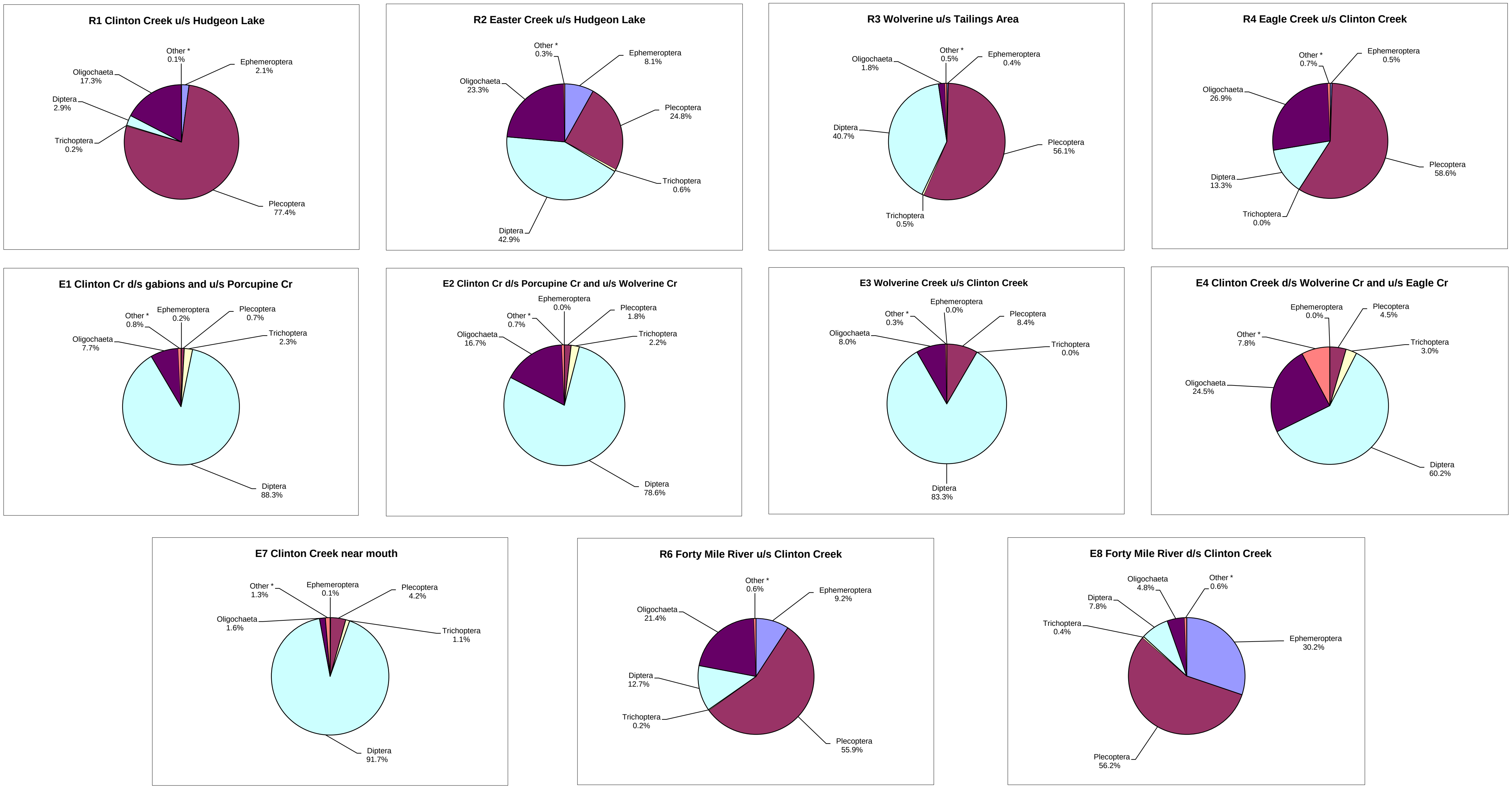
TABLE 4

TAXONOMIC DISTRIBUTION OF BENTHIC INVERTEBRATES

SITE	LOCATION	DOMINANT (³ 25%)	SUBDOMINANT (10% to 24.9%)	COMMON (1.0% to 9.9%)	RARE (0.1% to 0.9%)
R1	Clinton Cr u/s Hudgeon Lake	Plecoptera	Oligochaeta	Diptera Ephemeroptera	Trichoptera Other
R2	Easter Cr u/s Hudgeon Lake	Diptera	Plecoptera Oligochaeta	Ephemeroptera	Trichoptera Other
R3	Wolverine Cr u/s Tailings area	Plecoptera Diptera		Oligochaeta	Trichoptera Ephemeroptera Other
R4	Eagle Cr u/s Clinton Cr	Plecoptera Oligochaeta	Diptera		Ephemeroptera Other
R6	Forth Mile River u/s Clinton Cr	Plecoptera	Oligochaeta Diptera	Ephemeroptera	Other Trichoptera
E1	Clinton Cr d/s gabions & u/s Porcupine Cr	Diptera		Oligochaeta Trichoptera	Other Plecoptera Ephemeroptera
E2	Clinton Cr d/s Porcupine & u/s Wolverine Cr	Diptera	Oligochaeta	Trichoptera Plecoptera	Other
E3	Wolverine Cr u/s Clinton Cr	Diptera		Plecoptera Oligochaeta	Other
E4	Clinton Cr d/s Wolverine & u/s Eagle Cr	Diptera	Oligochaeta	Other Plecoptera Trichoptera	
E7	Clinton Cr near mouth	Diptera		Plecoptera Oligochaeta Trichoptera	Ephemeroptera Other
E8	Forth Mile R d/s Clinton Cr	Plecoptera Ephemeroptera		Diptera Oligochaeta	Trichoptera Other

With just a cursory visual review of Figure 1, it is obvious that the composition of the benthic communities at the reference sites is considerably different from that of the exposed sites. Note that the two communities on the Forty Mile River were relatively similar. The communities at the reference sites were comprised of large numbers of Plecoptera (stoneflies) and this order was either dominant or subdominant at these sites. The populations at the exposed sites were dominated by large numbers of Dipterans (true flies).

FIGURE 1 THE COMPOSITION OF THE BENTHIC COMMUNITIES AT EACH OF THE SITES IN THE CLINTON CREEK STUDY AREA, 2009



NOTE: "Other" consists of one or more of the following: Coleoptera, Collembola, Amphipoda, Arachnida, and Gastropoda

Throughout the study area the most abundant organism present was *Diamesa sp.* (from the subfamily Diamesinae of the family Chironomidae belonging to the order of Diptera), forming 17.1 % of the total invertebrates collected (Appendix A). This was closely followed by the grouping "Cricotopus/Orthocladius sp." also within the order Diptera, with 15.4%. The third most abundant grouping was "Family Nemouridae", within the order Plecoptera, which formed 11.3% of all the invertebrates captured within the study area.

Oligochaeta, a class within the phylum Annelida (aquatic earthworms), formed a significant portion of the communities, especially at the reference sites where it was frequently subdominant. Studies at the Brewery Creek Mine Site on the lower Dempster Highway, in similar habitat and similar latitudes as the Clinton Creek study area, documented high numbers of Oligochaeta at most of the sites as well (Burns, 2009). They appear to be ubiquitous in these types of mountain streams and do not indicate a stressed environment.

3.4 Stream Sediment Geochemistry

Following the second field trip, Minnow recommended that stream sediment samples be collected from Wolverine Creek upstream of the culverts (E3), Clinton Creek just downstream of Wolverine Creek (labelled E4 but not in the same location as the water quality site that is situated just upstream of Eagle Creek) and from the Porcupine Beaver Pond.

The analytical results for the three stream sediment samples are presented in Table 5 and are compared to the CCME (1999) interim freshwater sediment quality guidelines (ISQG) and to the probable effects levels (PEL). Generally, concentrations greater than the PEL have a 50% incidence of creating adverse biological effects.

With the exception of three of the analyzed metals (chromium, cobalt and nickel), the stream sediments from the Porcupine Beaver Pond had the greatest concentration of the metals tested. The ISQG was exceeded here for mercury, arsenic, cadmium, chromium, copper and zinc, with the PEL also exceeded for arsenic and chromium. The ISQG for arsenic was also exceeded at the other two sites. The PEL for chromium was significantly exceeded at E-3 and E-4. To put these high chromium concentrations into perspective, the Yukon stream sediment database maintained by Environment Canada was reviewed. Of the 2,614 stream sediment samples where chromium was detected, the concentrations ranged from 0.2 ppm to 363 ppm. The highest concentrations were documented from stream sediments in the South MacMillan River, part of the Pelly River drainage. The concentrations recorded in the stream sediments at Wolverine (1,180 ppm) and Clinton (1,170 ppm) Creeks are the highest yet recorded.

TABLE 5 SUMMARY OF STREAM SEDIMENT METAL CONCENTRATIONS, SEPT 2009

Parameter	Units	E-3, Wolverine Cr u/s culverts	E-4, Clinton Cr just d/s culverts	Porcupine Beaver Pond	ISQG	PEL
Mercury	mg/kg	0.02	0.03	**0.24**	0.17	0.486
Antimony	ug/g	1.3	1.6	3.5		
Arsenic	ug/g	**8.6**	**11.6**	**28.4**	5.9	17
Barium	ug/g	132	202	370		
Beryllium	ug/g	<0.1	0.1	0.4		
Cadmium	ug/g	0.15	0.19	**2.28**	0.6	3.5
Chromium	ug/g	**1180**	**1170**	**331**	37.3	90.0
Cobalt	ug/g	69.5	77.2	38.2		
Copper	ug/g	8	8	**45**	35.7	197
Lead	ug/g	3.6	3	11.1	35	91.3
Molybdenum	ug/g	<1	1	5		
Nickel	ug/g	1660	1600	590		
Selenium	ug/g	0.6	0.6	6.7		
Silver	ug/g	0.1	<0.1	0.6		
Thallium	ug/g	<0.05	<0.05	0.26		
Tin	ug/g	<1	<1	<1		
Uranium	ug/g	2.3	2.2	2.6		
Vanadium	ug/g	4	<0.1	22.7		
Zinc	ug/g	35	39	**148**	123	315
Asbestos	%	15 - 20	15 - 20	20 - 25		

Note: ISQG = Interim freshwater Sediment Quality Guidelines, in **bold** where exceeded.
PEL = Probable Effects Level (>50% of adverse effects occur above this level), shaded and in **bold** where exceeded.

4.0 RECOMMENDATIONS

It is recommended that additional water quality and stream sediment samples be collected from all sites of the study area in the spring, summer and fall of 2010 to create a larger database before drawing any long term conclusions. It is also recommended that dissolved metals be included as an analytical parameter when the creeks are flowing turbid to determine the portion of the metals that are in the bioavailable and hence more toxic phase.

5.0 REFERENCES

Burns, B.E. 2009. *Biological Monitoring Survey at Brewery Creek, Y.T. 2009.* Laberge Environmental Services. Prepared for Alexco Resource Corporation.

APPENDIX A

BENTHIC INVERTEBRATE DATA, 2009

BENTHIC INVERTEBRATE DATA, CLINTON CREEK STUDY AREA 2009

Laberge Env. Services 2009

Clinton Creek

Cordillera Consulting
Taxonomist: Sue Salter
suesalter@shaw.ca
250-494-7553

	Sample Site	Clinton Cr u/s Hudgeon Lake			Easter Cr u/s Hudgeon Lake			Wolverine Cr u/s tailings			Eagle Creek u/s culvert			Forty Mile River u/s Clinton Cr		Clinton Cr d/s gabions, u/s Porcupine Cr		
	Sample ID:	R1-A	R1-B	R1-C	R2-A	R2-B	R2-C	R3-A	R3-B	R3-C	R4-A	R4-B	R4-C	R6-A	R6-B	E1-A	E1-B	E1-C
	CC#:	090349	090350	090351	090352	090353	090354	090377	090378	090379	090355	090356	090357	090373	090374	090358	090359	090360
	Subsample amount:	13/100	25/100	14/100	100/100	37/100	49/100	100/100	46/100	100/100	16/100	20/100	19/100	100/100	100/100	10/100	4/100	29/100
		total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total
PHYLUM ARTHROPODA																		
Class: Insecta																		
Order: Ephemeroptera																		
Family: Ameletidae																		
Ameletus sp.	nymph				2	5	4							4	32			
Family: Baetidae																		
Acentrella sp.	nymph	8		7	1													
Baetis sp.	nymph				3	8	6								1			
Baetis bicaudatus	nymph			7	2													
Baetis tricaudatus	nymph				10	35	12										25	
Family: Ephemerellidae	nymph (juv./dam.)						2			1								
Drunella doddsi	nymph							1										
Ephemerella sp.	nymph													1				
Family: Heptageniidae	nymph (juv./dam.)			14	12	30	12			3				6	1			
Cinygmula sp.	nymph	39	16	36							6	15	5					
Epeorus sp.	nymph				2													
Rhithrogena sp.	nymph																	
Stenonema femoratum	nymph														2			
Family: Leptophlebiidae	nymph (juv./dam.)			7														
Order: Plecoptera	nymph (juv./dam.)						6	48			19	10	69					
Family: Capniidae	nymph (juv./dam.)	293	320	511	50	211	106	15	40	10	44	65	122	46	234	10	25	
Capnia sp.	nymph											5	5					
Family: Chloroperlidae																		
Suwallia sp.	nymph																	
Family: Nemouridae	nymph (juv./dam.)	1132	492	1108	28	30	14	57	191	23	738	645	488				50	
Ostrocerca sp.	nymph		136	170		3	2	127	202	21	275	290	159					
Podmosta sp.	nymph	493	136	213							94	85	37					
Family: Perlodidae	nymph (juv./dam.)													1	4			
Isoperla sp.	nymph																	
Skwala sp.	nymph																	
Family: Taeniopterygidae	nymph (juv./dam.)									2								
Order: Trichoptera	larvae (juv./dam.)							2		1								7
Family: Brachycentridae	larvae (juv./dam.)																200	
Brachycentrus sp.	larvae															30	50	
Micrasema sp.	larvae																	14
Family: Glossosomatidae																		
Glossosoma sp.	larvae																	
Family: Lepidostomatidae																		
Lepidostoma sp.	larvae	8																
Family: Limnephilidae	larvae (juv./dam.)					5	4		2	2					1			
Dicosmoecus sp.	larvae		4															
Ecclisomyia sp.	larvae																	
Psychoglypha sp.	larvae																	
Family: Rhyacophilidae																		
Rhyacophila sp.	larvae				1													

Appendix A **BENTHIC INVERTEBRATE DATA, CLINTON CREEK STUDY AREA 2009**

	Sample Site	Clinton Cr u/s Hudgeon Lake			Easter Cr u/s Hudgeon Lake			Wolverine Cr u/s tailings			Eagle Creek u/s culvert			Forty Mile River u/s Clinton Cr		Clinton Cr d/s gabions, u/s Porcupine Cr		
	Sample ID:	R1-A	R1-B	R1-C	R2-A	R2-B	R2-C	R3-A	R3-B	R3-C	R4-A	R4-B	R4-C	R6-A	R6-B	E1-A	E1-B	E1-C
	CC#:	090349	090350	090351	090352	090353	090354	090377	090378	090379	090355	090356	090357	090373	090374	090358	090359	090360
	Subsample amount:	13/100	25/100	14/100	100/100	37/100	49/100	100/100	46/100	100/100	16/100	20/100	19/100	100/100	100/100	10/100	4/100	29/100
		total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total
Order: Coleoptera	larvae (juv./dam.)																	
Family: Chrysomelidae	larvae													1				
Family: Dytiscidae																		
Oreodytes sp.	adult																	
Family: Hydraenidae																		
Hydraena sp.	larvae																	
Family: Hydrophilidae	larvae (juv./dam.)								2									
Order: Diptera UID	pupae					3								1			125	27
Order: Diptera UID	larvae (juv./dam.)								2		25			1				
Family: Ceratopogonidae	larvae (juv./dam.)		4					1										
Alluaudomyia sp.	larvae																	
Bezzia/Palpomyia sp.	larvae																	
Ceratopogon sp.	larvae						2											3
Culicoides sp.	larvae				1										1			
Mallochohelea sp.	larvae																	
Probezzia sp.	larvae														1			
Family: Chironomidae	pupae							25										
Family: Chironomidae	larvae																	
Subfamily : Chironominae	larvae																	
Tribe : Tanytarsini	larvae																	
Micropsectra/Tanytarsus	larvae				1	157	48	7	7	23			11	11	13	110	250	61
Rheocricotopus sp.	larvae									3								
Stempellina sp.	larvae																	
Tribe : Chironominae	larvae																	
Tribelos sp.	larvae					3			4									116
Subfamily : Orthocladiinae	larvae																	
Brillia sp.	larvae																	
Corynoneura sp.	larvae			7	1	5							11				125	
Cricotopus/Orthocladius sp.	larvae				46	100	52	48	147	73	6	5		8	23	2300	1375	153
Eukiefferiella sp.	larvae	39	44	36	21	62	68			5	13	10	58			320		388
Euryhapsis sp.	larvae															280	75	41
Diplocladius sp	larvae				5					8								
Heterotrissocladius sp.	larvae				2													
Hydrobaenus sp.	larvae									2						50		7
Krenosmittia sp.	larvae																	
Metriocnemus sp.	larvae				2													
Parametricnemus sp.	larvae																	27
Parorthocladius sp.	larvae					3												
Pseudosmittia sp.	larvae																	
Tvetenia sp.	larvae																3425	
Subfamily : Diamesinae	larvae																	
Diamesa sp.	larvae				36	78	34	35	33	25	119	25	37				1000	
Paghastia sp.	larvae				3		4											
Potthastia longimana	larvae												5				100	
Subfamily : Tanypodinae	larvae													1	3	40	350	20
Procladius sp.	larvae														1			
Family: Empididae	larvae																	

Appendix A **BENTHIC INVERTEBRATE DATA, CLINTON CREEK STUDY AREA 2009**

	Sample Site	Clinton Cr u/s Hudgeon Lake			Easter Cr u/s Hudgeon Lake			Wolverine Cr u/s tailings			Eagle Creek u/s culvert			Forty Mile River u/s Clinton Cr		Clinton Cr d/s gabions, u/s Porcupine Cr		
	Sample ID:	R1-A	R1-B	R1-C	R2-A	R2-B	R2-C	R3-A	R3-B	R3-C	R4-A	R4-B	R4-C	R6-A	R6-B	E1-A	E1-B	E1-C
	CC#:	090349	090350	090351	090352	090353	090354	090377	090378	090379	090355	090356	090357	090373	090374	090358	090359	090360
	Subsample amount:	13/100	25/100	14/100	100/100	37/100	49/100	100/100	46/100	100/100	16/100	20/100	19/100	100/100	100/100	10/100	4/100	29/100
		total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total
Chelifera/Metachela sp.	larvae	15	4													10	25	20
Clinocera sp.	larvae																	
Oreogeton sp.	larvae				1			1								10	25	7
Family: Muscidae																		
Limnophora sp.	larvae							1	2							10		
Family: Psychodidae																		
Pericoma sp.	larvae							1										
Family: Simuliidae	pupae				7	5	6	1	7		38	55	11					
Prosimulium sp.	nymph				1						200	40	11					
Simulium sp.	larvae		4		1			1	4							80	425	27
Family: Tipulidae	larvae (juv./dam.)						2											
Dicranota sp.	larvae		4	7		5	10	19	13		19	10				80		
Erioptera ilisia	larvae																	
Hesperoconopa sp.	larvae														1			
Ormosia sp.	larvae							18	7	6								
Rhabdomastix sp.	larvae																	
Tipula sp.	larvae			21				2	2			5	5			10		
Order: Collembola										1	6	10						
Class: Crustacea																		
Order: Amphipoda																		
Gammarus sp.																		
Class: Arachnida																		
Super-Order: Acariformes	deutonymph						2									10		3
Family: Hydrozetidae	adult					3								2				
Family: Hygrobatidae																		
Hygrobates sp.	adult										6							
Family: Lebertiidae																		
Lebertia sp.	adult																	
Family: Sperchontidae																		
Sperchon sp.	adult		4		1								16					7
PHYLUM MOLLUSCA																		
Class: Gastropoda								1								20		
Family: Hydrobiidae								1										
Family: Planorbidae																	50	3
PHYLUM ANNELIDA																		
Class: Oligochaeta																		
Family: Lumbriculidae		801		142	10	78	306				375	335	647	5	13	100	75	41
Rhynchelmis sp.		8				8	16			1	25	10	53	1				
Family : Naididae																		
Sub-Family: Tubificinae		8	160				2	6	13	4				8	45	140	500	20
Sub-Family: Naidinae														16	21		100	27
TOTAL SUBSAMPLE		**2841**	**1328**	**2286**	**250**	**837**	**720**	**418**	**680**	**214**	**2006**	**1620**	**1749**	**113**	**397**	**3610**	**8375**	**1020**
TOTAL PER SITE		6456			1807			1312			5375			510		13005		
TAXONOMIC RICHNESS/SAMPLE		11	13	14	26	21	23	22	17	19	17	17	18	16	17	18	21	21
TAXONOMIC RICHNESS/SITE		22			40			35			23			23		34		

Appendix A **BENTHIC INVERTEBRATE DATA, CLINTON CREEK STUDY AREA 2009**

Laberge Env. Services 2009
Clinton Creek
Cordillera Consulting
Taxonomist: Sue Salter
suesalter@shaw.ca
250-494-7553

	Sample Site	Clinton Cr d/s Porcupine Cr, u/s Wolverine Cr			Wolverine Cr			Clinton Cr d/s Wolverine Cr, u/s Eagle Cr			Clinton Cr near mouth			Forty Mile River d/s Clinton Cr		Total # of Invertebrates	%
	Sample ID:	E2-A	E2-B	E2-C	E3-A	E3-B	E3-C	E4-A	E4-B	E4-C	E7-A	E7-B	E7-C	E8-A	E8-B		
	CC#:	090361	090362	090363	090364	090365	090366	090367	090368	090369	090370	090371	090372	090375	090376		
	Subsample amount:	15/100	35/100	10/100	19/100	13/100	9/100	100/100	100/100	100/100	100/100	100/100	100/100	100/100	100/100		
		total	total	total	total	total	total	total	total	total	total	total	total	total	total		
PHYLUM ARTHROPODA																	
Class: Insecta																	
Order: Ephemeroptera																	
Family: Ameletidae																	
Ameletus sp.	nymph														4	51	0.11
Family: Baetidae																	
Acentrella sp.	nymph															16	0.03
Baetis sp.	nymph											1			2	21	0.05
Baetis bicaudatus	nymph															9	0.02
Baetis tricaudatus	nymph														1	83	0.18
Family: Ephemerellidae	nymph (juv./dam.)															3	0.01
Drunella doddsi	nymph															1	0.00
Ephemerella sp.	nymph															1	0.00
Family: Heptageniidae	nymph (juv./dam.)														43	121	0.26
Cinygmula sp.	nymph															117	0.25
Epeorus sp.	nymph															2	0.00
Rhithrogena sp.	nymph														87	87	0.19
Stenonema femoratum	nymph														2	4	0.01
Family: Leptophlebiidae	nymph (juv./dam.)															7	0.02
Order: Plecoptera	nymph (juv./dam.)				32	31	289				2	1	2		2	510	1.11
Family: Capniidae	nymph (juv./dam.)	40	15	50	11		11	19	2	2	20	5	17	36	194	2522	5.49
Capnia sp.	nymph															10	0.02
Family: Chloroperlidae																	
Suwallia sp.	nymph													1		1	0.00
Family: Nemouridae	nymph (juv./dam.)				69	62	44	2				2			2	5176	11.27
Ostrocerca sp.	nymph			10	27	23	111	2				1	2			1561	3.40
Podmosta sp.	nymph				11											1068	2.33
Family: Perlodidae	nymph (juv./dam.)								1				4		22	32	0.07
Isoperla sp.	nymph							1								1	0.00
Skwala sp.	nymph												1		2	3	0.01
Family: Taeniopterygidae	nymph (juv./dam.)															2	0.00
Order: Trichoptera	larvae (juv./dam.)			20												30	0.06
Family: Brachycentridae	larvae (juv./dam.)															200	0.44
Brachycentrus sp.	larvae	13	3					8	4							108	0.24
Micrasema sp.	larvae	34	20	30				4								101	0.22
Family: Glossosomatidae																	
Glossosoma sp.	larvae	7										2	1			10	0.02
Family: Lepidostomatidae																	
Lepidostoma sp.	larvae															8	0.02
Family: Limnephilidae	larvae (juv./dam.)		6								3	2	2	1		28	0.06
Dicosmoecus sp.	larvae															4	0.01
Ecclisomyia sp.	larvae			10									5	1		16	0.03
Psychoglypha sp.	larvae							1		2						3	0.01
Family: Rhyacophilidae																	
Rhyacophila sp.	larvae															1	0.00

Appendix A **BENTHIC INVERTEBRATE DATA, CLINTON CREEK STUDY AREA 2009**

	Sample Site	Clinton Cr d/s Porcupine Cr, u/s Wolverine Cr			Wolverine Cr			Clinton Cr d/s Wolverine Cr, u/s Eagle Cr			Clinton Cr near mouth			Forty Mile River d/s Clinton Cr		Total # of Invertebrates	%
	Sample ID:	E2-A	E2-B	E2-C	E3-A	E3-B	E3-C	E4-A	E4-B	E4-C	E7-A	E7-B	E7-C	E8-A	E8-B		
	CC#:	090361	090362	090363	090364	090365	090366	090367	090368	090369	090370	090371	090372	090375	090376		
	Subsample amount:	15/100	35/100	10/100	19/100	13/100	9/100	100/100	100/100	100/100	100/100	100/100	100/100	100/100	100/100		
		total	total	total	total	total	total	total	total	total	total	total	total	total	total		
Order: Coleoptera	larvae (juv./dam.)							1								1	0.00
Family: Chrysomelidae	larvae															1	0.00
Family: Dytiscidae																	
Oreodytes sp.	adult									1						1	0.00
Family: Hydraenidae																	
Hydraena sp.	larvae													1		1	0.00
Family: Hydrophilidae	larvae (juv./dam.)															2	0.00
Order: Diptera UID	pupae	27	20													203	0.44
Order: Diptera UID	larvae (juv./dam.)					8					1					37	0.08
Family: Ceratopogonidae	larvae (juv./dam.)								1						1	7	0.02
Alluaudomyia sp.	larvae												13			13	0.03
Bezzia/Palpomyia sp.	larvae	7		20												27	0.06
Ceratopogon sp.	larvae															5	0.01
Culicoides sp.	larvae															2	0.00
Mallochohelea sp.	larvae		15	10								1				26	0.06
Probezzia sp.	larvae	7	12					3	1							23	0.05
Family: Chironomidae	pupae						233			7						265	0.58
Family: Chironomidae	larvae																
Subfamily : Chironominae	larvae																
Tribe : Tanytarsini	larvae																
Micropsectra/Tanytarsus	larvae	174	44	320							11			6	8	1261	2.75
Rheocricotopus sp.	larvae															3	0.01
Stempellina sp.	larvae									2						2	0.00
Tribe : Chironominae	larvae																
Tribelos sp.	larvae															123	0.27
Subfamily : Orthocladiinae	larvae																
Brillia sp.	larvae																
Corynoneura sp.	larvae		6	20				2	1	1	6	2				187	0.41
Cricotopus/Orthocladius sp.	larvae	369	348	1200	90			26	51	28	211	167	212	1	3	7042	15.34
Eukiefferiella sp.	larvae	603	125	700		54	56	85	18	7	37	145	185			3077	6.70
Euryhapsis sp.	larvae		6	50												452	0.98
Diplocladius sp	larvae															13	0.03
Heterotrissocladius sp.	larvae															2	0.00
Hydrobaenus sp.	larvae		9	60												128	0.28
Krenosmittia sp.	larvae										1	3				4	0.01
Metriocnemus sp.	larvae															2	0.00
Parametricnemus sp.	larvae	40														67	0.15
Parorthocladius sp.	larvae															3	0.01
Pseudosmittia sp.	larvae													1		1	0.00
Tvetenia sp.	larvae	168													1	3594	7.83
Subfamily : Diamesinae	larvae																
Diamesa sp.	larvae		20		1378	2495	2498				7		7			7827	17.05
Pagastia sp.	larvae						11		3	2	9	3	5			40	0.09
Potthastia longimana	larvae	20	12	30												167	0.36
Subfamily : Tanypodinae	larvae	7	41	100				1							2	565	1.23
Procladius sp.	larvae															1	0.00
Family: Empididae	larvae						11									11	0.02

Appendix A

BENTHIC INVERTEBRATE DATA, CLINTON CREEK STUDY AREA 2009

	Sample Site	Clinton Cr d/s Porcupine Cr, u/s Wolverine Cr			Wolverine Cr			Clinton Cr d/s Wolverine Cr, u/s Eagle Cr			Clinton Cr near mouth			Forty Mile River d/s Clinton Cr		Total # of Invertebrates	%
	Sample ID:	E2-A	E2-B	E2-C	E3-A	E3-B	E3-C	E4-A	E4-B	E4-C	E7-A	E7-B	E7-C	E8-A	E8-B		
	CC#:	090361	090362	090363	090364	090365	090366	090367	090368	090369	090370	090371	090372	090375	090376		
	Subsample amount:	15/100	35/100	10/100	19/100	13/100	9/100	100/100	100/100	100/100	100/100	100/100	100/100	100/100	100/100		
		total	total	total	total	total	total	total	total	total	total	total	total	total	total		
Chelifera/Metachela sp.	larvae	34	15	30	32	23	122	1			40	56	49	2		478	1.04
Clinocera sp.	larvae		6	10		15										31	0.07
Oreogeton sp.	larvae				16		11				5	10	9			95	0.21
Family: Muscidae																	
Limnophora sp.	larvae															13	0.03
Family: Psychodidae																	
Pericoma sp.	larvae							1				1				3	0.01
Family: Simuliidae	pupae	20		20			11		1	1			2			184	0.40
Prosimulium sp.	nymph						11								1	264	0.57
Simulium sp.	larvae	101	6	130	5			7	2	1					1	795	1.73
Family: Tipulidae	larvae (juv./dam.)															2	0.00
Dicranota sp.	larvae	7	38	40	37	8		55	56	22	9	19	15	6		479	1.04
Erioptera ilisia	larvae													1		1	0.00
Hesperoconopa sp.	larvae															1	0.00
Ormosia sp.	larvae										1			1		33	0.07
Rhabdomastix sp.	larvae														1	1	0.00
Tipula sp.	larvae			20	5											71	0.15
Order: Collembola					5			1			1					25	0.05
Class: Crustacea																	
Order: Amphipoda																	
Gammarus sp.						15					1			1		17	0.04
Class: Arachnida																	
Super-Order: Acariformes	deutonymph	7	6									1	2			31	0.07
Family: Hydrozetidae	adult															5	0.01
Family: Hygrobatidae																	
Hygrobates sp.	adult															6	0.01
Family: Lebertiidae																	
Lebertia sp.	adult							4	2		1	3	2		1	13	0.03
Family: Sperchontidae																	
Sperchon sp.	adult	7	3	10				11	26	3	3		3			93	0.20
PHYLUM MOLLUSCA																	
Class: Gastropoda		7	3					1								32	0.07
Family: Hydrobiidae																1	0.00
Family: Planorbidae																53	0.12
PHYLUM ANNELIDA																	
Class: Oligochaeta																	
Family: Lumbriculidae		362	75	30		100	566	79	43	25	12	4				4224	9.20
Rhynchelmis sp.								2		1						125	0.27
Family : Naididae																	
Sub-Family: Tubificinae		13	58	400	21				2	4	2	1	3	6	4	1421	3.09
Sub-Family: Naidinae		127	12						1						12	316	0.69
TOTAL SUBSAMPLE		**2198**	**919**	**3320**	**1738**	**2834**	**3985**	**317**	**215**	**109**	**383**	**430**	**541**	**65**	**396**		
TOTAL PER SITE		6437			8557			641			1354			461			
TAXONOMIC RICHNESS/SAMPLE		24	26	24	14	11	14	23	17	16	21	21	21	14	22		
TAXONOMIC RICHNESS/SITE		35			24			32			33			32			

APPENDIX B

HABITAT CHARACTERISTICS OF THE BENTHIC INVERTEBRATE SITES, CLINTON CREEK, 2009

APPENDIX B HABITAT CHARACTERISTICS OF THE BENTHIC SITES IN THE CLINTON CREEK STUDY AREA, 2009

Site #	Site Description	Date Sampled	Time Sampled	NAD 83 Easting	Zone 07W Northing	Water Temp oC	pH	Conductivity uS/cm	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Velocity at each kick site (m/s)	Number of transects/ kicknet	Average Depth at sites (mcm)	Discharge (cms)
R1	Clinton Creek u/s Hudgeon Lake	19/08/2009	15:00	510600	7147506	6.6	*	762	*	*	0.642, 0.309, 0.771, 0.538	2, 2, 1	10	0.1737
R2	Easter Creek u/s Hudgeon Lake	19/08/2009	12:45	512006	7148015	7.2	*	822	*	*	0.521, 0.919, 0.462	3, 2, 2.5	20	0.0429
R3	Wolverine Cr u/s Tailings Upstream of beaver pond u/s of tailings	03/09/2009	8:00	513953	7148633	1.0	8.84				0.317, 0.319, 0.307 (0.0932)	3	14	0.062
R4	Eagle Creek u/s culvert	18/08/2009	16:45	515990	7145340	5.6	9.11	544	99.9	11.96	0.642, 0.522, 0.317	4	10	0.047
R6	Forty Mile River u/s Clinton Ck	03/09/2009	14:13	519436	7141962	7.5	8.26				0.591, 0.313	<1	30	Flow not Measured
E1	Clinton Creek d/s gabions and u/s Porcupine Creek	18/08/2009	12:10	513695	7147183	13.5	7.67	506	82	8.08	0.717, 0.375, 0.288	1.5	15	0.2605
E2	Clinton Creek d/s Porcupine and u/s Wolverine Cr	18/08/2009	15:15	514181	7147079	12.2	8.13	901	73.5	7.49	0.322, 0.327, 0.274	1	15	0.0925
E3	Wolverine Cr u/s culvert	18/08/2009	14:15	514183	7147163	9.1	8.82	865	94.5	10.31	0.442, 0.196, 0.386	4	15	0.063
E4	Clinton Creek d/s Wolverine Cr and u/s Eagle Creek	18/08/2009	15:30	515933	7145279	10.7	8.49	1191	83.7	8.83	0.576, 0.360, 0.237	1	20	0.2534
E7	Clinton Creek near mouth	18/08/2009	19:00	519421	7142049	10.1	8.44	1084	90.5	9.75	0.483, 1.096, 0.534	1	20	0.2758
E8	Forty Mile River d/s Clinton Ck	03/09/2009	13:15	519428	7142091	6.6	7.77				0.422, 0.805	<1	25	Flow not Measured

* meter malfunctioned

APPENDIX B HABITAT CHARACTERISTICS OF THE BENTHIC SITES IN THE CLINTON CREEK STUDY AREA, 2009

Site #	Site Description	Wetted Width (m)	Bankfull Width (m)	Riparian Vegetation	Canopy Coverage (%)	Particle Size Score			Embeddedness Score	General	Comments
						Dominant	SubDominant	Surrounding			
R1	Clinton Creek u/s Hudgeon Lake	7.5	8.0	grasses, willows, spruce, equestem	0 - 25	5	6	2	5	riffles, runs, pool	moose sign throughout, orange 'puffy' algae
R2	Easter Creek u/s Hudgeon Lake	2.5	2.5	willows, spruce, grasses, shrubby cinqfoil, eqistem, moss, grass of parnasus	0 - 25	4	5	2	5	riffles, runs, pool	large muddy flood plain, moose sign throughout, beaver activity - small dam between b & c, clean gravels
R3	Wolverine Cr u/s Tailings Upstream of beaver pond u/s of tailings	3.0	5.0	Mainly grasses, some shrubs in valley. White and black spruce, willows, shrubs and sparse poplar on slopes.	0	4	3	1	4	riffles, runs, not many pools	There is evidence of another creek bed on north side of valley. Entire valley could be bank full width in times of high water because valley floor is saturated. Approx 50m width.
R4	Eagle Creek u/s culvert	1.3	1.8	willows, alder, grasses, moss, equestem, rose, monks hood, languid lady	80	6	5	2	4	riffles, runs, not many pools	mostly clean washed gravels.
R6	Forty Mile River u/s Clinton Ck	N/A Wide River	N/A Wide River	Grasses, willows and sedges. White spruce, paper birch and trembling aspen up slopes.	0	7	6	5	2	River - Riffles and runs no pools.	R6(A) First visual riffle u/s of Clinton. R6(B) Drove to the residence of Earl and Sandy who allowed us access to riffle in front of thier house.
E1	Clinton Creek d/s gabions and u/s Porcupine Creek	6.03	22.2	mostly willows, aspen, grasses, fireweed	0 - 25	6	8	4 - 5	4 - 5	riffles, runs, pool	An unidentified 6" fish observed under an overhanging willow, water brown coloured, rust coloured deposit on rocks - slippery
E2	Clinton Creek d/s Porcupine and u/s Wolverine Cr	5.0		grasses, willows, spruce. Waste rock and eroded slopes, not much veg	0	6	7	4	2	riffles, pools, runs, side channels	many seeps from beaver pond upstream of site, minnows observed in pool u/s of Woverine culvert
E3	Wolverine Cr u/s culvert	2.02	24.0	grasses, willow,	0 - 25 (first), 70 - 80 (other 2)	6	5	2	4 - 5	riffles, runs, pools	large sandy flood plain u/s culvert, then willow forest complex
E4	Clinton Creek d/s Wolverine Cr and u/s Eagle Creek	5.5	12.7	willow, alder, spruce, grasses	0 - 25	7	6	2	3	riffles, runs, pools	Site E4a had a large boulder and difficult to sample
E7	Clinton Creek near mouth	4.2	14.3	willows, grasses, alder	0 - 25	7	6	2	4	riffles, runs	green moss/algae on rocks
E8	Forty Mile River d/s Clinton Ck	N/A Wide River	N/A Wide River	Grasses, willows and sedges. White spruce, paper birch and trembling aspen up slopes.	0	7	6	3	3	River - Riffles and runs no pools.	E8(A) Riffle at Clinton confuence. E8(B) Access RH bank riffle in center of river across from rock wall.

* meter malfunctioned

APPENDIX C

PHOTOS OF SAMPLE SITES AND

DISCHARGE VARIANCE, CLINTON CREEK, 2009

Clinton Creek 2009 Photos of Sample Sites and Discharge Variance

R1 Clinton Ck u/s Hudgeon Lake

R3 Wolverine Ck u/s of Tailings and Beaver Pond

R4 Eagle Ck u/s of Culvert

R6 Forty Mile River u/s Clinton Ck

E1 Clinton Ck d/s of Gabions u/s Porcupine Ck

E2 Clinton Ck d/s of Porcupine Ck u/s of Wolverine Ck

E3 Wolverine u/s Culvert d/s Tailings Flow Variance Aug 18/09

E3 Wolverine u/s Culvert d/s Tailings Flow Variance Sept 20/09

E4 Clinton Ck d/s Wolverine Ck u/s Eagle Ck

E7 Clinton Ck near Mouth

E8 Forty Mile d/s Clinton Ck Flow Variance Sept 3/09

E8 Forty Mile d/s Clinton Ck Flow Variance Sept 20/09

Flow Variance of First Gabion Aug 18/09

Flow Variance of First Gabion Sept 20/09

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Report Transmission Cover Page

Bill To:	YTG Energy, Mines and	Project:		Lot ID:	**704340**
Report To:	YTG Energy, Mines and	ID:		Approval Status:	Approved
	Box 2703 K-419	Name:	Clinton Creek	Invoice Frequency:	by Lot
	Whitehorse, YT, Canada	Location:	Clinton Creek	COD Status:	
	Y1A 2C6	LSD:		Control Number:	
Attn:	Rachel Pugh	P.O.:	P00014677	Date Received:	Sep 22, 2009
Sampled By:		Acct code:		Date Reported:	Oct 6, 2009
Company:	LES			Report Number:	1252984

Contact & Affiliation	Address	Delivery Commitments
Bonnie Burns Laberge Environmental Services	1-405 Ogilvie Street, Box 21072 Whitehorse, Yukon Territory Y1A 6P7 Phone: (867) 668-6838 Fax: (867) 667-6956 Email: bonnieburns@northwestel.net	On [Report Approval] send (COC, Test Report) by Email - Merge Reports On [Report Approval] send (Test Report) by Email - Single Report
Rachel Pugh YTG Energy, Mines and Resources	Box 2703 K-419 Whitehorse, Yukon Territory Y1A 2C6 Phone: (867) 456-6115 Fax: (867) 456-6780 Email: rachel.pugh@gov.yk.ca	On [Lot Verification] send (COA) by Email - Single Report On [Report Approval] send (COC, Test Report) by Email - Merge Reports On [Report Approval] send (Test Report) by Email - Single Report On [Lot Approval and Final Test Report Approval] send (COC, Test Report, Invoice) by Post M

Notes To Clients:

- Asbestos analysis was performed by a subcontract laboratory. See attached 1 page report from Exova Pointe Claire.
- TKN analysis was performed by a subcontract laboratory. See attached 1 page report 2923616.

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Exova

Sample Custody

Bill To:	YTG Energy, Mines and	Project:		Lot ID:	**704340**
Report To:	YTG Energy, Mines and	ID:		Control Number:	
	Box 2703 K-419	Name:	Clinton Creek	Date Received:	Sep 22, 2009
	Whitehorse, YT, Canada	Location:	Clinton Creek	Date Reported:	Oct 6, 2009
	Y1A 2C6	LSD:		Report Number:	1252984
Attn:	Rachel Pugh	P.O.:	P00014677		
Sampled By:		Acct code:			
Company:	LES				

Sample Disposal Date: November 05, 2009

All samples will be stored until this date unless other instructions are received. Please indicate other requirements below and return this form to the address or fax number on the top of this page.

☐ Extend Sample Storage Until ______________________ (MM/DD/YY)

The following charges apply to extended sample storage:

Storage for an additional 30 days	$ 2.50 per sample
Storage for an additional 60 days	$ 5.00 per sample
Storage for an additional 90 days	$ 7.50 per sample

☐ Return Sample, collect, to the address below via:

- ☐ Greyhound
- ☐ DHL
- ☐ Purolator
- ☐ Other (specify) ______________________

Name ______________________
Company ______________________
Address ______________________
____
Phone ______________________
Fax ______________________

Signature ______________________

Exova
#104, 19575-55 A Ave.
Surrey, British Columbia
V3S 8P8, Canada

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W: www.exova.com

Analytical Report

Bill To:	YTG Energy, Mines and	Project:	
Report To:	YTG Energy, Mines and	ID:	
	Box 2703 K-419	Name:	Clinton Creek
	Whitehorse, YT, Canada	Location:	Clinton Creek
	Y1A 2C6	LSD:	
Attn:	Rachel Pugh	P.O.:	P00014677
Sampled By:		Acct code:	
Company:	LES		

Lot ID:	**704340**
Control Number:	
Date Received:	Sep 22, 2009
Date Reported:	Oct 6, 2009
Report Number:	1252984

		Reference Number	704340-1	704340-2	704340-3	
		Sample Date	Sep 20, 2009	Sep 20, 2009	Sep 20, 2009	
		Sample Time	NA	NA	NA	
		Sample Location				
		Sample Description	Clinton Cr / E-3, Wolverine Cr u/s culverts	Clinton Cr / E-4, Clinton Cr just d/s culverts	Clinton Cr / Porcupine Beaver Pond	
		Matrix	Soil	Soil	Soil	
Analyte		**Units**	**Results**	**Results**	**Results**	Nominal Detection Limit
Classification						
Carbon	Total Inorganic	% dry weight	0.48	0.52	2.04	0.05
Carbon	Total Organic	% dry weight	0.71	0.31	1.59	0.05
Nitrogen	Total	% dry weight	0.04	0.02	0.13	0.02
Metals Strong Acid Digestion						
Mercury	Strong Acid Extractable	mg/kg	0.02	0.03	0.24	0.01
Strong Acid Leachable Metals						
Antimony	Strong Acid Extractable	ug/g	1.3	1.6	3.5	0.2
Arsenic	Strong Acid Extractable	ug/g	8.6	11.6	28.4	0.2
Barium	Strong Acid Extractable	ug/g	132	202	370	1
Beryllium	Strong Acid Extractable	ug/g	<0.1	0.1	0.4	0.1
Cadmium	Strong Acid Extractable	ug/g	0.15	0.19	2.28	0.01
Chromium	Strong Acid Extractable	ug/g	1180	1170	331	0.5
Cobalt	Strong Acid Extractable	ug/g	69.5	77.2	38.2	0.1
Copper	Strong Acid Extractable	ug/g	8	8	45	1
Lead	Strong Acid Extractable	ug/g	3.6	3.0	11.1	0.1
Molybdenum	Strong Acid Extractable	ug/g	<1	1	5	1
Nickel	Strong Acid Extractable	ug/g	1660	1600	590	0.5
Selenium	Strong Acid Extractable	ug/g	0.6	0.6	6.7	0.3
Silver	Strong Acid Extractable	ug/g	0.1	<0.1	0.6	0.1
Thallium	Strong Acid Extractable	ug/g	<0.05	<0.05	0.26	0.05
Tin	Strong Acid Extractable	ug/g	<1	<1	<1	1
Uranium	Strong Acid Extractable	ug/g	2.3	2.2	2.6	0.5
Vanadium	Strong Acid Extractable	ug/g	4.0	<0.1	22.7	0.1
Zinc	Strong Acid Extractable	ug/g	35	39	148	1
Particle Size Analysis - Dry Sieve						
2.0 mm sieve	% Retained	% by weight	19.9	3.0	11.6	0.1
850 micron sieve	% Retained	% by weight	7.4	9.8	18.9	0.1
425 micron sieve	% Retained	% by weight	8.1	32.5	19.2	0.1
250 micron sieve	% Retained	% by weight	19.1	32.4	12.8	0.1
150 micron sieve	% Retained	% by weight	22.4	12.0	10.3	0.1
106 micron sieve	% Retained	% by weight	12.7	4.2	8.2	0.1
53 micron sieve	% Retained	% by weight	7.4	3.6	10.6	0.1
Pan	% Retained	% by weight	3.0	2.4	8.1	
Salinity						
% Saturation		%	66	43	65	

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Exova

Analytical Report

Bill To:	YTG Energy, Mines and	Project:		Lot ID:	**704340**
Report To:	YTG Energy, Mines and	ID:		Control Number:	
	Box 2703 K-419	Name:	Clinton Creek	Date Received:	Sep 22, 2009
	Whitehorse, YT, Canada	Location:	Clinton Creek	Date Reported:	Oct 6, 2009
	Y1A 2C6	LSD:		Report Number:	1252984
Attn:	Rachel Pugh	P.O.:	P00014677		
Sampled By:		Acct code:			
Company:	LES				

		Reference Number	704340-1	704340-2	704340-3	
		Sample Date	Sep 20, 2009	Sep 20, 2009	Sep 20, 2009	
		Sample Time	NA	NA	NA	
		Sample Location				
		Sample Description	Clinton Cr / E-3, Wolverine Cr u/s culverts	Clinton Cr / E-4, Clinton Cr just d/s culverts	Clinton Cr / Porcupine Beaver Pond	
		Matrix	Soil	Soil	Soil	
Analyte		**Units**	**Results**	**Results**	**Results**	Nominal Detection Limit
Salinity - Continued						
Phosphorus	Saturated Paste	meq/L	0.007	0.004	0.007	0.001
Phosphorus	Saturated Paste	mg/kg	0.14	0.05	0.14	
Soil Acidity						
pH	1:2 Soil:Water	pH	8.6	8.6	8.0	

Approved by: [signature]

Andrew Garrard, BSc
General Manager

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Quality Control

Bill To:	YTG Energy, Mines and	Project:		Lot ID:	**704340**
Report To:	YTG Energy, Mines and	ID:		Control Number:	
	Box 2703 K-419	Name:	Clinton Creek	Date Received:	Sep 22, 2009
	Whitehorse, YT, Canada	Location:	Clinton Creek	Date Reported:	Oct 6, 2009
	Y1A 2C6	LSD:		Report Number:	1252984
Attn:	Rachel Pugh	P.O.:	P00014677		
Sampled By:		Acct code:			
Company:	LES				

Classification

Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Carbon	% dry weight	2.04	2.04	20	1.00	yes
Nitrogen	% dry weight	0.13	0.14	20	1.00	yes

Date Acquired: September 30, 2009

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Carbon	% dry weight	3.40	3.19	4.27	yes
Nitrogen	% dry weight	0.32	0.30	0.42	yes

Date Acquired: September 30, 2009

Metals Strong Acid Digestion

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Mercury	mg/kg	<0.01	-0.07	0.09	yes

Date Acquired: September 30, 2009

Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Mercury	mg/kg	0.03	0.03	10	0.03	yes

Date Acquired: September 30, 2009

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Mercury	mg/kg	0.36	0.15	0.45	yes

Date Acquired: September 30, 2009

Strong Acid Leachable Metals

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Antimony	ug/g	<0.2	-0.2	0.2	yes
Arsenic	ug/g	<0.2	-0.30	0.20	yes
Barium	ug/g	<1	-4	6	yes
Beryllium	ug/g	<0.1	-0.1	0.1	yes
Cadmium	ug/g	0.02	-0.20	0.20	yes
Chromium	ug/g	<0.5	-3.8	3.0	yes
Cobalt	ug/g	0.2	-0.4	0.4	yes
Copper	ug/g	<1	-2	2	yes
Lead	ug/g	<0.1	-0.2	0.4	yes
Molybdenum	ug/g	<1	-1	1	yes
Nickel	ug/g	<0.5	-0.5	0.6	yes
Selenium	ug/g	<0.3	-0.3	0.3	yes
Silver	ug/g	<0.1	-0.1	0.1	yes
Thallium	ug/g	<0.05	-0.05	0.05	yes
Tin	ug/g	<1	-1	1	yes
Vanadium	ug/g	<0.1	-0.1	0.1	yes
Zinc	ug/g	<1	-4	6	yes

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Quality Control

Bill To:	YTG Energy, Mines and	Project:		Lot ID:	**704340**
Report To:	YTG Energy, Mines and	ID:		Control Number:	
	Box 2703 K-419	Name:	Clinton Creek	Date Received:	Sep 22, 2009
	Whitehorse, YT, Canada	Location:	Clinton Creek	Date Reported:	Oct 6, 2009
	Y1A 2C6	LSD:		Report Number:	1252984
Attn:	Rachel Pugh	P.O.:	P00014677		
Sampled By:		Acct code:			
Company:	LES				

Strong Acid Leachable Metals - Continued

Blanks	Units	Measured	Lower Limit	Upper Limit		Passed QC
Date Acquired:	September 30, 2009					

Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Antimony	ug/g	1.3	1.4	20	0.4	yes
Arsenic	ug/g	8.6	9.5	20	0.44	yes
Barium	ug/g	132	122	20	2	yes
Beryllium	ug/g	<0.1	0.1	20	0.2	yes
Cadmium	ug/g	0.15	0.18	20	0.02	yes
Chromium	ug/g	1180	1250	20	1.1	yes
Cobalt	ug/g	69.5	70.8	20	0.2	yes
Copper	ug/g	8	9	20	2	yes
Lead	ug/g	3.6	4.1	20	0.2	yes
Molybdenum	ug/g	<1	<1	20	2	yes
Nickel	ug/g	1660	1780	20	1.1	yes
Selenium	ug/g	0.6	0.4	20	0.7	yes
Silver	ug/g	0.1	0.2	20	0.2	yes
Thallium	ug/g	<0.05	<0.05	20	0.11	yes
Tin	ug/g	<1	<1	20	2	yes
Uranium	ug/g	2.3	2.2	20	1.1	yes
Vanadium	ug/g	4.0	4.5	20	0.2	yes
Zinc	ug/g	35	39	20	2	yes
Date Acquired:	September 30, 2009					

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Antimony	ug/g	1.8	-0.1	4.1	yes
Arsenic	ug/g	93.4	78.84	117.24	yes
Barium	ug/g	265	214	311	yes
Beryllium	ug/g	0.8	0.7	1.2	yes
Cadmium	ug/g	2.21	1.90	2.56	yes
Chromium	ug/g	31.7	25.6	52.6	yes
Cobalt	ug/g	13.2	12.1	16.9	yes
Copper	ug/g	194	163	240	yes
Lead	ug/g	120	98.0	147.2	yes
Molybdenum	ug/g	3	2	4	yes
Nickel	ug/g	59.0	51.4	74.0	yes
Selenium	ug/g	0.8	0.5	1.2	yes
Silver	ug/g	1.1	0.8	1.4	yes
Thallium	ug/g	0.34	0.28	0.46	yes
Tin	ug/g	4	2	5	yes
Uranium	ug/g	1.3	1.1	1.7	yes
Vanadium	ug/g	47.4	41.6	58.9	yes
Zinc	ug/g	564	483	636	yes

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Quality Control

Bill To:	YTG Energy, Mines and	Project:		Lot ID:	**704340**
Report To:	YTG Energy, Mines and	ID:		Control Number:	
	Box 2703 K-419	Name:	Clinton Creek	Date Received:	Sep 22, 2009
	Whitehorse, YT, Canada	Location:	Clinton Creek	Date Reported:	Oct 6, 2009
	Y1A 2C6	LSD:		Report Number:	1252984
Attn:	Rachel Pugh	P.O.:	P00014677		
Sampled By:		Acct code:			
Company:	LES				

Strong Acid Leachable Metals - Continued

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Date Acquired:	September 30, 2009				

Particle Size Analysis - Dry Sieve

Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
2.0 mm sieve	% by weight	19.9	19.9	10	0.5	yes
850 micron sieve	% by weight	7.4	7.4	10	0.5	yes
425 micron sieve	% by weight	8.1	8.1	10	0.5	yes
250 micron sieve	% by weight	19.1	19.1	10	0.5	yes
150 micron sieve	% by weight	22.4	22.4	10	0.5	yes
106 micron sieve	% by weight	12.7	12.7	10	0.5	yes
53 micron sieve	% by weight	7.4	7.4	10	0.5	yes
Date Acquired:	September 28, 2009					

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
2.0 mm sieve	% by weight	0.2	-0.5	1.5	yes
850 micron sieve	% by weight	10.0	0.0	0.0	yes
425 micron sieve	% by weight	16.6	0.0	0.0	yes
250 micron sieve	% by weight	13.0	-8.8	33.2	yes
150 micron sieve	% by weight	10.8	10.2	18.6	yes
106 micron sieve	% by weight	9.9	0.0	0.0	yes
53 micron sieve	% by weight	14.2	25.9	33.3	yes
Pan	% by weight	25.0	0.0	0.0	yes
Date Acquired:	September 28, 2009				

Salinity

Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Electrical Conductivity	dS/m at 25 C	12.8	12.6	10	0.01	yes
Date Acquired:	September 26, 2009					

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Electrical Conductivity	dS/m at 25 C	1.48	1.12	1.68	yes
% Saturation	%	56	49	64	yes
Date Acquired:	September 26, 2009				

Soil Acidity

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
pH	pH	7.1	5.6	7.4	yes
Date Acquired:	September 30, 2009				

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC

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Quality Control

Bill To:	YTG Energy, Mines and	Project:		Lot ID:	**704340**
Report To:	YTG Energy, Mines and	ID:		Control Number:	
	Box 2703 K-419	Name:	Clinton Creek	Date Received:	Sep 22, 2009
	Whitehorse, YT, Canada	Location:	Clinton Creek	Date Reported:	Oct 6, 2009
	Y1A 2C6	LSD:		Report Number:	1252984
Attn:	Rachel Pugh	P.O.:	P00014677		
Sampled By:		Acct code:			
Company:	LES				

Soil Acidity - Continued

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
pH	pH	6.6	6.1	6.7	yes

Date Acquired: September 30, 2009

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Methodology and Notes

Bill To:	YTG Energy, Mines and	Project:		Lot ID:	**704340**
Report To:	YTG Energy, Mines and	ID:		Control Number:	
	Box 2703 K-419	Name:	Clinton Creek	Date Received:	Sep 22, 2009
	Whitehorse, YT, Canada	Location:	Clinton Creek	Date Reported:	Oct 6, 2009
	Y1A 2C6	LSD:		Report Number:	1252984
Attn:	Rachel Pugh	P.O.:	P00014677		
Sampled By:		Acct code:			
Company:	LES				

Method of Analysis

Method Name	Reference		Method	Date Analysis Started	Location
Carbon and Nitrogen in soil (FSJ)	SSSA Book Series 5	*	Nitrogen-Total, Ch 37	30-Sep-09	Exova Fort St. John
Carbon and Nitrogen in soil (FSJ)	SSSA Book Series 5	*	Total Carbon, Organic Carbon, and Organic Matter, Ch 34	30-Sep-09	Exova Fort St. John
Mercury (Hot Block) in Soil	US EPA	*	Determination of Hg in Sediment by Cold Vapor Atomic Absorption Spec, 245.5	30-Sep-09	Exova Edmonton
Metals ICP-MS (BCMOE SALM) in soil	B.C.M.O.E	*	Strong Acid Leachable Metals (SALM) in Soil, V 1.0, SALM	30-Sep-09	Exova Edmonton
Particle Size by Dry Sieve	Carter	*	Sieve Analysis (Mechanical Method), 55.4	28-Sep-09	Exova Edmonton
pH and Conductivity in general soil 1:2	McKeague	*	1:2 Soil:Water Ratio, 4.12	30-Sep-09	Exova Edmonton
Saturated Paste in General Soil	Carter	*	Electrical Conductivity and Soluble Salts, Chapter 15	26-Sep-09	Exova Edmonton

** Laboratory method(s) based on reference method*

References

Agronomy No 9, Part	Methods of Soil Analysis, Part 1
B.C.M.O.E	B.C. Ministry of Environment
Carter	Soil Sampling and Methods of Analysis.
McKeague	Manual on Soil Sampling and Methods of Analysis
SSSA Book Series 5	Methods of Soil Analysis, Part 3
US EPA	US Environmental Protection Agency Test Methods

Comments:

- Asbestos analysis was performed by a subcontract laboratory. See attached 1 page report from Exova Pointe Claire.
- TKN analysis was performed by a subcontract laboratory. See attached 1 page report 2923616.

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Canada
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Exova

Client Services Department
Exova - Surrey
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Surrey (British Columbia)
V3S 8P8

CERTIFICATE OF ANALYSIS

CERTIFICATE 09-2187 VERSION 1.0

Client :	Exova – Surrey – Client Serv. Dept.	**P.O. Number :**	Work Order 114751
Our Project:	09-350190	**Your Project :**	Lot 704340
Date Received :	September 25th 2009	**Date Analysed:**	October 1st 2009

MINERALOGICAL CHARACTERISATION BY POLARISED LIGHT MICROSCOPY AND DISPERSION STAINING COLOURS NIOSH METHOD 9002

Three (3) samples were submitted for analysis by polarised light microscopy and dispersion staining colours. The samples were prepared and observed using the following procedure :

A fragment of each sample was isolated. If needed in order to extract the fibres, the samples are submitted to light mechanical crushing. The particles and fibres produced are transferred to a glass slide, covered with a cover glass and immersed in the appropriate refractive index liquids in order to observe the dispersion staining colours. The orthoscopic and conoscopic optical properties of the samples are also used if they permit further characterisation of the samples. The results are summarised as follows :

704340-1 – Clinton Cr. – E-3, Wolverine Cr. u/s Culverts *	
Brown and grey sediments, presence of wood	
CHRYSOTILE asbestos fibres	**15 – 20 %**

* Dried sample.

704340-2 – Clinton Cr. – E-4, Clinton Cr. just d/s Culverts *	
Brown and grey sediments	
CHRYSOTILE asbestos fibres	**15 – 20 %**

* Dried sample.

704340-3 – Clinton Cr. – Porcupine Beaver Pond *	
Brown and grey sediments, presence of wood	
CHRYSOTILE asbestos fibres	**20 – 25 %**

* Dried sample.

CHIMISTE Martin Gravelle 2000-167 QUÉBEC

Analysed by : Annie Garand, Technician

Verified by : Martin Gravelle, B.Sc. Chemist

Notes : PLM has been known to miss asbestos in a small percentage of samples which contain asbestos. Therefore negative PLM results cannot be guaranteed. This analytical method is semi-quantitative. The applicability of this method varies between < 1 % and 100 % (v/v). Exova suggests that certain samples reported as « None detected », « traces » or « < 1% » be analysed by TEM. The present certificate relates only to the samples analysed. The present certificate may not be reproduced, except in full, without written approval by Exova. The laboratory is not responsible for the accuracy of results when requested to physically separate and analyse layered samples. The laboratory is not responsible for the representativeness of the samples submitted for analysis. Samples will be kept for a period of 60 days or according to the written request of the client. Terms and conditions: www.exova.ca/terms&conditions

EXOVA POINTE-CLAIRE PARTICIPATES IN THE AIHA PAT PROGRAM FOR BULK ASBESTOS.

EXOVA ACCUTEST

REPORT OF ANALYSIS

Exova Accutest

Client: Exova Canada Inc. (Surrey)
#104, 19575 - 55A Avenue
Surrey, BC
V3S 8P8
Attention: Exova Surrey

Report Number: 2923616
Date: 2009-10-05
Date Submitted: 2009-09-25

Project: 704340

P.O. Number: 114752
Matrix: Soil

Chain of Custody Number: 727183

								GUIDELINE		
		LAB ID:	746177	746178	746179					
		Sample Date:	2009-09-24	2009-09-24	2009-09-24					
		Sample ID:	704340-1 Clinton Cr E-3 Wolver	704340-2 Clinton Cr E-4 Clint	704340-3 Clinton Cr Porcupine					
PARAMETER	UNITS	MRL						TYPE	LIMIT	UNITS
Total Kjeldahl Nitrogen	%	0.01	0.04	0.02	0.11					

MRL = Method Reporting Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:
Results reported on dried sample basis.

APPROVAL: ____________
Lorna Wilson
Agriculture Lab Supervisor

LOT# 704340

LOT: Control Number

Exova

Environmental Sample Information Sheet

Note: Proper completion of this form is required in order to proceed with analysis

Billing Address:

Company: Energy Mines and Resources
Address: Assess & Abandoned Mines, K-419
Box 2703
Whitehorse, YT
Y1A 2C6

QA/QC Report [ ]

Report Result: Fax [ ] Mail [x] Courier [ ] e-mail [x] e-Service [ ]

Attention: Rachel Pugh
Phone: 86
Fax:
Cell:
e-mail: Rachel.Pugh@gov.yk.ca

Copy of Report To: Copy of invoice: [ ]

Company: Laberge Environmental Services
Address: P.O. Box 21072
Whitehorse, YT
Y1a 6P7

Mail invoice to this address for approval [ ]

Report Result: Fax [ ] Mail [x] Courier [ ] e-mail [x] e-Service [ ]

Attention: Bonnie Burns
Phone:
Fax:
Cell:
e-mail: bonnieburns@northwestel.net

Information to be included on Report and Invoice

Project ID:
Project Name: Clinton Creek
Project Location: Clinton Creek
Legal Location:
PO#:
Proj. Acct. Code:
Agreement ID:

RUSH Please contact the laboratory to confirm rush dates and times before submitting samples.

Upon filling out this section, client accepts that surcharges will be attached to this analysis

RUSH required on: All Analysis [ ] or As indicated [ ]
Date Required:
Signature:
Exova Authorization:

Sample Custody (Please Print)
Sampled by:
Company LES Signature
I authorize Exova to proceed with the work work indicated on this form:
Date: Initial:
Received by: Sample Temp.
Waybill #: Date Sept 22/09
Company Time

Special Instructions / Comments

Please email a copy of the results to:
michelle.f.bowman@gmail.com
Rachel.Pugh@gov.yk.ca
Note: Please analyze the metals, etc, on the bulk sample.
Ensure the soil is well mixed as each bag contains several grab samples.

Please indicate which regulations you are required to meet: CCME freshwater aquatic life

FOR LAB USE ONLY
Condifition of containers/coolers upon arrival at lab

[ ] Check here if Exova is required to report results directly to a regulatory body (Please include contact information)

[ ] Check here if you are testing POTABLE WATER for HUMAN CONSUMPTION

	Sample Identification	Location	Depth IN CM M	Date/Time Sampled	Matrix	Sampling Method	Number of Containers	Total Metals	TOC C/31	TP	Dissolved P	TN	TKN	Particle Size	Asbestos		
1	E-3, Wolverine Cr u/s culverts	Clinton Cr		20-Sep-09	Sediment	composite	1	X	X	X	X	X	X	X	X		
2	E-4, Clinton Cr just d/s culverts	Clinton Cr		20-Sep-09	Sediment	composite	1	X	X	X	X	X	X	X	X		
3	Porcupine Beaver Pond	Clinton Cr		20-Sep-09	Sediment	composite	1	X	X	X	X	X	X	X	X		
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	

Enter tests above (✓ relevant samples below)

NOTE: All hazardous samples must be labelled according to WHIMIS guidelines.

Page 1 of 2

MTP - TP } Total Phosp
0.CPd1

Availab P
05 → FARM code
SAPA — water soluble P (SLP)

APPENDIX C

WMEC (2009) Report

Clinton Creek,
Fish Community Survey
September, 2009

Prepared For
Rachel Pugh
Project Manager
Assessment and Abandoned Mines Branch
Energy, Mines and Resources
Government of Yukon

PREPARED BY
WHITE MOUNTAIN ENVIRONMENTAL CONSULTING
PAUL SPARLING-
P.O. Box 10140 Whitehorse,
Yukon Y1A 7A1

November, 2009

TABLE OF CONTENTS

List of Figures

INTRODUCTION

Data gaps in fisheries data at Clinton Creek Mine site were identified by Minnow Consulting (July 2009). The principle gaps were knowledge of the extent of fish utilization in some of the smaller tributaries to Clinton Creek; the affects those tributaries have on the primary productivity of Clinton Creek; and the affects on fish health. Based on these recommendations to further document fish utilization and fish health, field investigations were conducted in the Clinton Creek area during September of 2009.

The primary objective of this study was to build on base line fisheries data in order to provide a good indication of the magnitude and spatial extent of any mine-related influence on near-field areas. With the objective being met by sampling for fish at 5 previously established sites in and around the Clinton Creek mine site and establishing new reference areas away from the zone of influence in order to assist in identifying any substantive influence of mine exposure on the health of downstream fish populations.

Field investigations were conducted by White Mountain Environmental Consulting between September 7 and 13, 2009, under the authority of License # CL-09-42, issued by the Department of Fisheries and Oceans.

1.0 STUDY AREA

Sites for sampling fish in the Clinton Creek area were set adjacent to the benthic and macro invertebrate sites established during August of 2009, at previously established sites and on tributaries to the Fortymile River. The sites sampled are as follows (see Figure 1);

E1 – Clinton Creek downstream of gabion baskets/ upstream of Porcupine Creek
E2 – Clinton Creek adjacent to Porcupine Creek/ upstream of Wolverine Creek
E3 – Wolverine Creek upstream of hanging culvert
E4 – Clinton Creek downstream of Wolverine Creek/ upstream of Eagle Creek
E5 - Porcupine Creek upstream of Clinton Creek confluence
E6- Clinton Creek at the town-site access road
R4- Eagle Creek tributary to Clinton Creek,
R5- Mickey Creek
R7- Maiden Creek and
R8- Marten Creek.

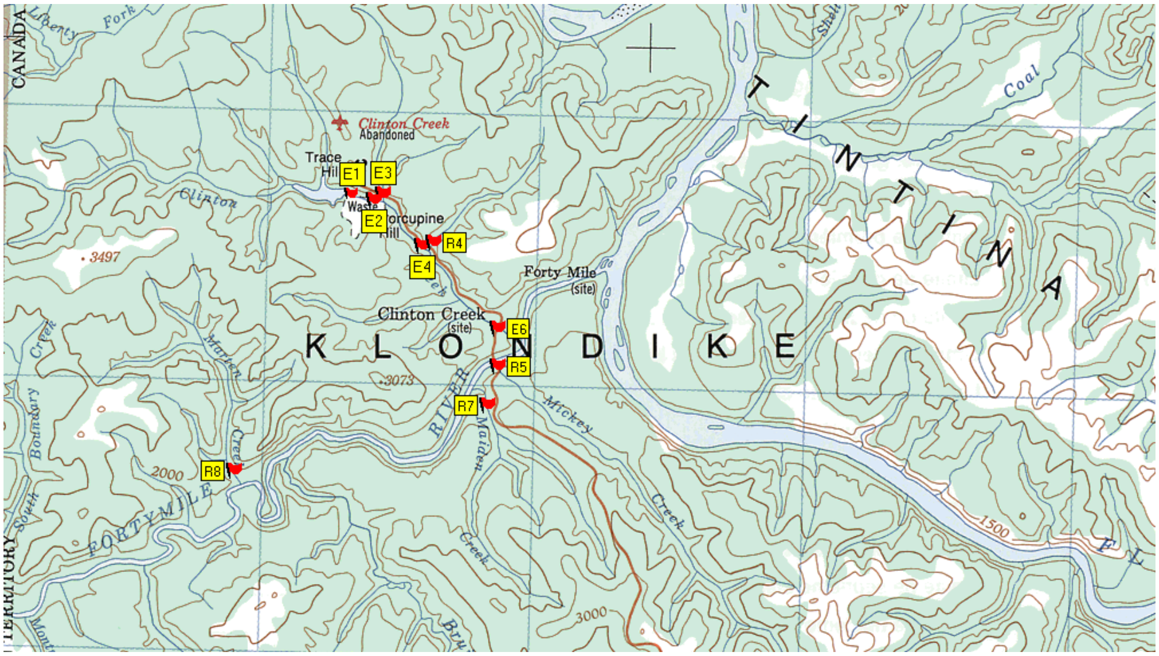

Figure 1: Map of the study area (from Topo map 116B & 116C) showing sample locations used during 2009 fisheries investigations at Clinton Creek mine site.

2.0 METHODS:

A total of four sites on Clinton Creek, three tributaries to Clinton Creek and three tributaries to the Forty Mile River were assessed between September 8 and 12, 2009.

Each site was assessed with similar fishing effort that included a variety of sampling techniques to ensure capture of all species present. The techniques applied were:
-minnow trapping with 10 traps per site baited with Yukon River salmon roe,
-electro fishing a maximum of 1,000 seconds over a reach up to 150 meters in length,
-and angling where appropriate to denote and record Arctic grayling.

All fish captured were identified by species, weighed and measured, inspected for any external lesions, tumors, other abnormalities or fin clips (all documented), and then released alive in the areas where they were caught.

Condition factor (K), a relative measure of fitness and robustness was calculated for adult and sub adult Arctic grayling using the following formula;

$$K = \frac{10^5 \times Wt}{L^3}$$

General fish habitat conditions were recorded and photographs representative of the site were taken. Habitat conditions were assessed through visual reconnaissance. Evaluations included assessments of creek width, depth, slope, velocity (floating object technique), bank stability, bottom substrates, available cover and adjacent vegetation. Residual pool depths were assessed by calculating the difference between the maximum pool depth and the out flow depth from the pool. Three pools at each site were assessed and an average depth was calculated. The flood pool depth was calculated at the same sites using the high water mark. Photographs representative of each site were taken.

3.0 RESULTS

Fish habitats in the Clinton Creek area were modified by an extreme freshet during the spring of 2009 (pers. com. Earl Rolph, area resident trapper). Many of the existing beaver dams were washed out during the high flows leaving few obstructions to upstream fish movements during the spring and early summer of 2009. Juvenile chinook salmon (jcs) and Artic grayling (all life stages) were well dispersed in the upstream reaches below Hudgeon Lake during this investigation. Fall weather conditions were building at the time of investigation and fish were not evenly distributed in Clinton Creek and it was thought that fish in Clinton Creek had started to move into winter habitat areas at the time.

All fish captured were examined for external abnormalities and the only fish found with an abnormality was an adult sculpin with a scab on its tail. Several other sculpin were captured in Clinton Creek that looked abnormally fat in the belly. Two of these sculpin were sacrificed to determine the cause, a large abdominal tape worm was found in each of these sculpins, tape worms such as these are not uncommon.

3.1 Site E1, Clinton Creek downstream of the gabion structure

This sample site includes the downstream end of the gabion baskets and the modified channel downstream of the gabions. This reach has had considerable anthropogenic modifications, from the initial waste rock slump to the construction of the gabion structure. The entirety of the sample reach falls within the zone of modification.

At the time of the investigation site E1 had an average wet width of 7.2m (the high water mark was indistinct and a bank full calculation was not possible although the modified channel width is 21.6m), the average depth was 0.4m and the average velocity was >1m/second. The gabion baskets and pools behind large boulders provide a significant amount of cover. A detailed listing of habitat conditions can be found in Appendix 1.

Angling effort consisted of 3 anglers for 15 minutes each, with a combined catch of 7 sub adult Arctic grayling and 4 more observed. The grayling were abundant in the largest pool at the downstream end of the gabion structure as well as in the small pools in the rapids below. All the captured grayling were considered sub-adults and ranged in length from 218 to 282mm, in weight from 105 to 155 grams and had an average condition factor (K) of 0.97.

A total of 9 minnow traps were set for an overnight period with an average soak time of 20 hours per trap. No fish were captured in any of the minnow traps.

A total of 766 seconds of electro-fishing time was expended for a total catch of 8 Arctic grayling sub-adults with a CPUE of 1.04 Arctic grayling/ 100 seconds. The grayling ranged in length from 186 to 264 mm and in weight from 72 to 233gm and had an average condition factor (K) value was 1.17.

3.2 Site E2, Clinton Creek upstream of Wolverine Creek

Habitats at site E2 have recently been modified by beaver activity. A large dam that held back Clinton Creek and Porcupine Creek in 2007, washed out, presumably in 2009. At the site of the old dam (approximately 50m upstream of Wolverine Creek) Clinton Creek now flows through a channel area with mid channel bars, cut banks, an attached large pool near the outlet of Porcupine Creek the area provides good cover with a variety of flows and substrates. A new beaver dam has been constructed, however the new dam only contains the flows from Porcupine Creek and this dam has created a pool parallel to Clinton Creek.

At the time of investigation site E2 had an average wet width of 5.7m inside a channel of 11m. The average velocity was 0.5 m/sec, the average residual pool depth was 0.86 meters and the flood pool depth was 1.5 meters. A detailed listing of habitat conditions can be found in Appendix 1.

Angling effort consisted of 3 anglers for 15 minutes each; catch was 3 adult and 3 sub adult Arctic grayling and 1 jcs. Numerous juvenile fish were observed chasing the flies during angling. The captured grayling ranged in length from 104 to 382 mm, in weight from 50 to 399 gm and had an average condition factor (K) of 0.92.

A total of 10 minnow traps were set at site E2 with an average soak time of 21.5 hours per trap. A total of 41 jcs and 22 slimy sculpin were captured. The mean length of the sculpin was 89.4mm and the mean weight was 4.1 grams.

A total of 813 seconds of electro-fishing time was expended for a total catch of 136 slimy sculpin, 2 sub adult Arctic grayling and 4 jcs. This catch represents a CPUE of 0.49 jcs/100 secs, 16.73 slimy sculpin/100 secs and 0.25 Arctic grayling/100 secs.

3.3 Site E3, Wolverine Creek upstream of hanging culvert

The mine site access road, which follows beside Clinton Creek, crosses Wolverine just above its confluence with Clinton Creek. The creek flows through 2 culverts (1m and 0.6m). The outflow from the culverts plunges > 1.5 meters and cascades the final few meters into Clinton Creek creating a complete barrier to fish passage. Above the culvert the creek has very limited fish habitat, very little cover with substrates consisting mostly of well washed fine gravel, likely derived from the mill site upstream. The creek likely could provide small seasonal habitats for rearing fish during summer months; however it is unlikely that the creek would provide over wintering habitat.

Upstream of the hanging culvert the creek is small and subject to flooding caused by the culvert. The 75m reach immediately upstream of the culverts has been flooded out on numerous occasions and has significant accumulations of fine materials (asbestos), the creek flows as a featureless glide in this reach. Small step riffles and pools caused by debris piles do occur in the wooded areas of the channel 75m upstream of the culvert.

At the time of the survey Wolverine Creek had an average wet width of 2.5m inside a channel of 5m with an average depth of 0.35 meters. The creek flows predominantly as a glide with several small riffles. A detailed description of habitat conditions can be found in Appendix 1.

Minnow traps were not set and angling effort was not exerted due to the small size of the creek.

A total of 435 seconds of electro-fishing time was expended in Wolverine Creek and no fish were captured or observed.

3.4 Site E4, Clinton Ck downstream of Wolverine Ck/ upstream of Eagle Ck

This sample reach starts at the confluence of Eagle Creek with Clinton Creek and extends upstream for 200 meters. Habitats in this reach are stable, partially confined by bedrock and away from the mine site access road. The reach provides a variety of habitat types however had a limited amount of cover at the observed flow condition.

At the time of the investigation the reach had an average wet width of 6.4 meters inside a channel width of 7.7 meters, the average residual pool depth was 0.55 meters and the flood pool depth was 1.3 meters, the average velocity was 0.9 m/second. The reach was 60% glide with a small rapid at the upstream end of the reach, 3 small riffles and a pool from a past beaver dam. A detailed listing of habitat conditions can be found in Appendix 1.

Angling effort consisted of 3 anglers for 15 minutes each, no fish were captured and no fish were observed. Extra angling time downstream of the confluence with Eagle Creek also captured no fish. Visibility was excellent at the time.

A total of 10 minnow traps were set at site E4 with an average soak time of 28 hours per trap. A total of 4 slimy sculpin and 1 Arctic grayling were captured. The sculpin had a mean length of 68 mm and a mean weight of 1.3 grams.

A total of 868 seconds of electro-fishing time was expended for a total catch of 45 slimy sculpin (24 captured and 21 observed), with a CPUE of 5.2 slimy sculpin/ 100 secs shock time. The mean weight of captured sculpin was 1.8 grams and the mean length was 64.9 mm.

3.5 Site E5, Porcupine Creek upstream of Clinton Creek confluence

Porcupine Creek flows into Clinton Creek approximately 75 meters upstream of Wolverine Creek. At the time of investigation the creek was blocked by a beaver dam that ran parallel to Clinton Creek with a resulting pond 25 meters in diameter. Upstream of the beaver pond the flows of Porcupine Creek run through the old mining area in a poorly defined channel that often runs subsurface making it difficult to calculate the volume of water in the creek. Fish habitats are very limited upstream of the beaver pond.

Angling effort consisting of 1 person fishing for 10 minutes captured no fish although adult and sub adult Arctic grayling were observed rising in the pond. Slimy sculpin were observed at the base of the dam adjacent to Clinton Creek. No other fishing effort was extended in this creek.

3.6 Site R4, Eagle Creek, upstream of hanging culvert

Eagle Creek is crossed by the mine site access road within 25 meters of its confluence with Clinton Creek. The culvert has a plunge of 0.5 meters on the downstream side and was a complete barrier to fish passage at the observed flow. Upstream of the culvert Eagle Creek flows in a well defined channel that is totally confined. At the time of the investigation the average wet width was 1.5 meters inside a channel of 2.5 meters that had abrupt banks rising 1.5 to 2.5 meters. The average depth was only 10 cm and the deepest water found was 0.45 meters. This creek has very limited if any fish habitat. The channel is scoured and obviously flows at higher levels. A detailed listing of habitat conditions can be found in Appendix 1.

Angling effort and minnow traps were not set in Eagle Creek due to the small size of the creek.

A total of 163 seconds of electro-fishing time was expended and no fish were captured. A span longer than 150 meters was covered during the electro-fishing.

3.7 Site E6, Clinton Creek at town site road Ford

This site is located immediately upstream of the old Clinton Creek Town site road. At present the road crosses Clinton Creek as a ford, during the life of the mine there was a bridge at this location and the old abutments remain downstream of the present ford.

At the time of investigation the creek had an average wet width of 6.4 meters inside a channel of 10.2 meters. The average velocity was 0.5 m/sec., the average residual pool depth was 0.45 meters and the flood pool depth was 1.35 meters. This reach flows mainly as a wide glide with riffling at the ford and pooling upstream created by a new and partial beaver dam. The banks are well defined with a small bedrock out crop at the upper end with shifting bed load and bar development along the sides and at corners towards the ford. Good cover is provided by pools and deep cut bank areas. A detailed listing of habitat conditions can be found in Appendix 1.

Angling effort consisted of 3 anglers for 15 minutes each, no fish were captured and only 2 sub adult grayling were observed.

A total of 10 minnow traps were set at site C Ck Ford with an average soak time of 17 hours per trap. A total of 3 jcs, 5 slimy sculpin and 2 Arctic grayling were captured. The mean length of the sculpins was 62.2 mm and the mean weight was1.4 grams.

A total of 1,052 seconds of electro-fishing time was expended for a total catch of 88 adult slimy sculpin representing a CPUE of 2.95 slimy sculpin/ 100 seconds of shock time. Of the sculpin recorded electro-fishing, 41 sculpin were sampled, they had a mean length of 60.3 mm and a mean weight of 1.3 grams.

3.8 Site R5, Mickey Creek

Mickey Creek was sampled immediately downstream of the road that accesses the bridge to Clinton Creek. The 3m culvert has a large plunge pool, however does not represent a complete barrier to fish passage. The pool creates some of the best fish habitats on Mickey Creek. Evidence that parts of this reach were placer mined in the distant past was noticed and the bottom substrates are very active and non compacted; however the site is not completely altered, was stable and has revegetated.

At the time of the investigation Mickey Creek had an average wet width of 4.1 meters inside a channel of 6.5 meters. The average velocity was 0.7 m/sec., the average residual pool depth was 0.5 meters and the flood pool depth was 1.2 meters. The channel was stable and offered a variety of small fish habitats. The best cover was provided by pools, notably the large pool at the culvert but also a few smaller pools downstream. Cover and available habitats diminish away from the culvert. A detailed listing of habitat conditions can be found in Appendix 1.

Angling effort consisted of 3 anglers for 15 minutes each, over a 350 meter long reach, a single sub adult grayling was angled, 2 adult, 5 sub adult and approximately 30 juvenile grayling were observed.

A total of 10 minnow traps were set at Mickey Creek with an average soak time of 19.6 hours per trap. A total of 23 jcs, 2 slimy sculpin and 1 Arctic grayling were captured. The mean weight of the sculpins was 3.35 grams and the mean length was 77 mm.

A total of 567 seconds of electro-fishing time was expended for a total catch of 1 juvenile Arctic grayling and 6 slimy sculpin representing a CPUE for slimy sculpin of 1.23/ 100 secs shock time. The mean weight of the sculpin captured was 3.0 grams and the mean length was 76.5 mm.

3.9 Site R7, Maiden Creek

Maiden Creek was sampled downstream of a recently active placer mine (not active in 2009) at a location more than a kilometer from the Forty Mile River. The site may have had historic mining decades ago. The fish habitats were limited due the small size of the creek but were stable in the fast flowing creek.

At the time of investigation the creek had an average wet width of 3.4 meters inside a channel 5.3 meters wide. The average velocity was 0.8 m/sec, the average residual pool depth was 0.45 meters and the average flood pool depth was 1.7 meters. Most of the sample reach was a riffle with occasional small pools. Cover was provided by large organic debris caused features. A detailed listing of habitat conditions can be found in Appendix 1.

Angling effort consisted of 3 anglers for 15 minutes each, over a 350 meter long reach; no fish were captured or observed.

A total of 10 minnow traps were set on Maiden Creek with an average soak time of 18 hours per trap. A single Arctic grayling was the only fish captured.

A total of 685 seconds of electro-fishing time was expended on Maiden Creek and no fish were captured or observed.

3.10 Site R8, Marten Creek

Marten Creek was sampled a short distance (300 m) from the Forty Mile River at the site of an active placer mine. The site sampled had been historically mined, decades ago and active mining had/was occurring upstream during 2009. At the time of sampling the water was turbid with residual placer debris. The channel was stable, flanked by a vertical bedrock wall for 40 meters on the right bank and had abundant cover of organic debris, pools and turbidity.

At the time of investigation the creek had an average wet width of 6.2 meters inside a channel 7.9 meters wide. The average velocity was 1 m/sec, with an average residual pool depth of 0.5 meters and an average flood pool depth of 1.2 meters. The creek flowed mostly as a rapid interspersed with runs and corner pools. A detailed listing of habitat conditions can be found in Appendix 1.

Angling effort consisted of 3 anglers for 15 minutes each, no fish were captured or observed.

A total of 10 minnow traps were set on Marten Creek, however due to site access constraints the traps were only in for a soak time of 2 hours each. The traps were set away from the area used for electro fishing. A single slimy sculpin was the only fish captured. The sculpin was 58 mm and weighed 1.4 grams,

A total of 716 seconds of electro-fishing time was expended with virtually no visibility into the water due to placer derived turbidity. The total catch recorded was 3 juvenile Arctic grayling and 19 adult slimy sculpin, representing a CPUE of 3.07 slimy sculpin/ 100 seconds shock time. The mean length of the sculpins sampled was 67 mm and the mean weight was 1.8 grams.

4.0 DISCUSSION

4.1 Fish Distribution and Fish Health

Fish distribution within the study area and the individual creeks was not even during this investigation. Ambient water temperatures were decreasing and fish appeared to have had moved into areas near over wintering sites. The highest densities of fish found were near the confluences of Porcupine and Wolverine Creeks on Clinton Creek. This area also had the warmest water temperatures of all sample sites and has several key factors that may make it suitable winter habitat; specifically that the flows of Clinton Creek will be attenuated by Hudgeon Lake and by the beaver pond on Porcupine Creek. At the time of investigation sculpin had moved into the shallow seep water coming out of the beaver dam on Porcupine Creek at the edge of Clinton Creek. An additional electro-fishing effort was extended between E1 and E2 at the access road ford crossing of Clinton Creek. This site had considerable numbers of fish, similar to E2 including the three species, grayling, sculpin and jcs.

Arctic grayling captured immediately below the gabion structures were more robust than those a short distance downstream at site E2. The condition factor (k) of grayling captured at the gabions (E1) was 1.17 and at E2 was 0.92.

Sculpin captured at E2 were slightly more robust than fish captured at either E6 or E4 (Figure 2), although older fish at E4 were heavier than at the other sites. Sculpin from Mickey Creek were more robust than those from Clinton Creek.

Sculpin from the older age classes were well represented at most sample stations, a lack of 40 to 55 mm length sculpins may indicate a low recruitment in the 3 year old length classes (Figure 3).

Visually, all the fish captured in Clinton Creek appeared healthy and no external abnormalities were noticed.

4.2 Evaluation of Reference Sites

Both Eagle Creek and Wolverine Creek, tributaries to Clinton Creek have limited amounts of fish habitat, are close to being ephemeral in nature and are blocked to upstream fish migrations by hanging culverts at their outlets to Clinton Creek. Neither of these creeks provides opportunity as reference areas for fish utilization.

The three tributaries to the Forty Mile River investigated for potential as reference sites have all been modified to some extent by placer mining in the past or at present.

Mickey Creek has been used in the past as a reference creek, has easy access and does have similar fish habitats to Clinton Creek. The most significant difference being the aspects, Clinton Creek faces south and Mickey Creek faces north.

Maiden Creek was sampled at the only location with easy enough access to make it practical, unfortunately this site has been extensively modified by placer mining in the last few years and does not have very productive fish habitat. This site should not be considered as a reference location in future investigations.

Marten Creek flows parallel to Clinton Creek in the next drainage basin to the west and both creeks face south. Marten Creek has excellent fish habitats and has flows similar in size to those of Clinton Creek near the mine site. Marten Creek has had and continues to have placer mining activity making it difficult to compare with Clinton Creek. This site should be considered during future investigations although it would be mandatory to contact the placer miner to discuss the location and timing of his mining activities before sampling at this site. Marten Creek was accessed on the placer miners road, strictly a four wheel drive access.

4.3 Clinton Creek Overview

At present Clinton Creek appears to have a vibrant, stable and healthy fish population relative to other creeks of its size in the Yukon drainage and Clinton Creek has been recognized as an important rearing habitat for juvenile salmon. The relative importance of Clinton Creek to the surrounding ecosystem in terms of importance as fish habitat is difficult to accurately gauge without extensive scientific evaluation, however it should not be underestimated.

The whole of the Forty Mile River basin has been an important placer mining area since the late 1800's and most if not all of the tributaries have been impacted by placer activity. Many of the shallow gravel bars on the Forty Mile itself have likewise been impacted. This makes it impossible to accurately assess the pre-impact fisheries of the area but at present the Forty Mile is a known natal river to chinook salmon however with lower densities of adult salmon than many other large tributaries to the Yukon River.

Placer mining has the effect of (temporarily) altering fish species composition of small tributaries. Clinton Creek appears to have had less recent placer activity than the other tributaries investigated during this study and as such may mean that Clinton Creek plays a very important role as a rearing habitat for juvenile salmon. The role of the main stem of the Forty Mile in terms of juvenile salmon rearing has never been defined.

The dominant threat to fisheries in the Clinton Creek basin arises from the unstable waste rock that slumped in the 1970's creating Hudgeon Lake. A failure in the slump would have dire consequences to the fish community downstream. At present Hudgeon Lake attenuates the flows of Clinton Creek, creating stable winter flows and less variation in thermal regimes, possibly enhancing the fishery potential of Clinton Creek. The constructed gabion channel has created a barrier to upstream fish migration.

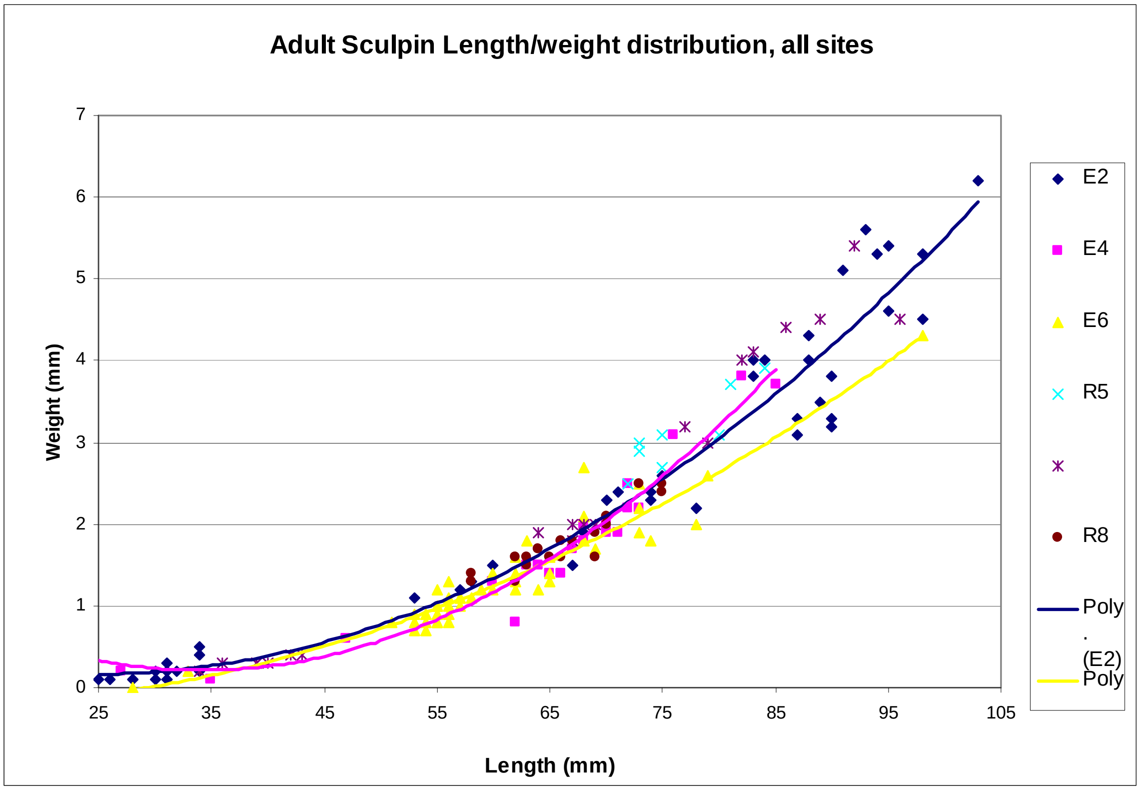

Figure 2: A comparison of slimy sculpin length weight relationships from all sites sampled during September, 2009 in the Clinton Creek area.

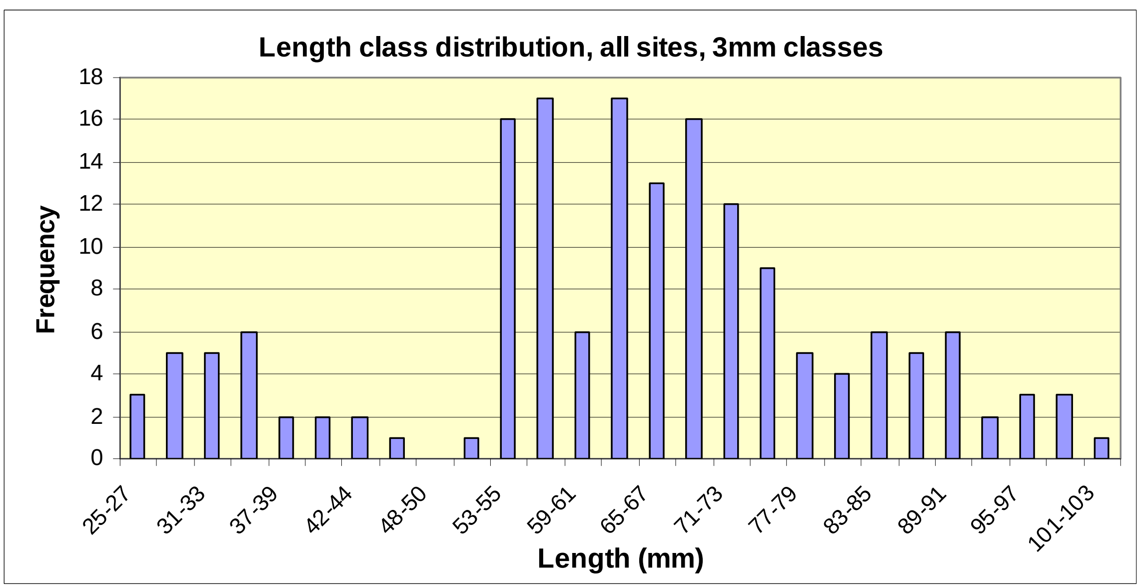

Figure 3: Combined length distribution for slimy sculpin from all areas sampled during September, 2009 in the Clinton area.

5.0 APPENDIX 1: Site Descriptions

5.1 SITE-E1 Clinton Creek, downstream of the gabion baskets

PARAMETER		UTM 0513080E/7147380N
Site	Survey Date (dd/mm/yr)	Sept. 8, 2009
	Site Elevation (ft)	1416’
	Aspect	East
	Site Survey Length (m)	140 m
Channel	Ave. Channel Width (m)	21.6m
	Ave. Wetted Width (m)	7.2m
	Ave. Bankfull Channel Depth (m)	No high water mark
	Ave. Residual Pool Depth (m)	0.47m
	Ave. Velocity	>1 m/sec
	Gradient (%)	4%
Cover	Cover Abundance	Trace
	Dominant Cover Type	Boulders
	Subdominant Cover Type	pools
	Other Cover Types Present	0
	% Crown Closure	0
	Left Bank Shape	Abrupt
	Texture	Bedrock
	Riparian Vegetation	Sparse willow
	Riparian Stage	immature
	Right Bank Shape	Abrupt
	Texture	Waste rock
	Riparian Vegetation	0
	Riparian Stage	n/a
	Instream Vegetation	algae
Morphology	Dominant Bed Material	Boulders
	Subdominant Bed Material	Cobbles
	D95 (cm)	80cm
	D (cm)	18cm
	Morphology	Gabions and step pools/ rapids
	Pattern	straight
	Islands	None
	Bars	none
	Confinement	100%

WATER QUALITY:

Date	pH	Temp (C)	Air temp (C)	Cond (uS/cm)	Visual color
Sept. 8, 09	8.33	11.9°	21°	470	Deep tannin stain

Figure 4: Clinton Creek at site E1 looking downstream from the gabions, September 8, 2009.

Figure 5: Clinton Creek site E1 looking upstream at the gabions, September 8. 2009. The pool the technician is standing in represents the uppermost location on Clinton Creek that fish were found.

Site E2

5.2 Clinton Creek, upstream of Wolverine Creek

PARAMETER		UTM 0514181E/ 7147077N
Site	Survey Date (dd/mm/yr)	September 8, 2009
	Site Elevation (ft)	1,223'
	Aspect	East
	Site Survey Length (m)	185 m
	Ave. Channel Width (m)	11.0m
	Ave. Wetted Width (m)	5.7m
	Ave. Bankfull Pool Depth (m)	1.5m
	Ave. Residual Pool Depth (m)	0.86m
	Ave. Velocity	0.5 m/sec
	Gradient (%)	1.5%
Cover	Cover Abundance	30%
	Dominant Cover Type	Pools
	Subdominant Cover Type	Cut banks
	Other Cover Types Present	Willow root wads
	% Crown Closure	0
	Left Bank Shape	Abrupt to open
	Texture	Fine with LOD
	Riparian Vegetation	Alder/ willow
	Riparian Stage	immature
	Right Bank Shape	Abrupt to open
	Texture	Fine with LOD
	Riparian Vegetation	Alder willow some young spruce
	Riparian Stage	Immature
	Instream Vegetation	none
Morphology	Dominant Bed Material	Cobble
	Subdominant Bed Material	Gravel
	D95 (cm)	24cm
	D (cm)	14cm (flat x 2 cm)
	Morphology	Riffle pool/ functioning gravel
	Pattern	Modified by beavers
	Islands	Occasional
	Bars	Mid channel and side
	Confinement	none

WATER QUALITY:

Date	pH	Temp (C)	Air temp (C)	Cond (uS/cm)	Visual color
Sept 8, 09	8.23	12.1°	19.3°	550	Light tannin stain

Figure 6: Clinton Creek Site E2, upstream of Wolverine and Porcupine Creeks, September 9, 2009. The gravel bars are remnants of a large beaver dam that crossed Clinton Creek and contained the flow from Porcupine Creek. The dam likely washed out in spring of ’09.

Figure 7: Porcupine Creek was dammed by beavers during the summer of 2009 at the confluence with Clinton Creek. The dam shown in the photo is only a secondary dam below the main dam and not the main dam. The flowing water is Clinton Creek.

Site E3

5.3 Wolverine Creek upstream of its confluence with Clinton Creek

PARAMETER		UTM 0514181E/ 7147077
Site	Survey Date (dd/mm/yr)	September 9, 2009
	Site Elevation (ft)	1230'
	Aspect	West
	Site Survey Length (m)	150m
Channel	Ave. Channel Width (m)	5.0m
	Ave. Wetted Width (m)	2.5m
	Ave. Bankfull Channel Depth (m)	Non-measurable
	Ave. Residual Pool Depth (m)	No pools
	% Pool/ Riffle/ Run	10 Pool/ 10 Riffle/ 80 Glide
	Ave. Velocity	<1m/sec
	Gradient (%)	1%
Cover	Cover Abundance	Trace
	Dominant Cover Type	LOD

	Subdominant Cover Type	None
	Other Cover Types Present	None
	% Crown Closure	100% after 50m from road
	Left Bank Shape	Gentle
	Texture	Sand
	Riparian Vegetation	Willow with spruce and birch
	Riparian Stage	Immature
	Right Bank Shape	Gentle
	Texture	Sand
	Riparian Vegetation	Willow with spruce and birch
	Riparian Stage	Immature
	Instream Vegetation	none
Morphology	Dominant Bed Material	Gravel
	Subdominant Bed Material	cobble
	D95 (cm)	6cm
	D (cm)	6cm
	Morphology	Riffle
	Pattern	straight
	Islands	None
	Bars	None
	Confinement	None

WATER QUALITY:

Date	pH	Temp (C)	Air temp (C)	Cond (uS/cm)	Visual color
Sept 9, 09	8.66	7.8°	17°	780	Light yellow tannin

Figure 8: Wolverine Creek immediately upstream of the road. Note the depositions of fines dropped out due to spring pooling upstream of the culverts. September 9, 2009.

Site E4

5.4 Clinton Creek upstream of Eagle Creek

PARAMETER		UTM 0515939E/ 7145284N
Site	Survey Date (dd/mm/yr)	September 8, 2009
	Site Elevation (ft)	1159’
	Aspect	South East
	Site Survey Length (m)	200m
Channel	Ave. Channel Width (m)	7.7m
	Ave. Wetted Width (m)	6.4m
	Ave. Flood Pool Depth (m)	1.3m
	Ave. Residual Pool Depth (m)	0.55m
	% Pool, Riffle, Run	10 pool/20 riffle/ 60 glide/ 10 rapid
	Ave. Velocity	0.85 m/sec
	Gradient (%)	1.5%
Cover	Cover Abundance	15%
	Dominant Cover Type	Boulders
	Subdominant Cover Type	Cut bank

	Other Cover Types Present	Small pools
	% Crown Closure	0
	Left Bank Shape	Sloped
	Texture	Fine
	Riparian Vegetation	Shrubs
	Riparian Stage	Mature
	Right Bank Shape	Sloped
	Texture	Fine
	Riparian Vegetation	Shrubs
	Riparian Stage	Mature
	Instream Vegetation	None
Morphology	Dominant Bed Material	Cobble
	Subdominant Bed Material	Gravel
	D95 (cm)	26cm
	D (cm)	9cm
	Morphology	Step pool/riffle glide
	Pattern	Straight
	Islands	None
	Bars	None
	Confinement	Partially entrenched

WATER QUALITY:

Date	pH	Temp (C)	Air Temp (C)	Cond (uS/cm)	Visual color
Sept.8, 09	8.14	8.5°	20°	860	Light tannin stain

Figure 9: Clinton Creek at site E4, 100 meters upstream of the confluence with Eagle Creek, Sept 8, 2009

Site: R4 Eagle Creek

5.5 Upstream of Hanging Culvert

PARAMETER		UTM 0515939E/ 7145284N
Site	Survey Date (dd/mm/yr)	September 8, 2009
	Site Elevation (ft)	1171’
	Aspect	South East
	Site Survey Length (m)	200m
Channel	Ave. Channel Width (m)	2.5m
	Ave. Wetted Width (m)	1.5m
	Ave. Flood Pool Depth (m)	n/a
	Ave. Residual Pool Depth (m)	n/a
	% Pool/ Riffle/ Run	10 pool/ 70 glide/ 20 riffle
	Ave. Velocity	>0.5 m/sec

	Gradient (%)	>2%
	% pool/ riffle / run/ rapid	10 small pool/ 70 run/ 20 riffle
Cover	Cover Abundance	Trace
	Dominant Cover Type	Large woody debris
	Subdominant Cover Type	Small woody debris
	Other Cover Types Present	None
	% Crown Closure	60%
	Left Bank Shape	Vertical to 1.5 m
	Texture	Vegetated
	Riparian Vegetation	Sedges/willow/alder/ spruce
	Riparian Stage	Mature
	Right Bank Shape	Vertical to 1.5 m
	Texture	Vegetated
	Riparian Vegetation	Sedges/willow/alder/ spruce
	Riparian Stage	Mature
	Instream Vegetation	none
Morphology	Dominant Bed Material	Cobble
	Subdominant Bed Material	Gravel
	D95 (cm)	15cm
	D (cm)	12cm
	Morphology	riffle
	Pattern	Straight
	Islands	None
	Bars	None
	Confinement	entrenched

WATER QUALITY:

Date	pH	Temp (C)	Air Temp (C)	Cond (uS/cm	Visual color
Sept. 9,09	8.52	4.5	15	510	Gin clear

Figure 10: Eagle Creek immediately upstream of the culvert at the Clinton mine site access road, September 8, 2009.

Figure 11: Eagle Creek entering Clinton Creek through the suspended culvert. September 8, 2009.

SITE: E6

5.6 Clinton Creek At Town Site Ford

	PARAMETER	UTM 0518539E/ 7142465N
Site	Survey Date (dd/mm/yr)	September 10, 2009
	Site Elevation (ft)	1103’
	Site Survey Length (m)	300m
Channel	Ave. Channel Width (m)	10.15m
	Ave. Wetted Width (m)	6.39m
	Ave. Flood Pool Depth (m)	1.35
	Ave. Residual Pool Depth (m)	0.45
	% pool/ riffle/ run	10 pool/ 30 riffle/ 60 glide
	Ave. Velocity	0.5 m/sec
	Gradient (%)	1.5%
Cover	Cover Abundance	10%
	Dominant Cover Type	Loose cobbles
	Subdominant Cover Type	Undercut banks
	Other Cover Types Present	Debris piles
	% Crown Closure	5%
	Left Bank Shape	Flat
	Texture	Fine
	Riparian Vegetation	Willow/ alder with occ. Mat spruce
	Riparian Stage	mature
	Right Bank Shape	Vertical
	Texture	Fine with embedded sticks
	Riparian Vegetation	Willow/ alder with occ. Mat spruce
	Riparian Stage	Mature
	Instream Vegetation	None
Morphology	Dominant Bed Material	Gravel
	Subdominant Bed Material	Sand
	D95 (cm)	18cm
	D (cm)	12cm
	Morphology	Riffle pool/ functioning gravel
	Pattern	Gentle meanders
	Islands	None
	Bars	Point bars opposite riffles
	Confinement	Confined on R and open on L

WATER QUALITY:

Date	pH	Temp (C)	Air temp (C)	Cond (uS/cm)	Visual color
Sept 10, 09	8.15	8.7°	15°	830	Clear- light tannin

Figure 12: Looking downstream at Site E6, Clinton Creek at the town site ford. The ford follows the riffle line upstream of the old bridge abutments. September 10, 2009.

Site R5
5.7 Mickey Creek

PARAMETER		UTM 0518822E/ 7140723N
Site	Survey Date (dd/mm/yr)	September 10, 2009
	Site Elevation (ft)	1030'
	Site Survey Length (m)	300m
Channel	Ave. Channel Width (m)	6.52m
	Ave. Wetted Width (m)	4.10m
	Ave. Flood Pool Depth (m)	1.19m
	Ave. Residual Pool Depth (m)	0.49m
	% Pool/ Riffle/ Run	10 pool/ 10 glide/ 80 riffle
	Ave. Velocity	0.5 m/sec
	Gradient (%)	2%
Cover	Cover Abundance	10%
	Dominant Cover Type	Undercut banks
	Subdominant Cover Type	Plunge pool
	Other Cover Types Present	Woody debris

	% Crown Closure	80%
	Left Bank Shape	Abrupt rise of 1 m
	Texture	Fine
	Riparian Vegetation	Willow/ alder/ poplar/ spruce
	Riparian Stage	Mature
	Right Bank Shape	Abrupt rise 2 m
	Texture	Coarse
	Riparian Vegetation	Willow/ alder/ poplar/ spruce
	Riparian Stage	Mature
	Instream Vegetation	None
Morphology	Dominant Bed Material	Cobble
	Subdominant Bed Material	Gravel
	D95 (cm)	18cm
	D (cm)	15cm
	Morphology	Riffle pool/ functioning gravel
	Pattern	Meandering
	Islands	Occasional
	Bars	Occasional point bar
	Confinement	Mostly confined

WATER QUALITY:

Date	pH	Temp (C)	Air temp (C)	Cond (uS/cm)	Visual color
Sept 10,09	8.01	5.1°	14.5°	310	Gin clear

Figure 13: Mickey Creek downstream of the culvert pool. September 11, 2009.

Site R7

5.8 Maiden Creek

	PARAMETER	UTM 0518333E/ 7139251N
Site	Survey Date (dd/mm/yr)	September 11, 2009
	Site Elevation (ft)	1095'
	Site Survey Length (m)	300m
Channel	Ave. Channel Width (m)	5.25m
	Ave. Wetted Width (m)	3.40m
	Ave. Flood Pool Depth (m)	1.67m
	Ave. Residual Pool Depth (m)	0.47m
	% pool, riffle, glide	<10 pool/ 10 glide/ 80 riffle
	Ave. Velocity	0.35 m/sec
	Gradient (%)	2%
Cover	Cover Abundance	30%
	Dominant Cover Type	Lg. woody debris
	Subdominant Cover Type	Undercut banks
	Other Cover Types Present	Small plunge pools
	% Crown Closure	30%
	Left Bank Shape	Abrupt rise 2 to 3m
	Texture	Fines with woody debris
	Riparian Vegetation	Alder / willow/ spruce
	Riparian Stage	mature
	Right Bank Shape	Abrupt rise 2 to 3m
	Texture	Fines with woody debris
	Riparian Vegetation	Alder / willow/ spruce
	Riparian Stage	mature
	Instream Vegetation	None
Morphology	Dominant Bed Material	Cobble
	Subdominant Bed Material	Gravel
	D95 (cm)	28cm
	D (cm)	14cm
	Morphology	Step pool/ riffle pool
	Pattern	Meandering
	Islands	None
	Bars	Occasional d/s of logs

	Confinement	confined

WATER QUALITY:

Date	pH	Temp (C)	Air Temp (C)	Cond (uS/cm)	Visual color
Sept 11, 09	7.90	4.2°	12°	320	Light tannin

Figure 14: Maiden Creek, September 11. 2009.

Site R8

5.9 Marten Creek.

PARAMETER		UTM: 0509095, 7136575 (WP87)
Site	Survey Date (dd/mm/yr)	11/9/09
	Site Elevation (ft)	1072'
	Aspect	South
	Site Survey Length (m)	230
Channel	Ave. Channel Width (m)	7.9
	Ave. Wetted Width (m)	6.2
	Ave. Bankfull Channel Depth (m)	18.6

	Ave. Residual Pool Depth (m)	Not sure which figures to take
	% pool/ riffle/ glide	5 sm. Pool/ 30 run/ 65 rapid
	Ave. Velocity	1.1 m/sec
	Gradient (%)	1%
Cover	Cover Abundance	80%
	Dominant Cover Type	Turbidity
	Subdominant Cover Type	LWD
	Other Cover Types Present	Abundant in-stream LOD
	% Crown Closure	10%
	Left Bank Shape	Abrupt (mined)
	Texture	Fine
	Riparian Vegetation	Birch, spruce, alder
	Riparian Stage	Mature
	Right Bank Shape	Abrupt (mined)
	Texture	Some bed rocked
	Riparian Vegetation	Birch, spruce, alder
	Riparian Stage	Mature
	Instream Vegetation	none
Morphology	Dominant Bed Material	Cobble
	Subdominant Bed Material	Gravel
	D95 (cm)	28
	D (cm)	18
	Morphology	Rapid 10%, 5% pool, 30% run, 55% glide
	Pattern	Irregular wandering/straight
	Islands	none
	Bars	Side and point
	Confinement	Totally confined
	Stream flow	Moderate to low. Mined, mostly straight. Mostly riffle with some rapid caused by log jams.

WATER QUALITY:

Date	pH	Temp (C)	Air Temp (C)	Cond (uS/cm)	Visual color
Sept 11, 09	8.01	5.2	15		Tannin stain with high silt load

Figure 15: Sampling on Marten Creek, September 11, 2009

Figure 16: The largest corner pool on Marten Creek was at the edge of the placer mined area, September 11, 2009.

APPENDIX D

Environment Canada (2009) Report

ENVIRONMENT CANADA   ENVIRONNEMENT CANADA
Environmental Protection   Protection de l'environnement

Memorandum

to: Rachel Pugh (YG)
from: Martin Guilbeault (EC)
date: November 24, 2009
ref: Clinton Creek Mine, Yukon
re: **August 2009 – Clinton Creek Mine Site Visit (Type II)**

Martin Guilbeault and Eric Soprovich of Environment Canada (EC) were at the Clinton Creek Mine Site on August 11th, 2009 for a site visit along with Pat Roach of Indian and Northern Affairs (INAC). This site visit occurred one day after Rachel Pugh, project manager with Yukon Government (YG) was also at the abandoned asbestos mine. The main focus of the trip for EC was to examine site conditions such as hydrology and to obtain a general site orientation and overview of site layout. EC also collected some water quality and sediment samples. It is recognized that the information collected was not specifically requested by Yukon Government (YG) prior to the site visit and that EC collected this data to supplement existing data and perhaps contribute to understanding the overall site water quality.

The purpose of this memo is to provide a summary of the field activities and analytical results from the Clinton Creek Mine visit on August 11th 2009. No interpretation of the data has been completed to date by EC.

The crew drove to site from Dawson the morning of August 11th and returned to Dawson that evening. EC collected surface water samples from four locations and sediment samples from two locations (Figure 1.) and also took photographs of the site. These photographs are available electronically.

Site Conditions

Weather conditions on August 11th were sunny and +10 C to + 15 C. Flow at the site generally appeared to be low (photos available). It was also noted that the water level on the Forty Mile River was very low. It was also noted that there was no water in “Creek Pit”, located between Porcupine Pit and an area where water discharges to beaver ponds. This was documented with photos.

Canada

Sampling Activities

Surface water samples were collected from four locations (WC-1, CC-1, PP-1, PC-1) and two sediment samples were collected from one location (WC-1). These samples were collected from Wolverine Creek, Clinton Creek, Porcupine Pit, Porcupine Creek and Wolverine Creek respectively. Samples were collected for general chemistry parameters (1L plastic bottle), dissolved and total metals analysis (one 120 ml plastic bottle for each). Field parameters (ORP, pH, Temp., Cond.) were also recorded (Table 1). Samples for total and dissolved metals were preserved with 1 ml of nitric acid immediately after sampling and all dissolved metals samples were filtered in the field using 0.45 micron syringe filters. All samples were submitted to the Environment Canada Pacific Environmental Sciences Centre (PESC) laboratory in Vancouver, BC.

Other Site Activities

The overall site visit consisted of: 1) an examination of the gabion structures along Clinton Creek downstream of Hudgeon Lake, 2) the old mill site, 3) the old airstrip, 4) the tailings pile, and 5) examination of conditions in Porcupine Pit. Several photos were recorded and are available upon request.

Attachments:

1. Table 1. Field Chemistry Measurements
2. Photos. August 2009 Sampling Locations
3. Sample analysis report, PESC laboratory

Table 1. Field Chemistry field parameters, Clinton Creek Mine, August 11, 2009

Sample ID	Location	Northing	Easting	Sample Time	Temp C	SpCond uS/cm	Cond uS/cm	pH	DO (mg/L)	ORP mV	Comments
Clinton WC-1	Wolverine Creek upstream of culvert before it enters Clinton Creek	N 64d 26.968'	W 140d 42.139'	12:30	5.72	845	534	8.15	11.89	197	asbestos fibres and serpentine waste rock in creek bed, redish algae in creek bottom
Clinton CC-1	Clinton Creek upstream of Wolverine Creek culvert	N 64d 26.951'	W 140d 42.152'	12:45	10.23	1142	823	7.56	6.75	< -1	creek is a few m wide and approx. 60cm deep, small grayling and juvenile chinook noted at sampling location
Clinton PP-1	Porcupine Pit	N 64d 26.668'	W 140d 43.389'	15:15	15.04	2596	2101	8.32	9.88	142	sample collected from surface
Clinton PC-1	Porcupine Creek	N 64d 26.884'	W 140d 42.512'	16:00	2.19	2979	1681	7.12	4.79	178	long green filamentous algae where Creek discharges to beaver pond
Clinton CC-1 SED1	Clinton Creek, upstream of confluence with Wolverine Creek			14:30							sediment sample
Clinton CC-1 SED2	same location as SED1			14:30							sediment sample

* coordinates recorded with a handheld GPS unit

Photo 1. Sampling location WC-1, Wolverine Creek upstream of culvert discharging to Clinton Creek.

Photo 2. Sampling location CC-1 (water and sediments), Clinton Creek upstream of confluence (culvert) with Wolverine Creek.

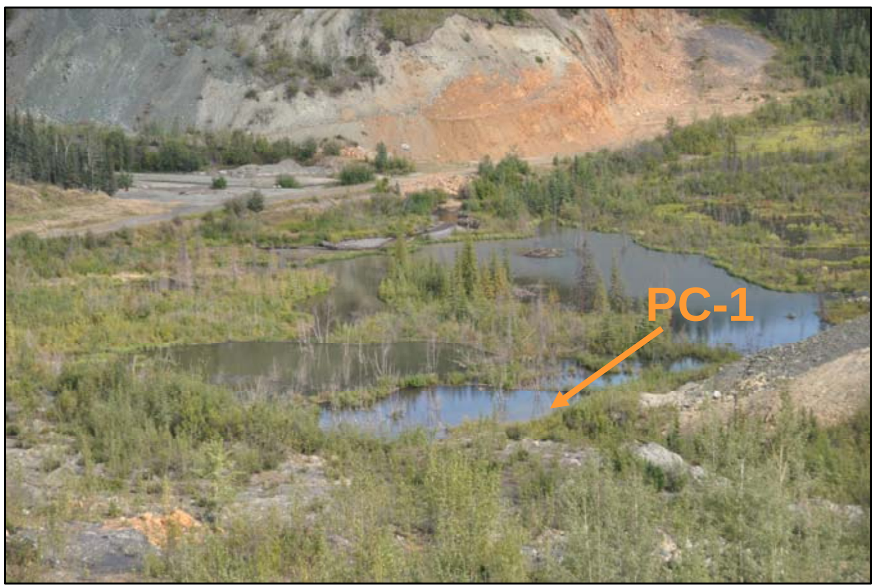

Photo 3. Sampling location PC-1, Porcupine Creek where groundwater Discharges to area of beaver ponds.

Photo 4. Sampling location PP-1, Porcupine Pit.

Pacific and Yukon Laboratory for Environmental Testing (PYLET)
2645 Dollarton Highway
North Vancouver, BC. Canada V7H - 1B1
Phone (604) 924-2500 Fax (604) 924-2555

Environment Canada / Environnement Canada

Friday November 27, 2009 At 1:52PM

Final Analytical Results with QC data

FOLDER # : 200900752

Location:	CLINTON CREEK MINE (ABANDONED ASBESTOS MINE)
Type of Sample:	Fresh Water/General (FWGE) Soil (Bottom Sediment) (SOSE)
Submitted By:	Martin Guilbeault Environment Canada 91782 Alaska Hwy Whitehorse, YT Canada Y1A 5B7 Phone: 867-667-4592 Fax: 867-667-7962
Logged In:	Wednesday August 19, 2009
Completed:	Friday November 27, 2009 (955 results)
Client Code:	2561-101 2561-101 EP YUKON ENV ASSESSMENT
Sample Priority:	Normal

Authorized by: ____________________________

Richard Strub
QA Officer

Notes:

Folder re-released Nov 25, 2009 - Added missing test Extractable ICP to 196374. NB.

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS

PYLET Order No: 196372 - Client Sample ID: CLINTON WC-1 **Arrival Temperature: 6°C**
Sampling Date: 8/11/2009 Start Time: 1220

General

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
***Acidity, Tot.&pH4.5**				
Acidity, Total	FWGE	< 1	1	mg CaCO3 / L
***Alkalinity,TotpH4.5**				
Alkalinity to pH 4.5	FWGE	242.7	0.5	mg CaCO3 / L
***ICA (Cl F SO4)**				
Chloride (Cl)	FWGE	2.1	0.1	mg/L
Fluoride (F)	FWGE	0.19	0.01	mg/L
Sulphate (SO4)	FWGE	238	10	mg/L
***pH**				
pH	FWGE	8.38	0.01	pH Units
***Residue, Filterable**				
Solids, Total Dissolved (FR)	FWGE	757	10	mg/L
Analysis performed after recommended hold time.				
***Residue, Nonfilt.**				
Solids, Total Suspended (NFR)	FWGE	< 5	5	mg/L
Analysis performed after recommended hold time.				
***SpecificConductance**				
Conductivity	FWGE	859	2	uS/cm

Metals

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
***ICP, Dissolved**				
Aluminum (Al)	FWGE	< 0.05	0.05	mg/L
Antimony (Sb)	FWGE	< 0.05	0.05	mg/L
Arsenic (As)	FWGE	< 0.05	0.05	mg/L
Barium (Ba)	FWGE	0.064	0.001	mg/L
Berylium (Be)	FWGE	< 0.001	0.001	mg/L
Boron (B)	FWGE	0.24	0.01	mg/L
Cadmium (Cd)	FWGE	< 0.005	0.005	mg/L
Calcium (Ca)	FWGE	60.1	0.1	mg/L
Chromium (Cr)	FWGE	< 0.005	0.005	mg/L
Cobalt (Co)	FWGE	< 0.005	0.005	mg/L
Copper (Cu)	FWGE	< 0.005	0.005	mg/L
Iron (Fe)	FWGE	0.009	0.005	mg/L
Lead (Pb)	FWGE	< 0.05	0.05	mg/L
Magnesium (Mg)	FWGE	81.0	0.1	mg/L
Manganese (Mn)	FWGE	0.016	0.001	mg/L

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
PYLET Order No: 196372 - Client Sample ID: CLINTON WC-1				**Arrival Temperature: 6°C**
Sampling Date: 8/11/2009 Start Time: 1220				
Molybdenum (Mo)	FWGE	< 0.01	0.01	mg/L
Nickel (Ni)	FWGE	< 0.02	0.02	mg/L
Phosphorus (P)	FWGE	< 0.1	0.1	mg/L
Potassium (K)	FWGE	1.2	0.1	mg/L
Selenium (Se)	FWGE	< 0.05	0.05	mg/L
Silicon (Si)	FWGE	4.56	0.05	mg/L
Silver (Ag)	FWGE	< 0.01	0.01	mg/L
Sodium (Na)	FWGE	5.2	0.1	mg/L
Strontium (Sr)	FWGE	0.420	0.001	mg/L
Sulfur (S)	FWGE	83.2	0.05	mg/L
Tin (Sn)	FWGE	0.06	0.05	mg/L
Titanium (Ti)	FWGE	< 0.002	0.002	mg/L
Vanadium (V)	FWGE	< 0.01	0.01	mg/L
Zinc (Zn)	FWGE	< 0.05	0.05	mg/L
***ICP, Extractable**				
Aluminum (Al)	FWGE	< 0.05	0.05	mg/L
Antimony (Sb)	FWGE	< 0.05	0.05	mg/L
Arsenic (As)	FWGE	< 0.05	0.05	mg/L
Barium (Ba)	FWGE	0.067	0.001	mg/L
Berylium (Be)	FWGE	< 0.001	0.001	mg/L
Boron (B)	FWGE	0.25	0.01	mg/L
Cadmium (Cd)	FWGE	< 0.005	0.005	mg/L
Calcium (Ca)	FWGE	62.9	0.1	mg/L
Chromium (Cr)	FWGE	< 0.005	0.005	mg/L
Cobalt (Co)	FWGE	< 0.005	0.005	mg/L
Copper (Cu)	FWGE	< 0.005	0.005	mg/L
Iron (Fe)	FWGE	0.013	0.005	mg/L
Lead (Pb)	FWGE	< 0.05	0.05	mg/L
Magnesium (Mg)	FWGE	85.3	0.1	mg/L
Manganese (Mn)	FWGE	0.017	0.001	mg/L
Molybdenum (Mo)	FWGE	< 0.01	0.01	mg/L
Nickel (Ni)	FWGE	0.02	0.02	mg/L
Phosphorus (P)	FWGE	0.2	0.1	mg/L
Potassium (K)	FWGE	1.2	0.1	mg/L
Selenium (Se)	FWGE	< 0.05	0.05	mg/L
Silicon (Si)	FWGE	4.70	0.05	mg/L
Silver (Ag)	FWGE	< 0.01	0.01	mg/L
Sodium (Na)	FWGE	5.4	0.1	mg/L
Strontium (Sr)	FWGE	0.438	0.001	mg/L
Sulfur (S)	FWGE	84.5	0.05	mg/L
Tin (Sn)	FWGE	0.07	0.05	mg/L
Titanium (Ti)	FWGE	< 0.002	0.002	mg/L
Vanadium (V)	FWGE	< 0.01	0.01	mg/L

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
PYLET Order No: 196372 - Client Sample ID: CLINTON WC-1				**Arrival Temperature: 6°C**
Sampling Date: 8/11/2009 Start Time: 1220				
Zinc (Zn)	FWGE	< 0.05	0.05	mg/L
***ICP, Total**				
Aluminum (Al)	FWGE	< 0.06	0.06	mg/L
Antimony (Sb)	FWGE	< 0.06	0.06	mg/L
Arsenic (As)	FWGE	0.14	0.06	mg/L
Barium (Ba)	FWGE	0.062	0.001	mg/L
Berylium (Be)	FWGE	< 0.001	0.001	mg/L
Boron (B)	FWGE	0.26	0.01	mg/L
Cadmium (Cd)	FWGE	< 0.006	0.006	mg/L
Calcium (Ca)	FWGE	65.0	0.1	mg/L
Chromium (Cr)	FWGE	< 0.006	0.006	mg/L
Cobalt (Co)	FWGE	< 0.006	0.006	mg/L
Copper (Cu)	FWGE	< 0.02	0.02	mg/L
Iron (Fe)	FWGE	< 0.05	0.05	mg/L
Lead (Pb)	FWGE	< 0.06	0.06	mg/L
Magnesium (Mg)	FWGE	80.3	0.1	mg/L
Manganese (Mn)	FWGE	0.004	0.001	mg/L
Molybdenum (Mo)	FWGE	< 0.01	0.01	mg/L
Nickel (Ni)	FWGE	< 0.02	0.02	mg/L
Phosphorus (P)	FWGE	0.4	0.1	mg/L
Potassium (K)	FWGE	1.0	0.1	mg/L
Selenium (Se)	FWGE	< 0.06	0.06	mg/L
Silicon (Si)	FWGE	4.69	0.06	mg/L
Silver (Ag)	FWGE	< 0.01	0.01	mg/L
Sodium (Na)	FWGE	5.4	0.1	mg/L
Strontium (Sr)	FWGE	0.412	0.001	mg/L
Sulfur (S)	FWGE	82.4	0.06	mg/L
Tin (Sn)	FWGE	< 0.06	0.06	mg/L
Titanium (Ti)	FWGE	< 0.002	0.002	mg/L
Vanadium (V)	FWGE	< 0.01	0.01	mg/L
Zinc (Zn)	FWGE	< 0.05	0.05	mg/L
Hardness, Diss. CaMg				
Hardness, Dissolved Calcium+Magnesium - calc.	FWGE	484	0.4	mg CaCO3 / L
Hardness, Diss.Total				
Hardness, Dissolved Total - calc.	FWGE	484	0.4	mg CaCO3 / L
Hardness, Extr. CaMg				
Hardness, Extractable Calcium+Magnesium - calc.	FWGE	508	0.4	mg CaCO3 / L
Hardness, Extr.Total				
Hardness, Extractable Total - calc.	FWGE	509	0.4	mg CaCO3 / L
Nutrients				
***Nitrogen, Ammonia**				

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
PYLET Order No: 196372 - Client Sample ID: CLINTON WC-1				**Arrival Temperature: 6°C**
Sampling Date: 8/11/2009 Start Time: 1220				
Nitrogen, Ammonia as N	FWGE	< 0.002	0.002	mg/L
***Nitrogen, NO 2**				
Nitrogen, Nitrite as N	FWGE	< 0.002	0.002	mg/L
***Nitrogen, NO 23**				
Nitrogen, Nitrate + Nitrite as N	FWGE	0.061	0.002	mg/L
***Phosphorus, Total**				
Phosphorus, Total as P	FWGE	0.006	0.002	mg/L
PYLET Order No: 196373 - Client Sample ID: CLINTON CC-1				
Sampling Date: 8/11/2009 Start Time: 1245				
General				
***Acidity, Tot.&pH4.5**				
Acidity, Total	FWGE	5	1	mg CaCO3 / L
***Alkalinity,TotpH4.5**				
Alkalinity to pH 4.5	FWGE	234.0	0.5	mg CaCO3 / L
***ICA (Cl F SO4)**				
Chloride (Cl)	FWGE	2.8	0.1	mg/L
Fluoride (F)	FWGE	0.12	0.01	mg/L
Sulphate (SO4)	FWGE	576	30	mg/L
***pH**				
pH	FWGE	8.07	0.01	pH Units
***Residue, Filterable**				
Solids, Total Dissolved (FR)	FWGE	1090	10	mg/L
Analysis performed after recommended hold time.				
***Residue, Nonfilt.**				
Solids, Total Suspended (NFR)	FWGE	< 5	5	mg/L
Analysis performed after recommended hold time.				
***SpecificConductance**				
Conductivity	FWGE	1160	2	uS/cm
Metals				
***ICP, Dissolved**				
Aluminum (Al)	FWGE	< 0.05	0.05	mg/L
Antimony (Sb)	FWGE	0.05	0.05	mg/L
Arsenic (As)	FWGE	< 0.05	0.05	mg/L
Barium (Ba)	FWGE	0.080	0.001	mg/L

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
PYLET Order No: 196373 - Client Sample ID: CLINTON CC-1				
Sampling Date: 8/11/2009 Start Time: 1245				
Berylium (Be)	FWGE	< 0.001	0.001	mg/L
Boron (B)	FWGE	0.12	0.01	mg/L
Cadmium (Cd)	FWGE	< 0.005	0.005	mg/L
Calcium (Ca)	FWGE	111	0.1	mg/L
Chromium (Cr)	FWGE	< 0.005	0.005	mg/L
Cobalt (Co)	FWGE	< 0.005	0.005	mg/L
Copper (Cu)	FWGE	< 0.005	0.005	mg/L
Iron (Fe)	FWGE	0.595	0.005	mg/L
Lead (Pb)	FWGE	< 0.05	0.05	mg/L
Magnesium (Mg)	FWGE	97.9	0.1	mg/L
Manganese (Mn)	FWGE	0.697	0.001	mg/L
Molybdenum (Mo)	FWGE	< 0.01	0.01	mg/L
Nickel (Ni)	FWGE	0.03	0.02	mg/L
Phosphorus (P)	FWGE	0.2	0.1	mg/L
Potassium (K)	FWGE	1.5	0.1	mg/L
Selenium (Se)	FWGE	< 0.05	0.05	mg/L
Silicon (Si)	FWGE	5.61	0.05	mg/L
Silver (Ag)	FWGE	< 0.01	0.01	mg/L
Sodium (Na)	FWGE	7.1	0.1	mg/L
Strontium (Sr)	FWGE	0.804	0.001	mg/L
Sulfur (S)	FWGE	151	0.05	mg/L
Tin (Sn)	FWGE	0.06	0.05	mg/L
Titanium (Ti)	FWGE	< 0.002	0.002	mg/L
Vanadium (V)	FWGE	< 0.01	0.01	mg/L
Zinc (Zn)	FWGE	< 0.05	0.05	mg/L
***ICP, Extractable**				
Aluminum (Al)	FWGE	< 0.05	0.05	mg/L
Antimony (Sb)	FWGE	0.05	0.05	mg/L
Arsenic (As)	FWGE	< 0.05	0.05	mg/L
Barium (Ba)	FWGE	0.084	0.001	mg/L
Berylium (Be)	FWGE	< 0.001	0.001	mg/L
Boron (B)	FWGE	0.12	0.01	mg/L
Cadmium (Cd)	FWGE	< 0.005	0.005	mg/L
Calcium (Ca)	FWGE	112	0.1	mg/L
Chromium (Cr)	FWGE	< 0.005	0.005	mg/L
Cobalt (Co)	FWGE	< 0.005	0.005	mg/L
Copper (Cu)	FWGE	< 0.005	0.005	mg/L
Iron (Fe)	FWGE	0.908	0.005	mg/L
Lead (Pb)	FWGE	< 0.05	0.05	mg/L
Magnesium (Mg)	FWGE	100	0.1	mg/L
Manganese (Mn)	FWGE	0.717	0.001	mg/L
Molybdenum (Mo)	FWGE	< 0.01	0.01	mg/L
Nickel (Ni)	FWGE	0.03	0.02	mg/L

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
PYLET Order No: 196373 - Client Sample ID: CLINTON CC-1				
Sampling Date: 8/11/2009 Start Time: 1245				
Phosphorus (P)	FWGE	0.4	0.1	mg/L
Potassium (K)	FWGE	1.4	0.1	mg/L
Selenium (Se)	FWGE	< 0.05	0.05	mg/L
Silicon (Si)	FWGE	5.74	0.05	mg/L
Silver (Ag)	FWGE	< 0.01	0.01	mg/L
Sodium (Na)	FWGE	7.3	0.1	mg/L
Strontium (Sr)	FWGE	0.829	0.001	mg/L
Sulfur (S)	FWGE	148	0.05	mg/L
Tin (Sn)	FWGE	0.08	0.05	mg/L
Titanium (Ti)	FWGE	< 0.002	0.002	mg/L
Vanadium (V)	FWGE	< 0.01	0.01	mg/L
Zinc (Zn)	FWGE	< 0.05	0.05	mg/L
***ICP, Total**				
Aluminum (Al)	FWGE	< 0.06	0.06	mg/L
Antimony (Sb)	FWGE	< 0.06	0.06	mg/L
Arsenic (As)	FWGE	0.17	0.06	mg/L
Barium (Ba)	FWGE	0.079	0.001	mg/L
Berylium (Be)	FWGE	< 0.001	0.001	mg/L
Boron (B)	FWGE	0.13	0.01	mg/L
Cadmium (Cd)	FWGE	< 0.006	0.006	mg/L
Calcium (Ca)	FWGE	117	0.1	mg/L
Chromium (Cr)	FWGE	< 0.006	0.006	mg/L
Cobalt (Co)	FWGE	< 0.006	0.006	mg/L
Copper (Cu)	FWGE	< 0.02	0.02	mg/L
Iron (Fe)	FWGE	0.82	0.05	mg/L
Lead (Pb)	FWGE	< 0.06	0.06	mg/L
Magnesium (Mg)	FWGE	98.0	0.1	mg/L
Manganese (Mn)	FWGE	0.704	0.001	mg/L
Molybdenum (Mo)	FWGE	< 0.01	0.01	mg/L
Nickel (Ni)	FWGE	0.03	0.02	mg/L
Phosphorus (P)	FWGE	0.5	0.1	mg/L
Potassium (K)	FWGE	1.4	0.1	mg/L
Selenium (Se)	FWGE	< 0.06	0.06	mg/L
Silicon (Si)	FWGE	5.81	0.06	mg/L
Silver (Ag)	FWGE	0.03	0.01	mg/L
Sodium (Na)	FWGE	7.1	0.1	mg/L
Strontium (Sr)	FWGE	0.809	0.001	mg/L
Sulfur (S)	FWGE	145	0.06	mg/L
Tin (Sn)	FWGE	0.07	0.06	mg/L
Titanium (Ti)	FWGE	< 0.002	0.002	mg/L
Vanadium (V)	FWGE	< 0.01	0.01	mg/L
Zinc (Zn)	FWGE	< 0.05	0.05	mg/L
Hardness, Diss. CaMg				

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
PYLET Order No: 196373 - Client Sample ID: CLINTON CC-1				
Sampling Date: 8/11/2009 Start Time: 1245				
Hardness, Dissolved Calcium+Magnesium - calc.	FWGE	680	0.4	mg CaCO3 / L
Hardness, Diss.Total				
Hardness, Dissolved Total - calc.	FWGE	683	0.4	mg CaCO3 / L
Hardness, Extr. CaMg				
Hardness, Extractable Calcium+Magnesium - calc.	FWGE	693	0.4	mg CaCO3 / L
Hardness, Extr.Total				
Hardness, Extractable Total - calc.	FWGE	697	0.4	mg CaCO3 / L
Nutrients				
***Nitrogen, Ammonia**				
Nitrogen, Ammonia as N	FWGE	0.051	0.002	mg/L
***Nitrogen, NO 2**				
Nitrogen, Nitrite as N	FWGE	< 0.002	0.002	mg/L
***Nitrogen, NO 23**				
Nitrogen, Nitrate + Nitrite as N	FWGE	0.045	0.002	mg/L
***Phosphorus, Total**				
Phosphorus, Total as P	FWGE	0.011	0.002	mg/L
PYLET Order No: 196374 - Client Sample ID: CLINTON PP-1				
Sampling Date: 8/11/2009 Start Time: 1500				
General				
***Acidity, Tot.&pH4.5**				
Acidity, Total	FWGE	< 1	1	mg CaCO3 / L
***Alkalinity,TotpH4.5**				
Alkalinity to pH 4.5	FWGE	166.7	0.5	mg CaCO3 / L
***ICA (Cl F SO4)**				
Chloride (Cl)	FWGE	29	1	mg/L
Fluoride (F)	FWGE	0.04	0.01	mg/L
Sulphate (SO4)	FWGE	1830	50	mg/L
***pH**				
pH	FWGE	8.37	0.01	pH Units
***Residue, Filterable**				
Solids, Total Dissolved (FR)	FWGE	3070	10	mg/L
wieght too high				
Analysis performed after recommended hold time.				
***Residue, Nonfilt.**				

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
PYLET Order No: 196374 - Client Sample ID: CLINTON PP-1				
Sampling Date: 8/11/2009 Start Time: 1500				
Solids, Total Suspended (NFR)	FWGE	< 5	5	mg/L
Analysis performed after recommended hold time.				
***SpecificConductance**				
Conductivity	FWGE	2700	2	uS/cm
Metals				
***ICP, Dissolved**				
Aluminum (Al)	FWGE	< 0.05	0.05	mg/L
Antimony (Sb)	FWGE	0.18	0.05	mg/L
Arsenic (As)	FWGE	0.05	0.05	mg/L
Barium (Ba)	FWGE	0.008	0.001	mg/L
Berylium (Be)	FWGE	< 0.001	0.001	mg/L
Boron (B)	FWGE	4.22	0.01	mg/L
Cadmium (Cd)	FWGE	< 0.005	0.005	mg/L
Calcium (Ca)	FWGE	83.9	0.1	mg/L
Chromium (Cr)	FWGE	< 0.005	0.005	mg/L
Cobalt (Co)	FWGE	< 0.005	0.005	mg/L
Copper (Cu)	FWGE	< 0.005	0.005	mg/L
Iron (Fe)	FWGE	< 0.005	0.005	mg/L
Lead (Pb)	FWGE	< 0.05	0.05	mg/L
Magnesium (Mg)	FWGE	380	1	mg/L
Manganese (Mn)	FWGE	< 0.001	0.001	mg/L
Molybdenum (Mo)	FWGE	< 0.01	0.01	mg/L
Nickel (Ni)	FWGE	0.05	0.02	mg/L
Phosphorus (P)	FWGE	0.2	0.1	mg/L
Potassium (K)	FWGE	3.9	0.1	mg/L
Selenium (Se)	FWGE	< 0.05	0.05	mg/L
Silicon (Si)	FWGE	0.91	0.05	mg/L
Silver (Ag)	FWGE	0.02	0.01	mg/L
Sodium (Na)	FWGE	26.0	0.1	mg/L
Strontium (Sr)	FWGE	0.450	0.001	mg/L
Sulfur (S)	FWGE	489	0.05	mg/L
Tin (Sn)	FWGE	0.08	0.05	mg/L
Titanium (Ti)	FWGE	< 0.002	0.002	mg/L
Vanadium (V)	FWGE	< 0.01	0.01	mg/L
Zinc (Zn)	FWGE	< 0.05	0.05	mg/L
***ICP, Extractable**				
Aluminum (Al)	FWGE	< 0.05	0.05	mg/L
Antimony (Sb)	FWGE	0.20	0.05	mg/L
Arsenic (As)	FWGE	0.07	0.05	mg/L
Barium (Ba)	FWGE	0.009	0.001	mg/L
Berylium (Be)	FWGE	< 0.001	0.001	mg/L

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
PYLET Order No: 196374 - Client Sample ID: CLINTON PP-1				
Sampling Date: 8/11/2009 Start Time: 1500				
Boron (B)	FWGE	4.43	0.01	mg/L
Cadmium (Cd)	FWGE	< 0.005	0.005	mg/L
Calcium (Ca)	FWGE	92.4	0.1	mg/L
Chromium (Cr)	FWGE	< 0.005	0.005	mg/L
Cobalt (Co)	FWGE	< 0.005	0.005	mg/L
Copper (Cu)	FWGE	< 0.005	0.005	mg/L
Iron (Fe)	FWGE	< 0.005	0.005	mg/L
Lead (Pb)	FWGE	< 0.05	0.05	mg/L
Magnesium (Mg)	FWGE	409	1	mg/L
Manganese (Mn)	FWGE	< 0.001	0.001	mg/L
Molybdenum (Mo)	FWGE	< 0.01	0.01	mg/L
Nickel (Ni)	FWGE	0.06	0.02	mg/L
Phosphorus (P)	FWGE	1.0	0.1	mg/L
Potassium (K)	FWGE	4.1	0.1	mg/L
Selenium (Se)	FWGE	< 0.05	0.05	mg/L
Silicon (Si)	FWGE	1.04	0.05	mg/L
Silver (Ag)	FWGE	0.02	0.01	mg/L
Sodium (Na)	FWGE	26.2	0.1	mg/L
Strontium (Sr)	FWGE	0.470	0.001	mg/L
Sulfur (S)	FWGE	605	0.5	mg/L
Tin (Sn)	FWGE	0.09	0.05	mg/L
Titanium (Ti)	FWGE	< 0.002	0.002	mg/L
Vanadium (V)	FWGE	< 0.01	0.01	mg/L
Zinc (Zn)	FWGE	< 0.05	0.05	mg/L
Hardness, Diss. CaMg				
Hardness, Dissolved Calcium+Magnesium - calc.	FWGE	1770	0.4	mg CaCO3 / L
Hardness, Diss.Total				
Hardness, Dissolved Total - calc.	FWGE	1770	0.4	mg CaCO3 / L
Hardness, Extr. CaMg				
Hardness, Extractable Calcium+Magnesium - calc.	FWGE	1920	0.4	mg CaCO3 / L
Hardness, Extr.Total				
Hardness, Extractable Total - calc.	FWGE	1920	0.4	mg CaCO3 / L
Nutrients				
***Nitrogen, Ammonia**				
Nitrogen, Ammonia as N	FWGE	0.006	0.002	mg/L
***Nitrogen, NO 2**				
Nitrogen, Nitrite as N	FWGE	0.005	0.002	mg/L
***Nitrogen, NO 23**				
Nitrogen, Nitrate + Nitrite as N	FWGE	0.036	0.002	mg/L
***Phosphorus, Total**				

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
PYLET Order No: 196374 - Client Sample ID: CLINTON PP-1				
Sampling Date: 8/11/2009 Start Time: 1500				
Phosphorus, Total as P	FWGE	< 0.002	0.002	mg/L
PYLET Order No: 196375 - Client Sample ID: CLINTON PC-1				
Sampling Date: 8/11/2009 Start Time: 1600				
General				
***Acidity, Tot.&pH4.5**				
Acidity, Total	FWGE	17	1	mg CaCO3 / L
***Alkalinity,TotpH4.5**				
Alkalinity to pH 4.5	FWGE	388.4	0.5	mg CaCO3 / L
***ICA (Cl F SO4)**				
Chloride (Cl)	FWGE	13	0.5	mg/L
Fluoride (F)	FWGE	0.12	0.01	mg/L
Sulphate (SO4)	FWGE	1753	50	mg/L
***pH**				
pH	FWGE	7.90	0.01	pH Units
***Residue, Filterable**				
Solids, Total Dissolved (FR)	FWGE	3510	10	mg/L
wieght too high				
Analysis performed after recommended hold time.				
***Residue, Nonfilt.**				
Solids, Total Suspended (NFR)	FWGE	< 5	5	mg/L
Analysis performed after recommended hold time.				
***SpecificConductance**				
Conductivity	FWGE	3100	2	uS/cm
Metals				
***ICP, Dissolved**				
Aluminum (Al)	FWGE	< 0.05	0.05	mg/L
Antimony (Sb)	FWGE	0.17	0.05	mg/L
Arsenic (As)	FWGE	< 0.05	0.05	mg/L
Barium (Ba)	FWGE	0.019	0.001	mg/L
Berylium (Be)	FWGE	< 0.001	0.001	mg/L
Boron (B)	FWGE	0.50	0.01	mg/L
Cadmium (Cd)	FWGE	< 0.005	0.005	mg/L
Calcium (Ca)	FWGE	232	0.1	mg/L
Chromium (Cr)	FWGE	< 0.005	0.005	mg/L
Cobalt (Co)	FWGE	< 0.005	0.005	mg/L

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
PYLET Order No: 196375 - Client Sample ID: CLINTON PC-1				
Sampling Date: 8/11/2009 Start Time: 1600				
Copper (Cu)	FWGE	< 0.005	0.005	mg/L
Iron (Fe)	FWGE	< 0.005	0.005	mg/L
Lead (Pb)	FWGE	< 0.05	0.05	mg/L
Magnesium (Mg)	FWGE	375	1	mg/L
Manganese (Mn)	FWGE	< 0.001	0.001	mg/L
Molybdenum (Mo)	FWGE	< 0.01	0.01	mg/L
Nickel (Ni)	FWGE	0.09	0.02	mg/L
Phosphorus (P)	FWGE	0.5	0.1	mg/L
Potassium (K)	FWGE	4.2	0.1	mg/L
Selenium (Se)	FWGE	< 0.05	0.05	mg/L
Silicon (Si)	FWGE	6.47	0.05	mg/L
Silver (Ag)	FWGE	0.02	0.01	mg/L
Sodium (Na)	FWGE	28.4	0.1	mg/L
Strontium (Sr)	FWGE	2.76	0.001	mg/L
Sulfur (S)	FWGE	697	0.5	mg/L
Tin (Sn)	FWGE	0.07	0.05	mg/L
Titanium (Ti)	FWGE	< 0.002	0.002	mg/L
Vanadium (V)	FWGE	< 0.01	0.01	mg/L
Zinc (Zn)	FWGE	< 0.05	0.05	mg/L
***ICP, Extractable**				
Aluminum (Al)	FWGE	< 0.05	0.05	mg/L
Antimony (Sb)	FWGE	0.17	0.05	mg/L
Arsenic (As)	FWGE	0.05	0.05	mg/L
Barium (Ba)	FWGE	0.020	0.001	mg/L
Berylium (Be)	FWGE	< 0.001	0.001	mg/L
Boron (B)	FWGE	0.54	0.01	mg/L
Cadmium (Cd)	FWGE	< 0.005	0.005	mg/L
Calcium (Ca)	FWGE	260	0.1	mg/L
Chromium (Cr)	FWGE	< 0.005	0.005	mg/L
Cobalt (Co)	FWGE	< 0.005	0.005	mg/L
Copper (Cu)	FWGE	< 0.005	0.005	mg/L
Iron (Fe)	FWGE	< 0.005	0.005	mg/L
Lead (Pb)	FWGE	< 0.05	0.05	mg/L
Magnesium (Mg)	FWGE	387	1	mg/L
Manganese (Mn)	FWGE	< 0.001	0.001	mg/L
Molybdenum (Mo)	FWGE	< 0.01	0.01	mg/L
Nickel (Ni)	FWGE	0.10	0.02	mg/L
Phosphorus (P)	FWGE	1.2	0.1	mg/L
Potassium (K)	FWGE	4.3	0.1	mg/L
Selenium (Se)	FWGE	< 0.05	0.05	mg/L
Silicon (Si)	FWGE	7.29	0.05	mg/L
Silver (Ag)	FWGE	0.02	0.01	mg/L
Sodium (Na)	FWGE	30.0	0.1	mg/L

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
PYLET Order No: 196375 - Client Sample ID: CLINTON PC-1				
Sampling Date: 8/11/2009 Start Time: 1600				
Strontium (Sr)	FWGE	2.87	0.001	mg/L
Sulfur (S)	FWGE	643	0.5	mg/L
Tin (Sn)	FWGE	0.08	0.05	mg/L
Titanium (Ti)	FWGE	< 0.002	0.002	mg/L
Vanadium (V)	FWGE	< 0.01	0.01	mg/L
Zinc (Zn)	FWGE	< 0.05	0.05	mg/L
***ICP, Total**				
Aluminum (Al)	FWGE	< 0.06	0.06	mg/L
Antimony (Sb)	FWGE	< 0.06	0.06	mg/L
Arsenic (As)	FWGE	0.22	0.06	mg/L
Barium (Ba)	FWGE	0.018	0.001	mg/L
Berylium (Be)	FWGE	< 0.001	0.001	mg/L
Boron (B)	FWGE	0.54	0.01	mg/L
Cadmium (Cd)	FWGE	< 0.006	0.006	mg/L
Calcium (Ca)	FWGE	245	0.1	mg/L
Chromium (Cr)	FWGE	< 0.006	0.006	mg/L
Cobalt (Co)	FWGE	< 0.006	0.006	mg/L
Copper (Cu)	FWGE	< 0.02	0.02	mg/L
Iron (Fe)	FWGE	< 0.05	0.05	mg/L
Lead (Pb)	FWGE	< 0.06	0.06	mg/L
Magnesium (Mg)	FWGE	429	1	mg/L
Manganese (Mn)	FWGE	< 0.001	0.001	mg/L
Molybdenum (Mo)	FWGE	< 0.01	0.01	mg/L
Nickel (Ni)	FWGE	0.09	0.02	mg/L
Phosphorus (P)	FWGE	1.2	0.1	mg/L
Potassium (K)	FWGE	3.9	0.1	mg/L
Selenium (Se)	FWGE	< 0.06	0.06	mg/L
Silicon (Si)	FWGE	6.72	0.06	mg/L
Silver (Ag)	FWGE	0.01	0.01	mg/L
Sodium (Na)	FWGE	27.9	0.1	mg/L
Strontium (Sr)	FWGE	2.75	0.001	mg/L
Sulfur (S)	FWGE	683	0.6	mg/L
Tin (Sn)	FWGE	0.06	0.06	mg/L
Titanium (Ti)	FWGE	< 0.002	0.002	mg/L
Vanadium (V)	FWGE	< 0.01	0.01	mg/L
Zinc (Zn)	FWGE	< 0.05	0.05	mg/L
Hardness, Diss. CaMg				
Hardness, Dissolved Calcium+Magnesium - calc.	FWGE	2120	0.4	mg CaCO3 / L
Hardness, Diss.Total				
Hardness, Dissolved Total - calc.	FWGE	2130	0.4	mg CaCO3 / L
Hardness, Extr. CaMg				

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS

PYLET Order No: 196375 - Client Sample ID: CLINTON PC-1
Sampling Date: 8/11/2009 Start Time: 1600

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
Hardness, Extractable Calcium+Magnesium - calc.	FWGE	2240	0.4	mg CaCO3 / L
Hardness, Extr.Total				
Hardness, Extractable Total - calc.	FWGE	2250	0.4	mg CaCO3 / L

Nutrients

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
***Nitrogen, Ammonia**				
Nitrogen, Ammonia as N	FWGE	< 0.002	0.002	mg/L
Analysis performed after recommended hold time.				
***Nitrogen, NO 2**				
Nitrogen, Nitrite as N	FWGE	< 0.002	0.002	mg/L
***Nitrogen, NO 23**				
Nitrogen, Nitrate + Nitrite as N	FWGE	0.443	0.002	mg/L
***Phosphorus, Total**				
Phosphorus, Total as P	FWGE	0.003	0.002	mg/L

PYLET Order No: 196376 - Client Sample ID: CLINTON WC-1 SED1
Sampling Date: 8/11/2009 Start Time: 1630

Metals

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
***ICP, Total blockdig**				
Aluminum (Al)	SOSE	4290	5	ug/g(dry)
Antimony (Sb)	SOSE	15	5	ug/g(dry)
Arsenic (As)	SOSE	15	5	ug/g(dry)
Barium (Ba)	SOSE	32.5	0.1	ug/g(dry)
Berylium (Be)	SOSE	< 0.1	0.1	ug/g(dry)
Boron (B)	SOSE	109	1	ug/g(dry)
Cadmium (Cd)	SOSE	< 0.5	0.5	ug/g(dry)
Calcium (Ca)	SOSE	6260	10	ug/g(dry)
Chromium (Cr)	SOSE	1110	0.5	ug/g(dry)
Cobalt (Co)	SOSE	45.1	0.5	ug/g(dry)
Copper (Cu)	SOSE	6.1	0.5	ug/g(dry)
Iron (Fe)	SOSE	29900	0.5	ug/g(dry)
Lead (Pb)	SOSE	< 5	5	ug/g(dry)
Magnesium (Mg)	SOSE	203000	100	ug/g(dry)
Manganese (Mn)	SOSE	623	0.1	ug/g(dry)
Molybdenum (Mo)	SOSE	< 1	1	ug/g(dry)
Nickel (Ni)	SOSE	1550	2	ug/g(dry)
Phosphorus (P)	SOSE	198	10	ug/g(dry)

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
PYLET Order No: 196376 - Client Sample ID: CLINTON WC-1 SED1				
Sampling Date: 8/11/2009 Start Time: 1630				
Potassium (K)	SOSE	84	10	ug/g(dry)
Selenium (Se)	SOSE	< 5	5	ug/g(dry)
Silicon (Si)	SOSE	245	5	ug/g(dry)
Silver (Ag)	SOSE	< 1	1	ug/g(dry)
Sodium (Na)	SOSE	16	10	ug/g(dry)
Strontium (Sr)	SOSE	26.0	0.1	ug/g(dry)
Sulfur (S)	SOSE	395	5	ug/g(dry)
Tin (Sn)	SOSE	13	5	ug/g(dry)
Titanium (Ti)	SOSE	16.5	0.2	ug/g(dry)
Vanadium (V)	SOSE	19	1	ug/g(dry)
Zinc (Zn)	SOSE	33.3	0.2	ug/g(dry)
***ICPMS, Tot.blockdig**				
Arsenic (As)	SOSE	14.0	0.1	ug/g (dry)
Selenium (Se)	SOSE	0.7	0.2	ug/g (dry)
***Mercury, total**				
Mercury (Hg)	SOSE	0.039	0.002	ug/g(dry)
PYLET Order No: 196377 - Client Sample ID: CLINTON WC-1 SED2				
Sampling Date: 8/11/2009 Start Time: 1630				

Metals

***ICP, Total blockdig**				
Aluminum (Al)	SOSE	4350	5	ug/g(dry)
Antimony (Sb)	SOSE	14	5	ug/g(dry)
Arsenic (As)	SOSE	12	5	ug/g(dry)
Barium (Ba)	SOSE	28.5	0.1	ug/g(dry)
Berylium (Be)	SOSE	< 0.1	0.1	ug/g(dry)
Boron (B)	SOSE	113	1	ug/g(dry)
Cadmium (Cd)	SOSE	< 0.5	0.5	ug/g(dry)
Calcium (Ca)	SOSE	4640	10	ug/g(dry)
Chromium (Cr)	SOSE	1100	0.5	ug/g(dry)
Cobalt (Co)	SOSE	49.3	0.5	ug/g(dry)
Copper (Cu)	SOSE	6.2	0.5	ug/g(dry)
Iron (Fe)	SOSE	26600	0.5	ug/g(dry)
Lead (Pb)	SOSE	< 5	5	ug/g(dry)
Magnesium (Mg)	SOSE	198000	100	ug/g(dry)
Manganese (Mn)	SOSE	655	0.1	ug/g(dry)
Molybdenum (Mo)	SOSE	< 1	1	ug/g(dry)
Nickel (Ni)	SOSE	1530	2	ug/g(dry)

TEST DESCRIPTION	MATRIX	RESULT	MDL	UNITS
PYLET Order No: 196377 - Client Sample ID: CLINTON WC-1 SED2				
Sampling Date: 8/11/2009 Start Time: 1630				
Phosphorus (P)	SOSE	138	10	ug/g(dry)
Potassium (K)	SOSE	73	10	ug/g(dry)
Selenium (Se)	SOSE	< 5	5	ug/g(dry)
Silicon (Si)	SOSE	248	5	ug/g(dry)
Silver (Ag)	SOSE	< 1	1	ug/g(dry)
Sodium (Na)	SOSE	11	10	ug/g(dry)
Strontium (Sr)	SOSE	21.2	0.1	ug/g(dry)
Sulfur (S)	SOSE	296	5	ug/g(dry)
Tin (Sn)	SOSE	13	5	ug/g(dry)
Titanium (Ti)	SOSE	16.3	0.2	ug/g(dry)
Vanadium (V)	SOSE	17	1	ug/g(dry)
Zinc (Zn)	SOSE	27.8	0.2	ug/g(dry)
***ICPMS, Tot.blockdig**				
Arsenic (As)	SOSE	9.8	0.1	ug/g (dry)
Selenium (Se)	SOSE	0.7	0.2	ug/g (dry)
***Mercury, total**				
Mercury (Hg)	SOSE	0.017	0.002	ug/g(dry)

QC Information:

***Acidity, Tot.&pH4.5** **UNITS:** mg CaCO3 / L **MATRIX:** FWGE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Acidity, Total	196784-1	< MDL	< 1		1	1	BLE
Acidity, Total	196785-1	25.0	24	95.6	1	1	REF
Acidity, Total	196786-1	50.0	46	91.6	1	1	REF
Acidity, Total	196787-1	886.750000	871	97.4	1	1	REF
Acidity, Total	196788-1	4	4	98.9	1	1	REP

***Alkalinity,TotpH4.5** **UNITS:** mg CaCO3 / L **MATRIX:** FWGE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Alkalinity to pH 4.5	196818-1	104.876000	105	98.8	1	0.5	REF
Alkalinity to pH 4.5	196823-1	27.3	27.6	101.0	1	0.5	REP
Alkalinity to pH 4.5	196826-1	166.7	164.5	98.7	1	0.5	REP
Alkalinity, Total	196799-1	< MDL	< 0.5		1	0.5	BLE
Alkalinity, Total	196820-1	12.3	12.3	100.0	1	0.5	REP
Alkalinity, Total	196828-1		< 0.5		1	0.5	REP

***ICA (Cl F SO4)** **UNITS:** mg/L **MATRIX:** FWGE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Chloride (Cl)	196569-1	< MDL	< 0.1		1	0.1	BLE
Chloride (Cl)	198038-1	< MDL	< 0.1		1	0.1	BLE
Chloride (Cl)	196573-1	3.28	2.7	82.3	1	0.1	REF
Chloride (Cl)	198042-1	3.28	3.5	106.7	1	0.1	REF
Chloride (Cl)	196576-1	1.0	1.0	99.9	1	0.1	REP
Chloride (Cl)	198046-1	0.6	0.6	103.1	1	0.1	REP
Fluoride (F)	196569-1	< MDL	< 0.01		1	0.01	BLE
Fluoride (F)	198038-1	< MDL	< 0.01		1	0.01	BLE
Fluoride (F)	196572-1	0.216	0.21	97.8	1	0.01	REF
Fluoride (F)	198041-1	0.216	0.24	113.0	1	0.01	REF
Fluoride (F)	196576-1		< 0.01		1	0.01	REP
Fluoride (F)	198046-1	0.09	0.08	91.3	1	0.01	REP
Sulphate (SO4)	196569-1	< MDL	< 0.5		1	0.5	BLE
Sulphate (SO4)	198038-1	< MDL	< 0.5		1	0.5	BLE
Sulphate (SO4)	196574-1	13.0	12.5	96.0	1	0.5	REF
Sulphate (SO4)	198043-1	13.0	12.9	99.5	1	0.5	REF
Sulphate (SO4)	196576-1	6.7	6.7	99.9	1	0.5	REP
Sulphate (SO4)	198046-1	8.3	8.3	100.1	1	0.5	REP

***ICP, Dissolved** **UNITS:** mg/L **MATRIX:** FWGE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Aluminum (Al)	197203-1	< MDL	< 0.05		1	0.05	BLE
Aluminum (Al)	198335-1	< MDL	< 0.05		1	0.05	BLE
Aluminum (Al)	197208-1	2.41412500	2.31	95.5	1	0.05	REF
Aluminum (Al)	197889-1	2.41412500	2.40	99.5	1	0.05	REF
Aluminum (Al)	197255-1		< 0.05		1	0.05	REP
Aluminum (Al)	197256-1		< 0.05		1	0.05	REP
Aluminum (Al)	197257-1		< 0.05		1	0.05	REP
Aluminum (Al)	197258-1		< 0.05		1	0.05	REP
Aluminum (Al)	197259-1		< 0.05		1	0.05	REP

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Aluminum (Al)	197890-1		< 0.05		1	0.05	REP
Aluminum (Al)	197891-1		< 0.05		1	0.05	REP
Aluminum (Al)	197892-1		< 0.05		1	0.05	REP
Antimony (Sb)	197203-1	< MDL	< 0.05		1	0.05	BLE
Antimony (Sb)	198335-1	< MDL	< 0.05		1	0.05	BLE
Antimony (Sb)	197208-1	0.76368750	0.75	98.2	1	0.05	REF
Antimony (Sb)	197889-1	0.76368750	0.75	98.1	1	0.05	REF
Antimony (Sb)	197255-1		< 0.05		1	0.05	REP
Antimony (Sb)	197256-1		< 0.05		1	0.05	REP
Antimony (Sb)	197257-1		< 0.05		1	0.05	REP
Antimony (Sb)	197258-1		< 0.05		1	0.05	REP
Antimony (Sb)	197259-1		< 0.05		1	0.05	REP
Antimony (Sb)	197890-1		< 0.05		1	0.05	REP
Antimony (Sb)	197891-1		< 0.05		1	0.05	REP
Antimony (Sb)	197892-1		< 0.05		1	0.05	REP
Arsenic (As)	197203-1	< MDL	< 0.05		1	0.05	BLE
Arsenic (As)	198335-1	< MDL	< 0.05		1	0.05	BLE
Arsenic (As)	197208-1	0.70158750	0.70	100.1	1	0.05	REF
Arsenic (As)	197889-1	0.70158750	0.70	99.8	1	0.05	REF
Arsenic (As)	197255-1		< 0.05		1	0.05	REP
Arsenic (As)	197256-1		< 0.05		1	0.05	REP
Arsenic (As)	197257-1		< 0.05		1	0.05	REP
Arsenic (As)	197258-1		< 0.05		1	0.05	REP
Arsenic (As)	197259-1		< 0.05		1	0.05	REP
Arsenic (As)	197890-1		< 0.05		1	0.05	REP
Arsenic (As)	197891-1		< 0.05		1	0.05	REP
Arsenic (As)	197892-1		< 0.05		1	0.05	REP
Barium (Ba)	197203-1	< MDL	< 0.001		1	0.001	BLE
Barium (Ba)	198335-1	< MDL	< 0.001		1	0.001	BLE
Barium (Ba)	197208-1	0.75565000	0.743	98.3	1	0.001	REF
Barium (Ba)	197889-1	0.75565000	0.747	98.8	1	0.001	REF
Barium (Ba)	197255-1	0.017	0.017	101.0	1	0.001	REP
Barium (Ba)	197256-1	0.007	0.007	99.6	1	0.001	REP
Barium (Ba)	197257-1		< 0.001		1	0.001	REP
Barium (Ba)	197258-1	0.064	0.064	100.6	1	0.001	REP
Barium (Ba)	197259-1	0.164	0.166	101.3	1	0.001	REP
Barium (Ba)	197890-1		< 0.001		1	0.001	REP
Barium (Ba)	197891-1	0.012	0.012	97.0	1	0.001	REP
Barium (Ba)	197892-1	0.096	0.096	99.9	1	0.001	REP
Berylium (Be)	197203-1	< MDL	< 0.001		1	0.001	BLE
Berylium (Be)	198335-1	< MDL	< 0.001		1	0.001	BLE
Berylium (Be)	197208-1	0.73023750	0.706	96.7	1	0.001	REF
Berylium (Be)	197889-1	0.73023750	0.718	98.4	1	0.001	REF
Berylium (Be)	197255-1		< 0.001		1	0.001	REP
Berylium (Be)	197256-1		< 0.001		1	0.001	REP
Berylium (Be)	197257-1		< 0.001		1	0.001	REP
Berylium (Be)	197258-1		< 0.001		1	0.001	REP
Berylium (Be)	197259-1		< 0.001		1	0.001	REP
Berylium (Be)	197890-1		< 0.001		1	0.001	REP
Berylium (Be)	197891-1		< 0.001		1	0.001	REP
Berylium (Be)	197892-1		< 0.001		1	0.001	REP
Boron (B)	197203-1	< MDL	< 0.01		1	0.01	BLE

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Boron (B)	198335-1	< MDL	< 0.01		1	0.01	BLE
Boron (B)	197208-1	1.27	1.24	97.3	1	0.01	REF
Boron (B)	197889-1	1.27	1.27	99.8	1	0.01	REF
Boron (B)	197255-1	0.02	0.02	99.4	1	0.01	REP
Boron (B)	197256-1	0.06	0.06	97.7	1	0.01	REP
Boron (B)	197257-1		< 0.01		1	0.01	REP
Boron (B)	197258-1	0.24	0.25	104.0	1	0.01	REP
Boron (B)	197259-1	0.15	0.15	98.2	1	0.01	REP
Boron (B)	197890-1		< 0.01		1	0.01	REP
Boron (B)	197891-1	0.03	0.03	97.0	1	0.01	REP
Boron (B)	197892-1		< 0.01		1	0.01	REP
Cadmium (Cd)	197203-1	< MDL	< 0.005		1	0.005	BLE
Cadmium (Cd)	198335-1	< MDL	< 0.005		1	0.005	BLE
Cadmium (Cd)	197208-1	0.32702500	0.318	97.2	1	0.005	REF
Cadmium (Cd)	197889-1	0.32702500	0.325	99.3	1	0.005	REF
Cadmium (Cd)	197255-1		< 0.005		1	0.005	REP
Cadmium (Cd)	197256-1		< 0.005		1	0.005	REP
Cadmium (Cd)	197257-1		< 0.005		1	0.005	REP
Cadmium (Cd)	197258-1		< 0.005		1	0.005	REP
Cadmium (Cd)	197259-1		< 0.005		1	0.005	REP
Cadmium (Cd)	197890-1		< 0.005		1	0.005	REP
Cadmium (Cd)	197891-1		< 0.005		1	0.005	REP
Cadmium (Cd)	197892-1		< 0.005		1	0.005	REP
Calcium (Ca)	197203-1	< MDL	< 0.1		1	0.1	BLE
Calcium (Ca)	198335-1	< MDL	< 0.1		1	0.1	BLE
Calcium (Ca)	197205-1	90.4	90.7	100.3	1	0.1	REF
Calcium (Ca)	197887-1	90.4	89.3	98.8	1	0.1	REF
Calcium (Ca)	197255-1	46.5	46.1	99.1	1	0.1	REP
Calcium (Ca)	197256-1	27.8	27.3	98.1	1	0.1	REP
Calcium (Ca)	197257-1		< 0.1		1	0.1	REP
Calcium (Ca)	197258-1	60.2	62.2	103.4	1	0.1	REP
Calcium (Ca)	197259-1	19.8	19.5	98.6	1	0.1	REP
Calcium (Ca)	197890-1		< 0.1		1	0.1	REP
Calcium (Ca)	197891-1	24.9	24.7	99.1	1	0.1	REP
Calcium (Ca)	197892-1	0.5	0.5	97.8	1	0.1	REP
Chromium (Cr)	197203-1	< MDL	< 0.005		1	0.005	BLE
Chromium (Cr)	198335-1	< MDL	< 0.005		1	0.005	BLE
Chromium (Cr)	197208-1	0.12023750	0.113	94.1	1	0.005	REF
Chromium (Cr)	197889-1	0.12023750	0.121	100.4	1	0.005	REF
Chromium (Cr)	197255-1		< 0.005		1	0.005	REP
Chromium (Cr)	197256-1		< 0.005		1	0.005	REP
Chromium (Cr)	197257-1		< 0.005		1	0.005	REP
Chromium (Cr)	197258-1		< 0.005		1	0.005	REP
Chromium (Cr)	197259-1		< 0.005		1	0.005	REP
Chromium (Cr)	197890-1		< 0.005		1	0.005	REP
Chromium (Cr)	197891-1		< 0.005		1	0.005	REP
Chromium (Cr)	197892-1		< 0.005		1	0.005	REP
Cobalt (Co)	197203-1	< MDL	< 0.005		1	0.005	BLE
Cobalt (Co)	198335-1	< MDL	< 0.005		1	0.005	BLE
Cobalt (Co)	197208-1	0.19761250	0.197	99.7	1	0.005	REF
Cobalt (Co)	197889-1	0.19761250	0.196	98.9	1	0.005	REF
Cobalt (Co)	197255-1		< 0.005		1	0.005	REP

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Cobalt (Co)	197256-1		< 0.005		1	0.005	REP
Cobalt (Co)	197257-1		< 0.005		1	0.005	REP
Cobalt (Co)	197258-1		< 0.005		1	0.005	REP
Cobalt (Co)	197259-1		< 0.005		1	0.005	REP
Cobalt (Co)	197890-1		< 0.005		1	0.005	REP
Cobalt (Co)	197891-1		< 0.005		1	0.005	REP
Cobalt (Co)	197892-1		< 0.005		1	0.005	REP
Copper (Cu)	197203-1	< MDL	< 0.005		1	0.005	BLE
Copper (Cu)	198335-1	< MDL	< 0.005		1	0.005	BLE
Copper (Cu)	197208-1	0.42848750	0.401	93.7	1	0.005	REF
Copper (Cu)	197889-1	0.42848750	0.432	100.7	1	0.005	REF
Copper (Cu)	197255-1		< 0.005		1	0.005	REP
Copper (Cu)	197256-1		< 0.005		1	0.005	REP
Copper (Cu)	197257-1		< 0.005		1	0.005	REP
Copper (Cu)	197258-1		< 0.005		1	0.005	REP
Copper (Cu)	197259-1		< 0.005		1	0.005	REP
Copper (Cu)	197890-1		< 0.005		1	0.005	REP
Copper (Cu)	197891-1		< 0.005		1	0.005	REP
Copper (Cu)	197892-1	0.669	0.671	100.4	1	0.005	REP
Iron (Fe)	197203-1	< MDL	< 0.005		1	0.005	BLE
Iron (Fe)	198335-1	< MDL	< 0.005		1	0.005	BLE
Iron (Fe)	197208-1	0.27560000	0.263	95.5	1	0.005	REF
Iron (Fe)	197889-1	0.27560000	0.276	100.3	1	0.005	REF
Iron (Fe)	197255-1		< 0.005		1	0.005	REP
Iron (Fe)	197256-1		< 0.005		1	0.005	REP
Iron (Fe)	197257-1		< 0.005		1	0.005	REP
Iron (Fe)	197258-1	0.009	0.009	105.4	1	0.005	REP
Iron (Fe)	197259-1		< 0.005		1	0.005	REP
Iron (Fe)	197890-1		< 0.005		1	0.005	REP
Iron (Fe)	197891-1		< 0.005		1	0.005	REP
Iron (Fe)	197892-1	0.195	0.196	100.6	1	0.005	REP
Lead (Pb)	197203-1	< MDL	< 0.05		1	0.05	BLE
Lead (Pb)	198335-1	< MDL	< 0.05		1	0.05	BLE
Lead (Pb)	197208-1	0.24082500	0.23	94.8	1	0.05	REF
Lead (Pb)	197889-1	0.24082500	0.24	100.9	1	0.05	REF
Lead (Pb)	197255-1		< 0.05		1	0.05	REP
Lead (Pb)	197256-1		< 0.05		1	0.05	REP
Lead (Pb)	197257-1		< 0.05		1	0.05	REP
Lead (Pb)	197258-1		< 0.05		1	0.05	REP
Lead (Pb)	197259-1		< 0.05		1	0.05	REP
Lead (Pb)	197890-1		< 0.05		1	0.05	REP
Lead (Pb)	197891-1		< 0.05		1	0.05	REP
Lead (Pb)	197892-1	0.93	0.93	100.3	1	0.05	REP
Magnesium (Mg)	197203-1	< MDL	< 0.1		1	0.1	BLE
Magnesium (Mg)	198335-1	< MDL	< 0.1		1	0.1	BLE
Magnesium (Mg)	197205-1	26.1	26.0	99.5	1	0.1	REF
Magnesium (Mg)	197887-1	26.1	25.6	98.2	1	0.1	REF
Magnesium (Mg)	197255-1	12.7	12.7	100.0	1	0.1	REP
Magnesium (Mg)	197256-1	6.1	5.9	96.1	1	0.1	REP
Magnesium (Mg)	197257-1		< 0.1		1	0.1	REP
Magnesium (Mg)	197258-1	81.0	80.9	99.9	1	0.1	REP
Magnesium (Mg)	197259-1	5.5	5.5	100.1	1	0.1	REP

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Magnesium (Mg)	197890-1		< 0.1		1	0.1	REP
Magnesium (Mg)	197891-1	6.0	6.0	99.8	1	0.1	REP
Magnesium (Mg)	197892-1		< 0.1		1	0.1	REP
Manganese (Mn)	197203-1	< MDL	< 0.001		1	0.001	BLE
Manganese (Mn)	198335-1	< MDL	< 0.001		1	0.001	BLE
Manganese (Mn)	197208-1	0.47850000	0.450	94.0	1	0.001	REF
Manganese (Mn)	197889-1	0.47850000	0.478	100.0	1	0.001	REF
Manganese (Mn)	197255-1		< 0.001		1	0.001	REP
Manganese (Mn)	197256-1		< 0.001		1	0.001	REP
Manganese (Mn)	197257-1		< 0.001		1	0.001	REP
Manganese (Mn)	197258-1	0.016	0.016	102.2	1	0.001	REP
Manganese (Mn)	197259-1	0.009	0.009	99.9	1	0.001	REP
Manganese (Mn)	197890-1		< 0.001		1	0.001	REP
Manganese (Mn)	197891-1	0.016	0.016	99.1	1	0.001	REP
Manganese (Mn)	197892-1	0.008	0.008	100.0	1	0.001	REP
Molybdenum (Mo)	197203-1	< MDL	< 0.01		1	0.01	BLE
Molybdenum (Mo)	198335-1	< MDL	< 0.01		1	0.01	BLE
Molybdenum (Mo)	197208-1	0.47242500	0.47	99.4	1	0.01	REF
Molybdenum (Mo)	197889-1	0.47242500	0.47	98.6	1	0.01	REF
Molybdenum (Mo)	197255-1		< 0.01		1	0.01	REP
Molybdenum (Mo)	197256-1		< 0.01		1	0.01	REP
Molybdenum (Mo)	197257-1		< 0.01		1	0.01	REP
Molybdenum (Mo)	197258-1		< 0.01		1	0.01	REP
Molybdenum (Mo)	197259-1		< 0.01		1	0.01	REP
Molybdenum (Mo)	197890-1		< 0.01		1	0.01	REP
Molybdenum (Mo)	197891-1		< 0.01		1	0.01	REP
Molybdenum (Mo)	197892-1		< 0.01		1	0.01	REP
Nickel (Ni)	197203-1	< MDL	< 0.02		1	0.02	BLE
Nickel (Ni)	198335-1	< MDL	< 0.02		1	0.02	BLE
Nickel (Ni)	197208-1	0.20178750	0.19	95.2	1	0.02	REF
Nickel (Ni)	197889-1	0.20178750	0.20	100.0	1	0.02	REF
Nickel (Ni)	197255-1		< 0.02		1	0.02	REP
Nickel (Ni)	197256-1		< 0.02		1	0.02	REP
Nickel (Ni)	197257-1		< 0.02		1	0.02	REP
Nickel (Ni)	197258-1		< 0.02		1	0.02	REP
Nickel (Ni)	197259-1		< 0.02		1	0.02	REP
Nickel (Ni)	197890-1		< 0.02		1	0.02	REP
Nickel (Ni)	197891-1		< 0.02		1	0.02	REP
Nickel (Ni)	197892-1		< 0.02		1	0.02	REP
Phosphorus (P)	197203-1	< MDL	< 0.1		1	0.1	BLE
Phosphorus (P)	198335-1	< MDL	< 0.1		1	0.1	BLE
Phosphorus (P)	197255-1		< 0.1		1	0.1	REP
Phosphorus (P)	197256-1		< 0.1		1	0.1	REP
Phosphorus (P)	197257-1		< 0.1		1	0.1	REP
Phosphorus (P)	197258-1		0.1		1	0.1	REP
Phosphorus (P)	197259-1		< 0.1		1	0.1	REP
Phosphorus (P)	197890-1		< 0.1		1	0.1	REP
Phosphorus (P)	197891-1		< 0.1		1	0.1	REP
Phosphorus (P)	197892-1		< 0.1		1	0.1	REP
Potassium (K)	197203-1	< MDL	< 0.1		1	0.1	BLE
Potassium (K)	198335-1	< MDL	< 0.1		1	0.1	BLE
Potassium (K)	197205-1	4.01	4.0	99.3	1	0.1	REF

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Potassium (K)	197887-1	4.01	4.0	98.7	1	0.1	REF
Potassium (K)	197255-1	1.7	1.7	99.1	1	0.1	REP
Potassium (K)	197256-1	3.0	2.9	96.9	1	0.1	REP
Potassium (K)	197257-1		< 0.1		1	0.1	REP
Potassium (K)	197258-1	1.2	1.2	99.1	1	0.1	REP
Potassium (K)	197259-1	16.5	16.9	102.1	1	0.1	REP
Potassium (K)	197890-1		< 0.1		1	0.1	REP
Potassium (K)	197891-1	1.0	1.0	98.0	1	0.1	REP
Potassium (K)	197892-1		< 0.1		1	0.1	REP
Selenium (Se)	197203-1	< MDL	< 0.05		1	0.05	BLE
Selenium (Se)	198335-1	< MDL	< 0.05		1	0.05	BLE
Selenium (Se)	197208-1	0.12665000	0.13	99.2	1	0.05	REF
Selenium (Se)	197889-1	0.12665000	0.13	100.3	1	0.05	REF
Selenium (Se)	197255-1		< 0.05		1	0.05	REP
Selenium (Se)	197256-1		< 0.05		1	0.05	REP
Selenium (Se)	197257-1		< 0.05		1	0.05	REP
Selenium (Se)	197258-1		< 0.05		1	0.05	REP
Selenium (Se)	197259-1		< 0.05		1	0.05	REP
Selenium (Se)	197890-1		< 0.05		1	0.05	REP
Selenium (Se)	197891-1		< 0.05		1	0.05	REP
Selenium (Se)	197892-1		< 0.05		1	0.05	REP
Silicon (Si)	197203-1	< MDL	< 0.05		1	0.05	BLE
Silicon (Si)	198335-1	< MDL	< 0.05		1	0.05	BLE
Silicon (Si)	197205-1	1.19	1.17	98.5	1	0.05	REF
Silicon (Si)	197887-1	1.19	1.21	101.7	1	0.05	REF
Silicon (Si)	197255-1	9.98	9.96	99.8	1	0.05	REP
Silicon (Si)	197256-1	6.37	6.20	97.3	1	0.05	REP
Silicon (Si)	197257-1		< 0.05		1	0.05	REP
Silicon (Si)	197258-1	4.56	4.70	103.1	1	0.05	REP
Silicon (Si)	197259-1	6.25	6.22	99.5	1	0.05	REP
Silicon (Si)	197890-1		< 0.05		1	0.05	REP
Silicon (Si)	197891-1	11.1	11.1	100.3	1	0.05	REP
Silicon (Si)	197892-1		< 0.05		1	0.05	REP
Silver (Ag)	197203-1	< MDL	< 0.01		1	0.01	BLE
Silver (Ag)	198335-1	< MDL	< 0.01		1	0.01	BLE
Silver (Ag)	197255-1		< 0.01		1	0.01	REP
Silver (Ag)	197256-1		< 0.01		1	0.01	REP
Silver (Ag)	197257-1		< 0.01		1	0.01	REP
Silver (Ag)	197258-1		< 0.01		1	0.01	REP
Silver (Ag)	197259-1		< 0.01		1	0.01	REP
Silver (Ag)	197890-1		< 0.01		1	0.01	REP
Silver (Ag)	197891-1		< 0.01		1	0.01	REP
Silver (Ag)	197892-1		< 0.01		1	0.01	REP
Sodium (Na)	197203-1	< MDL	< 0.1		1	0.1	BLE
Sodium (Na)	198335-1	< MDL	< 0.1		1	0.1	BLE
Sodium (Na)	197205-1	50.1	51.9	103.6	1	0.1	REF
Sodium (Na)	197887-1	50.1	49.7	99.1	1	0.1	REF
Sodium (Na)	197255-1	7.9	8.1	102.4	1	0.1	REP
Sodium (Na)	197256-1	6.7	6.7	100.0	1	0.1	REP
Sodium (Na)	197257-1		< 0.1		1	0.1	REP
Sodium (Na)	197258-1	5.2	5.4	103.2	1	0.1	REP
Sodium (Na)	197259-1	5.9	5.8	98.4	1	0.1	REP

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Sodium (Na)	197890-1		< 0.1		1	0.1	REP
Sodium (Na)	197891-1	7.9	7.6	96.8	1	0.1	REP
Sodium (Na)	197892-1	0.2	0.2	98.3	1	0.1	REP
Strontium (Sr)	197203-1	< MDL	< 0.001		1	0.001	BLE
Strontium (Sr)	198335-1	< MDL	< 0.001		1	0.001	BLE
Strontium (Sr)	197208-1	0.25590000	0.251	98.0	1	0.001	REF
Strontium (Sr)	197889-1	0.25590000	0.252	98.5	1	0.001	REF
Strontium (Sr)	197255-1	0.168	0.167	99.5	1	0.001	REP
Strontium (Sr)	197256-1	0.232	0.229	98.9	1	0.001	REP
Strontium (Sr)	197257-1		< 0.001		1	0.001	REP
Strontium (Sr)	197258-1	0.421	0.420	99.8	1	0.001	REP
Strontium (Sr)	197259-1	0.158	0.161	102.0	1	0.001	REP
Strontium (Sr)	197890-1		< 0.001		1	0.001	REP
Strontium (Sr)	197891-1	0.123	0.122	98.9	1	0.001	REP
Strontium (Sr)	197892-1	0.005	0.005	100.2	1	0.001	REP
Sulfur (S)	197203-1	< MDL	< 0.05		1	0.05	BLE
Sulfur (S)	198335-1	< MDL	< 0.05		1	0.05	BLE
Sulfur (S)	197205-1	37.9	37.4	98.5	1	0.05	REF
Sulfur (S)	197887-1	37.9	39.2	103.4	1	0.05	REF
Sulfur (S)	197255-1	11	11	101.3	1	0.05	REP
Sulfur (S)	197256-1	9.50	9.18	96.6	1	0.05	REP
Sulfur (S)	197257-1		< 0.05		1	0.05	REP
Sulfur (S)	197258-1	83.1	86.5	104.1	1	0.05	REP
Sulfur (S)	197259-1	9.25	9.23	99.8	1	0.05	REP
Sulfur (S)	197890-1		< 0.05		1	0.05	REP
Sulfur (S)	197891-1	6.85	6.84	99.9	1	0.05	REP
Sulfur (S)	197892-1	1.87	1.87	99.9	1	0.05	REP
Tin (Sn)	197203-1	< MDL	< 0.05		1	0.05	BLE
Tin (Sn)	198335-1	< MDL	< 0.05		1	0.05	BLE
Tin (Sn)	197207-1	3.080	2.94	95.4	1	0.05	REF
Tin (Sn)	197888-1	3.080	2.97	96.3	1	0.05	REF
Tin (Sn)	197255-1		< 0.05		1	0.05	REP
Tin (Sn)	197256-1		< 0.05		1	0.05	REP
Tin (Sn)	197257-1		< 0.05		1	0.05	REP
Tin (Sn)	197258-1	0.06	0.06	102.5	1	0.05	REP
Tin (Sn)	197259-1		< 0.05		1	0.05	REP
Tin (Sn)	197890-1		< 0.05		1	0.05	REP
Tin (Sn)	197891-1		< 0.05		1	0.05	REP
Tin (Sn)	197892-1		< 0.05		1	0.05	REP
Titanium (Ti)	197203-1	< MDL	< 0.002		1	0.002	BLE
Titanium (Ti)	198335-1	< MDL	< 0.002		1	0.002	BLE
Titanium (Ti)	197207-1	0.170	0.169	99.2	1	0.002	REF
Titanium (Ti)	197888-1	0.170	0.173	101.5	1	0.002	REF
Titanium (Ti)	197255-1		< 0.002		1	0.002	REP
Titanium (Ti)	197256-1		< 0.002		1	0.002	REP
Titanium (Ti)	197257-1		< 0.002		1	0.002	REP
Titanium (Ti)	197258-1		< 0.002		1	0.002	REP
Titanium (Ti)	197259-1		< 0.002		1	0.002	REP
Titanium (Ti)	197890-1		< 0.002		1	0.002	REP
Titanium (Ti)	197891-1		< 0.002		1	0.002	REP
Titanium (Ti)	197892-1		< 0.002		1	0.002	REP
Vanadium (V)	197203-1	< MDL	< 0.01		1	0.01	BLE

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Vanadium (V)	198335-1	< MDL	< 0.01		1	0.01	BLE
Vanadium (V)	197208-1	0.73566250	0.73	99.7	1	0.01	REF
Vanadium (V)	197889-1	0.73566250	0.73	99.4	1	0.01	REF
Vanadium (V)	197255-1		< 0.01		1	0.01	REP
Vanadium (V)	197256-1		< 0.01		1	0.01	REP
Vanadium (V)	197257-1		< 0.01		1	0.01	REP
Vanadium (V)	197258-1		< 0.01		1	0.01	REP
Vanadium (V)	197259-1		< 0.01		1	0.01	REP
Vanadium (V)	197890-1		< 0.01		1	0.01	REP
Vanadium (V)	197891-1		< 0.01		1	0.01	REP
Vanadium (V)	197892-1		< 0.01		1	0.01	REP
Zinc (Zn)	197203-1	< MDL	< 0.05		1	0.05	BLE
Zinc (Zn)	198335-1	< MDL	< 0.05		1	0.05	BLE
Zinc (Zn)	197208-1	0.61860000	0.62	99.5	1	0.05	REF
Zinc (Zn)	197889-1	0.61860000	0.61	98.2	1	0.05	REF
Zinc (Zn)	197255-1		< 0.05		1	0.05	REP
Zinc (Zn)	197256-1		< 0.05		1	0.05	REP
Zinc (Zn)	197257-1		< 0.05		1	0.05	REP
Zinc (Zn)	197258-1		< 0.05		1	0.05	REP
Zinc (Zn)	197259-1		< 0.05		1	0.05	REP
Zinc (Zn)	197890-1		< 0.05		1	0.05	REP
Zinc (Zn)	197891-1		< 0.05		1	0.05	REP
Zinc (Zn)	197892-1	0.53	0.53	99.8	1	0.05	REP

***ICP, Extractable UNITS:** mg/L **MATRIX:** FWGE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Aluminum (Al)	197051-1	< MDL	< 0.05		1	0.05	BLE
Aluminum (Al)	197057-1	2.42525000	2.51	98.6	1	0.05	REF
Aluminum (Al)	197062-1		< 0.05		1	0.05	REP
Antimony (Sb)	197051-1	< MDL	< 0.05		1	0.05	BLE
Antimony (Sb)	197057-1	0.76077500	0.76	99.9	1	0.05	REF
Antimony (Sb)	197062-1		< 0.05		1	0.05	REP
Arsenic (As)	197051-1	< MDL	< 0.05		1	0.05	BLE
Arsenic (As)	197057-1	0.69618750	0.71	98.8	1	0.05	REF
Arsenic (As)	197062-1		< 0.05		1	0.05	REP
Barium (Ba)	197051-1	< MDL	< 0.001		1	0.001	BLE
Barium (Ba)	197057-1	0.75385000	0.788	102.8	1	0.001	REF
Barium (Ba)	197062-1	0.067	0.065	97.6	1	0.001	REP
Berylium (Be)	197051-1	< MDL	< 0.001		1	0.001	BLE
Berylium (Be)	197057-1	0.72841250	0.749	105.3	1	0.001	REF
Berylium (Be)	197062-1		< 0.001		1	0.001	REP
Boron (B)	197051-1	< MDL	< 0.01		1	0.01	BLE
Boron (B)	197057-1	1.27525000	1.27	102.6	1	0.01	REF
Boron (B)	197062-1	0.25	0.25	101.8	1	0.01	REP
Cadmium (Cd)	197051-1	< MDL	< 0.005		1	0.005	BLE
Cadmium (Cd)	197057-1	0.32520000	0.331	101.6	1	0.005	REF
Cadmium (Cd)	197062-1		< 0.005		1	0.005	REP
Calcium (Ca)	197051-1	< MDL	< 0.1		1	0.1	BLE
Calcium (Ca)	197053-1	91.0598113	94.1	103.9	1	0.1	REF
Calcium (Ca)	197062-1	62.9	62.6	99.5	1	0.1	REP
Chromium (Cr)	197051-1	< MDL	< 0.005		1	0.005	BLE
Chromium (Cr)	197057-1	0.12082500	0.125	98.9	1	0.005	REF

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Chromium (Cr)	197062-1		< 0.005		1	0.005	REP
Cobalt (Co)	197051-1	< MDL	< 0.005		1	0.005	BLE
Cobalt (Co)	197057-1	0.19741250	0.204	104.6	1	0.005	REF
Cobalt (Co)	197062-1		< 0.005		1	0.005	REP
Copper (Cu)	197051-1	< MDL	< 0.005		1	0.005	BLE
Copper (Cu)	197057-1	0.43008750	0.436	104.7	1	0.005	REF
Copper (Cu)	197062-1		< 0.005		1	0.005	REP
Iron (Fe)	197051-1	< MDL	< 0.005		1	0.005	BLE
Iron (Fe)	197057-1	0.27700000	0.284	111.0	1	0.005	REF
Iron (Fe)	197062-1	0.013	0.013	100.9	1	0.005	REP
Lead (Pb)	197051-1	< MDL	< 0.05		1	0.05	BLE
Lead (Pb)	197057-1	0.24053750	0.24	101.3	1	0.05	REF
Lead (Pb)	197062-1		< 0.05		1	0.05	REP
Magnesium (Mg)	197051-1	< MDL	< 0.1		1	0.1	BLE
Magnesium (Mg)	197053-1	25.9630188	27.0	104.5	1	0.1	REF
Magnesium (Mg)	197062-1	85.3	83.5	97.9	1	0.1	REP
Manganese (Mn)	197051-1	< MDL	< 0.001		1	0.001	BLE
Manganese (Mn)	197057-1	0.48112500	0.494	106.5	1	0.001	REF
Manganese (Mn)	197062-1	0.017	0.017	100.0	1	0.001	REP
Molybdenum (Mo)	197051-1	< MDL	< 0.01		1	0.01	BLE
Molybdenum (Mo)	197057-1	0.47216250	0.48	101.1	1	0.01	REF
Molybdenum (Mo)	197062-1		< 0.01		1	0.01	REP
Nickel (Ni)	197051-1	< MDL	< 0.02		1	0.02	BLE
Nickel (Ni)	197057-1	0.20253750	0.21	100.3	1	0.02	REF
Nickel (Ni)	197062-1	0.02	0.02	99.3	1	0.02	REP
Phosphorus (P)	197051-1	< MDL	< 0.1		1	0.1	BLE
Phosphorus (P)	197062-1	0.3	0.2	71.8	1	0.1	REP
Potassium (K)	197051-1	< MDL	< 0.1		1	0.1	BLE
Potassium (K)	197053-1	4.01	4.1	102.3	1	0.1	REF
Potassium (K)	197062-1	1.2	1.2	97.4	1	0.1	REP
Selenium (Se)	197051-1	< MDL	< 0.05		1	0.05	BLE
Selenium (Se)	197057-1	0.12635000	0.13	101.7	1	0.05	REF
Selenium (Se)	197062-1		< 0.05		1	0.05	REP
Silicon (Si)	197051-1	< MDL	< 0.05		1	0.05	BLE
Silicon (Si)	197053-1	1.17988679	1.19	101.6	1	0.05	REF
Silicon (Si)	197062-1	4.70	4.69	99.7	1	0.05	REP
Silver (Ag)	197051-1	< MDL	< 0.01		1	0.01	BLE
Silver (Ag)	197062-1		< 0.01		1	0.01	REP
Sodium (Na)	197051-1	< MDL	< 0.1		1	0.1	BLE
Sodium (Na)	197053-1	49.8567924	51.9	104.1	1	0.1	REF
Sodium (Na)	197062-1	5.4	5.4	100.7	1	0.1	REP
Strontium (Sr)	197051-1	< MDL	< 0.001		1	0.001	BLE
Strontium (Sr)	197057-1	0.25538750	0.265	103.1	1	0.001	REF
Strontium (Sr)	197062-1	0.439	0.428	97.6	1	0.001	REP
Sulfur (S)	197051-1	< MDL	< 0.05		1	0.05	BLE
Sulfur (S)	197053-1	38.2357547	41.1	108.7	1	0.05	REF
Sulfur (S)	197062-1	84.5	84.1	99.6	1	0.05	REP
Tin (Sn)	197051-1	< MDL	< 0.05		1	0.05	BLE
Tin (Sn)	197055-1	3.03550000	3.02	98.0	1	0.05	REF
Tin (Sn)	197062-1	0.07	0.07	103.0	1	0.05	REP
Titanium (Ti)	197051-1	< MDL	< 0.002		1	0.002	BLE
Titanium (Ti)	197055-1	0.16782500	0.169	99.2	1	0.002	REF

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Titanium (Ti)	197062-1		< 0.002		1	0.002	REP
Vanadium (V)	197051-1	< MDL	< 0.01		1	0.01	BLE
Vanadium (V)	197057-1	0.73293750	0.75	101.5	1	0.01	REF
Vanadium (V)	197062-1		< 0.01		1	0.01	REP
Zinc (Zn)	197051-1	< MDL	< 0.05		1	0.05	BLE
Zinc (Zn)	197057-1	0.61745000	0.63	104.5	1	0.05	REF
Zinc (Zn)	197062-1		< 0.05		1	0.05	REP

***ICP, Total UNITS:** mg/L **MATRIX:** FWGE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Aluminum (Al)	198327-1	< MDL	< 0.06		1	0.06	BLL
Aluminum (Al)	198330-1	2.40650000	2.34	92.0	1	0.06	REF
Aluminum (Al)	198331-1	0.13	0.12	95.7	1	0.06	REP
Aluminum (Al)	198332-1		< 0.06		1	0.06	REP
Aluminum (Al)	198333-1		< 0.06		1	0.06	REP
Aluminum (Al)	198334-1		< 0.06		1	0.06	REP
Antimony (Sb)	198327-1	< MDL	< 0.06		1	0.06	BLL
Antimony (Sb)	198330-1	0.76760000	0.74	96.1	1	0.06	REF
Antimony (Sb)	198331-1		< 0.06		1	0.06	REP
Antimony (Sb)	198332-1		< 0.06		1	0.06	REP
Antimony (Sb)	198333-1		< 0.06		1	0.06	REP
Antimony (Sb)	198334-1		< 0.06		1	0.06	REP
Arsenic (As)	198327-1	< MDL	< 0.06		1	0.06	BLL
Arsenic (As)	198330-1	0.70952500	0.68	94.7	1	0.06	REF
Arsenic (As)	198331-1		< 0.06		1	0.06	REP
Arsenic (As)	198332-1		< 0.06		1	0.06	REP
Arsenic (As)	198333-1		0.07		1	0.06	REP
Arsenic (As)	198334-1	0.12	0.12	97.1	1	0.06	REP
Barium (Ba)	198327-1	< MDL	< 0.001		1	0.001	BLL
Barium (Ba)	198330-1	0.76757500	0.722	94.3	1	0.001	REF
Barium (Ba)	198331-1	0.106	0.103	97.0	1	0.001	REP
Barium (Ba)	198332-1		< 0.001		1	0.001	REP
Barium (Ba)	198333-1	0.047	0.046	97.3	1	0.001	REP
Barium (Ba)	198334-1	0.025	0.024	96.3	1	0.001	REP
Berylium (Be)	198327-1	< MDL	< 0.001		1	0.001	BLL
Berylium (Be)	198330-1	0.72278750	0.684	96.1	1	0.001	REF
Berylium (Be)	198331-1		< 0.001		1	0.001	REP
Berylium (Be)	198332-1		< 0.001		1	0.001	REP
Berylium (Be)	198333-1		< 0.001		1	0.001	REP
Berylium (Be)	198334-1		< 0.001		1	0.001	REP
Boron (B)	198327-1	< MDL	0.02		1	0.01	BLL
Boron (B)	198330-1	1.28687500	1.24	100.1	1	0.01	REF
Boron (B)	198331-1		< 0.01		1	0.01	REP
Boron (B)	198332-1		< 0.01		1	0.01	REP
Boron (B)	198333-1		< 0.01		1	0.01	REP
Boron (B)	198334-1	0.02	0.02	98.3	1	0.01	REP
Cadmium (Cd)	198327-1	< MDL	< 0.006		1	0.006	BLL
Cadmium (Cd)	198330-1	0.32595000	0.311	95.5	1	0.006	REF
Cadmium (Cd)	198331-1	0.026	0.024	91.2	1	0.006	REP
Cadmium (Cd)	198332-1		< 0.006		1	0.006	REP
Cadmium (Cd)	198333-1		< 0.006		1	0.006	REP
Cadmium (Cd)	198334-1		< 0.006		1	0.006	REP

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Calcium (Ca)	198327-1	< MDL	< 0.1		1	0.1	BLL
Calcium (Ca)	198328-1	90.2	88.9	98.6	1	0.1	REF
Calcium (Ca)	198331-1	0.6	0.6	99.1	1	0.1	REP
Calcium (Ca)	198332-1		< 0.1		1	0.1	REP
Calcium (Ca)	198333-1	28.6	29.2	102.1	1	0.1	REP
Calcium (Ca)	198334-1	109	108	99.2	1	0.1	REP
Chromium (Cr)	198327-1	< MDL	< 0.006		1	0.006	BLL
Chromium (Cr)	198330-1	0.12633750	0.123	97.6	1	0.006	REF
Chromium (Cr)	198331-1		< 0.006		1	0.006	REP
Chromium (Cr)	198332-1		< 0.006		1	0.006	REP
Chromium (Cr)	198333-1		< 0.006		1	0.006	REP
Chromium (Cr)	198334-1		< 0.006		1	0.006	REP
Cobalt (Co)	198327-1	< MDL	< 0.006		1	0.006	BLL
Cobalt (Co)	198330-1	0.20077500	0.197	101.2	1	0.006	REF
Cobalt (Co)	198331-1		< 0.006		1	0.006	REP
Cobalt (Co)	198332-1		< 0.006		1	0.006	REP
Cobalt (Co)	198333-1		< 0.006		1	0.006	REP
Cobalt (Co)	198334-1		< 0.006		1	0.006	REP
Copper (Cu)	198327-1	< MDL	< 0.02		1	0.02	BLL
Copper (Cu)	198330-1	0.43326250	0.43	103.9	1	0.02	REF
Copper (Cu)	198331-1	3.16	2.78	87.9	1	0.02	REP
Copper (Cu)	198332-1	0.10	0.10	98.9	1	0.02	REP
Copper (Cu)	198333-1		< 0.02		1	0.02	REP
Copper (Cu)	198334-1		< 0.02		1	0.02	REP
Iron (Fe)	198327-1	< MDL	< 0.05		1	0.05	BLL
Iron (Fe)	198330-1	0.27996250	0.28	108.4	1	0.05	REF
Iron (Fe)	198331-1	2.49	2.18	87.4	1	0.006	REP
Iron (Fe)	198332-1		< 0.006		1	0.006	REP
Iron (Fe)	198333-1		< 0.05		1	0.05	REP
Iron (Fe)	198334-1	0.13	0.13	99.7	1	0.05	REP
Lead (Pb)	198327-1	< MDL	< 0.06		1	0.06	BLL
Lead (Pb)	198330-1	0.24558750	0.24	101.6	1	0.06	REF
Lead (Pb)	198331-1	1.24	1.19	95.8	1	0.06	REP
Lead (Pb)	198332-1		< 0.06		1	0.06	REP
Lead (Pb)	198333-1		< 0.06		1	0.06	REP
Lead (Pb)	198334-1		< 0.06		1	0.06	REP
Magnesium (Mg)	198327-1	< MDL	< 0.1		1	0.1	BLL
Magnesium (Mg)	198328-1	25.7	25.5	99.1	1	0.1	REF
Magnesium (Mg)	198331-1		< 0.1		1	0.1	REP
Magnesium (Mg)	198332-1		< 0.1		1	0.1	REP
Magnesium (Mg)	198333-1	10.2	10.4	101.8	1	0.1	REP
Magnesium (Mg)	198334-1	12.2	11.9	97.9	1	0.1	REP
Manganese (Mn)	198327-1	< MDL	< 0.001		1	0.001	BLL
Manganese (Mn)	198330-1	0.48597500	0.467	100.6	1	0.001	REF
Manganese (Mn)	198331-1	0.011	0.011	99.3	1	0.001	REP
Manganese (Mn)	198332-1		< 0.001		1	0.001	REP
Manganese (Mn)	198333-1		< 0.001		1	0.001	REP
Manganese (Mn)	198334-1	0.041	0.041	100.0	1	0.001	REP
Molybdenum (Mo)	198327-1	< MDL	< 0.01		1	0.01	BLL
Molybdenum (Mo)	198330-1	0.48192500	0.47	99.2	1	0.01	REF
Molybdenum (Mo)	198331-1		< 0.01		1	0.01	REP
Molybdenum (Mo)	198332-1		< 0.01		1	0.01	REP

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Molybdenum (Mo)	198333-1		< 0.01		1	0.01	REP
Molybdenum (Mo)	198334-1	<0.01	0.01	100.5	1	0.01	REP
Nickel (Ni)	198327-1	< MDL	< 0.02		1	0.02	BLL
Nickel (Ni)	198330-1	0.20857500	0.20	97.4	1	0.02	REF
Nickel (Ni)	198331-1		< 0.02		1	0.02	REP
Nickel (Ni)	198332-1		< 0.02		1	0.02	REP
Nickel (Ni)	198333-1		< 0.02		1	0.02	REP
Nickel (Ni)	198334-1		< 0.02		1	0.02	REP
Phosphorus (P)	198327-1	< MDL	0.2		1	0.1	BLL
Phosphorus (P)	198331-1	0.2	0.2	114.8	1	0.1	REP
Phosphorus (P)	198332-1	0.1	0.1	92.2	1	0.1	REP
Phosphorus (P)	198333-1	0.3	0.3	87.2	1	0.1	REP
Phosphorus (P)	198334-1	0.4	0.5	119.2	1	0.1	REP
Potassium (K)	198327-1	< MDL	< 0.1		1	0.1	BLL
Potassium (K)	198328-1	3.97	3.9	99.0	1	0.1	REF
Potassium (K)	198331-1		< 0.1		1	0.1	REP
Potassium (K)	198332-1		< 0.1		1	0.1	REP
Potassium (K)	198333-1	0.2	0.2	91.3	1	0.1	REP
Potassium (K)	198334-1	9.9	9.9	100.2	1	0.1	REP
Selenium (Se)	198327-1	< MDL	< 0.06		1	0.06	BLL
Selenium (Se)	198330-1	0.13255000	0.12	96.8	1	0.06	REF
Selenium (Se)	198331-1		< 0.06		1	0.06	REP
Selenium (Se)	198332-1		< 0.06		1	0.06	REP
Selenium (Se)	198333-1		< 0.06		1	0.06	REP
Selenium (Se)	198334-1		< 0.06		1	0.06	REP
Silicon (Si)	198327-1	< MDL	< 0.06		1	0.06	BLL
Silicon (Si)	198328-1	1.19	1.09	91.4	1	0.06	REF
Silicon (Si)	198331-1	0.28	0.28	99.2	1	0.06	REP
Silicon (Si)	198332-1		< 0.06		1	0.06	REP
Silicon (Si)	198333-1	0.89	0.92	103.0	1	0.06	REP
Silicon (Si)	198334-1	3.35	3.30	98.4	1	0.06	REP
Silver (Ag)	198327-1	< MDL	0.02		1	0.01	BLL
Silver (Ag)	198331-1	0.03	0.03	103.2	1	0.01	REP
Silver (Ag)	198332-1	0.01	0.01	98.9	1	0.01	REP
Silver (Ag)	198333-1		< 0.01		1	0.01	REP
Silver (Ag)	198334-1		0.02		1	0.01	REP
Sodium (Na)	198327-1	< MDL	< 0.1		1	0.1	BLL
Sodium (Na)	198328-1	49.6	49.7	100.3	1	0.1	REF
Sodium (Na)	198331-1	0.2	0.2	100.3	1	0.1	REP
Sodium (Na)	198332-1		< 0.1		1	0.1	REP
Sodium (Na)	198333-1	1.9	1.9	102.0	1	0.1	REP
Sodium (Na)	198334-1	3.6	3.4	94.4	1	0.1	REP
Strontium (Sr)	198327-1	< MDL	< 0.001		1	0.001	BLL
Strontium (Sr)	198330-1	0.26087500	0.249	96.8	1	0.001	REF
Strontium (Sr)	198331-1	0.006	0.006	96.4	1	0.001	REP
Strontium (Sr)	198332-1		< 0.001		1	0.001	REP
Strontium (Sr)	198333-1	0.078	0.076	97.6	1	0.001	REP
Strontium (Sr)	198334-1	0.981	0.951	97.0	1	0.001	REP
Sulfur (S)	198327-1	< MDL	< 0.06		1	0.06	BLL
Sulfur (S)	198328-1	37.6	36.7	97.7	1	0.06	REF
Sulfur (S)	198331-1	4.25	3.95	93.0	1	0.06	REP
Sulfur (S)	198332-1		< 0.06		1	0.06	REP

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Sulfur (S)	198333-1	10.5	10.7	102.0	1	0.06	REP
Sulfur (S)	198334-1	55.5	54.6	98.3	1	0.06	REP
Tin (Sn)	198327-1	< MDL	< 0.06		1	0.06	BLL
Tin (Sn)	198329-1	3.080	2.98	96.7	1	0.06	REF
Tin (Sn)	198331-1		< 0.06		1	0.06	REP
Tin (Sn)	198332-1		< 0.06		1	0.06	REP
Tin (Sn)	198333-1		< 0.06		1	0.06	REP
Tin (Sn)	198334-1		< 0.06		1	0.06	REP
Titanium (Ti)	198327-1	< MDL	< 0.002		1	0.002	BLL
Titanium (Ti)	198329-1	0.170	0.164	96.2	1	0.002	REF
Titanium (Ti)	198331-1	0.007	0.007	98.8	1	0.002	REP
Titanium (Ti)	198332-1		< 0.002		1	0.002	REP
Titanium (Ti)	198333-1		< 0.002		1	0.002	REP
Titanium (Ti)	198334-1		< 0.002		1	0.002	REP
Vanadium (V)	198327-1	< MDL	< 0.01		1	0.01	BLL
Vanadium (V)	198330-1	0.74800000	0.71	97.0	1	0.01	REF
Vanadium (V)	198331-1		< 0.01		1	0.01	REP
Vanadium (V)	198332-1		< 0.01		1	0.01	REP
Vanadium (V)	198333-1		< 0.01		1	0.01	REP
Vanadium (V)	198334-1		< 0.01		1	0.01	REP
Zinc (Zn)	198327-1	< MDL	< 0.05		1	0.05	BLL
Zinc (Zn)	198330-1	0.61511250	0.61	101.7	1	0.05	REF
Zinc (Zn)	198331-1	4.58	4.13	90.1	1	0.05	REP
Zinc (Zn)	198332-1		< 0.05		1	0.05	REP
Zinc (Zn)	198333-1		< 0.05		1	0.05	REP
Zinc (Zn)	198334-1	0.07	0.07	96.2	1	0.05	REP

***ICP, Total blockdig** **UNITS:** ug/g(dry) **MATRIX:** SOSE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Aluminum (Al)	197471-1	< MDL	< 5		1	5	BLL
Aluminum (Al)	197475-1	13650	13400	98.2	1	5	REF
Aluminum (Al)	197477-1	10,600	9590	90.5	1	5	REP
Aluminum (Al)	197479-1	8,800	9930	112.8	1	5	REP
Antimony (Sb)	197471-1	< MDL	< 5		1	5	BLL
Antimony (Sb)	197477-1		< 5		1	5	REP
Antimony (Sb)	197479-1		< 5		1	5	REP
Arsenic (As)	197471-1	< MDL	< 5		1	5	BLL
Arsenic (As)	197477-1		< 5		1	5	REP
Arsenic (As)	197479-1		< 5		1	5	REP
Barium (Ba)	197471-1	< MDL	< 0.1		1	0.1	BLL
Barium (Ba)	197475-1	123.340000	126	101.9	1	0.1	REF
Barium (Ba)	197477-1	39.2	30.0	76.5	1	0.1	REP
Barium (Ba)	197479-1	33.5	35.3	105.2	1	0.1	REP
Berylium (Be)	197471-1	< MDL	< 0.1		1	0.1	BLL
Berylium (Be)	197477-1	<0.1	0.1	112.2	1	0.1	REP
Berylium (Be)	197479-1	0.1	0.2	142.5	1	0.1	REP
Boron (B)	197471-1	< MDL	< 1		1	1	BLL
Boron (B)	197477-1	3	3	112.4	1	1	REP
Boron (B)	197479-1	2	2	108.7	1	1	REP
Cadmium (Cd)	197471-1	< MDL	< 0.5		1	0.5	BLL
Cadmium (Cd)	197477-1		< 0.5		1	0.5	REP
Cadmium (Cd)	197479-1		< 0.5		1	0.5	REP

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Calcium (Ca)	197471-1	< MDL	< 10		1	10	BLL
Calcium (Ca)	197475-1	44303	44100	99.6	1	10	REF
Calcium (Ca)	197477-1	5,100	5140	100.8	1	10	REP
Calcium (Ca)	197479-1	3,917	4690	119.7	1	10	REP
Chromium (Cr)	197471-1	< MDL	< 0.5		1	0.5	BLL
Chromium (Cr)	197472-1	46.4971428	48.1	110.5	1	0.5	REF
Chromium (Cr)	197473-1	23.8104347	25.6	107.1	1	0.5	REF
Chromium (Cr)	197475-1	75.4920000	76.6	104.0	1	0.5	REF
Chromium (Cr)	197477-1	29.8	31.2	104.6	1	0.5	REP
Chromium (Cr)	197479-1	11.6	12.2	105.3	1	0.5	REP
Cobalt (Co)	197471-1	< MDL	< 0.5		1	0.5	BLL
Cobalt (Co)	197472-1	9.71	10.2	104.6	1	0.5	REF
Cobalt (Co)	197473-1	11.7308695	12.1	104.2	1	0.5	REF
Cobalt (Co)	197475-1	12.1	12.3	101.4	1	0.5	REF
Cobalt (Co)	197477-1	6.9	5.7	82.7	1	0.5	REP
Cobalt (Co)	197479-1	5.7	6.1	106.2	1	0.5	REP
Copper (Cu)	197471-1	< MDL	< 0.5		1	0.5	BLL
Copper (Cu)	197472-1	322	316	101.6	1	0.5	REF
Copper (Cu)	197473-1	32.5333913	32.1	103.9	1	0.5	REF
Copper (Cu)	197475-1	81.7173333	82.0	100.4	1	0.5	REF
Copper (Cu)	197477-1	24.1	18.9	78.5	1	0.5	REP
Copper (Cu)	197479-1	43.9	37.7	85.8	1	0.5	REP
Iron (Fe)	197471-1	< MDL	< 0.5		1	0.5	BLL
Iron (Fe)	197475-1	49300	47600	96.5	1	0.5	REF
Iron (Fe)	197477-1	16,278	13600	83.5	1	0.5	REP
Iron (Fe)	197479-1	12,102	13500	111.6	1	0.5	REP
Lead (Pb)	197471-1	< MDL	< 5		1	5	BLL
Lead (Pb)	197472-1	178	165	92.4	1	5	REF
Lead (Pb)	197475-1	242	226	93.3	1	5	REF
Lead (Pb)	197477-1		< 5		1	5	REP
Lead (Pb)	197479-1		< 5		1	5	REP
Magnesium (Mg)	197471-1	< MDL	< 10		1	10	BLL
Magnesium (Mg)	197475-1	11983	12500	104.2	1	10	REF
Magnesium (Mg)	197477-1	5,245	3980	75.9	1	10	REP
Magnesium (Mg)	197479-1	4,115	4380	106.4	1	10	REP
Manganese (Mn)	197471-1	< MDL	< 0.1		1	0.1	BLL
Manganese (Mn)	197472-1	266	262	102.3	1	0.1	REF
Manganese (Mn)	197473-1	301.841739	310	102.4	1	0.1	REF
Manganese (Mn)	197475-1	1128	1150	102.3	1	0.1	REF
Manganese (Mn)	197477-1	249	199	79.9	1	0.1	REP
Manganese (Mn)	197479-1	211	219	104.0	1	0.1	REP
Molybdenum (Mo)	197471-1	< MDL	< 1		1	1	BLL
Molybdenum (Mo)	197477-1	2	1	65.8	1	1	REP
Molybdenum (Mo)	197479-1		< 1		1	1	REP
Nickel (Ni)	197471-1	< MDL	< 2		1	2	BLL
Nickel (Ni)	197472-1	35.6	34	96.1	1	2	REF
Nickel (Ni)	197473-1	41.4	41	98.6	1	2	REF
Nickel (Ni)	197475-1	57.9233333	54	93.4	1	2	REF
Nickel (Ni)	197477-1	11	11	101.6	1	2	REP
Nickel (Ni)	197479-1	8	8	101.0	1	2	REP
Phosphorus (P)	197471-1	< MDL	< 10		1	10	BLL
Phosphorus (P)	197475-1	1268	1310	103.0	1	10	REF

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Phosphorus (P)	197477-1	420	406	96.6	1	10	REP
Phosphorus (P)	197479-1	419	500	119.3	1	10	REP
Potassium (K)	197471-1	< MDL	< 10		1	10	BLL
Potassium (K)	197475-1	2036	2100	103.3	1	10	REF
Potassium (K)	197477-1	1,511	1190	78.8	1	10	REP
Potassium (K)	197479-1	1,290	1300	100.8	1	10	REP
Selenium (Se)	197471-1	< MDL	< 5		1	5	BLL
Selenium (Se)	197477-1		< 5		1	5	REP
Selenium (Se)	197479-1		< 5		1	5	REP
Silicon (Si)	197471-1	< MDL	< 5		1	5	BLL
Silicon (Si)	197477-1	413	496	120.0	1	5	REP
Silicon (Si)	197479-1	420	429	102.2	1	5	REP
Silver (Ag)	197471-1	< MDL	< 1		1	1	BLL
Silver (Ag)	197477-1	3	2	75.5	1	1	REP
Silver (Ag)	197479-1	2	2	126.2	1	1	REP
Sodium (Na)	197471-1	< MDL	< 10		1	10	BLL
Sodium (Na)	197475-1	217	213	98.0	1	10	REF
Sodium (Na)	197477-1	1,062	1020	96.0	1	10	REP
Sodium (Na)	197479-1	552	569	103.0	1	10	REP
Strontium (Sr)	197471-1	< MDL	< 0.1		1	0.1	BLL
Strontium (Sr)	197472-1	65.7	65.8	100.2	1	0.1	REF
Strontium (Sr)	197473-1	56.9	57.0	100.2	1	0.1	REF
Strontium (Sr)	197475-1	68.4	67.4	98.5	1	0.1	REF
Strontium (Sr)	197477-1	37.7	38.8	102.9	1	0.1	REP
Strontium (Sr)	197479-1	30.6	31.0	101.4	1	0.1	REP
Sulfur (S)	197471-1	< MDL	< 5		1	5	BLL
Sulfur (S)	197477-1	95	72	76.1	1	5	REP
Sulfur (S)	197479-1	32	36	113.2	1	5	REP
Tin (Sn)	197471-1	< MDL	< 5		1	5	BLL
Tin (Sn)	197472-1	16.4	18	108.6	1	5	REF
Tin (Sn)	197477-1	6	5	90.2	1	5	REP
Tin (Sn)	197479-1		< 5		1	5	REP
Titanium (Ti)	197471-1	< MDL	< 0.2		1	0.2	BLL
Titanium (Ti)	197475-1	91.1510000	108	118.2	1	0.2	REF
Titanium (Ti)	197477-1	596	545	91.4	1	0.2	REP
Titanium (Ti)	197479-1	446	483	108.3	1	0.2	REP
Vanadium (V)	197471-1	< MDL	< 1		1	1	BLL
Vanadium (V)	197472-1	69.6	72	103.2	1	1	REF
Vanadium (V)	197473-1	55.1	56	102.3	1	1	REF
Vanadium (V)	197475-1	30.5	32	106.2	1	1	REF
Vanadium (V)	197477-1	46	40	87.5	1	1	REP
Vanadium (V)	197479-1	31	36	117.2	1	1	REP
Zinc (Zn)	197471-1	< MDL	2.5		1	0.2	BLL
Zinc (Zn)	197472-1	371	382	102.9	1	0.2	REF
Zinc (Zn)	197473-1	141	141	99.9	1	0.2	REF
Zinc (Zn)	197475-1	1415	1480	104.9	1	0.2	REF
Zinc (Zn)	197477-1	31.4	23.9	76.1	1	0.2	REP
Zinc (Zn)	197479-1	54.4	53.8	98.8	1	0.2	REP

***Mercury, total UNITS:** ug/g(dry) **MATRIX:** SOSE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Mercury (Hg)	198288-1	< MDL	< 0.002		1	0.002	BLL

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Mercury (Hg)	198289-1	2.98705539	2.76	92.4	1	0.002	REF
Mercury (Hg)	198290-1	0.080	0.074	92.8	1	0.002	REF
Mercury (Hg)	198291-1	2.74	2.62	95.5	1	0.002	REF
Mercury (Hg)	196864-1		0.004		1	0.002	REP
Mercury (Hg)	197199-1		0.196		1	0.002	REP
Mercury (Hg)	198292-1		< 0.002		1	0.002	REP
Mercury (Hg)	198293-1	0.004	0.004	89.8	1	0.002	REP
Mercury (Hg)	198294-1		0.004		1	0.002	REP
Mercury (Hg)	198295-1		0.002		1	0.002	REP
Mercury (Hg)	198296-1		0.027		1	0.002	REP
Mercury (Hg)	198297-1		0.004		1	0.002	REP
Mercury (Hg)	198298-1		0.020		1	0.002	REP
Mercury (Hg)	198299-1		0.012		1	0.002	REP

***Nitrogen, Ammonia UNITS:** mg/L **MATRIX:** FWGE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Nitrogen, Ammonia as N	196588-1	< MDL	< 0.002		1	0.002	BLE
Nitrogen, Ammonia as N	196963-1	< MDL	< 0.002		1	0.002	BLE
Nitrogen, Ammonia as N	196591-1	1.40	1.38	98.7	1	0.002	REF
Nitrogen, Ammonia as N	196966-1	1.40	1.38	98.8	1	0.002	REF
Nitrogen, Ammonia as N	196599-1	0.051	0.052	101.8	1	0.002	REP
Nitrogen, Ammonia as N	196969-1		< 0.002		1	0.002	REP
Nitrogen, Ammonia as N	196974-1		< 0.002		1	0.002	REP
Nitrogen, Ammonia as N	196975-1	0.002	0.003	126.9	1	0.002	REP

***Nitrogen, NO 2 UNITS:** mg/L **MATRIX:** FWGE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Nitrogen, Nitrite as N	196590-1	< MDL	< 0.002		1	0.002	BLE
Nitrogen, Nitrite as N	196593-1	1.04401666	1.05	101.0	1	0.002	REF
Nitrogen, Nitrite as N	196595-1		< 0.002		1	0.002	REP
Nitrogen, Nitrite as N	196601-1		0.002		1	0.002	REP

***Nitrogen, NO 23 UNITS:** mg/L **MATRIX:** FWGE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Nitrogen, Nitrate + Nitrite as N	196589-1	< MDL	< 0.002		1	0.002	BLE
Nitrogen, Nitrate + Nitrite as N	196592-1	1.48	1.46	98.5	1	0.002	REF
Nitrogen, Nitrate + Nitrite as N	196594-1	0.015	0.016	104.0	1	0.002	REP
Nitrogen, Nitrate + Nitrite as N	196596-1	0.065	0.061	93.7	1	0.002	REP
Nitrogen, Nitrate + Nitrite as N	196597-1	0.044	0.045	101.3	1	0.002	REP
Nitrogen, Nitrate + Nitrite as N	196598-1	0.091	0.093	102.4	1	0.002	REP
Nitrogen, Nitrate + Nitrite as N	196600-1	0.045	0.044	98.0	1	0.002	REP

***pH UNITS:** pH Units **MATRIX:** FWGE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
pH	196800-1	5.66705585	5.26		1	0.01	BLE
pH	196791-1	7.38	7.38	100.0	1	0.01	REF
pH	196819-1	6.71	6.82	101.6	1	0.01	REP
pH	196825-1	8.37	8.37	100.0	1	0.01	REP

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE

***Phosphorus, Total UNITS: mg/L MATRIX: FWGE**

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Phosphorus, Total as P	197246-1	< MDL	< 0.002		1	0.002	BLL
Phosphorus, Total as P	197248-1	3.09702000	3.18	102.7	25	0.05	REF
Phosphorus, Total as P	197249-1	0.004	0.004	102.4	1	0.002	REP
Phosphorus, Total as P	197250-1	0.003	0.003	100.0	1	0.002	REP
Phosphorus, Total as P	197251-1	0.007	0.006	81.6	1	0.002	REP
Phosphorus, Total as P	197252-1	0.006	0.006	98.4	1	0.002	REP

***Residue, Filterable UNITS: mg/L MATRIX: FWGE**

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Solids, Total Dissolved (FR)	196976-1	< MDL	25		1	10	BLE
Solids, Total Dissolved (FR)	197179-1	< MDL	< 10		1	10	BLE
Solids, Total Dissolved (FR)	196977-1	557	556	99.9	1	10	REF
Solids, Total Dissolved (FR)	197180-1	557	572	102.7	1	10	REF
Solids, Total Dissolved (FR)	197063-1	1,088	1100	101.1	1	10	REP
Solids, Total Dissolved (FR)	197181-1	3,508	3240	92.4	1	10	REP

***Residue, Nonfilt. UNITS: mg/L MATRIX: FWGE**

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Solids, Total Suspended (NFR)	197103-1	< MDL	< 5		1	5	BLE
Solids, Total Suspended (NFR)	197105-1	39.4	39	99.8	1	5	REF
Solids, Total Suspended (NFR)	197107-1		< 5		1	5	REP
Solids, Total Suspended (NFR)	197108-1		< 5		1	5	REP

***SpecificConductance UNITS: uS/cm MATRIX: FWGE**

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Conductivity	196626-1	< MDL	< 2		1	2	BLE
Conductivity	196628-1	12900	13000	101.0	1	2	REF
Conductivity	196629-1	14.8278378	14	97.8	1	2	REF
Conductivity	196630-1	716	710	99.2	1	2	REF
Conductivity	196639-1	495.748333	494	98.3	1	2	REF
Conductivity	196644-1	2,700	2690	99.6	1	2	REP
Conductivity	196647-1	73	73	100.4	1	2	REP

Hardness, Diss. CaMg UNITS: mg CaCO3 / L MATRIX: FWGE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Hardness, Dissolved Calcium+Magnes	197203-1		< 0.4		1	0.4	BLE
Hardness, Dissolved Calcium+Magnes	198335-1		< 0.4		1	0.4	BLE
Hardness, Dissolved Calcium+Magnes	197255-1		167		1	0.4	REP
Hardness, Dissolved Calcium+Magnes	197256-1		92.4		1	0.4	REP
Hardness, Dissolved Calcium+Magnes	197257-1		< 0.4		1	0.4	REP
Hardness, Dissolved Calcium+Magnes	197258-1		489		1	0.4	REP
Hardness, Dissolved Calcium+Magnes	197259-1		71.5		1	0.4	REP
Hardness, Dissolved Calcium+Magnes	197890-1		< 0.4		1	0.4	REP
Hardness, Dissolved Calcium+Magnes	197891-1		86.4		1	0.4	REP
Hardness, Dissolved Calcium+Magnes	197892-1		1.5		1	0.4	REP

QC Information:

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE

Hardness, Diss.Total UNITS: mg CaCO3 / L **MATRIX:** FWGE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Hardness, Dissolved Total - calc.	197203-1		< 0.4		1	0.4	BLE
Hardness, Dissolved Total - calc.	198335-1		< 0.4		1	0.4	BLE
Hardness, Dissolved Total - calc.	197255-1		168		1	0.4	REP
Hardness, Dissolved Total - calc.	197256-1		92.6		1	0.4	REP
Hardness, Dissolved Total - calc.	197257-1		< 0.4		1	0.4	REP
Hardness, Dissolved Total - calc.	197258-1		489		1	0.4	REP
Hardness, Dissolved Total - calc.	197259-1		71.9		1	0.4	REP
Hardness, Dissolved Total - calc.	197890-1		< 0.4		1	0.4	REP
Hardness, Dissolved Total - calc.	197891-1		86.6		1	0.4	REP
Hardness, Dissolved Total - calc.	197892-1		4.4		1	0.4	REP

Hardness, Extr. CaMg UNITS: mg CaCO3 / L **MATRIX:** FWGE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Hardness, Extractable Calcium+Magn	197051-1		< 0.4		1	0.4	BLE
Hardness, Extractable Calcium+Magn	197062-1		500		1	0.4	REP

Hardness, Extr.Total UNITS: mg CaCO3 / L **MATRIX:** FWGE

ANALYTE	ALIQ#	EXPECTED	RESULT	% REC	DIL'N	MDL	QC TYPE
Hardness, Extractable Total - calc.	197051-1		< 0.4		1	0.4	BLE
Hardness, Extractable Total - calc.	197062-1		501		1	0.4	REP

Note: **All QC information is batch associated. Duplicate analysis are not necessarily those of this report. Percent recovery for duplicate analysis represents the percent recovery of REP2 as compared to REP1 of a sample duplicate.**

BLE - Blank, Equipment
BLL - Blank, Method
BLX - Blank, Extraction
REA - Replicate Spike, Known Addition
REF - Reference Material
REG - Regular Sample
RRF - Replicate Reference Material
REK - Replicate, Spike
REP - Replicate, Regular
RTS - Replicate Test Sample
SPA - Spike, Known Addition
SPK - Spike
TST - Test Sample 1=Present 2=Absent
MDL - Method Detection Limit

APPENDIX E

Water and Sediment Quality Data

Table E.1: Effects-based water quality benchmarks considered for the evaluation of water quality at Clinton Creek.

Variables	Units	Water quality criteria				
		Canadian water quality guideline (for protection of FW aquatic life)[a]	British Columbia (freshwater)[b]	Saskatchewan[c]	Ontario Provincial Water Quality Objective[d]	Canadian Drinking Water Quality Guideline[a]
Non-Metals						
Total Phosphorus (colourimetric method)	mg/L		0.005-0.015 (lakes)		0.03 for rivers[e]	
Dissolved Orthophosphate-P						
Dissolved Organic Carbon						
Total Ammonia	mg/L	0.19[f]	1.9[f]		0.25[f]	
Total Kjeldahl Nitrogen						
Nitrate and Nitrite - N						
Bicarbonate						
Carbonate						
Hydroxide						
Total Alkalinity	mg/L as $CaCO_3$				no decreases more than 25% of natural concentration[g]	
Dissolved Sulphate	mg/L		50			500[h]
Total Suspended Solids		no more than 5 mg/L above background[g]				
Hardness	mg/L as $CaCO_3$					
pH (lab)	pH units	6.5-9.0	6.5 - 9.0		6.5-8.5	6.5-8.5
Conductivity (field)	μS/cm					
Electrical Conductivity (lab)	μS/cm					
Dissolved Oxygen	mg/L					
Dissolved Oxygen	%					
Temperature (field)	°C					
Total Metals						
Aluminum	mg/L	0.005 - 0.100[i]	0.05	0.005 - 0.100[i]	0.015 - 0.075[e]	0.1
Antimony	mg/L				0.02[e]	0.006
Arsenic	mg/L	0.005	0.005	0.005	0.005[e]	0.005 proposed
Barium	mg/L					1.0
Beryllium	mg/L				0.011 - 1.1[j]	
Bismuth	mg/L					
Boron	mg/L		1.2		0.2[e]	5.000
Cadmium	mg/L	0.000017 or more depending on hardness[k]		0.000017 or more depending on hardness[k]	0.0001 - 0.0005[e]	0.005
Calcium	mg/L					
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[l]	0.002-0.008[m]	0.002-0.004[l]	0.001-0.005[e]	1.0[h]
Iron	mg/L	0.3		0.3	0.300	0.3[h]
Lead	mg/L	0.001 - 0.007[n]	0.005-0.011[m]	0.001 - 0.007[n]	0.001 - 0.005[e]	0.010
Lithium	mg/L					
Magnesium	mg/L					
Manganese	mg/L		hardness dependent[q]			0.05[j]
Molybdenum	mg/L	0.073	1		0.04[e]	
Nickel	mg/L	0.025 - 0.150[o]		0.025 - 0.150[o]	0.025	
Phosphorus (ICP scan)	mg/L					
Potassium	mg/L					
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[p]	0.0001	0.0001	
Sodium	mg/L					200[h]
Strontium	mg/L					
Sulfur	mg/L					
Tellurium	mg/L					
Thallium	mg/L	0.0008			0.0003[e]	
Thorium	mg/L					
Tin	mg/L					
Titanium	mg/L					
Uranium	mg/L			0.015	0.005[e]	0.02
Vanadium	mg/L				0.006[e]	
Zinc	mg/L	0.030	0.0075-0.090[m]	0.030	0.02[e]	5.0
Zirconium					0.004	

(shaded) criteria selected for evaluation of surface water data

[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] interim objective

[f] guideline pH and temperature dependent to achieve un-ionized ammonia of <0.02 mg/L

[g] computed from data presented in this report and shown in Table E.4

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

[i] 0.005 mg/L at pH<6.5; 0.1 mg/L at pH ≥ 6.5

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

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

[l] 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

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

[n] 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

[o] 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

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

[q] manganese = 0.0044 (hardness) + 0.605

Table E.2: Selected water quality guidelines (from Table E.1) applied to the evaluation of water quality at Clinton Creek Mine.

Variables	Units	Selected water quality guidelines[a]
Non-metals		
Total Phosphorus (colourimetric method)	mg/L	0.03
Dissolved Orthophosphate-P	mg/L	-
Dissolved Organic Carbon	mg/L	-
Total Ammonia	mg/L	0.19[b]
Total Kjeldahl Nitrogen	mg/L	-
Nitrate and Nitrite - N	mg/L	-
Bicarbonate	mg/L as $CaCO_3$	-
Carbonate	mg/L as $CaCO_3$	-
Hydroxide	mg/L as $CaCO_3$	-
Total Alkalinity	mg/L as $CaCO_3$	16[c]
Dissolved Sulphate	mg/L	50
Total Suspended Solids	mg/L	107[d]
Hardness	mg/L as $CaCO_3$	-
pH (lab)	pH units	6.5-9.0
Conductivity (field)	µS/cm	-
Electrical Conductivity (lab)	µS/cm	-
Dissolved Oxygen	mg/L	9.5
Dissolved Oxygen	%	-
Temperature (field)	°C	-
Total Metals		
Aluminum	mg/L	0.1[e]
Antimony	mg/L	0.02
Arsenic	mg/L	0.005
Barium	mg/L	1.0
Beryllium	mg/L	1.1[f]
Bismuth	mg/L	-
Boron	mg/L	1.2
Cadmium	mg/L	0.00003[f]
Calcium	mg/L	-
Chromium	mg/L	0.001
Cobalt	mg/L	0.004
Copper	mg/L	0.002[f]
Iron	mg/L	0.3
Lead	mg/L	0.002[f]
Lithium	mg/L	-
Magnesium	mg/L	-
Manganese	mg/L	1[f]
Molybdenum	mg/L	0.073
Nickel	mg/L	0.065[f]
Phosphorus (ICP scan)	mg/L	0.03
Potassium	mg/L	-
Selenium	mg/L	0.001
Silicon	mg/L	-
Silver	mg/L	0.0001
Sodium	mg/L	200
Strontium	mg/L	-
Sulfur	mg/L	-
Tellurium	mg/L	-
Thallium	mg/L	0.0008
Thorium	mg/L	-
Tin	mg/L	-
Titanium	mg/L	-
Uranium	mg/L	0.015
Vanadium	mg/L	0.006
Zinc	mg/L	0.030
Zirconium	mg/L	0.004

[a] Benchmarks were selected from relevant water quality criteria as shown in Table E.1.
[b] based on conservative assumption of pH 8.5 and temperature of 15°C
[c] guideline = 5th percentile of reference x 0.25
[d] guideline = 95th percentile of reference + 5 mg/L
[e] guideline based on pH ≥ 6.5
[f] guideline derived using lower end of reference hardnesses (100 mg/L as CaCO3)

Table E.3: Guidelines selected (grey shading) for evaluating sediment quality at Clinton Creek, 2009.

Parameter	Units	Canadian[a]		British Columbia[b]				Ontario[c]	
		ISQG[d]	PEL[e]	ISQG	PEL	LEL[f]	SEL[g]	LEL	SEL
Total Kjeldahl Nitrogen	mg/kg	-	-	-	-	-	-	550	4800
Asbestos	%	-	-	-	-	-	-	-	-
Aluminum	mg/kg	-	-	-	-	-	-	-	-
Antimony	mg/kg	-	-	-	-	-	-	-	-
Arsenic	mg/kg	5.9	17	5.9	17	-	-	-	-
Barium	mg/kg	-	-	-	-	-	-	-	-
Beryllium	mg/kg	-	-	-	-	-	-	-	-
Boron	mg/kg	-	-	-	-	-	-	-	-
Cadmium	mg/kg	0.6	3.5	0.6	3.5	-	-	-	-
Calcium	mg/kg	-	-	-	-	-	-	-	-
Chromium	mg/kg	37.3	90	37.3	90	-	-	-	-
Cobalt	mg/kg	-	-	-	-	-	-	-	-
Copper	mg/kg	35.7	197	35.7	197			-	-
Iron	mg/kg	-	-	-	-	21,200	43,766	-	-
Lead	mg/kg	35.0	91.3	35	91	-	-	-	-
Magnesium	mg/kg	-	-	-	-	-	-	-	-
Manganese	mg/kg	-	-	-	-	-	-	460	1,100
Mercury	mg/kg	-	-	0.170	0.486	-	-	-	-
Molybdenum	mg/kg	-	-	-	-	-	-	-	-
Nickel	mg/kg	-	-	16	75	-	-	-	-
Phosphorus	mg/kg	-	-	-	-	-	-	600	2,000
Potassium	mg/kg	-	-	-	-	-	-	-	-
Selenium	mg/kg	-	-	2[e]		-	-	-	-
Silicon	mg/kg	-	-	-	-	-	-	-	-
Silver	mg/kg	-	-	-	-	-	-	-	-
Sodium	mg/kg	-	-	-	-	-	-	-	-
Strontium	mg/kg	-	-	-	-	-	-	-	-
Sulfur	mg/kg	-	-	-	-	-	-	-	-
Thallium	mg/kg	-	-	-	-	-	-	-	-
Tin	mg/kg	-	-	-	-	-	-	-	-
Titanium	mg/kg	-	-	-	-	-	-	-	-
Uranium	mg/kg	-	-	-	-	-	-	-	-
Vanadium	mg/kg	-	-	-	-	-	-	-	-
Zinc	mg/kg	123	315	123	315	-	-	-	-

[a] CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (updated in 2001), Canadian Council of Ministers of the Environment, Winnipeg

[b] BCMOE (British Columbia Ministry of Environment). 2006. A Compendium of Working Water Quality Guidelines for British Columbia, 2006 Edition. Updated August 2006.

[c] OMOE (Ontario Ministry of Environment). 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario , August 1993

[d] Interim sediment quality guideline

[e] Probable effect level

[f] Lowest effect level

[g] Severe effect level

Table E.4: Analytical water sample data and summary statistics for reference stations in the vicinity of Clinton Creek Mine, 2009.

Parameter	Units	R1		R2 (HL-03)		R3 (WC-01)	R4 (EC-01)				R6 (FM-01)	Summary Statistics[b]					Background Benchmarks			Guideline[a]	Guideline source[a]
		Clinton Creek u/s of Hudgeon Lake		Easter Creek u/s of Hudgeon Lake		Wolverine Creek u/s of tailings	Eagle Creek u/s of culvert				Forty Mile River u/s of Clinton Creek	n	mean	Standard Deviation	Minimum	Maximum	5th percentile	95th percentile	95th percentile (Sept. 20 excluded)[c]		
		19-Aug-09[d]	2-Sept-09[d]	19-Aug-09[d]	2-Sept-09[d]	3-Sept-09[d]	18-Aug-09[d]	3-Sept-09[d]	20-Sept-09[d]	30-Sept-09[e]	3-Sept-09[d]										
Non-metals																					
Total Phosphorus (colourimetric method)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.11	-	<0.05	1	0.11	-	0.11	0.11	-	-		0.03	PWQO
Dissolved Orthophosphate-P	mg/L	0.03	0.04	0.04	0.05	0.06	0.03	0.05	0.05	-	0.05	9	0.04	0.01	0.03	0.06	0.03	0.06		-	-
Dissolved Organic Carbon	mg/L	12.8	17.9	4.8	10.7	15.7	11.8	15.9	23.1	-	12.7	9	14	5.1	4.8	23.1	7.2	21		-	-
Total Ammonia (N)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	9	<0.05	0	<0.05	<0.05	<0.05	<0.05		0.19	CWQG
Kjeldahl Nitrogen	mg/L	0.35	0.33	0.18	0.27	0.42	0.3	0.37	0.6	-	0.32	9	0.3	0.1	0.18	0.6	0.2	0.5		-	-
Nitrate and Nitrite - N	mg/L	0.15	0.37	0.02	<0.01	0.01	0.09	0.16	0.25	-	0.15	9	0.13	0.12	0.01	0.37	0.010	0.32		-	-
Bicarbonate	mg/L	190	130	280	220	180	180	150	80	-	70	9	164	66	70	280	74	256		-	-
Carbonate	mg/L	<6	<6	<6	<6	<6	<6	<6	<6	-	<6	9	<6	0	<6	<6	<6	<6		-	-
Hydroxide	mg/L	<5	<5	<5	<5	<5	<5	<5	<5	-	<5	9	<5	0	<5	<5	<5	<5		-	-
Total Alkalinity	mg/L as CaCO3	156	105	233	180	148	150	124	66	-	61	9	136	54	61	233	63	212		16	PWQO
Dissolved Sulfate (SO4)	mg/L	273	125	241	164	225	144	99.2	38.2	-	29.5	9	149	86.2	29.5	273	33.0	260		50	BCWQG
Total Suspended Solids	mg/L	3	7	<2	2	9	<2	10	164	-	<2	9	22	53	<2	164	2	102	10	107	CWQG
Total Hardness	mg/L as CaCO3	491	273	532	396	444	323	251	130	-	94.9	9	326	154	94.9	532	109	516		-	-
pH (lab)	pH units	7.88	7.73	8.05	7.94	7.96	8.09	7.94	7.66	-	7.66	9	7.88	0.160	7.66	8.09	7.66	8.07		6.5-9.0	CWQG
Conductivity (field)	µS/cm	762	-	822	-	-	544	-	-	-	-	3	709	146	544	822	-	-		-	-
Electrical Conductivity (lab)	µS/cm at 25 C	785	457	816	635	703	548	438	226	-	191	9	533	226	191	816	205	804		-	-
Dissolved Oxygen	mg/L	-	-	-	-	-	11.96	-	-	-	-	1	11.96	-	11.96	11.96	-	-		9.5	CWQG
Dissolved Oxygen	%	-	-	-	-	-	99.9	-	-	-	-	1	99.9	-	99.9	99.9	-	-		-	-
Temperature (field)	°C	6.6	3.5	7.2	1.0	1.0	5.6	0.3	2.1	-	7.5	9	4	3	0.3	7.5	0.6	7		-	-
Total Metals																					
Aluminum	mg/L	0.085	0.186	0.024	0.032	0.155	0.104	**0.22**	1.93	0.099	0.092	10	0.29	0.58	0.024	1.93	0.028	1.2	0.21	0.1	CWQG
Antimony	mg/L	0.0002	0.0002	0.0005	0.0006	<0.0002	0.0003	0.0003	0.0004	0.0003	<0.0002	10	0.0003	0.0001	<0.0002	0.0006	0.0002	0.0006		0.02	PWQO
Arsenic	mg/L	0.0006	0.0013	0.0008	0.0012	0.0013	0.0012	0.0016	0.0026	0.0009	0.0009	10	0.001	0.0006	0.0006	0.0026	0.0007	0.002		0.005	CWQG
Barium	mg/L	0.046	0.037	0.051	0.042	0.045	0.065	0.058	0.113	0.056	0.033	10	0.055	0.023	0.033	0.113	0.035	0.091		1.0	CDWQG
Beryllium	mg/L	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	0.00005	<0.00004	<0.00004	10	<0.00004	0.000003	<0.00004	0.00005	<0.00004	0.00005		1.1	PWQO
Bismuth	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	10	<0.001	0	<0.001	<0.001	<0.001	<0.001		-	-
Boron	mg/L	0.009	0.007	0.017	0.017	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	10	0.008	0.005	<0.005	0.017	<0.005	0.017		1.2	BCWQG
Cadmium	mg/L	0.00004	0.00004	0.00001	0.00007	0.00024	0.00004	0.00003	0.00018	0.00004	<0.00001	10	0.00007	0.00008	<0.00001	0.00024	0.00001	0.00021		0.00003	CWQG
Calcium	mg/L	88.7	56.1	87.2	66.2	80.6	69.9	56.6	31.5	57.8	24.9	10	62.0	21.5	24.9	88.7	27.9	88.0		-	-
Chromium	mg/L	0.0004	0.0009	<0.0004	0.0009	0.0011	0.0006	0.0011	0.0052	0.0009	0.0005	10	0.001	0.001	<0.0004	0.0052	0.0004	0.003		0.001	CWQG
Cobalt	mg/L	0.00031	0.00032	0.00019	0.00016	0.00032	0.00017	0.00024	0.00163	0.00015	0.00015	10	0.00036	0.00045	0.00015	0.00163	0.00015	0.0010	0.00032	0.004	BCWQG
Copper	mg/L	0.002	0.004	<0.001	0.002	0.002	0.003	0.003	0.008	0.003	0.003	10	0.003	0.002	<0.001	0.008	<0.001	0.006		0.002	CWQG
Iron	mg/L	0.294	**0.504**	0.205	0.226	0.502	0.216	0.393	3.45	0.163	0.208	10	0.616	1.00	0.163	3.45	0.182	2.12	0.503	0.3	CWQG
Lead	mg/L	0.0002	0.0002	<0.0001	<0.0001	0.0002	0.0002	0.0002	0.0027	0.0001	<0.0001	10	0.0004	0.0008	<0.0001	0.0027	0.0001	0.002	0.0002	0.002	CWQG
Lithium	mg/L	0.004	0.004	0.007	0.008	0.005	0.002	0.002	0.002	0.001	0.003	10	0.004	0.002	0.001	0.008	0.001	0.008		-	-
Magnesium	mg/L	65.4	32.3	76.5	56	59	36	26.6	12.6	27	7.93	10	40	23	7.93	76.5	10	72		-	-
Manganese	mg/L	0.0944	0.0528	0.103	0.0725	0.0813	0.0157	0.0237	0.0951	0.0097	0.0118	10	0.056	0.038	0.0097	0.103	0.011	0.099		1	BCWQG
Molybdenum	mg/L	0.0012	0.001	0.0008	0.0007	0.001	0.0012	0.001	0.0006	0.0011	0.0004	10	0.0009	0.0003	0.0004	0.0012	0.0005	0.0012		0.073	CWQG
Nickel	mg/L	0.004	0.004	0.003	0.003	0.004	0.004	0.004	0.011	0.005	0.002	10	0.004	0.002	0.002	0.011	0.002	0.008		0.065	CWQG
Phosphorus (ICP scan)	mg/L	0.012	0.012	0.012	0.015	0.013	0.018	**0.023**	0.14	0.015	<0.01	10	0.027	0.040	<0.01	0.14	0.011	0.087	0.021	0.03	PWQO
Potassium	mg/L	0.6	0.4	1	0.9	0.8	0.4	0.3	0.4	0.3	1	10	0.6	0.3	0.3	1	0.3	1		-	-
Selenium	mg/L	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	0.0015	0.0024	<0.0006	10	0.00087	0.00061	<0.0006	0.0024	<0.0006	0.0020		0.001	CWQG
Silicon	mg/L	4.31	4.81	5.13	5.58	6.26	5.06	5.51	7.98	5.34	4.91	10	5.49	1.02	4.31	7.98	4.54	7.21		-	-
Silver	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00007	<0.00001	<0.00001	10	0.00002	0.00002	<0.00001	0.00007	<0.00001	0.00004		0.0001	CWQG
Sodium	mg/L	4.36	2.54	4.41	3.53	3.96	4.9	3.74	2.33	3.73	3.86	10	3.7	0.80	2.33	4.9	2.4	4.7		200	CDWQG
Strontium	mg/L	0.408	0.264	0.452	0.363	0.363	0.323	0.274	0.144	0.248	0.134	10	0.297	0.105	0.134	0.452	0.139	0.432		-	-
Sulfur	mg/L	90.4	44.5	80.5	56.7	80.9	48.8	36.3	14.3	38.2	11.2	10	50.2	27.3	11.2	90.4	12.6	86.1		-	-
Tellurium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	10	<0.0001	0	<0.0001	<0.0001	<0.0001	<0.0001		-	-
Thallium	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	10	<0.00001	0	<0.00001	<0.00001	<0.00001	<0.00001		0.0008	CWQG
Thorium	mg/L	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	10	<0.0004	0	<0.0004	<0.0004	<0.0004	<0.0004		-	-
Tin	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	10	<0.0001	0	<0.0001	<0.0001	<0.0001	<0.0001		-	-
Titanium	mg/L	0.0027	0.0055	0.0013	0.0013	0.005	0.0045	**0.0078**	0.0553	0.0034	0.0016	10	0.009	0.02	0.0013	0.0553	0.001	0.03	0.007	-	-
Uranium	mg/L	0.0038	0.0017	0.008	0.005	0.0045	0.0039	0.0025	0.0009	0.0019	0.0006	10	0.0033	0.0022	0.0006	0.008	0.0007	0.0067		0.015	SKWQG
Vanadium	mg/L	0.0003	0.0006	0.0002	0.0005	0.001	0.0007	0.0009	0.0061	0.0005	0.0006	10	0.0011	0.0018	0.0002	0.0061	0.0002	0.0038		0.006	PWQO
Zinc	mg/L	0.006	0.004	0.004	0.005	0.008	0.009	0.014	0.024	0.007	0.006	10	0.0087	0.0061	0.004	0.024	0.004	0.0195		0.030	CWQG
Zirconium	mg/L	0.0007	0.0011	0.0002	0.0004	0.0007	0.0009	0.0013	0.0017	0.001	0.0007	10	0.0009	0.0004	0.0002	0.0017	0.0003	0.0015		0.004	PWQO

(grey) < MDL exceeds guideline. Value excluded from summary statistic calculations.
(yellow) value is greater than the 95th percentile of reference or is less than the 5th percentile of reference
(orange) value is greater than the 95th percentile of reference and guideline or is less than the 5th percentile of reference and guideline
bold value is greater than the 95th percentile of reference computed without September 20, 2009 data (high flow event)

Note: Station identifiers are those used by Minnow and, in parentheses, those used by the Yukon Territory Government

[a] see Table E.1 for supporting information
[b] values reported as less than the detection limit were used at the detection limit for calculating summary statistics.
[c] the watersheds around Clinton Creek were flooded on September 20, 2009 therefore 95th percentiles excluding data from this date were also calculated for some substances which may have been influenced by the flood conditions
[d] water quality data provided by Laberge Environmental Services
[e] water quality data provided by the Yukon Territory Government

Table E.5: Evaluation of water quality at mine-exposed stations in the vicinity of Clinton Creek Mine, 2009.

Variables	Units	Guideline source[e]	Guideline[e]	5th percentile[a]	95th percentile[a]	95th percentile (Sept. 20 excluded)[f]	HL-06	E1 (CC-03)			PP-01		E5 (PC-04)	
							Clinton Creek just d/s of Hudgeon Lake	Clinton Creek d/s of gabions u/s of Porcupine Creek			Porcupine Pit		Porcupine Beaver Pond	
							30-Sept-09[b]	18-Aug-09[c]	2-Sept-09[c]	20-Sept-09[c]	11-Aug-09	30-Sept-09[b]	11-Aug-09[d]	30-Sept-09[b]
Non-metals														
Total Phosphorus (colourimetric method)	mg/L	PWQO	0.03	-	-	-	-	<0.05	<0.05	<0.05	-	-	-	-
Dissolved Orthophosphate-P	mg/L	-	-	0.03	0.06	-	-	0.03	0.04	0.04	-	-	-	-
Dissolved Organic Carbon	mg/L	-	-	7.2	21	-	-	15.4	18.3	17.1	-	-	-	-
Total Ammonia (N)	mg/L	CWQG	0.19	<0.05	<0.05	-	-	<0.05	<0.05	<0.05	-	-	-	-
Kjeldahl Nitrogen	mg/L	-	-	0.2	0.5	-	-	0.49	0.47	0.48	-	-	-	-
Nitrate and Nitrite - N	mg/L	CWQG	-	0.010	0.32	-	-	0.04	<0.01	0.13	-	-	-	-
Bicarbonate	mg/L	-	-	74	256	-	-	160	140	130	-	-	-	-
Carbonate	mg/L	-	-	<6	<6	-	-	<6	<6	<6	-	-	-	-
Hydroxide	mg/L	-	-	<5	<5	-	-	<5	<5	<5	-	-	-	-
Total Alkalinity[c]	mg/L as CaCO3	PWQO	16	63	212	-	-	136	111	106	-	-	-	-
Dissolved Sulfate (SO4)	mg/L	BCWQG	50	33.0	260	-	-	157	126	117	-	-	-	-
Total Suspended Solids	mg/L	CWQG	107	2	102	10	-	<2	<2	12	-	-	-	-
Total Hardness	mg CaCO3/L	-	-	109	516	-	-	311	281	263	-	-	-	-
pH (lab)	pH units	CWQG	6.5-9.0	7.66	8.07	-	-	7.77	7.91	7.92	-	-	-	-
Conductivity (field)	µS/cm	-	-	-	-	-	-	506	-	-	-	-	-	-
Electrical Conductivity (lab)	µS/cm at 25 C	-	-	205	804	-	-	548	468	457	-	-	-	-
Dissolved Oxygen	mg/L	CWQG	6.5	-	-	-	-	8.08[g]	-	-	-	-	-	-
Dissolved Oxygen	%	-	-	-	-	-	-	82	-	-	-	-	-	-
Temperature (field)	°C	-	-	-	-	-	-	13.5	11.0	7.9	-	-	-	-
Total Metals														
Aluminum	mg/L	CWQG	0.1	0.028	1.2	0.21	0.147	0.022	0.041	0.206	< 0.06	<0.005	< 0.06	<0.005
Antimony	mg/L	PWQO	0.02	0.0002	0.0006	-	0.0003	0.0003	0.0003	0.0003	< 0.06	0.0151	< 0.06	0.0027
Arsenic	mg/L	CWQG	0.005	0.0007	0.002	-	0.0009	0.0016	0.0013	0.0012	< 0.06	0.0072	0.22	0.0151
Barium	mg/L	CDWQG	1.0	0.035	0.091	-	0.041	0.038	0.039	0.047	0.01	0.009	0.018	0.014
Beryllium	mg/L	PWQO	1.1	<0.00004	0.00005	-	<0.00004	<0.00004	<0.00004	<0.00004	< 0.001	<0.00004	< 0.001	<0.00004
Bismuth	mg/L	-	-	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	-	<0.001	-	<0.001
Boron	mg/L	BCWQG	1.2	<0.005	0.017	-	0.007	0.014	0.01	0.012	4.84	4.69	0.54	0.077
Cadmium	mg/L	CWQG	0.00003	0.00001	0.00021	-	0.00006	0.00005	0.00004	0.00004	< 0.006	0.00009	< 0.006	0.00002
Calcium	mg/L	-	-	27.9	88.0	-	47.8	63.5	55.7	51.6	91.7	97.4	245	258
Chromium	mg/L	CWQG	0.001	0.0004	0.003	-	0.001	0.0007	0.0008	0.0024	< 0.006	0.0008	< 0.006	0.0014
Cobalt	mg/L	BCWQG	0.004	0.00015	0.0010	0.00032	**0.00039**	**0.00042**	**0.00034**	0.00062	< 0.006	0.00026	< 0.006	0.00022
Copper	mg/L	CWQG	0.002	<0.001	0.006	-	0.004	0.002	0.003	0.004	< 0.02	<0.001	< 0.02	0.001
Iron	mg/L	CWQG	0.3	0.182	2.12	0.503	0.467	0.262	0.226	0.635	0.05	<0.010	< 0.05	<0.01
Lead	mg/L	CWQG	0.002	0.0001	0.002	0.0002	**0.0003**	<0.0001	<0.0001	0.0008	< 0.06	<0.0001	< 0.06	<0.0001
Lithium	mg/L	-	-	0.001	0.008	-	0.003	0.005	0.004	0.003	-	0.099	-	0.011
Magnesium	mg/L	-	-	10	72	-	28.5	37.1	34.4	32.6	479	<0.05	429	167
Manganese	mg/L	BCWQG	1	0.011	0.099	-	0.0881	0.0586	0.0612	0.0988	0.003	0.0048	< 0.001	0.0003
Molybdenum	mg/L	CWQG	0.073	0.0005	0.0012	-	0.0009	0.0011	0.0009	0.001	0.01	0.0106	< 0.01	0.0018
Nickel	mg/L	CWQG	0.065	0.002	0.008	-	0.004	0.009	0.006	0.008	0.05	0.058	0.09	0.022
Phosphorus (ICP scan)	mg/L	PWQO	0.03	0.011	0.087	0.021	0.017	<0.01	<0.01	<0.01	0.5	<0.01	1.2	0.016
Potassium	mg/L	-	-	0.3	1	-	0.6	0.8	0.7	0.8	4.1	4.6	3.9	1.6
Selenium	mg/L	CWQG	0.001	<0.0006	0.0020	-	0.0007	0.0007	<0.0006	0.0007	< 0.06	0.0052	< 0.06	0.0178
Silicon	mg/L	-	-	4.54	7.21	-	4.47	3.66	3.89	4.31	1.37	1.13	6.72	5.28
Silver	mg/L	CWQG	0.0001	<0.00001	0.00004	-	0.00001	<0.00001	<0.00001	0.00003	< 0.01	<0.00001	0.01	<0.00001
Sodium	mg/L	CDWQG	200	2.4	4.7	-	2.64	2.95	2.78	2.65	26.6	31	27.9	3.24
Strontium	mg/L	-	-	0.139	0.432	-	0.222	0.329	0.271	0.26	0.486	0.545	2.75	1.2
Sulfur	mg/L	-	-	12.6	86.1	-	39.6	50.4	46.4	42.8	781	615	683	297
Tellurium	mg/L	-	-	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001	-	<0.0001
Thallium	mg/L	CWQG	0.0008	<0.00001	<0.00001	-	<0.00001	0.00001	<0.00001	<0.00001	-	0.00023	-	0.00001
Thorium	mg/L	-	-	<0.0004	<0.0004	-	<0.0004	<0.0004	<0.0004	<0.0004	-	<0.0004	-	<0.0004
Tin	mg/L	-	-	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	0.06	<0.0001	0.06	<0.0001
Titanium	mg/L	-	-	0.001	0.03	0.007	0.004	0.0007	0.0008	0.0066	< 0.002	<0.0004	< 0.002	0.0009
Uranium	mg/L	SKWQG	0.015	0.0007	0.0067	-	0.0015	0.002	0.002	0.0019	-	0.0073	-	0.0041
Vanadium	mg/L	PWQO	0.006	0.0002	0.0038	-	0.0006	0.0002	0.0002	0.001	< 0.01	0.0003	< 0.01	0.0002
Zinc	mg/L	CWQG	0.030	0.004	0.0195	-	0.01	0.008	0.004	0.005	< 0.05	0.006	< 0.05	0.008
Zirconium	mg/L	PWQO	0.004	0.0003	0.0015	-	0.0011	0.0007	0.0008	0.0014	-	0.0002	-	0.0002

Variables	E2 (CC-01)					E3 (WC-05)					E4 (CC-04)				E6 (CC-06)	E7 (CC-07)			E8 (FM-02)	
	Clinton Creek d/s of Porcupine Creek u/s of Wolverine Creek					Wolverine Creek u/s of culvert					Clinton Creek d/s of Wolverine Creek u/s of Eagle Creek				Clinton Creek u/s of townsite ford	Clinton Creek near mouth			Forty Mile River d/s of Clinton Creek	
	11-Aug-09[d]	18-Aug-09[c]	2-Sept-09[c]	20-Sept-09[c]	30-Sept-09[b]	11-Aug-09[d]	18-Aug-09[c]	2-Sept-09[c]	20-Sept-09[c]	30-Sept-09[b]	18-Aug-09[c]	3-Sept-09[c]	20-Sept-09[c]	30-Sept-09[b]	30-Sept-09[b]	18-Aug-09[c]	3-Sept-09[c]	20-Sept-09[c]	3-Sept-09[c]	20-Sept-09[c]
Non-metals																				
Total Phosphorus (colourimetric method)	-	<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
Dissolved Orthophosphate-P	-	0.03	0.04	0.04	-	-	0.03	0.05	0.05	-	0.03	0.04	0.04	-	-	0.03	0.04	0.04	0.04	0.04
Dissolved Organic Carbon	-	14	17	15	-	-	9.1	12.6	19.4	-	10.1	14.5	16.5	-	-	10.7	13.6	18	12.6	17.3
Total Ammonia (N)	-	<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
Kjeldahl Nitrogen	-	0.36	0.42	0.5	-	-	0.28	0.31	0.57	-	0.28	0.36	0.5	-	-	0.26	0.35	0.51	0.32	0.57
Nitrate and Nitrite - N	-	0.04	<0.01	0.11	-	-	0.15	0.09	0.08	-	0.06	0.02	0.1	-	-	0.06	0.06	0.15	0.1	0.15
Bicarbonate	-	240	160	130	-	-	260	220	100	-	310	200	140	-	-	280	200	130	140	120
Carbonate	-	<6	<6	<6	-	-	<6	<6	<6	-	<6	<6	<6	-	-	<6	<6	<6	<6	<6
Hydroxide	-	<5	<5	<5	-	-	<5	<5	<5	-	<5	<5	<5	-	-	<5	<5	<5	<5	<5
Total Alkalinity[c]	-	196	128	107	-	-	218	182	88	-	251	164	115	-	-	230	168	109	116	100
Dissolved Sulfate (SO4)	-	294	162	120	-	-	279	221	112	-	416	246	136	-	-	366	244	126	141	110
Total Suspended Solids	-	4	2	20	-	-	2	<2	28	-	3	2	21	-	-	<2	<2	58	<2	58
Total Hardness	-	584	346	265	-	-	565	497	244	-	819	472	296	-	-	713	484	284	289	259
pH (lab)	-	7.84	7.86	7.93	-	-	8.36	8.2	7.87	-	7.97	7.84	7.85	-	-	7.95	7.84	7.8	7.77	7.79
Conductivity (field)	-	901	-	-	-	-	865	-	-	-	1191	-	-	-	-	1084	-	-	-	-
Electrical Conductivity (lab)	-	886	561	467	-	-	862	742	421	-	1180	770	516	-	-	1080	771	483	504	441
Dissolved Oxygen	-	7.49[g]	-	-	-	-	10.31	-	-	-	8.83[g]	-	-	-	-	9.75	-	-	-	-
Dissolved Oxygen	-	73.5	-	-	-	-	94.5	-	-	-	83.7	-	-	-	-	90.5	-	-	-	-
Temperature (field)	-	12.2	10.7	8.1	-	-	9.1	6.1	3.4	-	10.7	7.0	7.9	-	-	10.1	5.8	6.8	6.6	6.7
Total Metals																				
Aluminum	< 0.06	0.014	0.035	0.177	0.105	< 0.06	0.02	0.019	0.47	0.042	0.014	0.026	0.206	0.052	0.054	0.014	0.027	0.586	0.061	0.721
Antimony	< 0.06	0.0003	0.0003	0.0004	0.0003	< 0.06	0.0021	0.0016	0.0007	0.0013	0.0007	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0002	0.0004
Arsenic	0.17	0.0034	0.0017	0.0013	0.0008	0.14	0.0023	0.0023	0.0017	0.0018	0.0021	0.0018	0.0015	0.0013	0.001	0.0011	0.0012	0.0019	0.0011	0.0019
Barium	0.079	0.063	0.041	0.045	0.04	0.062	0.051	0.049	0.057	0.046	0.059	0.046	0.045	0.04	0.04	0.06	0.045	0.06	0.04	0.057
Beryllium	< 0.001	<0.00004	<0.00004	0.00004	<0.00004	< 0.001	<0.00004	<0.00004	0.00007	<0.00004	<0.00004	<0.00004	0.00006	0.00004	<0.00004	<0.00004	<0.00004	0.00004	<0.00004	0.00007
Bismuth	-	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.13	0.074	0.026	0.015	0.021	0.26	0.199	0.169	0.054	0.136	0.166	0.071	0.026	0.068	0.053	0.106	0.074	0.027	0.037	0.023
Cadmium	< 0.006	0.00005	0.00003	0.00006	0.00003	< 0.006	<0.00001	0.00007	0.00002	<0.00001	0.00005	0.00374	0.00006	0.00003	0.00004	0.00003	0.00002	0.0001	0.00001	0.00007
Calcium	117	97	64.7	51.8	58.1	65	69	67.8	38.6	53.9	107	75.5	53.7	71.4	66	103	77.3	50.9	52.1	47
Chromium	< 0.006	0.0008	0.0009	0.0029	0.0014	< 0.006	0.0014	0.0014	0.0056	0.0014	0.0009	0.0009	0.0047	0.0011	0.0012	0.0009	0.001	0.0059	0.0008	0.0059
Cobalt	< 0.006	0.002	**0.0006**	0.00075	**0.00038**	< 0.006	0.00018	0.00016	0.00068	0.00017	0.00134	**0.00074**	0.00088	**0.00084**	**0.00064**	**0.0004**	**0.00047**	0.00139	0.00031	0.00136
Copper	< 0.02	0.001	0.002	0.003	0.003	< 0.02	<0.001	0.002	0.004	0.002	0.001	0.003	0.004	0.002	0.002	0.001	0.002	0.005	0.002	0.005
Iron	**0.82**	**1.04**	0.363	0.643	0.376	< 0.05	0.064	0.089	1.25	0.122	0.48	0.376	0.778	0.423	0.355	0.148	0.255	1.61	0.244	1.87
Lead	< 0.06	<0.0001	<0.0001	0.0008	0.0002	< 0.06	0.0001	<0.0001	0.001	<0.0001	<0.0001	**0.0007**	0.0008	0.0001	0.0001	<0.0001	<0.0001	0.0014	<0.0001	0.001
Lithium	-	0.014	0.007	0.004	0.005	-	0.006	0.007	0.003	0.006	0.029	0.015	0.006	0.014	0.012	0.024	0.017	0.007	0.011	0.006
Magnesium	98	82.9	44.8	33	34.7	80.3	95.3	79.5	35.8	61.9	134	68.8	39.3	65.7	57.5	111	70.7	38.2	38.7	34.4
Manganese	0.704	0.536	0.138	0.116	0.0534	0.004	0.0242	0.0248	0.0702	0.0227	0.365	0.17	0.131	0.18	0.143	0.149	0.132	0.179	0.0712	0.17
Molybdenum	< 0.01	0.0019	0.0012	0.001	0.001	< 0.01	0.0014	0.0013	0.0009	0.0011	0.002	0.0014	0.0011	0.0014	0.0012	0.0017	0.0015	0.0011	0.0009	0.001
Nickel	0.03	0.023	0.01	0.01	0.006	< 0.02	0.016	0.015	0.013	0.014	0.028	0.016	0.014	0.016	0.014	0.015	0.014	0.018	0.008	0.016
Phosphorus (ICP scan)	0.5	0.018	0.015	0.017	0.014	0.4	0.017	0.011	0.023	0.014	<0.01	**0.023**	0.02	0.013	0.01	0.015	0.01	0.057	0.013	0.047
Potassium	1.4	1.2	0.8	0.8	0.6	1	1.1	1	0.7	0.8	1.5	1	0.8	0.9	0.8	1.4	1.1	0.9	1	0.8
Selenium	< 0.06	<0.0006	<0.0006	0.0007	0.0011	< 0.06	<0.0006	<0.0006	0.0008	<0.0006	<0.0006	<0.0006	0.001	<0.0006	<0.0006	<0.0006	<0.0006	0.0008	<0.0006	0.001
Silicon	5.81	5	4.18	4.25	4.48	4.69	4.13	5.17	6.26	5.33	4.78	4.3	4.62	4.71	4.55	4.55	4.57	5.47	4.81	5.81
Silver	0.03	<0.00001	<0.00001	0.00003	<0.00001	< 0.01	<0.00001	<0.00001	0.00002	<0.00001	<0.00001	<0.00001	0.00002	<0.00001	<0.00001	<0.00001	<0.00001	0.00004	<0.00001	0.00003
Sodium	7.1	5.46	3.37	2.68	3.06	5.4	5.29	4.87	3.14	4.42	8.81	5	3.14	5.4	4.7	8.01	5.24	3.1	4.65	3.05
Strontium	0.809	0.599	0.33	0.264	0.284	0.412	0.36	0.358	0.195	0.289	0.858	0.464	0.286	0.44	0.395	0.75	0.515	0.283	0.336	0.265
Sulfur	145	101	58.7	43.8	50.9	82.4	89	80.3	39.3	65.7	141	84.7	49.8	79.1	71.6	123	85	47.7	49.6	42.9
Tellurium	-	<0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Thallium	-	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	<0.00001	<0.00001	<0.00001
Thorium	-	<0.0004	<0.0004	<0.0004	<0.0004	-	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Tin	0.07	<0.0001	<0.0001	<0.0001	<0.0001	< 0.06	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium	< 0.002	0.0008	0.0009	0.005	0.0039	< 0.002	0.0015	0.0008	0.0128	0.0021	0.0008	0.0009	0.007	0.0033	0.0019	0.0008	0.0009	0.0207	0.0018	0.0236
Uranium	-	0.002	0.0019	0.0018	0.0019	-	0.0022	0.002	0.0014	0.0014	0.003	0.0019	0.0017	0.0019	0.0017	0.0035	0.0021	0.0017	0.0014	0.0015
Vanadium	< 0.01	0.0004	0.0003	0.0011	0.0005	< 0.01	0.0003	0.0004	0.0019	0.0004	0.0003	0.0003	0.0012	0.0004	0.0003	0.0002	0.0003	0.0024	0.0005	0.0028
Zinc	< 0.05	0.004	0.004	0.008	0.007	< 0.05	0.003	0.003	0.005	0.003	0.005	0.015	0.008	0.006	0.006	0.006	0.009	0.008	0.005	0.011
Zirconium	-	0.0006	0.0007	0.0012	0.001	-	0.0002	0.0004	0.001	0.0005	0.001	0.0008	0.0012	0.0011	0.0013	0.001	0.001	0.0013	0.001	0.0011

value is greater than the 95th percentile of reference or is less than the 5th percentile of reference

value is greater than the 95th percentile of reference and guideline or is less than the 5th percentile of reference and guideline (or method detection limit is above guideline)

bold value is greater than the 95th percentile of reference computed without September 20, 2009 data (high flow event)

Note: Station identifiers are those used by Minnow and, in parentheses, those used by the Yukon Territory Government

[a] variables were screened for values exceeding the 95th percentile of reference except total alkalinity, bicarbonate, carbonate, hydroxide, and pH which were screened for values below the 5th percentile of reference.

[b] water quality data provided by the Yukon Territory Government

[c] water quality data provided by Laberge Environmental Services

[d] water quality data provided by Environment Canada

[e] see Table E.1 for supporting information

[f] the watersheds around Clinton Creek were flooded on September 20, 2009 therefore 95th percentiles excluding data from this date were also calculated for some substances which may have been influenced by the flood conditions

[g] value exceeds the CWQG guideline for early life stages of coldwater aquatic biota (9.5 mg/L)

APPENDIX F

Benthic Invertebrate Data

Table F.1: Central and non-central t-test results for benthic macroinvertebrate communities of individual reference streams compared to the pooled reference data (based on mean of n=3 samples per area).

Area		CA1	CA2	Abundance	Richness	% Diptera	% Chiron.	% EPT	% Plecopt.	% Oligo.
R1-R4	mean	0.8	0.4	1245.8	18.2	26.7	22.3	56.8	53.3	16.1
Reference	sd	0.6	0.2	853.8	4.4	22.0	21.4	19.0	21.9	10.6
R1	mean	1.35	0.71	2152	13	3	2	81	79	16
Clinton Creek	sd	0.18	0.06	442	0.9	1	1	6	6	7
u/s of Hudgeon Lake	cP	0.20	0.07	0.21	0.10	0.13	0.17	0.11	0.13	0.96
	ncP	0.90	0.68	0.85	0.77	0.84	0.89	0.75	0.80	1.00
R2	mean	0.16	0.35	602	23	44	41	36	26	20
Easter Creek	sd	0.17	0.09	179	1	6	6	6	4	13
u/s of Hudgeon Lake	cP	0.16	0.63	0.28	0.13	0.27	0.22	0.15	0.10	0.78
	ncP	0.87	1.00	0.95	0.80	0.94	0.91	0.82	0.77	0.99
R3	mean	0.34	0.22	437	19	47	40	51	50	2
Wolverine Creek	sd	0.52	0.25	135	1	11	12	11	12	0
u/s tailings	cP	0.36	0.31	0.18	0.70	0.26	0.32	0.71	0.83	0.07
	ncP	0.96	0.90	0.89	1.00	0.91	0.93	1.00	1.00	0.72
R4	mean	1.28	0.38	1792	17	13	5	59	59	27
Eagle Creek	sd	0.16	0.09	114	0	4	1	5	5	6
u/s of culvert	cP	0.24	0.80	0.34	0.77	0.35	0.24	0.84	0.71	0.24
	ncP	0.94	1.00	0.97	1.00	0.97	0.94	1.00	1.00	0.86

Different from reference mean (cP < 0.1) .
Similar to reference mean (cP > 0.9).
Different from reference range (ncP < 0.1).
Similar to reference range (ncP < 0.9).

Table F.2: Central and non-central t-test results for mine-exposed stream benthic macroinvertebrate communities compared to reference streams (n=3 samples per area).

Site		CA1	CA2	Abundance	Richness	% Diptera	% Chiron.	% EPT	% Plecopt.	% Oligo.
R1-R4	mean	0.8	0.4	1245.8	18.2	26.7	22.3	56.8	53.3	16.1
Reference	sd	0.6	0.2	853.8	4.4	22.0	21.4	19.0	21.9	10.6
E1	mean	-1.11	0.43	4335	20	89	82	2	0	8
Clinton Ck. d/s gabions	sd	0.18	0.45	2154	1.0	1	2	1	0	1
upstream of Porcupine	cP	0.00	0.96	0.16	0.53	0.01	0.01	0.00	0.01	0.24
	ncP	0.19	1.00	0.13	0.99	0.22	0.23	0.22	0.31	0.94
E2	mean	-0.96	0.62	2146	25	78	68	4	2	17
Clinton Ck. d/s Porcupine	sd	0.21	0.06	694	0.7	3	4	0	0	3
upstream of Wolverine	cP	0.01	0.17	0.29	0.06	0.01	0.02	0.01	0.01	0.88
	ncP	0.22	0.88	0.85	0.66	0.33	0.39	0.23	0.33	1.00
E3	mean	0.05	-1.94	2852	13	85	82	8	8	6
Wolverine Creek	sd	0.11	0.22	649	1.0	6	6	2	2	4
upstream of culvert	cP	0.11	0.00	0.08	0.12	0.01	0.01	0.01	0.02	0.23
	ncP	0.80	0.01	0.48	0.80	0.25	0.23	0.27	0.41	0.90
E4	mean	-0.45	0.55	214	19	62	38	6	4	25
Clinton Ck. d/s Wolverine	sd	0.10	0.03	60	2.2	2	3	3	2	2
upstream of Eagle	cP	0.02	0.32	0.10	0.88	0.05	0.29	0.01	0.01	0.23
	ncP	0.44	0.97	0.78	1.00	0.61	0.96	0.25	0.35	0.93
E7	mean	-1.03	0.52	451	21	92	75	5	4	2
Clinton Ck.	sd	0.05	0.05	47	0.0	2	1	1	1	1
upstream of mouth	cP	0.00	0.45	0.18	0.32	0.00	0.01	0.01	0.01	0.07
	ncP	0.21	0.99	0.90	0.97	0.20	0.30	0.24	0.36	0.72

Yellow	Different from reference mean (cP < 0.1) .
Light green	Similar to reference mean (cP > 0.9).
Orange	Different from reference range (ncP < 0.1).
Green	Similar to reference range (ncP < 0.9).

Table F.3: Central and non-central t-tests results for reference versus mine-exposed riverine benthic macroinvertebrate communities (n=2 samples per area).

Site		CA1	CA2	Abundance	Richness	% Diptera	% Chiron.	% EPT	% Plecopt.	% Oligo.
Forty Mile River u/s Clinton Creek										
	R6-A	0.16	0.81	113	16	19.5	17.7	51.3	41.6	26.5
	R6-B	0.46	0.89	397	17	10.8	10.1	69.3	59.9	19.9
	mean	**0.31**	**0.85**	**255.0**	**16.5**	**15.2**	**13.9**	**60.3**	**50.8**	**23.2**
	sd	**0.15**	**0.04**	**142.0**	**0.5**	**4.3**	**3.8**	**9.0**	**9.2**	**3.3**
Forty Mile River d/s Clinton Creek										
	E8-A	0.37	0.79	65	14	27.7	12.3	60.0	56.9	9.2
	E8-B	0.80	0.96	396	22	4.5	3.5	91.2	56.1	4.0
	mean	**0.58**	**0.88**	**230.5**	**18.0**	**16.1**	**7.9**	**75.6**	**56.5**	**6.6**
	sd	**0.22**	**0.08**	**165.5**	**4.0**	**11.6**	**4.4**	**15.6**	**0.4**	**2.6**
cP value		0.41	0.79	0.92	0.75	0.94	0.41	0.48	0.60	0.06

Different from reference mean (cP < 0.1) . [yellow]
Similar to reference mean (cP > 0.9). [green]

Table F.4: Taxon weighting associated with CA of benthic community data, Clinton Creek, 2009.

Taxa	CA-1 (26.4%)	CA-2 (24.6%)
Ameletus sp.	0.47	0.97
Baetis sp.	0.19	0.58
Baetis tricaudatus	-0.25	0.31
Family: Heptageniidae	0.61	0.81
Cinygmula sp.	1.65	0.79
Order: Plecoptera	0.45	-1.45
Family: Capniidae	0.95	0.78
Family: Nemouridae	1.47	0.58
Ostrocerca sp.	1.20	0.25
Podmosta sp.	1.63	0.75
Family: Perlodidae	0.56	1.11
Brachycentrus sp.	-1.14	0.38
Micrasema sp.	-1.13	0.79
Family: Limnephilidae	-0.42	0.61
Order: Diptera UID	-1.11	0.22
Order: Diptera UID	1.13	-0.22
Probezzia sp.	-0.91	0.74
Micropsectra/Tanytarsus	-0.90	0.58
Corynoneura sp.	-0.86	0.15
Cricotopus/Orthocladius sp.	-1.18	0.57
Eukiefferiella sp.	-0.92	0.66
Euryhapsis sp.	-1.43	0.70
Hydrobaenus sp.	-1.41	0.84
Diamesa sp.	-0.04	-1.97
Paghastia sp.	-0.48	-0.18
Potthastia longimana	-1.07	0.24
Subfamily : Tanypodinae	-1.19	0.24
Chelifera/Metachela sp.	-0.59	-0.43
Oreogeton sp.	-0.84	-0.36
Family: Simuliidae	0.70	0.41
Prosimulium sp.	1.55	0.33
Simulium sp.	-1.14	0.30
Dicranota sp.	-0.54	0.40
Ormosia sp.	0.49	0.19
Tipula sp.	0.18	0.55
Order: Collembola	1.01	-0.10
Super-Order: Acariformes	-1.16	0.77
Lebertia sp.	-0.73	0.73
Sperchon sp.	-0.39	0.69
Order: Gastropoda	-1.27	0.80
Family: Lumbriculidae	0.72	0.16
Rhynchelmis sp.	1.16	0.48
Sub-Family: Tubificinae	-0.83	0.47
Sub-Family: Naidinae	-0.79	0.54