SHERWOOD COPPER CORP.

Minto Explorations Ltd.

ENVIRONMENTAL EFFECTS MONITORING
FIRST STUDY DESIGN

Minto Project, Yukon Territory



July 2007

Prepared by:

ACCESS CONSULTING GROUP

minnow environmental inc.

SHERWOOD COPPER CORP.

Minto Explorations Ltd.

Minto Project, Yukon

ENVIRONMENTAL EFFECTS MONITORING

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July 10, 2007

Prepared For Minto Explorations Ltd.

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minnow environmental inc.

ACCESS CONSULTING GROUP

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1.0 INTRODUCTION

1.1 Site Description

Minto Explorations Ltd. (MEL) – a wholly owned subsidiary of the Sherwood Copper Corporation – is in the process of developing the Minto Copper Project in Yukon Territory approximately 240 km northwest of Whitehorse (Figure 1.1). The Minto orebody (copper/gold/silver) is located in the upper reaches of the Minto Creek watershed approximately 12 km to the west of the Minto Creek confluence with the Yukon River (Figure. 1.2)

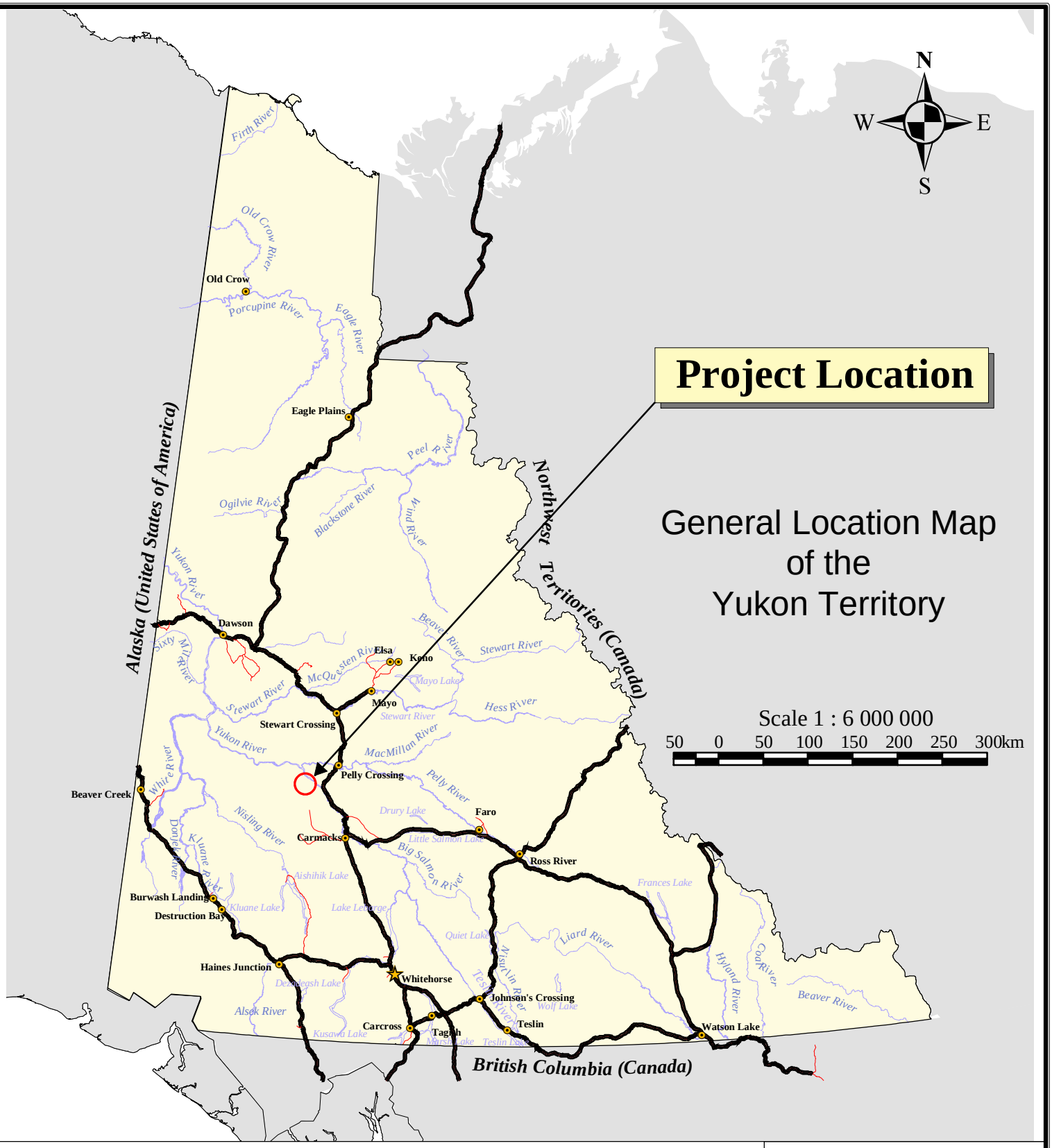
The Minto Project, with a production target of mid-2007, will include an open pit mine, a mill, a mill pond, a camp, waste rock dumps, a dry tailings stack and a water impoundment area. The mill will include crushing, grinding (semi-autogenous), flotation and concentrate drying modules, and tailings will be filtered for dry stacking. The mill was originally permitted for 1,800 metric tones per day, but a recent amendment has increased the permitted capacity to 2,400 metric tones per day. Target production is 35 to 45 million tonnes of concentrate per year. Concentrate will be trucked 420 km by road to Skagway Alaska prior to shipping overseas.

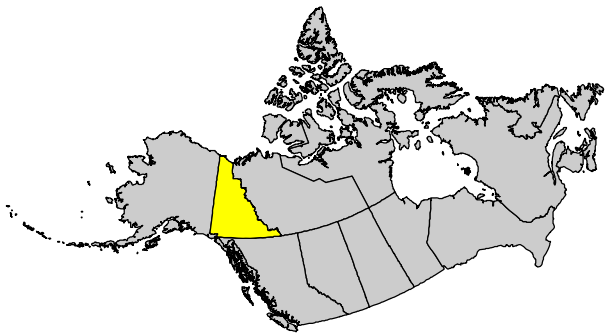
The water impoundment area is located on Minto Creek approximately 1.5 kilometers to the east (downstream) of the mill and has a capacity of approximately 300,000 m^3. This impoundment area will receive site drainage as well as excess water from the milling process. It is contained by a dam, and discharge from the outlet structure (dam spillway) or dam seepage will represent the mine's final effluent discharge.

The project has undergone environmental assessment under the federal and territorial instruments and has a Type A Water Use License and Quartz Mining License authorizing project production and water use.

1.2 Background

Federal effluent regulations for the metal mining industry (Metal Mining Effluent Regulations; MMER) were updated in the Canada Gazette in June 2002 (Government of Canada 2002). These regulations, administered under the federal *Fisheries Act*, apply to mining and milling operations that discharge effluent(s) at a combined rate greater than 50 m^3/day. The MMER outline requirements for routine effluent monitoring, toxicity testing, compliance limits and





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Environmental Effects Monitoring Study Design

Drawn By: HD	**Figure 1.1**
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N

Wolverine Creek
Unnamed Creek
SFN R-41B
Yukon River
Minto Creek
Minto Mine Site
SFN R-10B
Lhutsaw Wetland Habitat Protection Area
Von Wilczek Creek
#2
North Klondike Highway
SFN R-11B
SFN R-44A
Minto Access Road
SFN R-40B
Minto
SFN R-6A
Big Creek
Dark Creek
To Carmacks
SFN R-43B
McCabe Creek

Legend

- Minto Mine Site
- Contour (100' interval)
- Limited used road
- Road
- Access Road
- Trail
- Watercourse
- Minto Claim - DEF
- Minto Claim - MINTO
- Waterbody
- Habitat Protection Area
- First Nation Settlement Land

Projection: UTM Zone 8 NAD83
Units: Meters
NTS Sheet 115 I/10 and 115 I/11

National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced under license from © Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Figure 1.2

Project Area Overview

Scale: 1:100,000

0 0.5 1 2 3 4 km

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Environmental Effects Monitoring (EEM). The objective of EEM is to determine whether mining activity is causing an effect on fish, benthic invertebrate communities and/or the use of fisheries resources (based on mercury accumulation in fish tissues). The Minto Mine triggered the MMER on July 10, 2006. In accordance with the MMER, an EEM Study Design (or a historical data report) is required within 12 months of becoming subject to the MMER and at least 6 months prior to conducting the first study (scheduled for May 2008). An Interpretive Report of the First EEM study is required within 30 months of triggering the MMER (January 2009).

1.3 Objective

The objective of this First EEM Study Design document is to provide a comprehensive overview of the characteristics of the mine and its local environment (site characterization), and, based on this information, describe how chemical and biological monitoring will be conducted to meet the objectives of the EEM program.

As the project is on Type A Settlement Land of the Selkirk First Nation (SFN) and a signed cooperation agreement is in place, MEL and SFN will work cooperatively on the EEM Study Implementation.

1.4 Report Organization

The content of this report reflects the requirements outlined under the under the EEM portion of the MMER (Government of Canada 2002) and in the Technical Guidance Document for Metal Mining EEM (Environment Canada 2002a). A detailed site characterization is provided in Section 2.0. Section 3.0 describes the study design for all components of EEM required at the Minto Mine, including a fish survey, a benthic invertebrate community survey, sublethal effluent toxicity testing, effluent characterization and receiving water quality monitoring. Section 4.0 provides a timetable of activities. References cited throughout the document are provided in Section 5.0.

1.5 Contacts

Please contact Mr. Bill Dunn as follows if there are any questions or comments regarding this report.

Mr. Bill Dunn, Manager of Corporate and Regulatory Affairs

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In the event that Mr. Dunn should be unavailable to address technical questions or comments pertaining to the Site Characterization, Mr. Scott Keesey of Access Consulting Group may also be contacted as follows.

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2.0 SITE CHARACTERIZATION

Site characterization information is required with each EEM study design, and must be included in detail in the first study design. Site characterization draws on previous assessments and historical studies but may also make use of complementary field data to provide adequate background for the study design. In the case of the Minto Mine, a substantial quantity of data characterizing the site was available, but biological data were limited. Therefore, additional biological data were collected in 2007 to support the site characterization. Site characterization provides the critical background information that forms the foundation for study design.

2.1 Mine History

The Minto Project is a copper-gold-silver project located on the west side of the Yukon River approximately 75 km (47 miles) north-northwest of Carmacks, Yukon Territory. The mine site and access road lie within the traditional territory of the Selkirk First Nation and comprises part of land claim settlement parcels R-6A, R-44A (Type A settlement lands) and R-40B. MEL concluded a comprehensive cooperation agreement with the SFN on September 16, 1997. This agreement is still in effect.

The Minto Property is centered at approximately 62°37'N latitude and 137°15'W longitude (NAD 83, UTM Zone 8 coordinates 6945000N, 384000E). The Minto Project consists of 284 claims. There are 120 pending quartz claims, 99 quartz claims and 65 quartz claims under lease. The 100% registered owner of the claims and leases is MEL. The quartz claims are in good standing while the DEF leases are valid until October 7, 2007 and the Minto leases are valid until May 13, 2018.

Copper deposits at the Minto Project location were first discovered in 1970 and claims were staked in 1971. Extensive exploration yielded the first significant drill intersection in July of 1973. The Minto and DEF claims and leases cover an area of approximately 25.9 km^2. Mineable reserves for the deposit, above a cut-off grade of 0.50% copper, consist of 8,510,000 tonnes at grades of 1.81% copper, 0.57 g/t gold and 7.57 g/t silver. Current project design parameters are based upon 8,850,800 t at grades of 1.68% copper, 0.60 g/t gold and 6.9 g/t silver.

A total complement of 110 employees will be employed at the Minto Mine when it is in full production. A camp to accommodate 54 persons was constructed in 1998, and was expanded to its present capacity of 180 persons in the summer of 2006. The camp is presently at full capacity with the mine construction management, contractors and support staff.

The property is accessible by crossing the Yukon River at Minto Landing. Barge landings have been constructed for ice-free crossing and an ice bridge is used upon freeze-up of the Yukon River.

2.2 Minto Operations

The Minto operation currently includes an open pit mine with associated waste dumps and ore storage areas, a mill plant and mill water pond, a concentrate storage shed, a filter building, a dry-stack tailings storage area, a water retention dam with reclaim water reservoir, a pH adjustment (NaOH) water treatment plant for pit dewatering, administrative offices, an airstrip, and a camp (Fig. 2.1.)

2.2.1 Mining

The ore deposits are to be mined using conventional open pit truck and loader operations and processed in a mill plant on site. The plant will initially process 1,563 tpd (metric tons per day) of ore in year 1 defined as Phase 1. In year 2, the plant throughput will increase to 2,400 tpd of ore for the rest of the mine life, defined as Phase 2. Tailings will be thickened and vacuum filtered into a ‘cake’ and deposited on a bench to the south (upslope) of Minto Creek, and precipitation and surface water will collect in the main water storage pond. Operation of the tailings facility will be in accordance with the *Minto Mine Tailings Management Plan*, prepared by Access Consulting Group (ACG 2007).

Minto Mine Project

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N

Main Waste Dump

Oxide Pad for Low-grade Ore Stockpile

Open Pit

Mill Site

Camp

Main Water Dam

Impounded Water Surface

Access Road and Power Transmission Line

Creek

Minto

Mill Pond

High Grade Ore Stockpile Pad

Finger Drains

Finger Drains

Tailings Deposit

South Diversion Ditch

Diversion Berms

Old Airport Road

Solid Waste Facility

Land Treatment Facility

Airstrip

Ice-rich Overburden Dump

Explosives Yard

Legend

- Access Road
- Road
- Exploration Road / Trail
- Transmission Line
- Contour
- Site Feature Profile Contour
- Water Course
- Areas of Construction

Original Drawing by HATCH
ACAD-Overall for Reclamation.dwg, Drawn by D.L.N Feb. 06

Projection: UTM Zone 8 NAD83
Units: Meters
NTS: 115I/11

Figure 2.1

Ultimate Overall Site Plan

Scale: 0 100 200 400 m

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2.2.2 Ore Processing

In general, the Minto plant was designed to process 1,563 tpd of ore containing copper, gold and silver to produce a copper concentrate. In Phase 2, provisions will be made to the plant layout and design to accommodate the increased throughput. The main changes will include a new building extension to contain the second ball mill circuit, 3 additional rougher flotation cells and also the utilization of the new re-cleaner cells in the main mill building (Fig.s 2.2-2.4).

Equipment will be sized to handle both Phase 1 and 2 tonnages. The plant will consist of the following main unit operations:

- Primary crushing;
- Coarse ore conveying;
- 2 stage grinding circuits for Phase 1;
- Additional Ball Mill circuit for Phase 2;
- Copper flotation;
- Concentrate thickening and pumping;
- Concentrate filtration;
- Concentrate storage (on-site);
- Tailings handling; and
- Water reclaim.

The primary crushing circuit will operate 6 hours per day, 365 days per year at an availability of 75%. The mill circuit will operate 24 hours per day, 365 days per year at an availability of 90%. Availability is the scheduled and unscheduled downtime for equipment maintenance. The milling systems are currently being commissioned, and ramping up will continue into the third quarter of 2007 with startup anticipated mid way through the quarter. (HATCH 2006)

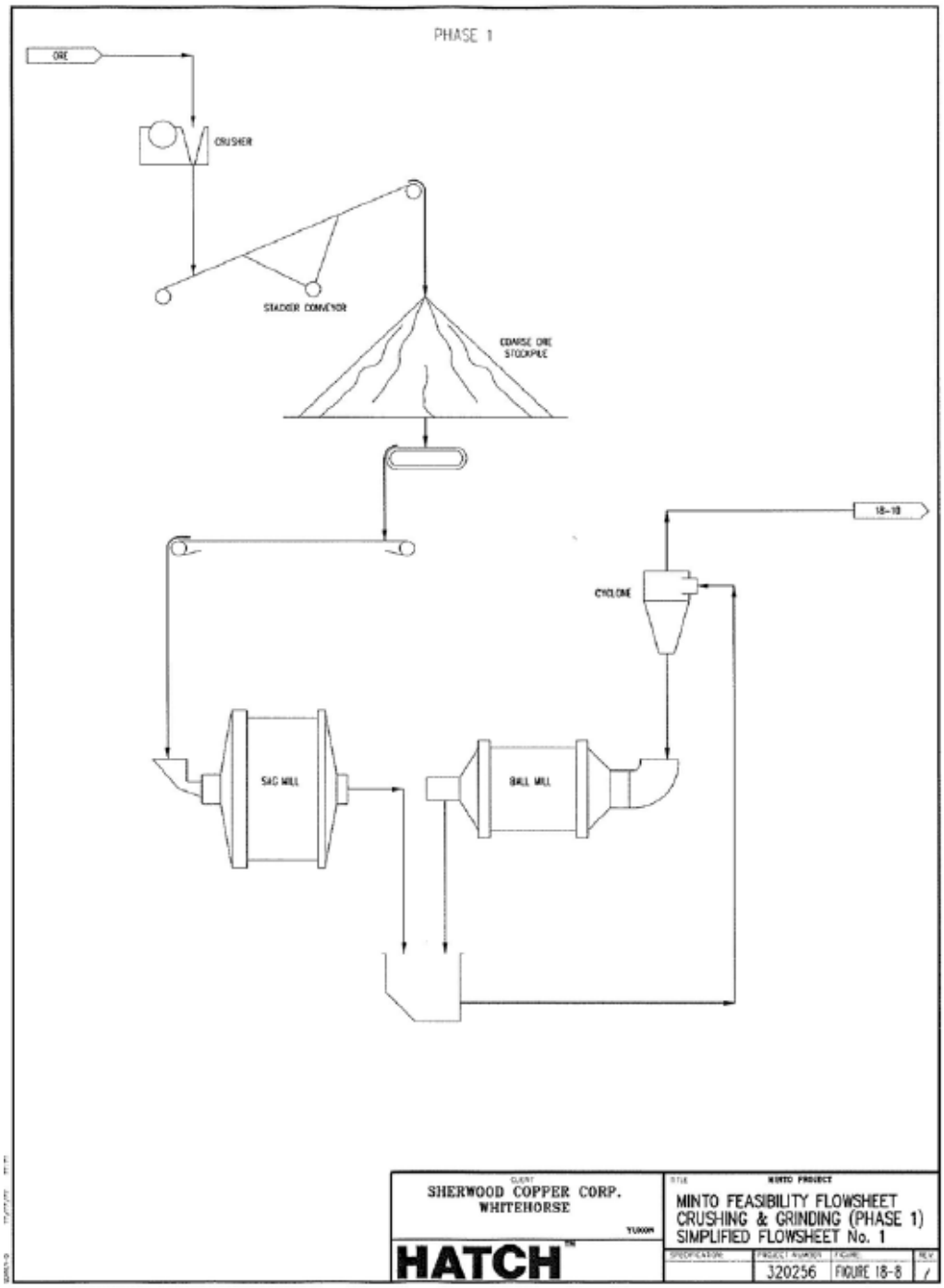


Figure 2.2 Crushing and Grinding Flowsheet for Phase 1 (HATCH 2006)

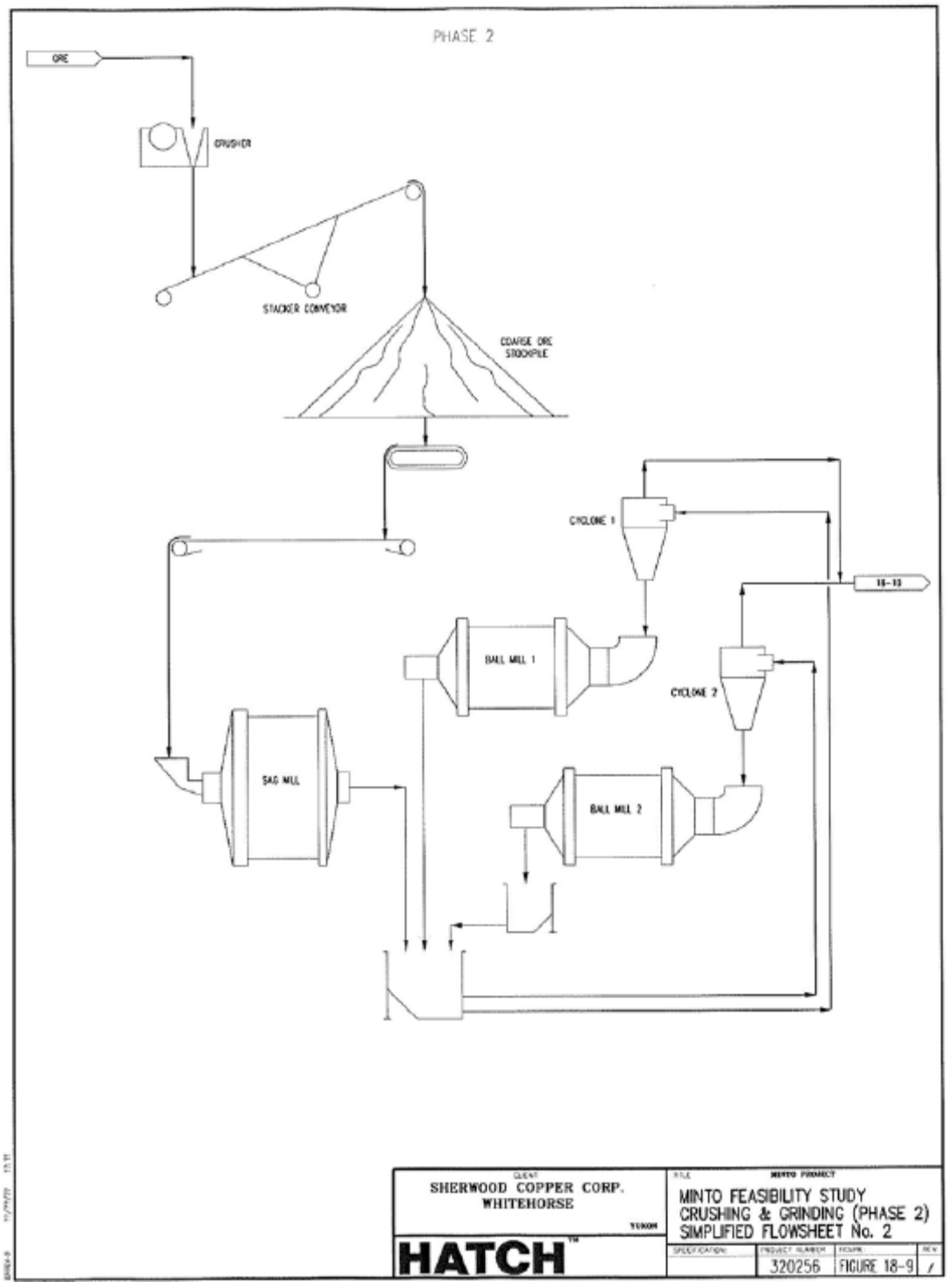


Figure 2.3 Crushing and Grinding Flowsheet for Phase 2 (HATCH 2006)

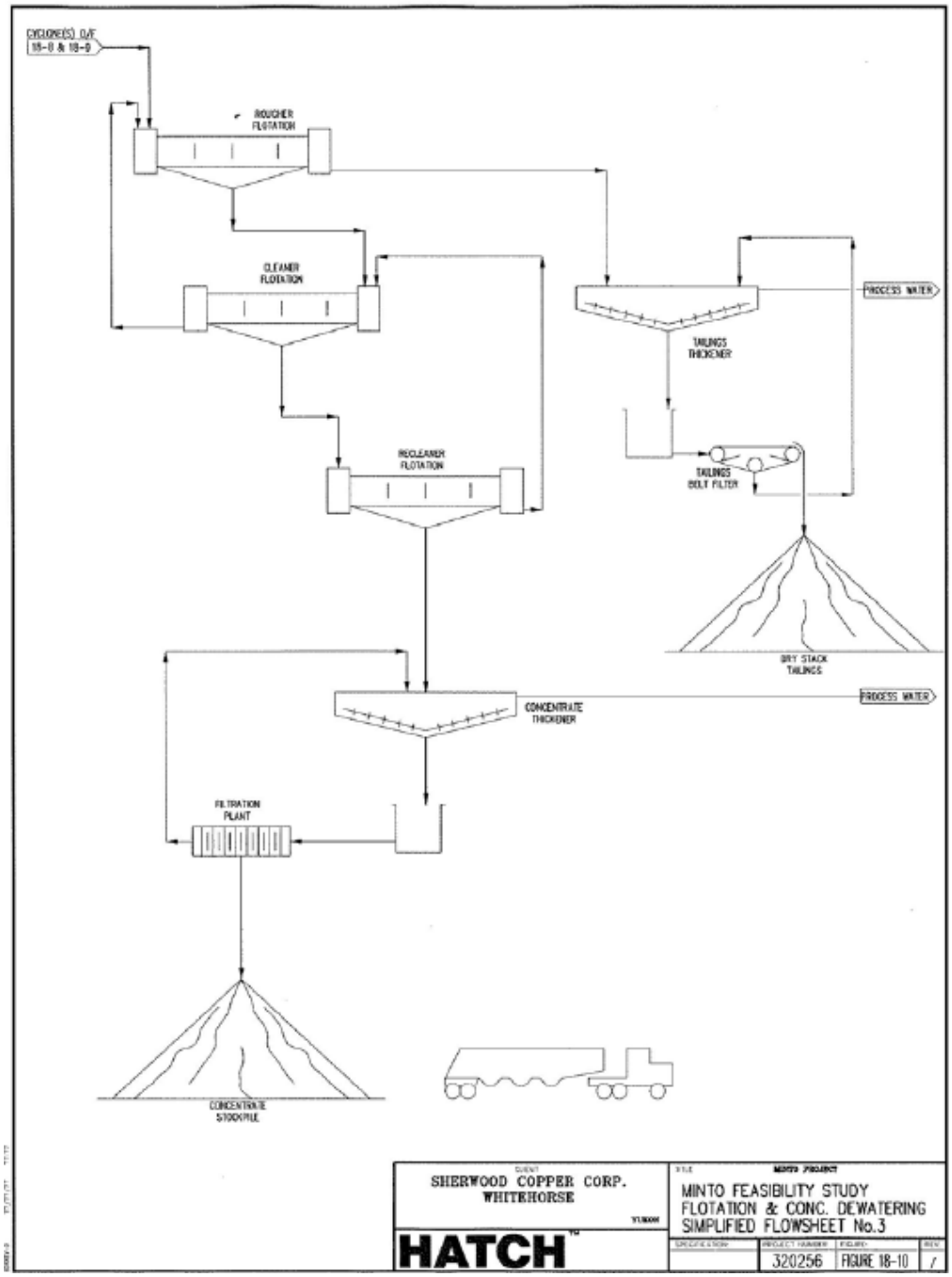


Figure 2.4 Milling Process Flowsheet – Floatation and Concentrate Dewatering (HATCH 2006)

The following process reagents are currently proposed for use in Minto's milling process:

- PAX – Potassium Amyl Xanthate;
- MIBC – Methyl Isobutyl Carbinol;
- Concentrate Flocculant – AE4330 Flocculant; and
- Tailings Flocculant – AE4270 Flocculant

The Minto site has in place an Emergency Response Plan – prepared in 2006 by ACG – that outlines prevention and response protocols specifically for dealing with hazardous materials at the site, including the above-mentioned process reagents. This plan is part of the larger Environmental and Human Health and Safety Plan for the site, and outlines spill response, containment, and reporting protocols to follow in the event of a release of a deleterious substance. Minto Explorations Ltd. is committed to safe and compliant handling of hazardous materials on the site, and to prompt and safe response to spill events.

2.2.3 Tailings Management

The following information outlining management of the project tailings is excerpted from EBA Engineering Consultants' January 2007 document *Geotechnical Design Report – "Dry" Stack Tailings Storage Facility – Minto Mine, Yukon* (EBA 2007). It outlines the preliminary tailings management considerations for the Dry Stack Tailings Storage Facility (DSTSF) that were incorporated into the company's Tailings Management Plan, and form the foundation for the Tailings Operation, Maintenance and Surveillance Manual (currently being prepared.)

> *The mine plan indicates that approximately 5,517,000 tonnes of tailings will be produced over an eight year period. The tailings will be transported by conveyor to the DSTSF at 83% solids and mechanically placed to form an engineered "dry" stack. The tailings material at 83% solids is equivalent to a gravimetric moisture content of 20%. Referencing this moisture content against the moisture density relationship detailed in Appendix C, the mechanically engineered tailings should achieve a density of 1,600 kg/m3 which is equivalent to 95% of the Standard Proctor Maximum Dry Density. On this basis a storage volume of 3,758,000 m3 will be required to accommodate the 5,517,000 tonnes of tailings at a placed density of 1,600 kg/m3.*
>
> *Laboratory tests undertaken on samples of tailings material have characterized the material as sand and silt, with a trace of clay, which generally exhibits the properties of a cohesionless material. On the basis that the tailings will be placed at a solids content of approximately 83% and a dry density of 1,600 kg/m3, little or no bleed water is expected to emanate from the*

tailings upon placement and compaction. Accordingly, the tailings can be classified as a "dry" stackable material and will be in an unsaturated condition upon placement.

The selected tailings site is east of the mill and processing buildings within the valley profile above the Minto Creek (Fig. 2.1). The site will meet the storage requirement for 3.8 million m^3 of tailings. This location minimizes potential impacts to Minto Creek, both during operations and at closure as the tailings are stored out of the main creek valley.

The 0.4 km^2 facility area will provide for complete storage and confinement of the stacked tailings, with the toe of the facility designed above the flood level of Minto Creek. This design elevation is also well above the reservoir level created by the water dam. The stack will have an outer slope of 4:1 (horizontal:vertical) and will be up to 26 m deep in the central area of the storage facility.

Minto Mine's tailings storage area will include:

- an access road;
- tailings stack starter bench;
- slope drainage blanket;
- finger drains along existing valley drainages; and
- diversion berms for run-on surface water management.

The waste rock starter bench will provide a working bench onto which the initial tailings will be mechanically placed, spread and compacted in controlled lifts. The tailings stack will be progressively developed using a bottom up placement approach, and the bench face and tailings surface will be reclaimed (covered and revegetated) progressively during operations, when tailings placement configurations are final in certain areas.

As the toe of the tailings storage area will be constructed at the outlet of a mountain slope catchment, management of the catchment area water is required. Small ephemeral creeks originally collected the surface run-off and reported to Minto Creek, with the total watershed approximately 3.42 km^2 in size. Approximately 2.5 km^2 of this area, however, is upslope of the airstrip access road and the engineered diversion ditch that forms a part of this road (Fig. 2.1).

Construction of the storage facility has and will continue to interrupt the natural drainage in the remaining area, therefore a water diversion system is being constructed to divert the

surface run-off water around and under the tailings facility. During operations, the surface of the tailings stack will be contoured to control the runoff of direct precipitation. Water diversion berms will be constructed around the perimeter of the tailings storage facility, and will divert run-on water from the catchment area above the tailings facility around the stack and into the main reservoir.

In addition to the main diversion ditch and the diversion berms, finger drains are to be constructed along existing drainage courses under the tailings stack to intercept near surface seepage, eventually conveying it under the stack to the main water reservoir. The reclaim system will take make-up water from the reservoir to the mill, where a treatment system will provide control of the quality of the effluent released back into the main reservoir. This treatment system is currently being designed based on preliminary water quality results from the mill process effluent, and will be optimized during operations in response to water quality in the main reservoir and the mill 'bleed' water.

The water management system for the tailings storage area has been designed to function throughout the life of the facility (EBA 2007.)

2.3 Effluent Management and Quality

2.3.1 Effluent Discharge

The mine site is currently transitioning from construction phase to the operational phase, and as such the processes and systems that will ultimately determine the nature of the site effluent are mostly in the process of being commissioned. Prior to August 2006 when the main dam construction began, runoff from the site construction activities generally reported directly to Minto Creek and to the sampling location known as W3, downstream of the current dam location. Although this is still the case, the main dam reservoir now collects and retains runoff and creek flow from the mine exposure area. A reclaim line will pump make-up water from the reclaim reservoir to the mill as needed. The reservoir is currently half full, and the only effluent reporting to the W3 sampling location is approximately 10 L/s of seepage/groundwater discharge between the dam toe and the sampling point. Contingency plans are currently in place to return the dam seepage flow (~5 L/s) back to the main reservoir. It is expected that the groundwater discharge flow (approximately 5 L/s) from upstream of the W3 site will constitute the only "effluent" from the site this year, as it is not expected that the reservoir will spill any impounded water this season.

Site W3 (Fig. 2.5) is the final point of discharge for the Minto Mine project. Located on Minto Creek approximately 300 m downstream of the toe of the Minto main water dam, the site is located in the natural creek watercourse along a reach with a relatively deep channel and steep banks in a 'run' section of the stream.

This location was selected as the final point of discharge based on the following considerations:

- Minto Creek runs through the property and is being diverted for operations at the mine site;
- The main water dam is located across Minto Creek, upstream of the final point of discharge and will be the final source for site effluents;
- There will be spilling of water over the main dam and seepage under the main dam, with a stilling basin and possible re-circulation seepage pond downstream of the stilling basin. Both the main dam spillage and dam seepage will be monitored; and
- The Minto Creek W3 monitoring station is consistent with the Type A Water Use Licence (QZ96-006).

Therefore, the final point of discharge at W3 is downstream of all water management and treatment facilities and potential sources of deleterious substances from the site operations and would represent the final effluent point from all sources to the receiving waters of Minto Creek. An emergent seep of water from near the foundation of the control structure at W3 (90^{o} V-notch weir with small impoundment and wing berms) that originated during construction of the W3 installation in July 2006 has persisted. This seepage (0.5 – 1.0 L/s) has also been sampled as effluent during the winter months, according to direction from Environment Canada. A source investigation is being planned to determine if this seepage is actually influenced by the mine exposure area.

Effluent water quality results at the W3 location are summarized in Section 2.3.3.

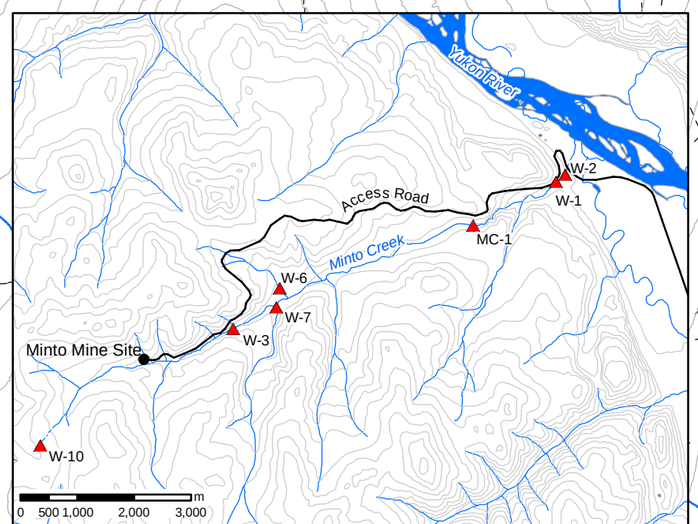
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N

Waste Rock Dump
Oxide Waste
Mill Site
Camp
Starter Pit
Mill Water Pond
Proposed Dry StackTailings Storage Facility
Main Water Dam
Main Access Road
MIN_CR EXP
W-8
W-7
W-3
W-2
W-20
Minto Creek
Ice Rich Overburden Dump
South Diversion Ditch
Minto Creek
Solid Waste Facility
Exploration Camp
Land Treatment Facility
Special Waste Storage
Airstrip
W-10
Explosives Plant Site
AN Storage Site
Magazine Sites



Legend

- Water Quality Surveillance Program Sites
- Access Road
- Exploration Road
- Contour
- Water Course
- Intermittent Water Course
- Water Body

Projection: UTM Zone 8 NAD83
Units: Meters
NTS: 105I/11
Basedata obtained from Yukon Engineering Services Nov3_06_status_plan.dwg and from Minto Mine Site Map for Access, June 21, 2007
Tailings data obtained from EBA 1200173 Figure 2 Site Plan.dwg

Figure 2.5

Water Quality Sample Sites

Scale:

0 50 100 200 300 400 500 600 m

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2.3.2 Applicable Regulations

With respect to regulations that apply to the discharge of effluent from the Minto Mine Site – and in addition to the Federal MMER under the Fisheries Act – the Yukon Water Board (YWB) issued a Type A Water Use Licence (QZ96-006), for the project on 27 January, 1998. Yukon Territorial Government (YTG) Development Assessment Branch completed a YEAA screening of the Type A Water Use Licence using the previous EARPGO screening and issued their screening report in March 2005. The YWB issued the amended Type A Water Use Licence (QZ04-064) in September 2005 with an expiry date of June 30, 2016. The Type A Water Use Licence is generally more restrictive than the MMER, and separate monitoring and reporting for effluent discharge and receiving water quality is required under the Water Use License's Water Quality Surveillance Program, which is summarized in Table 2.1.

2.3.3 Effluent Quality

Effluent quality monitoring is conducted under two programs, as outlined above in section 2.3.2. Specific to the federal MMER, monthly mean concentrations of parameters of deleterious substances have not exceeded discharge limits since the application of the regulations in July 2006 (Table 2.2.)

Expanded effluent quality monitoring efforts under MEL's Type A Water Use License – Water Quality Surveillance Program for a full suite of analytical parameters is summarized below (Table 2.3) with red values denoting parameters where concentrations in the effluent since July 2006 have exceeded either of the sets of discharge criteria. As the Water Use License discharge standards are more restrictive than the MMER criteria, these exceedances are primarily related to the former. Figures 2.6 through 2.12 chart the concentrations of these parameters relative to applicable effluent discharge standards. Concentrations of total mercury have been below 0.010 µg/L (0.00001 mg/L) in all effluent samples collected.

For the months of November 2006 to April 2007 inclusive, the surface water flow at the W3 location was frozen, so under Environment Canada direction, a persistent groundwater seepage flow below the W3 site was sampled and results were reported as the effluent quality.

Table 2.1 Compliance Monitoring Frequency and Limits Applicable to the Minto Mine Effluent.

Parameter	Units	Water Use License QZ96-006 Effluent Quality Standards		MMER Effluent Quality Standards		
		Frequency	Daily Limit	Frequency	Maximum Monthly Mean	Maximum Authorized Concentration in Grab
pH	pH units	weekly	6.5 - 9.0	-	-	-
Suspended Solids	mg/L	weekly	15	weekly	15.00	30.00
Aluminun	mg/L	weekly	0.5	-	-	-
Arsenic	mg/L	-	-	weekly	0.50	1.00
Iron	mg/L	weekly	1.0	-	-	-
Copper	mg/L	weekly	0.01	weekly	0.30	0.60
Lead	mg/L	weekly	0.002	weekly	0.20	0.40
Manganese	mg/L	weekly	0.2	-	-	-
Nickel	mg/L	weekly	0.065	weekly	0.50	1.00
Radium 226	Bq/L	-	-	weekly	0.37	1.11
Zinc	mg/L	weekly	0.03	weekly	0.50	1.00
total Ammonia	mg/L	weekly	1.0	-	-	-
Oil and Grease	visibility	weekly	no visible oil or grease	-	-	-
Toxicity (Rainbow Trout)	LT_{50}	monthly	Pass	-	-	-
Rainbow Trout Acute Lethality Test	<50% mortality in 100% effluent	-	-	monthly	Pass	
Daphnia magna Acute Lethality Test	<50% mortality in 100% effluent	-	-	monthly	Pass	

Note:
Cyanide analysis not required by MMER as it not a processing agent

Table 2.2. W3 Summary of MMER Effluent Monitoring for July 2006 to May 2007

Date	Mean Monthly Results											Maximum Authorized Monthly Mean Concentration (mg/L)
	Jul-06	Aug-06	Sep-06	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	May-07	
Physical Parameters												
Ph	7.85	7.90	7.91	7.79	7.51	7.85	7.92	7.35	7.75	7.77	7.90	n/a
Deleterious Substance												
Arsenic	0.000433	0.00056	0.000425	0.000275	0.00206	0.000425	0.00025	0.0001	0.0001	0.0005	0.0007	0.50
Copper	0.006	0.006	0.004	0.004	0.012	0.000	0.002	0.001	0.001	0.010	0.018	0.30
Cyanide	0.0007	0.0001	0.0008	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.00
Lead	0.0001	0.00012	0.000075	0.000063	0.00139	0.000213	0.000275	0.0002	0.00014	0.000575	0.00018	0.20
Nickel	0.0013	0.0016	0.0016	0.0013	0.0073	0.001	0.0008	0.0021	0.0005	0.0013	0.0014	0.50
Zinc	0.0027	0.0034	0.0028	0.002	0.022	0.007	0.004	0.0037	0.0042	0.009	0.0108	0.50
TSS	5.3	10.8	1.5	4.1	4.8	13.8	9.0	1.7	2.6	7.5	12.6	15.00
Radium 266	0.00	0.002	<0.005	0.0085	0.0032	0.0026	0	0	0.0012	0.0138	0	0.37

Table 2.3: Summary of W3 Effluent Chemistry, July 2006 to May 2007

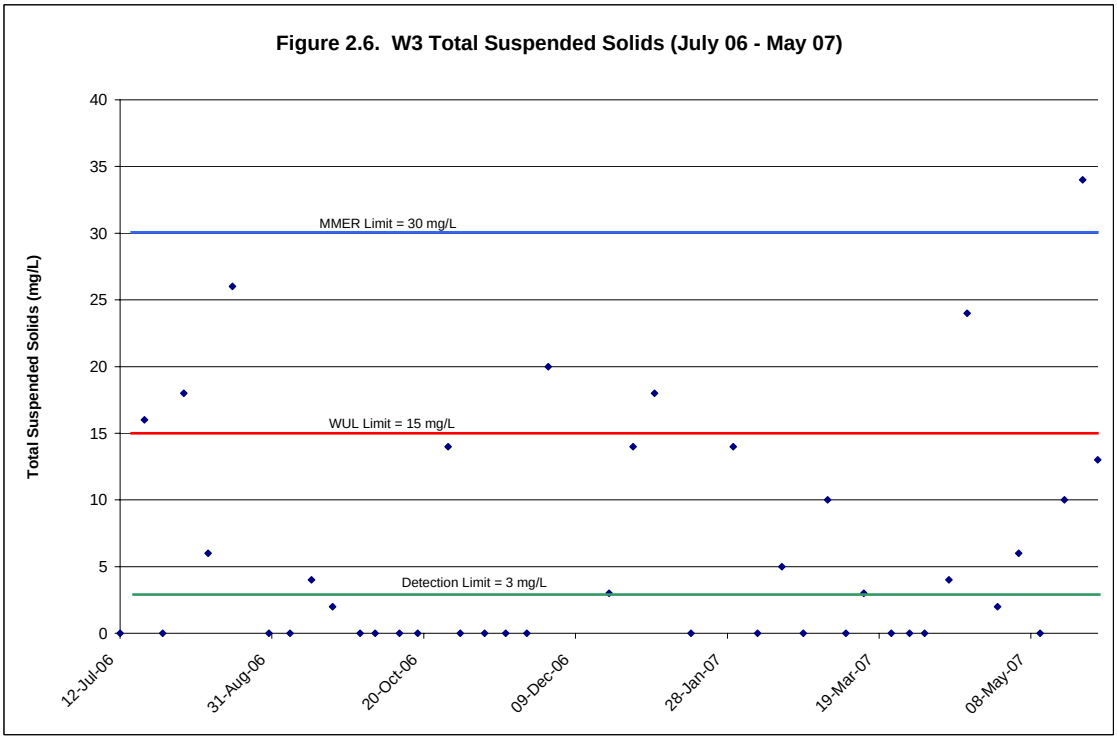
Parameter[1]	Summary Statistics					Detection Limit	Regulatory Limits	
	Count	Count > Regulatory Limit	Mean	Min	Max		Water Use License Standards	MMER Maximum Authorized Concentration in a Grab Sample
Physical Tests								
Conductivity	46		433.2	264.0	521.0	2.0		
Total Dissolved Solids	36		282	130	332	10		
Hardness	45		214.64	142.00	267.00	0.54		
pH (Lab)	46		7.780	7.050	8.360	0.010	6.5 to 9.0 pH units	
Total Suspended Solids (Lab)	45	8	12.3	2.0	34.0	3.0	15 mg/L	30.00 mg/L
Total Suspended Solids (On Site Hach)	43		8.51	0.00	65.00			
pH (Field)	49		7.63	6.38	8.80			
Temperature (field)	27		1.14	-0.10	6.10			
Conductivity (field)	27		470.56	309.00	585.00			
Turbidity	39		7.33	0.20	65.00			
Dissolved Anions								
Alkalinity-Total CaCO3	46		187.78	106.00	248.00	2.0		
Bromide Br	0							
Chloride Cl	29		2.24	0.90	4.10	0.50		
Fluoride F	0							
Sulphate SO4	43		40.77	22.10	48.00	0.50		
Nutrients								
Ammonia Nitrogen N	46		0.023	0.002	0.100	0.020	1.0 mg/l	
Nitrate Nitrogen N	46		0.9244	0.0080	4.8000	0.0050		
Nitrite Nitrogen N	32		0.1450	0.0600	0.1900	0.0010		
ortho-Phosphate	26		0.05	0.01	0.09			
Total Dissolved Phosphate	1		0.09	0.09	0.09			
Total Phosphorous	25		0.12	0.02	0.75			
Cyanides								
Total Cyanide CN	22		0.02	0.00	0.14	0.0050		2.00 mg/L
Total Metals (Trace)								
Aluminum T-Al	46	11	0.3028	0.0060	1.4600	0.0010	0.5 mg/L	
Antimony T-Sb	46		0.00187	0.00020	0.00500	0.00010		
Arsenic T-As	46		0.00070	0.00020	0.00900	0.00010		1.00 mg/L
Barium T-Ba	46		0.111370	0.051000	1.900000	0.000050		
Beryllium T-Be	46		< DL	< DL	< DL	0.00050		
Bismuth T-Bi	46		0.00055	0.00050	0.00060	0.00050		
Boron T-B	46		0.027	0.005	0.480	0.010		
Cadmium T-Cd	46		0.000019	0.000010	0.000030	0.000050		
Calcium T-Ca	46		49.791	38.900	64.400	0.050		
Chromium T-Cr	46		0.00122	0.00050	0.00670	0.00050		
Cobalt T-Co	46		0.00050	0.00010	0.00400	0.00010		
Copper T-Cu (Lab)	46	9	0.00676	0.00100	0.05000	0.00010	0.01 mg/L	0.60 mg/L
Copper (On Site Hach)	34		0.00149	0.00020	0.00500			
Iron T-Fe	46	4	0.466	0.100	1.800	0.030	1.0 mg/L	
Lead T-Pb	46	2	0.000468	0.000100	0.003100	0.000050	0.002 mg/L	0.40 mg/L
Lithium T-Li	46		0.0052	0.0020	0.0900	0.0050		
Magnesium T-Mg	46		22.90	11.00	52.70	0.10		
Manganese T-Mn	46	5	0.122891	0.008000	2.260000	0.000050	0.2 mg/L	
Mercury T-Hg	29		0.000100	0.000100	0.000100	0.000020		
Molybdenum T-Mo	46		0.003442	0.001000	0.060000	0.000050		
Nickel T-Ni	46		0.00224	0.00050	0.03000	0.00050	0.065 mg/L	1.00 mg/L
Phosphorous T-P	21		0.06	0.02	0.14	0.30		
Potassium T-K	46		1.9	1.4	3.0	2.0		
Selenium T-Se	46		0.0008	0.0002	0.0080	0.0010		
Silicon T-Si	46		6.691	5.170	10.100	0.050		
Silver T-Ag	46		0.000200	0.000200	0.000200	0.000010		
Sodium T-Na	46		13.1	7.7	15.8	2.0		
Strontium T-Sr	46		0.86585	0.23600	15.90000	0.00010		
Thallium T-Tl	46		< DL	< DL	< DL	0.00010		
Tin T-Sn	46		< DL	< DL	< DL	0.00010		
Titanium T-Ti	46		0.015	0.001	0.057	0.010		
Uranium T-U	46		0.003200	0.001000	0.058000	0.000010		
Vanadium T-V	46		0.0019	0.0004	0.0200	0.0010		
Zinc T-Zn	46	2	0.0071	0.0010	0.0500	0.0010	0.03 mg/L	1.00 mg/L
Dissolved Metals (Trace)								
Aluminum D-Al	44		0.0144	0.0050	0.0450	0.0010		
Antimony D-Sb	44		0.00020	0.00020	0.00020	0.00010		
Arsenic D-As	44		0.00041	0.00020	0.00110	0.00010		
Barium D-Ba	44		0.067773	0.049000	0.095000	0.000050		
Beryllium D-Be	44		0.00010	0.00010	0.00010	0.00050		
Bismuth D-Bi	44		0.00060	0.00050	0.00070	0.00050		
Boron D-B	44		0.013	0.004	0.022	0.010		
Cadmium D-Cd	44		0.000019	0.000010	0.000050	0.000050		
Calcium D-Ca	44		49.727	38.600	63.100	0.050		
Chromium D-Cr	44		0.00141	0.00050	0.00980	0.00050		
Cobalt D-Co	44		0.00028	0.00010	0.00080	0.00010		
Copper D-Cu	44		0.00445	0.00100	0.01800	0.00010		
Iron D-Fe	44		0.065	0.010	0.290	0.030		
Lead D-Pb	44		0.000240	0.000100	0.000500	0.000050		
Lithium D-Li	44		0.0027	0.0010	0.0050	0.0050		
Magnesium D-Mg	44		21.97	11.10	28.10	0.10		
Manganese D-Mn	44		0.119682	0.005000	2.160000	0.000050		
Mercury D-Hg	22		< DL	< DL	< DL	0.000020		
Molybdenum D-Mo	44		0.002047	0.001000	0.006000	0.000050		
Nickel D-Ni	44		0.00115	0.00050	0.00530	0.00050		
Phosphorus D-P	19		0.38	0.06	1.60	0.30		
Potassium D-K	43		1.9	1.4	2.8	2.0		
Selenium D-Se	44		0.0004	0.0003	0.0006	0.0010		
Silicon D-Si	44		6.283	4.570	7.440	0.050		
Silver D-Ag	44		0.000100	0.000100	0.000100	0.000010		
Sodium D-Na	43		13.5	7.2	16.6	2.0		
Strontium D-Sr	44		0.51070	0.23800	0.78000	0.00010		
Thallium D-Tl	44		0.00005	0.00005	0.00005	0.00010		
Tin D-Sn	44		0.00100	0.00100	0.00100	0.00010		
Titanium D-Ti	44		0.001	0.001	0.003	0.010		
Uranium D-U	44		0.001832	0.000800	0.002600	0.000010		
Vanadium D-V	44		0.0020	0.0006	0.0053	0.0010		
Zinc D-Zn	44		0.0030	0.0010	0.0120	0.0010		
Organic Parameters								
Dissolved Organic Carbon C	38		6.4	1.9	25.6	0.5		
Total Inorganic Carbon C	34		47.2294118	3	65.2	0.5		
Total Organic Carbon C	33		6.42424242	2	20	0.5		
Radiological Parameters								
Radium-226	42		0.0093	0.0050	0.0200	0.0050		1.11 Bq/L
Toxicity Testing'								
96 HourTrout LTSO Bioassay (hrs)	23						100%	
Percent Survival	22		99.09	90.00	100.00		(pH non-adjusted)	
Designation	22							
48 Hour Daphnia magna LTSO (hrs)	23							
Percent Survival								
Designation								

Notes:

[1] All units are in mg/L unless otherwise indicated

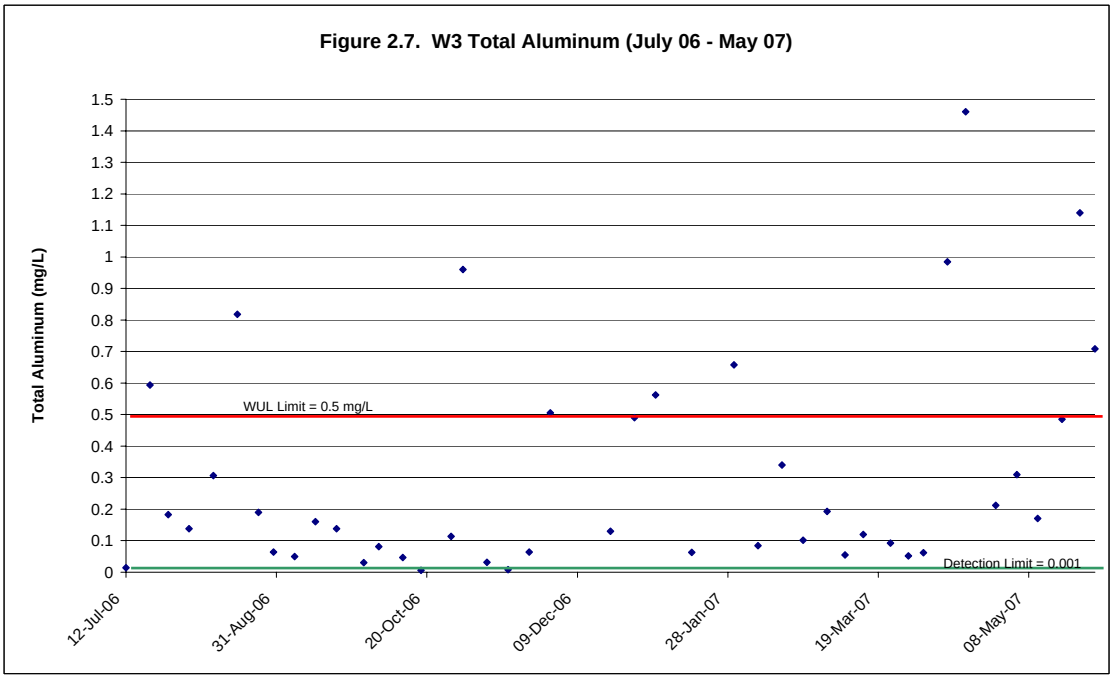
Value exceeds the Water Use Licnese standards or the MMER limit

Figure 2.6. W3 Total Suspended Solids (July 06 - May 07)

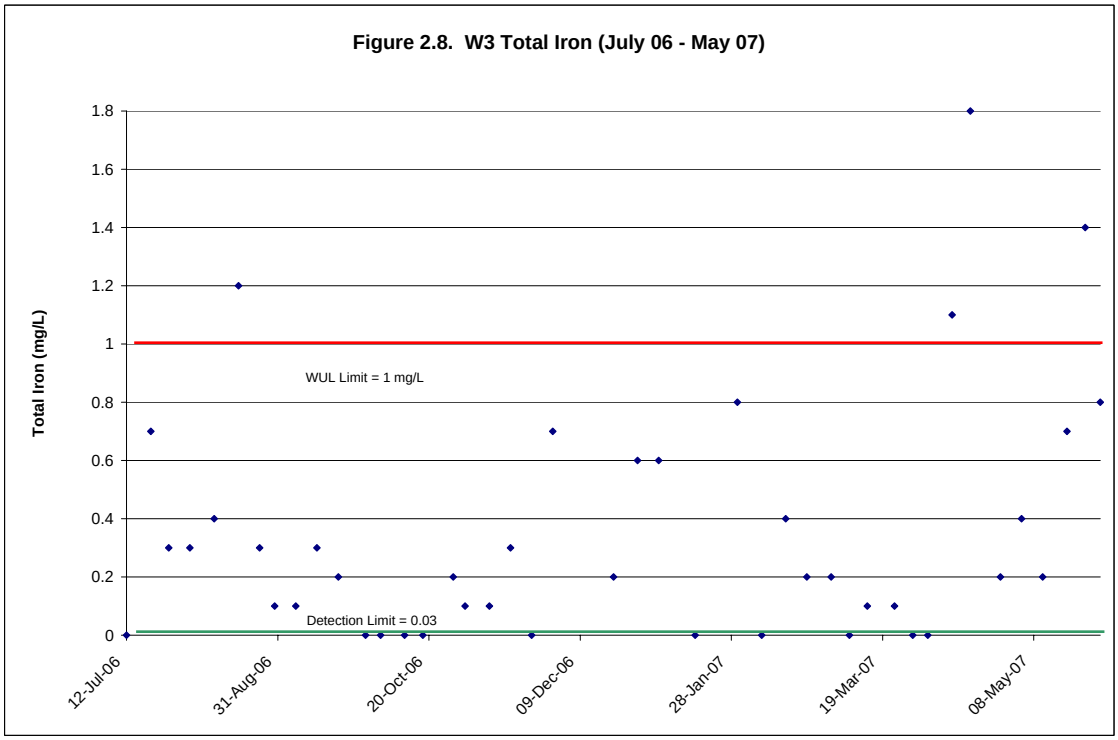


Notes:
W3 Groundwater Seep values used for 7-Feb-07 - 11-April-07
0 Values may represent actual 0 values or values less than detection limit

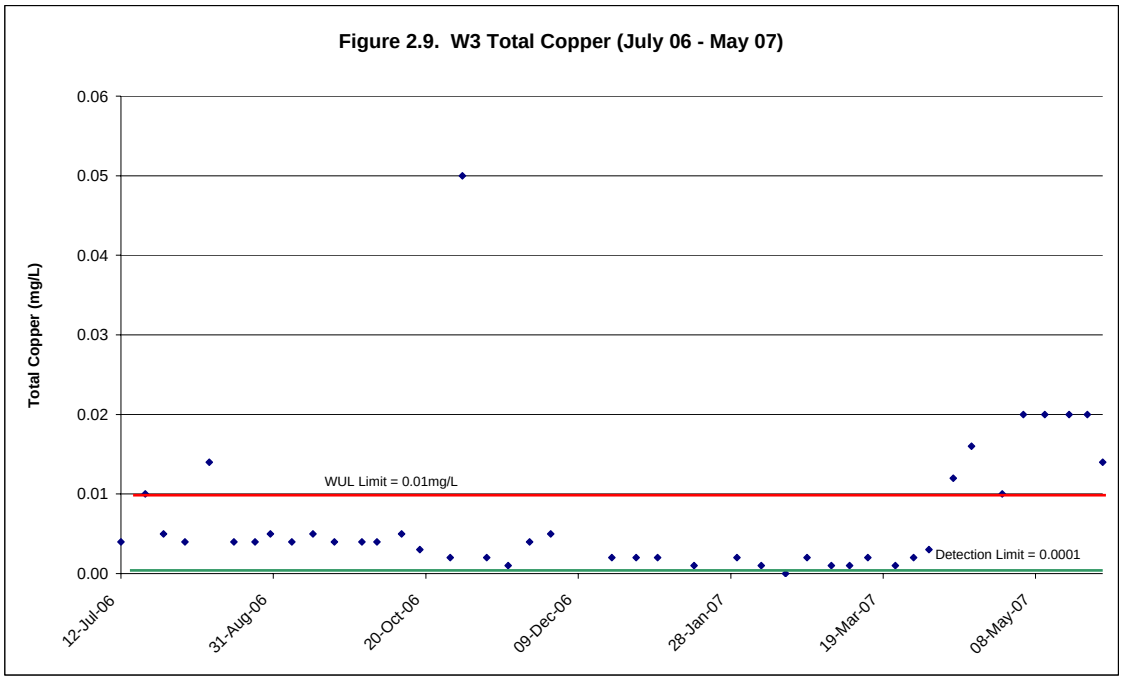
Figure 2.7. W3 Total Aluminum (July 06 - May 07)



Notes:
W3 Groundwater Seep values used for 7-Feb-07 - 11-April-07
0 Values may represent actual 0 values or values less than detection limit

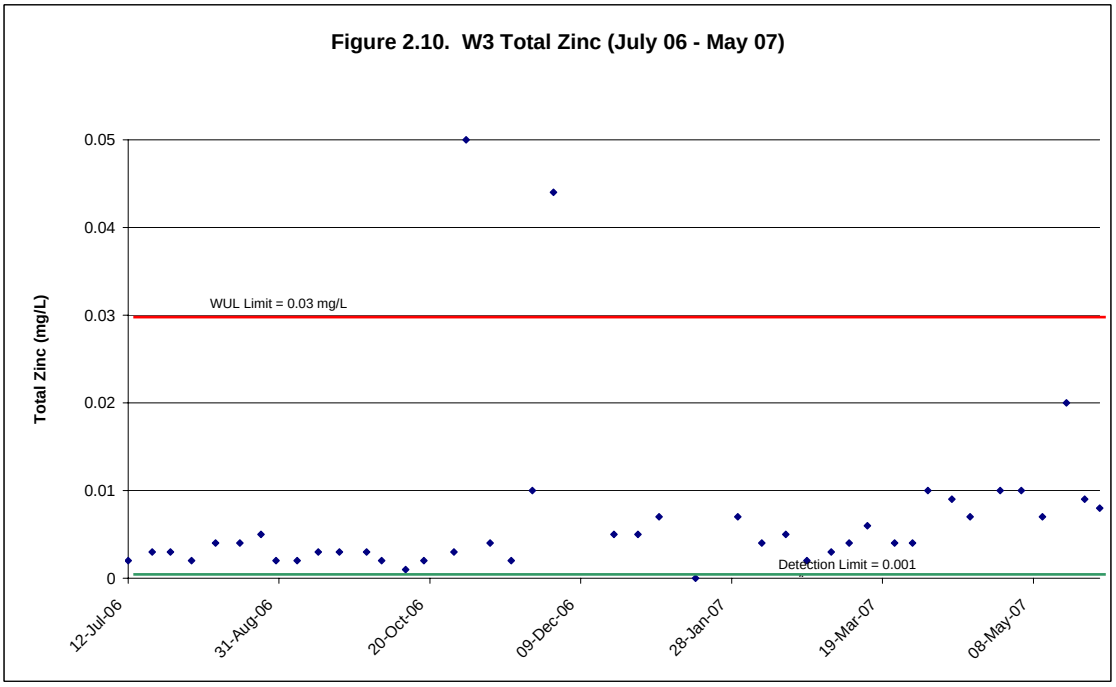


Notes:
W3 Groundwater Seep values used for 7-Feb-07 - 11-April-07
0 Values may represent actual 0 values or values less than detection limit



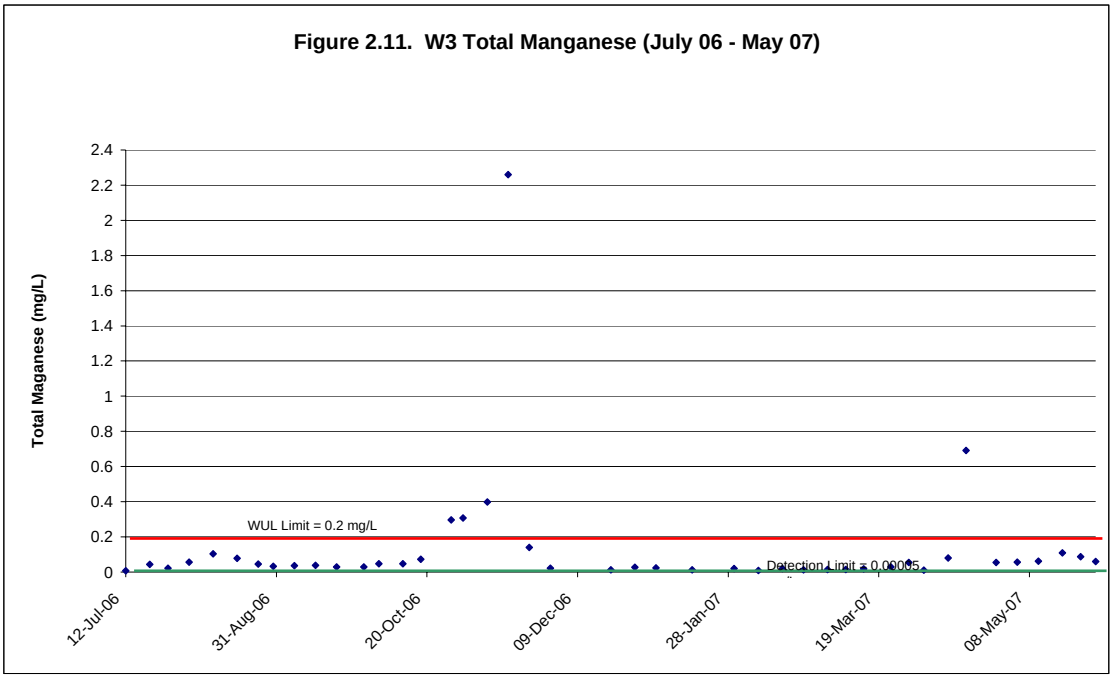
Notes:
W3 Groundwater Seep values used for 7-Feb-07 - 11-April-07
0 Values may represent actual 0 values or values less than detection limit

Figure 2.10. W3 Total Zinc (July 06 - May 07)



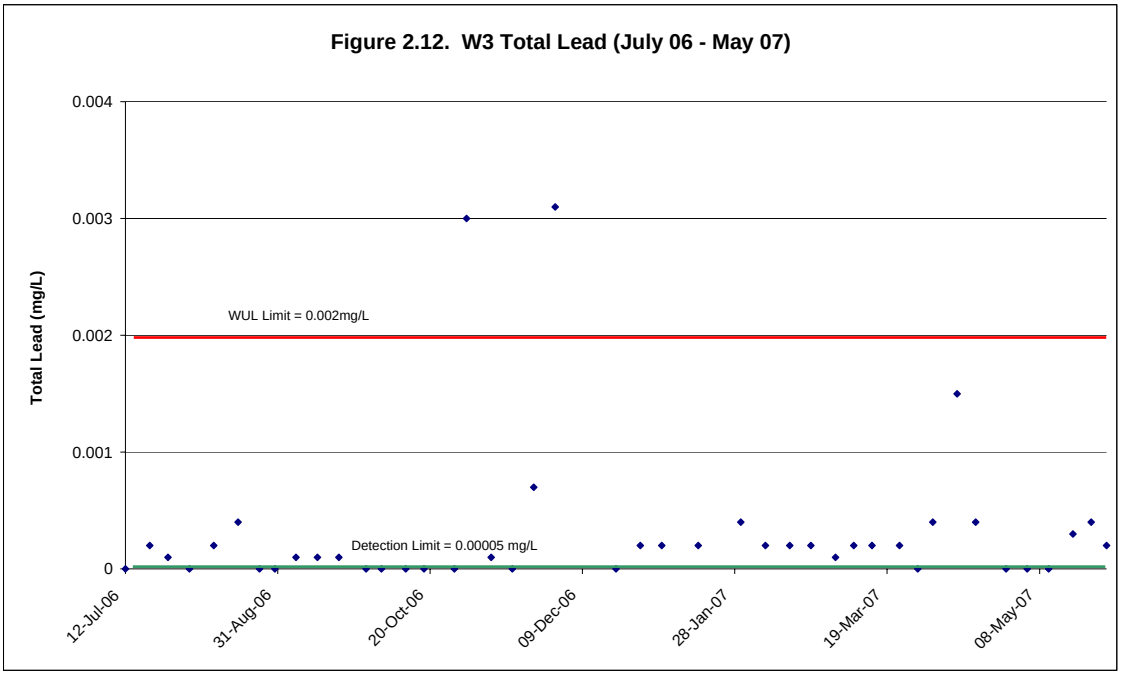
Notes:
W3 Groundwater Seep values used for 7-Feb-07 - 11-April-07
0 Values may represent actual 0 values or values less than detection limit

Figure 2.11. W3 Total Manganese (July 06 - May 07)



Notes:
W3 Groundwater Seep values used for 7-Feb-07 - 11-April-07
0 Values may represent actual 0 values or values less than detection limit

Figure 2.12. W3 Total Lead (July 06 - May 07)



Notes:
W3 Groundwater Seep values used for 7-Feb-07 - 11-April-07
0 Values may represent actual 0 values or values less than detection limit

Effluent quality monitoring for toxicity has been conducted at a minimum under the MMER schedule (monthly) since April 2006, and during early 2006 these tests were conducted weekly for site water quality characterization purposes. These bioassay tests are conducted for acute toxicity to rainbow trout (*Oncorhynchus mykiss,* 96 h pass/fail) and *Daphnia magna* (48 h pass/fail). All results have returned non-toxic to both species and 0% mortality was observed in 37 of 39 tests for trout and in 25 of 34 tests for *Daphnia* (Appendix A).

Under Part 1 of the MMER EEM Studies (Effluent and Water Quality Monitoring Studies), the site has conducted to date one sampling event. The required studies under this section are:

- Effluent Characterization;
- Sublethal Toxicity Testing; and
- Water Quality Monitoring.

These sampling events and analyses are intended to expand upon the regular (weekly) effluent monitoring program, and are conducted quarterly. The initial sampling event was conducted on June 5, 2007 at one exposure location (MINCR-EXP), at the toe of the dam (W20) at the site compliance point (W3) and at the W7 reference location (Fig 2.5). Results for the initial effluent characterization and water quality monitoring components are summarized in Table 2.4.

Table 2.4 Results from First Effluent Characterization, June 5 2007.

Sample Site Description	GW SEEP	W3	W7	MIN CR EXP	W20	Detection Limit
Parameter[1]						
Hardness	237	165	113	246	173	0.54
Temperature (field) (˚C)	1.7	5.4	0.4	1.0	5.9	n/a
Dissolved Oxygen	31.8% / 4.39 mg/L	91.4% / 9.60 mg/L	86.1% / 7.84 mg/L	88.1% / 7.66 mg/L	68.1% / 8.55 mg/L	n/a
Alkalinity-Total CaCO3	211	128	115	129	130	2.0
Ammonia Nitrogen	<0.05	<0.05	0	0.16	0.06	0.020
Nitrate Nitrogen	5	5	0	1.1	6.1	0.0050
Aluminum T-Al	0.03	0.62	1.73	50.4	0.142	0.0010
Cadmium T-Cd	<0.00001	0.00002	0.00003	0.00020	0.00001	0.000050
Iron T-Fe	<0.1	0.7	2.3	72	0.2	0.030
Mercury T-Hg	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	0.000020
Molybdenum T-Mo	0.002	0.003	0.001	0.005	0.004	0.000050

The initial sublethal toxicity tests, with the exception of the rainbow trout reproduction assay, returned non-toxic (Table 2.5). The rainbow trout tests were invalidated due to non-viable eggs, and the test will be repeated as soon as egg stock is available again.

Table 2.5 First Sublethal Toxicity Test Results, June 5, 2007

Analysis	Toxicity Values (mg/L)
Rainbow trout Early life stage[1.] LC_{25}	Invalid test due to non-viable eggs
Rainbow trout Early life stage[1.] LC_{50}	Invalid test due to non-viable eggs
Ceriodaphnia[2.] LC_{50}	> 100%
Ceriodaphnia[2.] IC_{25}	> 100%
Ceriodaphnia[2.] IC_{50}	> 100%
Selenastrum[3.] IC_{25}	> 90.91%*
Selenastrum[3.] IC_{50}	> 90.91%*
***Lemna minor* IC_{25}**	> 97%*
***Lemna minor* IC_{50}**	> 97%*

* Highest Concentration tested

LC_{25} = Concentration which would cause 25% mortality
LC_{50} = Concentration which would cause 50% mortality
IC_{25} = Concentration which would cause a 25% inhibition in reproduction or growth.
IC_{50} = Concentration which would cause a 50% inhibition in reproduction or growth.

1. Rainbow Trout Embryo 7 day Acute Static Exposure Bioassay
2. 7 ± 1 Day Survival and Reproduction Assessment Using *Ceriodaphnia dubia*
3. Growth Inhibition Bioassay with the Algae *Selenastrum capricornutum* (also known as *Pseudokirchneriella subcapitata)*

2.4 Effluent Mixing

The Minto Project is currently transitioning from the construction phase to milling operations, with only mill system testing having been conducted as the mill approaches full commissioning. As such, effluent from the property is not yet indicative of what will be produced during the operational life of the mine. In addition, there has been no release of water from the site in 2007, with the full volume of runoff from the exposure area being retained in the main reservoir. Since the construction of the dam in late 2006, the only effluent for the project has been groundwater discharge and local runoff in the vicinity of the

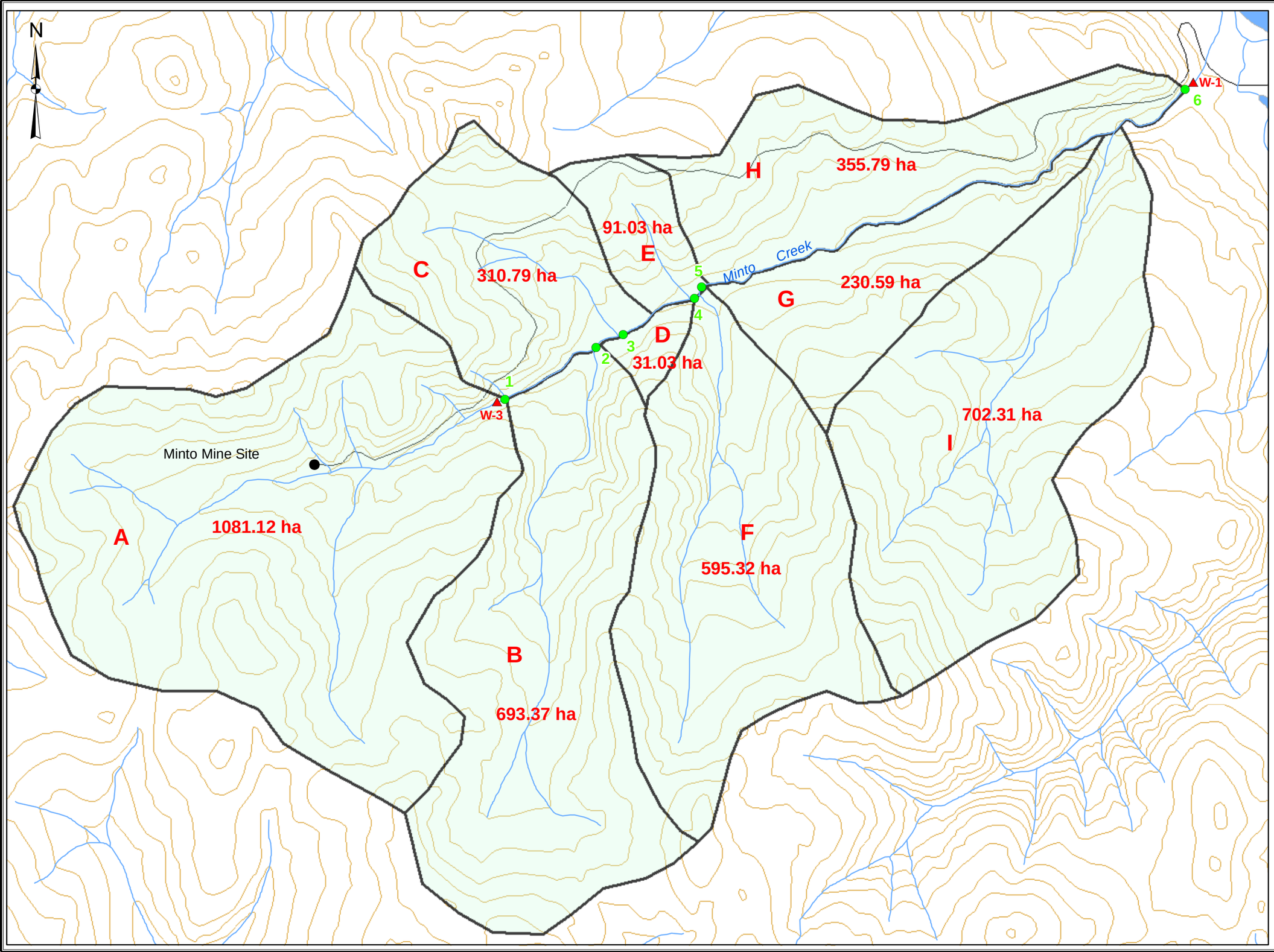
W3 sampling location. There is currently a steady cumulative groundwater discharge of approximately 5 L/s reporting to W3, originating downstream of the dam.

There is not anticipated to be any water released from the reservoir during 2007, as the lower than expected spring freshet runoff volumes have not provided the anticipated process water volume in the reservoir. It is not expected that the remaining base flows and meteoric water in the upper reaches of Minto Creek will fill the reservoir to full capacity.

For the purposes of determining effluent dilution characteristics in the receiving environment, the main catchments and their areas on Minto Creek were delineated and designated as catchments “A” to “I” (Fig. 2.13) and their associated surface areas calculated. Catchment A represents the mine “exposure” area, and the remaining catchments (“B” to “I”) constitute the incremental “dilution” contributions along Minto Creek. Points 1-6 on Fig. 2.13 are the locations where the dilutionary effect on the effluent have been calculated (Tables 2.6 and 2.7).

Due to the uncertainty surrounding the future effluent release volumes, the effluent mixing (dilution) calculations for the Minto Site have been conducted under two separate flow scenarios:

1. Using the monthly figures for W3 discharges based on regional hydrology (baseline conditions) without any water retention/diversion upstream of W3 (Table 2.6); and
2. Using a steady discharge of 5 L/s at W3, which is indicative of current conditions at the site (base flow with full reservoir retention, Table 2.7.)



Minto Mine Project

Environmental Effects Monitoring Study Design

SHERWOOD COPPER CORP.
Minto Explorations Ltd.

Legend

- Effluent Dilution Point
- Hydrometric Station
- Minto Mine Site
- Road
- Contour
- Water Course
- Water Body
- Catchment Area

Projection: UTM Zone 8 NAD83
Units: Meters
NTS: 115I/10 and 115I/11

National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced under license from © Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Figure 2.13

Catchment Areas and Effluent Dilution Points

Scale: 1:30,000

0 250 500 1,000 m

minnow environmental inc. | ACCESS CONSULTING GROUP

Drawn by: HD/PI | Checked by: SK | Date: June 2007

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Table 2.6. Effluent Dilution Calculations for Minto Creek under Baseline Conditions.

Catchment	% of Total Area (B-I)	Month						
		April	May	June	July	August	September	October
A	-	66,438	623,297	73,830	117,842	57,490	91,040	52,264
B	23.03%	142,525	205,212	21,247	76,816	73,417	78,805	96,041
C	10.32%	63,884	91,983	9,524	34,431	32,908	35,323	43,049
D+E	4.05%	25,090	36,125	3,740	13,523	12,924	13,873	16,907
F	19.80%	122,576	176,489	18,273	66,064	63,141	67,775	82,598
G+H+I	42.80%	264,916	381,435	39,493	142,780	136,463	146,477	178,514
Total for B-I	100.00%	618,991	891,244	92,277	333,615	318,854	342,252	417,109

Point on Creek	Catchment	Month						
		April	May	June	July	August	September	October
1 (at W3)	A	100%	100%	100%	100%	100%	100%	100%
2 (after W7)	B	32%	75%	78%	61%	44%	54%	35%
3	C	24%	68%	71%	51%	35%	44%	27%
4	D+E	22%	65%	68%	49%	33%	42%	25%
5	F	16%	55%	58%	38%	24%	32%	18%
6 (at W1)	G+H+I	10%	41%	44%	26%	15%	21%	11%

Table 2.7 Effluent Dilution Calculations for Minto Creek for Current Conditions.

Catchment	% of Total Area (B-I)	Month						
		April	May	June	July	August	September	October
A*	-	12960	13392	12960	13392	13392	12960	13392
B	23.03%	142,545	205,256	21,252	76,829	73,428	78,817	96,054
C	10.32%	63,893	92,002	9,526	34,437	32,913	35,328	43,055
D+E	4.05%	25,093	36,133	3,741	13,525	12,926	13,875	16,909
F	19.80%	122,593	176,526	18,277	66,075	63,151	67,785	82,610
G+H+I	42.80%	264,953	381,516	39,502	142,805	136,483	146,500	178,540
Total for B-I	100.00%	142,545	205,256	21,252	76,829	73,428	78,817	96,054

Point on Creek	Catchment	Month						
		April	May	June	July	August	September	October
1 (at W3)	A	100%	100%	100%	100%	100%	100%	100%
2 (after W7)	B	8%	6%	38%	15%	15%	14%	12%
3	C	6%	4%	30%	11%	11%	10%	9%
4	D+E	5%	4%	27%	10%	10%	9%	8%
5	F	4%	3%	20%	7%	7%	6%	5%
6 (at W1)	G+H+I	2%	1%	12%	4%	4%	4%	3%

* based on 5 L/s effluent discharge at W3

The percent effluent under each scenario starts at 100% at Point 1, and for the baseline conditions model ranges in from 44% in June to 10% in April at Point 6 (Station W1). For the current condition model – based on 5 L/s at W3 – the relative contributions of the catchments B to I is still based on baseline condition modeling, and as expected lead to percent effluent numbers at W1 ranging from 12% in June to 1% in May. These calculations will be adjusted as discharge data is collected during operations and site water balances are updated.

In each scenario, it is feasible to assume complete mixing of the effluent in Minto Creek shortly after the contributions of catchments B and C, based on the stream morphology and relatively low flow volumes. With the second scenario more likely to represent operational conditions at the site, the dilution effect of the incremental catchment areas on Minto Creek will be substantial.

2.5 Receiving Water Quality

Water quality in the Minto Creek drainage is characterized as neutral to slightly basic pH, moderately hard, moderately high in total suspended and dissolved solids and moderately to highly conductive. Concentrations of anions, nutrients, and cyanide/cyanogen-like compounds have been found to be moderate to high. In the upper and lower reaches of Minto Creek near the ore body, metal concentrations are generally moderately high with arsenic, chromium, iron, lead, cadmium, selenium, silver, zinc, copper, and aluminum present in high concentrations and in exceedance of the CCME Guidelines for the Protection of Freshwater Aquatic Life (Table 2.8.)

Table 2.8. Water Quality Summary of W2 Receiving Water, September 1993 to May 2007

Parameter[1]	Summary Statistics					Detection Limit	CCME Guidelines Water: Freshwater Aquatic Life
	Count	Count > CCME Guidelines	Mean	Min	Max		
Physical Tests							
Conductivity	105		263.32	61.00	602.00	2.0	
Total Dissolved Solids	103		182.40	67.00	394.00	10	
Hardness	69		118.93	10.00	216.00	0.54	
pH (Lab)	110		7.93	6.95	8.39	0.010	6.5 - 9.0
pH (Field)	68		8.12	7.10	8.60		6.5 - 9.0
Total Suspended Solids (Lab)	110		81.48	1.00	657.00	3.0	
Total Suspended Solids (On Site Hach)	74		25.66	0.00	265.00		
Tempurature (field)	3		1.20	-1.00	3.90		
Conductivity (field)	3		365.33	266.00	446.00		
Turbidity	109		20.27	0.30	100.00		
Dissolved Anions							
Alkalinity-Total CaCO3	109		121.43	25.0	286.0	2.0	
Bromide Br	61		<DL	0.0	0.0		
Chloride Cl	85		1.18	0.5	3.4	0.50	
Fluoride F	61		0.36	0.1	0.8		
Sulphate SO4	104		18.88	2.6	63.1	0.50	
Nutrients							
Ammonia Nitrogen N	95		0.017	0.003	0.060	0.020	1.04 - 2.33
Nitrate Nitrogen N	107		0.080	0.003	0.800	0.0050	
Nitrite Nitrogen N	93		0.003	0.001	0.025	0.0010	0.06
ortho-Phosphate	14		0.032	0.003	0.100		
Total Dissolved Phosphate	9		0.011	0.009	0.013		
Total Phosphorous	14		0.081	0.017	0.200		
Cyanides							
Total Cyanide CN	72		0.0101	0.0010	0.0270	0.0050	
Total Metals (Trace)							
Aluminum T-Al	110	88	1.1800	0.0070	22.8000	0.0010	0.005 - 0.1
Antimony T-Sb	110		0.0025	0.0001	0.0100	0.00010	
Arsenic T-As	110	7	0.0014	0.0003	0.0100	0.00010	0.005
Barium T-Ba	110		0.0715	0.0360	0.4310	0.000050	
Beryllium T-Be	110		0.0003	0.0000	0.0015	0.00050	
Bismuth T-Bi	107		0.0100	0.0100	0.0100	0.00050	
Boron T-B	104		0.0276	0.0040	0.3900	0.010	
Cadmium T-Cd	110	16	0.0002	0.0000	0.0006	0.000050	0.000017
Calcium T-Ca	110		33.0902	10.7000	70.0000	0.050	
Chromium T-Cr	110	30	0.0048	0.0005	0.0380	0.00050	0.001[a]
Cobalt T-Co	110		0.0015	0.0001	0.0164	0.00010	
Copper T-Cu (Lab)	110	43	0.0078	0.0012	0.0700	0.00010	0.002 - 0.004
Copper (On Site Hach)	64		0.0037	0.0001	0.0180		
Iron T-Fe	110	49	2.1346	0.0520	26.2000	0.030	0.3
Lead T-Pb	110	2	0.0013	0.0001	0.0086	0.000050	0.001 - 0.007
Lithium T-Li	91		0.0030	0.0010	0.0090	0.0050	
Magnesium T-Mg	110		12.3150	3.6300	32.5000	0.10	
Manganese T-Mn	110		0.0826	0.0060	0.6680	0.000050	
Mercury T-Hg	41		0.0000	0.0000	0.0001	0.000020	0.0001
Molybdenum T-Mo	110		0.0012	0.0004	0.0050	0.000050	0.073
Nickel T-Ni	110		0.0039	0.0005	0.0410	0.00050	0.025 - 0.15
Phosphorous T-P	67		0.1675	0.0600	0.3300	0.30	
Potassium T-K	87		2.5846	1.0000	5.5000	2.0	
Selenium T-Se	110	4	0.0033	0.0002	0.0100	0.0010	0.001
Silicon T-Si	86		7.1885	3.6800	25.6000	0.050	
Silver T-Ag	110	7	0.0001	0.0000	0.0006	0.000010	0.0001
Sodium T-Na	87		8.9858	2.3000	22.9000	2.0	
Strontium T-Sr	107		0.2846	0.0647	0.6620	0.00010	
Thallium T-Tl	87		<DL	<DL	<DL	0.00010	0.0008
Tin T-Sn	89		0.0003	0.0001	0.0005	0.00010	
Titanium T-Ti	89		0.0450	0.0008	0.3790	0.010	
Uranium T-U	105		0.0026	0.0002	0.0300	0.000010	
Vanadium T-V	110		0.0062	0.0005	0.0620	0.0010	
Zinc T-Zn	110	3	0.0105	0.0010	0.1250	0.0010	0.03
Dissolved Metals (Trace)							
Aluminum D-Al	86		0.0382	0.0050	0.3900	0.0010	
Antimony D-Sb	86		0.0067	0.0001	0.0100	0.00010	
Arsenic D-As	86		0.0013	0.0003	0.0100	0.00010	
Barium D-Ba	86		0.0574	0.0213	0.3280	0.000050	
Beryllium D-Be	86		0.0001	0.0000	0.0004	0.00050	
Bismuth D-Bi	83		0.0050	0.0007	0.0100	0.00050	
Boron D-B	80		0.0059	0.0020	0.0190	0.010	
Cadmium D-Cd	86		0.0001	0.0000	0.0003	0.000050	
Calcium D-Ca	86		30.9143	3.8000	70.1000	0.050	
Chromium D-Cr	86		0.0010	0.0004	0.0069	0.00050	
Cobalt D-Co	86		0.0003	0.0001	0.0010	0.00010	
Copper D-Cu	86		0.0031	0.0001	0.0060	0.00010	
Iron D-Fe	86		0.7289	0.0200	26.2000	0.030	
Lead D-Pb	86		0.0012	0.0001	0.0025	0.000050	
Lithium D-Li	65		0.0020	0.0010	0.0030	0.0050	
Magnesium D-Mg	86		10.5843	0.9000	31.4000	0.10	
Manganese D-Mn	86		0.0371	0.0027	0.6680	0.000050	
Mercury D-Hg	39		<DL	0.0000	0.0000	0.000020	
Molybdenum D-Mo	86		0.0012	0.0003	0.0025	0.000050	
Nickel D-Ni	86		0.0017	0.0005	0.0173	0.00050	
Phosphorus D-P	47		0.3620	0.0700	1.3000	0.30	
Potassium D-K	85		1.5818	0.0500	6.7000	2.0	
Selenium D-Se	86		0.0058	0.0002	0.0100	0.0010	
Silicon D-Si	81		5.8645	2.6900	12.5000	0.050	
Silver D-Ag	86		0.0004	0.0001	0.0005	0.000010	
Sodium D-Na	86		7.1544	1.9000	20.2000	2.0	
Strontium D-Sr	81		0.2680	0.0491	0.6520	0.00010	
Thallium D-Tl	65		<DL	0.0000	0.0000	0.00010	
Tin D-Sn	65		<DL	0.0000	0.0000	0.00010	
Titanium D-Ti	65		0.0009	0.0005	0.0028	0.010	
Uranium D-U	82		0.0036	0.0001	0.0300	0.000010	
Vanadium D-V	85		0.0018	0.0007	0.0050	0.0010	
Zinc D-Zn	81		0.0031	0.0005	0.0100	0.0010	
Organic Parameters							
Dissolved Organic Carbon C	58		13.5	7.5	30.3	0.5	
Total Inorganic Carbon C	52		33.3	4.03	67.3	0.5	
Total Organic Carbon C	58		14.7	7.8	34.2	0.5	
Radiological Parameters							
Radium-226	59		0.0080	0.0070	0.0100	0.0050	

Notes:

[1] All units are in mg/L unless otherwise indicated

[a] Based on guideline for Hexavalent chromium (Cr(VI))

Value exceeds the CCME Guidelines

Compared with Minto Creek, measured water quality parameters in the Yukon River were generally lower, though select metals also exceeded CCME guidelines (sites W4 and W5, Appendix B). This is not uncommon for large, turbid rivers. Data collected under HKP's Initial Environmental Evaluation (IEE; HKP 1994, Appendix C) indicated that Minto Creek did not significantly impact the Yukon River water quality at the time of that investigation. The limited subsequent data in 2005 for sites W4 and W5 on the Yukon River, the dilution model calculations for Minto Creek and the significant difference in discharge rates for Minto Creek and the Yukon River suggest that this is still the case.

2.6 Habitat Inventory and Classification

2.6.1 Receiving Environment

Minto Creek is an ephemeral watercourse with a mainstream length of approximately 17 km, flowing northeast before its confluence with the Yukon River. Flows in Minto Creek are generally characterized by peak flows in the spring during freshet and low flows in the summer. Minto Creek freezes and glaciates in the winter and has been observed to be entirely dry in the lower reaches in the mid-late summer. Sizeable flood events may also occur in the summer as a result of significant precipitation events. Minto Creek has 5 main tributaries, 4 of which join the Minto Creek mainstem upstream of the canyon (Fig. 2.13.)

Using the Cowardin *et al.* (1979) classification, Minto Creek is an upper perennial riverine system with a sand-gravel-cobble substrate. The topography of the area is dominated by rounded hills, with discontinuous permafrost areas on much of the north-facing slopes in the upper watershed. In-stream aquatic vegetation is minimal, likely due to seasonal scouring and glaciation.

The creek ranges from 2-3 m wetted width and 0.5-1.5 m in depth. The watercourse has two distinct reaches – upper and lower – which are divided by a steep canyon of gradient 21%. The lower reach is approximately 2 km long, with substantial LOD (large organic debris) and vegetative cover, with mostly sandy/silt substrate, with few cobbles and gravels. The low section of this reach contains backwater from the Yukon River, and the access road to the site crosses the creek (double culvert.) Cutbanks and riffle/run morphology with some pools dominate the depositional habitat of this reach. The gradient ranges in this section from 1.5% to 6% at the base of the canyon, where the substrate changes to mostly cobbles and boulders and the habitat is erosional. Elevations for this reach drop from 493m at the base of the canyon to 448m at the mouth of the creek at the Yukon River confluence (HKP 1994).

The upper reaches above the canyon range range in gradient from 6% at the headwaters to 1.5% just above the canyon, dropping in elevation from 902m to 582m at the head of the canyon. The history of forest fires in the vicinity have contributed significant LOD loading to these reaches, and vegetative cover is only just returning since the last burn in 1995. The substrate is primarily fine (silt/sand) with some cobble/gravel sections in this area of primarily riffle/run morphology with a few deep pools (HKP 1994). Recent investigations have also documented areas where creek flows in whole or in part migrate below the surface and re-emerge downstream. This has been observed at low-flow conditions.

The hydrograph for Minto Creek is sporadic, with a higher density of measurements resulting from a continuous site monitoring presence since the late winter of 2006. Fig. 2.14 presents the flow measurements collected at the upper (W3) and lower (W1) Minto Creek stations since 1993.

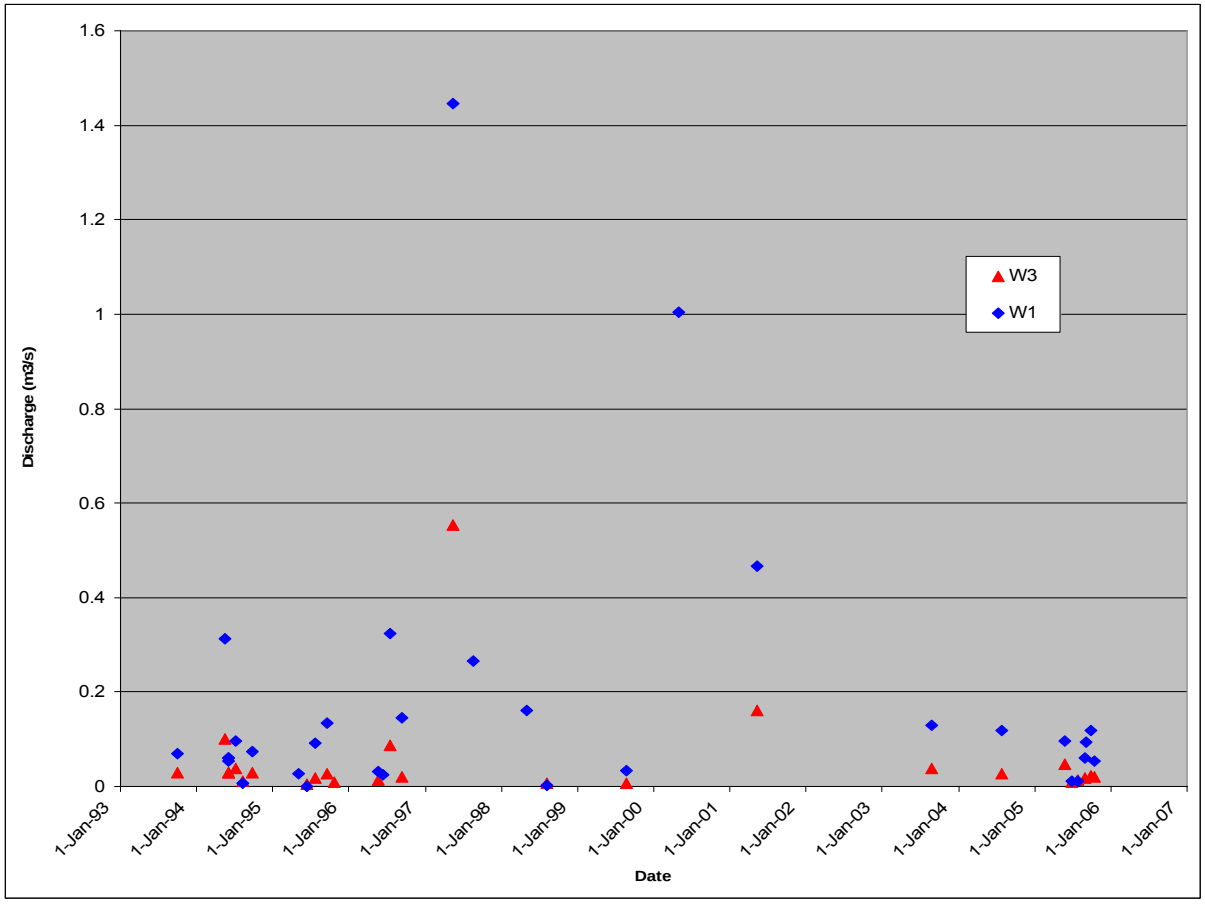


Figure 2.14 Spot Discharge Measurements for Minto Creek at Upper (W3) and Lower (W2) Hydrometric Stations from 1993 – 2006.

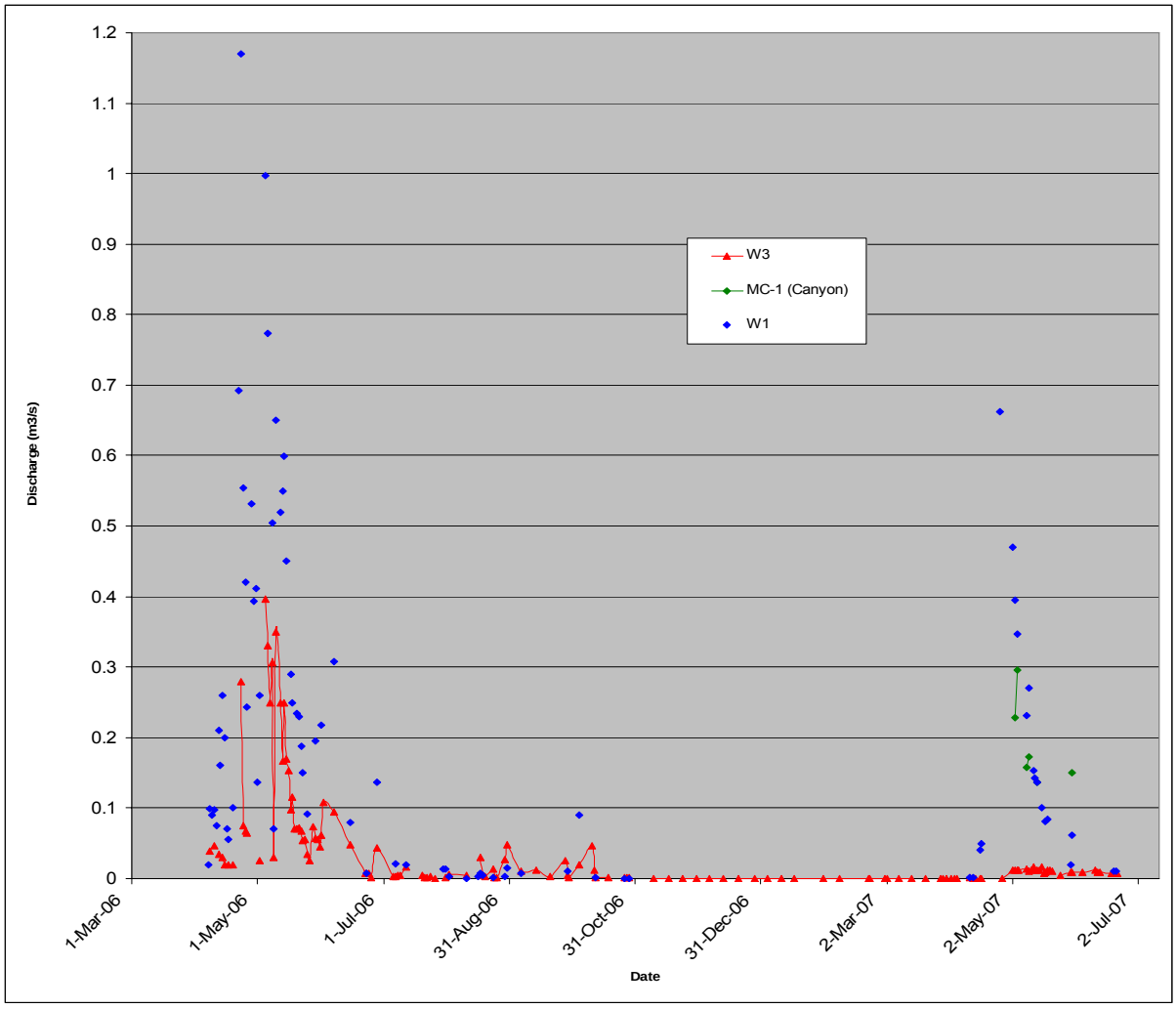


Figure 2.15. Discharge measurements for Minto Creek from April 2006 to July 2007.

One unusual hydrologic finding was that the lower reaches of Minto Creek returned lower flows than the upper reaches in the mid-late summer of 2006. This phenomenon has been identified by site observations in previous years, though not documented as flow readings. This is presumably due to reduced runoff retention times in the upper regions of the drainage as a result of the burn areas and also due to the high streambed infiltration that occurs within the lower reaches.

Hydrological studies conducted as part of the 1994 IEE, by Hallam Knight Piesold also indicate that a significant amount of infiltration of Minto Creek flow is occurring in the upper reaches of the watershed (HKP 1994). Up to 75% of the surface runoff may be entering the subsurface regime, resulting in a large amount of attenuation. As such, a reasonable estimate of maximum flow that would be expected at the Minto Creek crossing of the access

road at km 15.7 is approximately 5 m^3/sec. This compares to a 1:100 year flood event, assuming approximately 50% surface flow is lost to upstream subsurface attenuation (HKP 1994). The site hydrology data interpretation was updated in a report entitled *Memo CCL-MC1: Minto Copper Site Hydrology Update* by Clearwater Consultants Ltd. (Clearwater 2006, Appendix D). Recent flow monitoring at the head of the canyon on Minto Creek at the MC-1 site shows these flow losses in the lower reaches when plotted against the W2 site discharge measurements (Fig. 2.15). Minto Creek drains directly into the Yukon River, the primary regional drainage system, which flows northwesterly into Alaska, and then west southwesterly into the Pacific Ocean (Bering Sea).

2.6.2 Reference Areas

The fisheries reference area is located at the mouth of Unnamed Creek B, north of the Minto Creek drainage (Fig. 3.1). The watercourse has a mainstem length of 9.6 km and runs north-northeast into the Yukon River, with the confluence approximately 8 km downstream of the Minto Creek mouth. This system is very similar in drainage size, order and morphology to Minto Creek. A steep canyon near the mouth similarly divides the watercourse into distinct upper and lower sections, and represents a similar barrier to upstream fish migration/colonization. The average wetted width of the creek in the reference are is 2.5 m and the gradient is 3%. The substrate is mostly fines, gravels and small cobbles, with some larger cobbles and boulders. The creek morphology is mostly run with some riffles and pools, and stream cover is approximately 30% and is comprised of cut banks, deep pools and LOD (HKP 1994).

The first benthic invertebrate reference site named UNC-R (Fig. 3.1) is situated on the mainstem of Unnamed Creek B, upstream of the canyon. The average wetted width of the creek at this location is 2.0 m, with a gradient of 4.5%. The creek is mostly run, with some riffles but few pools. The substrate is fines, gravels and small cobbles and stream cover (80%) is vegetation, cut banks, and LOD (HKP 1994).

The second reference site for the benthic invertebrate study (established site W7, see Fig. 3.1) is located on a main tributary to Minto Creek, downstream (east) of the exposure area for the mining operations. Based on periodic flow measurements, the W7 tributary has a mean discharge rate (during the 'open' season) of approximately 5 L/s. The gradient of the watercourse in the vicinity of the W7 sampling location is approximately 8%, and the channel is very narrow (0.5 m wetted width) and approximately 0.4 m deep. The reach in this area is

dominated by chutes and small pools over cobble/boulder substrate with sections of fines in the depositional areas (pools). Vegetative cover in this section approaches 100%, with thick willow growth dominating.

2.7 Fish and Other Aquatic Resources

2.7.1 Fish Community

Fisheries resource data for Minto Creek and surrounding drainages is limited to information collected under the following programs:

- Hallam Knight Piesod's IEE (1994) for Minto Creek, Dark Creek and 2 unnamed creeks; and
- Fisheries investigations on lower Minto Creek by ACG for Minto Explorations Ltd. (2006/07)

HKP's fisheries investigation in 1994 was comprised of fish sampling and habitat assessments and surveys to identify spawning, rearing and overwintering areas, as well as barriers to fish migration. Minto Creek has been classified as a Type II habitat - salmonid rearing stream - by the Yukon Fisheries Protection Authorization, and all fisheries investigations have confirmed that this habitat is found in the lower sections of Minto Creek, and that a steep canyon 1.5 km upstream of the confluence with the Yukon River represents a barrier to fish migration. The effects of forest fire (reduced cover and substrate siltation) in the upper reaches also reduced the quality of the habitat upstream of the canyon in Minto Creek. The ephemeral nature of the creek also prohibits overwintering of fish populations in the lower reaches of the creek (HKP, 1994).

The August 1994 investigation returned adult and juvenile arctic grayling captures just downstream of the canyon, with slimy sculpins observed further downstream where creek flows were significantly reduced (HKP, 1994). At the time of this investigation, the Minto Creek valley below the canyon had not been burned by forest fire, so the creek cover (and consequent water temperatures/food source) and clean substrate in the area below the canyon provided good habitat for arctic grayling. In 1995 this area was part of a larger burn that impacted the majority of the watershed, resulting in a degredation of creek habitat in the

lower section primarily, including reduced vegetative cover, a significant increase in LOD loading and increased siltation of downstream reaches.

This change in morphology and the expected changes in fish usage have been confirmed by fisheries investigations in 2006 and 2007. The only fish species captured have been young of year chinook salmon (*Onchorynchus tshawatscha*) at the mouth of Minto Creek, in the upper reach of the flood zone (backwater) of the Yukon River, and slimy sculpin (*Cottus cognatus)* in the same location and further upstream in the vicinity of the road crossing and culvert. Sculpin were only captured in the June 2007 sampling event.

2.7.2 Fish Population Data

Catches and catch per unit effort (CPUE) have been low in all fish studies conducted on Minto Creek between 1994 and 2007 (Table 2.9). Significant effort in both trapping and electrofishing has returned very few individuals, most notably in the recent surveys of 2006 and 2007. In addition, there is little consistency in presence of species in the lower reaches of Minto Creek, suggesting the lack of a significant resident fish population. The morphological changes related to forest fire activity in the Minto Creek basin have likely contributed to fish population changes since the initial surveys of 1994. The unique low flow conditions that are periodically observed in the Minto Creek lower reaches with little or no flow existing also works against the establishment of resident fish populations in lower Minto Creek.

Table 2.9. Fish Community in Minto Creek.

Year, Study	Month	Stream/Site	Method	Effort (s)		Round Whitefish	Slimy Sculpin	Arctic Grayling	Chinook Salmon
1994 (Hallam Knight Piesold)	June	Minto Creek, Site 1	Electrofishing	210	number	1	-	-	-
					#/min	0.29	-	-	-
			Minnow Trap	NR	number	-	2		
		Minto Creek, Site 2	Electrofishing	270	number	-	-	-	-
					#/min	-	-	-	-
			Minnow Trap	NR	number	-	-	-	-
	August	Minto Creek, Site 1	Angling	3600	number	-	-	-	-
					#/min	-	-	-	-
			Minnow Trap	NR	number	-	2		
		Minto Creek, Site 2	Electrofishing	390	number	-	2	-	-
					#/min	-	0.31	-	-
			Minnow Trap	NR	number		2		
		Minto Creek, Site 3	Electrofishing	564	number	-	-	2	-
					#/min	-	-	0.21	-
	September	Minto Creek, Site 2	Electrofishing	270	number	-	-	-	-
					#/min	-	-	-	-
			Minnow Trap	NR	number	-	-	-	-
		Minto Creek, Site 3	Electrofishing	150	number	-	-	2	-
					#/min	-	-	0.8	-
2006 (R&D Environmental)	September	Minto Creek	Gee Trap	24h	number	-	-	-	-
					#/min	-	-	-	-
2007 (R&D Environmental)	May	Minto Creek, d/s Haul Road	Electrofishing	460	number	-	-	-	-
					#/min	-	-	-	-
			Gee Trap (x8)	15	number	-	-	-	-
					#/min	-	-	-	-
		Yukon River backwater at mouth of Minto Creek	Electrofishing	191	number	-	-	-	8
					#/min	-	-	-	2.51
			Gee Trap (x6)	5.5h	number	-	-	-	4
					#/min	-	-	-	0.01
		Minto Creek, ~100m u/s Haul Road	Gee Trap (x3)	15h	number	-	-	-	-
					#/min	-	-	-	-
		Minto Creek, @ base of canyon	Gee Trap (x5)	15h	number	-	-	-	-
					#/min	-	-	-	-
	June	Minto Creek, d/s Haul Road	Electrofishing	212	number	-	-	-	-
					#/min	-	-	-	-
			Gee Trap (x8)	22h	number	-	4	-	-
					#/min	-	0.0030	-	-
		Yukon River backwater at mouth of Minto Creek	Gee Trap (x5)	18h	number	-	1	-	24
					#/min	-	0.0009	-	0.0222
		Minto Creek, ~100m u/s Haul Road	Gee Trap (x2)	22h	number	-	1	-	-
					#/min	-	0.0008	-	-
		Minto Creek, @ base of canyon	Gee Trap (x5)	20h	number	-	-	-	-
					#/min	-	-	-	-

2.7.3 Fish Usability

There is no known documentation or instance of any human utilization of fish from Minto Creek as a food source. Accordingly, there is only one documented instance of fish tissue analysis from populations in Minto Creek (HKP 1994). Results from this event are difficult to compare between sites, due to low population numbers and the small size of individuals, with most metal results returning below detection limits. The highest copper, mercury and zinc concentrations were detected in arctic grayling muscle tissue from the mouth of Unnamed Creek B, with the highest arsenic concentrations seen in slimy sculpins from the mouth of Minto Creek. Arsenic and zinc concentrations in Minto Creek grayling muscle tissue may not be representative of baseline values due to the transient nature of the grayling in the lower reaches of Minto Cree (HKP 1994).

2.7.4 Benthic Invertebrate Communities

Limited benthic invertebrate data exists for the Minto Creek watershed. Benthic invertebrate population data has been previously collected in the watershed under two initiatives:

- Hallam Knight Piesod's IEE (1994); and
- Minto Explorations Ltd.'s Water License – Benthic Monitoring Program (2006 data only)

Under the IEE baseline data collection in August 1994, triplicate Hess samples (250 micron mesh) were collected from six sites in the Minto drainage, three of which overlap with the Water License Monitoring Program, which used a 300 micron mesh Surber Sampler. The data for W2, W3 and W7 have been compared for both studies in Table 2.10 below. There is no existing historical benthic invertebrate data for one of the reference sites (UNC-R).

Table 2.10 Benthic Summary Data for 2006 and 1994.

Benthic Data Summary for 2006 and 1994						
	W2		W3		W7	
	2006	1994	2006	1994	2006	1994
Density (m2)	10,018	9,327	2,070	2,637	2,379	20,140
Diversity	32	43	33	38	19	34
EPT Index	4	7	6	6	5	6
Richness Index	3.9	5.3	5.0	5.6	3.3	3.8
% sensitive	3.7	37.4	44.4	49.4	44.8	71.8
% facultative	88.7	62.2	53.6	44.5	22.6	23.2
% tolerant	7.5	0.4	2.1	6.1	32.6	5.0

Density was very similar for both years at W2 and W3. However, density was significantly higher at W7 in 1994 compared with 2006, although the 1994 figure is based on triplicate samples whereas the 2006 data is based on a single sample only, due to space constraints. All communities were more diverse in 1994, and although the EPT and Richness indices were very similar for both years at W3 and W7, both were higher in 1994 at W2.

2.8 Other Area Characteristics

2.8.1 Geological Setting

The following information on the geological setting of the Minto Project is taken from the Project Feasibility Study (HATCH 2006). This section of the study was prepared by Minto Explorations Ltd.

The Minto Project is found in the eastern margin of the Yukon-Tanana Composite Terrain, which is comprised of several metamorphic assemblages and batholiths. It is broadly contemporaneous with the Omineca Belt in nearby British Columbia.

The Minto Property and surrounding area are underlain by plutonic rocks of the Granite Mountain Batholith (Early Mesozoic Age). They vary in composition from quartz diorite and granodiorite to quartz monzonite. The batholith is unconformably overlain by clastic sedimentary rocks of the Tantalus Formation and andesitic to basaltic volcanic rocks of the Carmacks Group, both are assigned a Late Cretaceous age.

Outcrop exposure on the property is poor. Where exposure is available, it has been affected by deep weathering and variable oxidation, as the terrain was not glaciated during the last ice age event. Due to the very poor outcrop exposure and the buried nature of the Minto deposit, much of the property geology is based on observations from diamond drill core and extrapolation from regional observations.

Lithologically the Property is underlain by predominantly igneous rocks of granodiorite composition. In the few available outcrops and in drill core two basic units are distinguished, an equigranular phase and a potassic feldspar megacrystic phase. The equigranular phase is relatively leucocratic, grey to whitish in color and uniform in texture. The potassic-feldspar megacrystic phase can be slightly darker, may contain more biotite and hornblende and may be light pink in color. In surface exposures, the latter exhibits a very weak alignment of the feldspar megacrysts, defining an interpreted magmatic foliation.

As noted above copper-sulphide mineralization at Minto is strongly associated with foliated granodiorite. This foliation is defined by the alignment of biotite in areas of weak to moderate strain and by the segregation of quartz and feldspar into bands in areas of higher strain, giving the rock a gneissic texture in very strongly deformed areas.

2.8.2 Climate

A few (partial) months of meteorological data were collected in 1993 and 1994, and a complete meteorological station was established at the site in September 2005. The data includes temperatures (air and soil), incoming solar radiation, wind speed and direction, relative humidity, barometric pressure, and rainfall. No winter snowfall data have been collected with this station, but snow surveys have been carried out by J. Gibson & Associates in 1994, 1995, 1998 and 2006 at three locations in the Minto Creek catchment. These data are summarized in the Site Hydrology Update (Clearwater 2006).

Using orographic factors and regional climate data, the Minto Site is estimated to have a total average annual rainfall of 195 mm and an average annual snowfall of 136 mm. From data collected from the site climate station between September 2005 and July 2006, the prevailing wind direction is approximately 200^0 (SSW) with average windspeeds ranging from 0.23 m/s in January to 3.43 m/s in April. The mean site air temperature ranged from -19.25^{0}C in January to 15.55^{o}C in July. The air temperature readings ranged from a minimum of -36^{o}C to 25.95^{o}C.

3.0 EEM STUDY DESIGN

The EEM Study Design for the Minto Mine includes a benthic invertebrate community survey and a fish population survey each with supporting measures required for effective data interpretation. Other EEM components implemented by the Minto Mine are also discussed briefly (sublethal toxicity testing, effluent characterization and water quality monitoring). A fish usability assessment is not required at the Minto Mine because mercury concentrations in final effluent do not exceed 0.10 μg/L (Environment Canada 2002a). The benthic invertebrate community survey will be conducted in erosional habitat of upper Minto Creek (the immediate receiver of the Minto Mine effluent), with similar habitat in Unnamed Creek and a tributary to Minto Creek serving as reference areas (Table 3.1; Fig. 3.1). The fish population survey will be focused on lower Minto Creek, which is the area closest to the mine previously shown to support fish (Section 2.0). Similar habitat in Unnamed Creek will serve as a reference (Table 3.1; Fig. 3.1). The benthic survey will be conducted in the late summer (August) of 2008. The fish survey will be implemented in the spring (June) of 2008; however if fish catches are poor as may be expected based on previous results (Section 2.0), confirmatory fishing will also be conducted in the late summer (August) of 2008 concurrent with the benthic survey.

3.1 Benthic Invertebrate Community Survey

A benthic invertebrate community survey is required with each EEM study. The objective of the benthic survey is to determine whether mine effluent is having an effect on the benthic invertebrate community of the receiving environment (Environment Canada 2002a). Minto Creek is comprised predominantly of erosional benthic habitat with sand, gravel and cobble substrate (Section 2.0). The Minto Mine Cycle One EEM benthic invertebrate community survey will follow a Multiple Control/Impact (MCI) design with quantitative sampling to be conducted in erosional habitat in the upper Minto Creek effluent-exposed area, a reference area in Unnamed Creek and a reference area in a tributary to Minto Creek (Table 3.1; Fig. 3.1). The reference area in Unnamed Creek was identified as the most suitable reference during a site visit conducted in May 2007 but can only be accessed by helicopter. The use of two reference areas in the first EEM study will allow the comparison of the effluent-exposed benthic invertebrate community to both references and will allow the comparison of the two references to assess whether additional effort associated with accessing Unnamed Creek is warranted for future cycles of EEM.

Minto Mine Project

Environmental Effects Monitoring Study Design

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N

Wolverine Creek

Fisheries Survey
Reference Area

Unnamed Creek

Benthic Survey
Reference Area 1
(UNC-R)

Yukon River

Fisheries Survey
Exposure Area

Minto Creek

Benthic Survey
Exposure Area

Benthic Survey
Reference Area 2
(location of W-7)

Minto Mine Site

Big Creek

Legend

- Minto Mine Site
- Study Site
- Road
- Contour
- Water Course
- Water Body

Projection: UTM Zone 8 NAD83
Units: Meters
NTS: 115I/10 and 115I/11

National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced under license from © Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Figure 3.1

Study Sites

Scale: 0 500 1,000 2,000 m

minnow environmental inc. ACCESS CONSULTING GROUP

Drawn by: HD/PI	Checked by: SK	Date: June 2007

Our File: D:\Project\AllProjects\Minto\gis\mxd\EEM_Summer07\Fig3_1_StudySites.mxd

Table 3.1. Overview of the Benthic Invertebrate Community and Fish Population Surveys and Respective Supporting Measures for the Minto Mine Cycle One EEM Field Program, 2008

Area	Benthic Invertebrate Survey		Fish Survey		Supporting Water Quality	
	Overview	Supporting Data	Overview	Supporting Data	Field-Based Measures [a]	Analytical Samples [b]
Effluent-Exposed Areas						
Minto Creek - Upper	Quantitative Survey conducted August 2008, Erosional Habitat, 5 Stations, One sample per station with each a 3-grab composite using a Hess Sampler, 250 μm mesh	Substrate Description, Water Velocity & Depth, Field-based Water Quality, Habitat Notes, and GPS coordinates at all stations			Collected at all benthic invertebrate stations from mid-column	Five samples collected from mid-column during benthic invertebrate survey; Parameter suite includes all MMER compliance monitoring analytes
Minto Creek - Lower			Non-Lethal Survey conducted in June 2008 and repeated in August 2008 if insufficient numbers in June. Target the collection of 100 fish of two species (or 120 if both young-of-the-year and older age classes are available), subjected to length and fresh body weight. External abnormalities noted on all fish captured. Confirmatory ageing (10%) if supported by catch numbers.	Fishing Effort, Station Length, Wet and Bankfull Width, Mean Depth, Field-based Water Quality, Habitat Description and GPS coordinates	Collected at all fish survey areas from mid-column	One sample collected from mid-column during fish survey; Parameter suite includes all MMER compliance monitoring analytes
Reference Areas						
Unnamed Creek - Upper	Quantitative Survey conducted August 2008, Erosional Habitat, 5 Stations, One sample per station with each a 3-grab composite using a Hess Sampler, 250 μm mesh	Substrate Description, Water Velocity & Depth, Field-based Water Quality, Habitat Notes, and GPS coordinates at all stations			Collected at all benthic invertebrate stations from mid-column	Five samples collected from mid-column during benthic invertebrate survey; Parameter suite includes all MMER compliance monitoring analytes
North-Flowing Tributary to Minto Creek	Quantitative Survey conducted August 2008, Erosional Habitat, 5 Stations, One sample per station with each a 3-grab composite using a Hess Sampler, 250 μm mesh	Substrate Description, Water Velocity & Depth, Field-based Water Quality, Habitat Notes, and GPS coordinates at all stations			Collected at all benthic invertebrate stations from mid-column	Five samples collected from mid-column during benthic invertebrate survey; Parameter suite includes all MMER compliance monitoring analytes
Unnamed Creek - Lower			Non-Lethal Survey conducted in June 2008 and repeated in August 2008 if insufficient numbers in June. Target the collection of 100 fish of two species (or 120 if both young-of-the-year and older age classes are available), subjected to length and fresh body weight. External abnormalities noted on all fish captured. Confirmatory ageing (10%) if supported by catch numbers.	Fishing Effort, Station Length, Wet and Bankfull Width, Mean Depth, Field-based Water Quality, Habitat Description and GPS coordinates	Collected at all fish survey areas from mid-column	One sample collected from mid-column during fish survey; Parameter suite includes all MMER compliance monitoring analytes

[a] - Field-based water quality parameter suite includes water temperature, dissolved oxygen, pH and conductivity

[b] - Analytical water quality parameter suite includes hardness, alkalinity, pH, TSS, ammonia, nitrate, ICP total metal scan (aluminum, arsenic, cadmium, copper, iron, lead, molybdenum, nickel, zinc), mercury, and 226-radium

3.1.1 Sample Collection

Benthic samples will be collected using a 0.1 m^2 Hess Sampler outfitted with 250-µm mesh (250-µm mesh will be used to maintain consistency with previous benthic sampling and benthic sampling required under the existing water license). Five stations will be sampled in each study area to provide adequate statistical power to detect differences of ± two standard deviations at an α and β of 0.10 (Environment Canada 2002). A distance of at least three bankfull widths will be maintained between replicate stations in accordance with technical guidance (Environment Canada 2002a).

At each station, one sample representing a composite of three sub-samples (i.e., 0.3 m^2 total area) will be collected to ensure that each sample is representative of the benthic invertebrate community. Each sub-sample will be collected by carefully inserting the base of the Hess sampler into undisturbed substrate to a depth of approximately 10 cm. All material (e.g., gravel and cobble) contained within the sampler will be carefully washed, allowing the current to carry dislodged organisms into the collection net. After all substrate within the sampler has been completely washed and all organisms have been rinsed into the collection net, the sampler will be moved to the next sub-sample location and the procedure repeated. Following collection of the third sub-sample using the above procedure, all material and organisms retained in the collection net will be carefully transferred into pre-labeled two-litre wide-mouth plastic jars while working over a small tub. As a precautionary measure, internal sample labels will also be used to ensure correct sample identification at the lab in the event of unusual wear to external labeling. All samples will be preserved to a level of 10% buffered formalin within six hours of collection to eliminate the potential effects of within-sample predation that may affect abundance estimates.

Substrate size, water depth and water velocity will be carefully controlled among areas, stations and sub-samples, to minimize natural influences on community variability. All sampling stations will be marked using a handheld global positioning system (GPS), with coordinates recorded in latitude and longitudes using the North America Datum (NAD) of 1983. Supporting measures to be recorded at each benthic invertebrate sampling station are described in greater detail in Section 3.3.

3.1.2 Sample Processing

Benthic invertebrate samples will be shipped to a qualified benthic laboratory for taxonomic identification and counting. Quality assurance/quality control (QA/QC) and benthic sample processing procedures will adhere to protocols recommended by Environment Canada

(2002a). For samples requiring sub-sampling, the methods utilized will follow Environment Canada (2002b) guidance with sub-sampling error examined on a minimum of 10% of samples to verify that accuracy and precision are within 20%. Available guidance also requires 10% of samples to be re-sorted to verify that greater than 90% of the total number of organisms are recovered from the respective sample (Environment Canada 2002a).

All taxonomy will be conducted to the "lowest practical taxonomic level", which is typically genus or species, using the most recently available taxonomic keys. This level of taxonomy exceeds the minimum requirements of "family level" (Environment Canada 2002a). Following sample processing and taxonomic identification, representative specimens of each taxon will be preserved in 75% ethanol (with 3% glycerol) in separately labeled vials to form a voucher collection. The voucher collection will be verified by a qualified third party taxonomist to confirm taxonomic identifications prior to data analysis.

3.1.3 Data Analysis

As stipulated in the Technical Guidance Document (Environment Canada 2002a), EEM-endpoints used to determine effects on the benthic invertebrate community will include taxon richness (as identified to the lowest practical level), benthic invertebrate abundance (average number of organisms per m^2), Simpson's Evenness (calculated as in Smith and Wilson 1996) and the Bray-Curtis Index of Dissimilarity (calculated as in Bray and Curtis 1957). Other descriptors and statistical techniques used to assist with data interpretation will include Simpson's Diversity, EPT Index (EPT are insects of the orders Ephemeroptera, Plecoptera, Trichoptera or mayflies, stoneflies and caddisflies), presence/absence of taxa, percent composition of dominant taxa and/or correspondence analysis. The latter descriptors may also be useful in interpreting potential differences in benthic invertebrate communities between sampling areas. All required and selected benthic invertebrate community endpoints will be summarized by separately reporting mean, median, minimum, maximum, standard deviation, standard error and sample size for each study area.

For each of the benthic invertebrate community endpoints, statistical comparisons among exposed and reference areas will be conducted using Analysis of Variance (ANOVA) and post-hoc Bonferroni comparisons. Data will be assessed for normality and transformed as required to stabilize variances and satisfy the assumptions of ANOVA. In instances where variances can not be homogenized by transformation, post-hoc tests not requiring this assumption will be used instead of Bonferroni comparisons. All benthic indices will be plotted to explore spatial patterns and differences between exposed and reference areas to

assist in data interpretation. Correlation analysis will be used to determine statistically significant relationships between benthic invertebrate community metrics and supporting physical and chemical measures.

3.2 Fish Survey

Previous fishing efforts variously conducted from May to September have documented very low numbers of only four fish species in the lower sections of Minto Creek (Section 2.0). Furthermore, the same species have not been consistently captured in all fishing efforts, which indicates transient use. Therefore, it seems likely that target numbers may not be achieved. Nonetheless, for the cycle one EEM, it is considered useful to confirm the results of previous studies, recognizing that future cycles of EEM may require an alternative approach to the fish survey. Therefore, the proposed Minto Mine EEM fish survey will involve a non-lethal design (Environment Canada 2002a, 2005) using whichever two fish species are captured in greatest numbers. The two most captured species in Minto Creek in previous assessments have been slimy sculpin (*Cottus cognatus*) and juvenile chinook salmon (*Oncorhynchus tshawytscha*; Section 2.0). The Minto Cycle One fish survey will follow a Control/Impact (CI) design with semi-quantitative fishing effort focused on lower Minto Creek with similar habitat in Unnamed Creek serving as a reference area (Fig. 3.1). Slimy sculpin are considered an ideal sentinel species as they are the only non-migratory species consistently identified in previous fishing efforts. Slimy sculpin are demersal benthivores with relatively short age-to-maturation (Scott and Crossman 1998) and small home range. Chinook salmon are anadromous and do not appear to use Minto Creek for spawning. However, juvenile Chinook salmon have been documented to use lower Minto Creek, presumably on a transient, opportunistic basis for refuge and forage when moving down the Yukon River from upstream hatching/nursery areas. Juvenile Chinook salmon of the Yukon River can remain in fresh water for two years as they move seaward and feed on a wide variety of invertebrates (Scott and Crossman 1998).

The fish population survey will be conducted in the spring (June) of 2008, a period when lower Minto Creek has previously been occupied by fish (Section 2.0). If fishing yields numbers of both species lower than the target for a non-lethal survey (i.e., 100 to 120 fish from each area), then fishing will be repeated in the late summer (August) of 2008 concurrent with the benthic survey in order to provide further confirmation that the abundance of fish in Minto Creek is insufficient to conduct a conventional fish survey. The level of effort to be applied will exceed that of previous assessments in accordance with technical guidance and

to eliminate any uncertainty as to whether achieving the desired sample size is possible. As indicated previously, no assessment of fish usability is required at the Minto Mine because effluent mercury concentrations have been consistently below the 0.10 ug/L limit stipulated by Environment Canada (2002a).

3.2.1 Sample Collection

Fish communities of each study area will be sampled semi-quantitatively by backpack electrofishing and minnow trapping. All fishing will be conducted under a "Licence to Collect Fish for Scientific, Educational or Public Display Purposes". An electrofishing team, consisting of the electrofisher operator and a single netter, will conduct passes (or "sweeps") within each sampling area as required to yield the targeted numbers. All fish captured during each pass will be placed in aerated buckets of water. At the conclusion of each pass, total shocking effort (*i.e.*, electrofishing seconds) will be recorded. Similarly, the location of minnow trap deployment will be recorded as will deployment and retrieval times. All fish captured will be identified and enumerated (by electrofishing pass and minnow trap number). Any species that are clearly not candidates as sentinel species (based on relative abundance and suitability as sentinel species) will be released to the waters from which they were captured. Fishing will be conducted until 100 fish are captured from each area or until sufficient effort has been applied to ascertain that these numbers cannot be attained (per Techical Guidance [Environment Canada 2002a] and in discussion with Environment Canada). The capture of 100 age 1+ fish plus 20 young-of-the-year (per Environment Canada 2005) will likely not be relevant in this study, because young-of-the-year slimy sculpin will likely be too small to capture and the second potential sentinel species will likely only be present at the juvenile stage. Nonetheless, if any young-of-the-year are captured, they will be retained and assessed.

Ancillary measures collected within each area following fish sampling will include measurement of the approximate dimensions of the passes and river sections (length and width), depth and water velocity, and habitat feature observations (see Section 3.3). In addition, latitude and longitude will be recorded at the upstream and downstream boundary of each fish sampling reach.

3.2.2 Fish Processing

Physiological measurements collected from each fish will include all those recommended for non-lethal fish surveys (Environment Canada 2002a, 2005). Specifically, body length (total and fork), fresh body weight and external condition will be measured/assessed on all captured individuals following sedation using a dilute solution of clove oil in ethanol. Fish processing will be conducted in the sequence outlined in detail in the following paragraphs.

Fish length (total length for slimy sculpin and both total and fork length for the other potential sentinel species) will be measured to the nearest hundredth of a millimetre using digital calipers. Larger fish (> 12 cm) will be measured to the nearest millimetre using a measuring board. Fresh body-weight will be measured using an analytical balance with an accuracy of 0.001 g. Larger fish (> 100 g) will be weighed using using Pesola™ spring scales. These scales are typically demarcated at 1% of their total range and have a precision of ± 0.3%. If these scales are used, fish will be measured near the top of the scales range to ensure that measurements achieve resolution near 1%. This will be achieved by using a series of Pesola™ spring scales in the field (e.g., 200g, 300g, 500g, 1000 g). While taking these measurements, all fish will be carefully observed for external abnormalities, which will be recorded on data sheets. If catch numbers are sufficient to support a non-lethal survey for non-migratory species (e.g., slimy sculpin), confirmatory ageing will also be conducted on a subset of such species (approximately 10%). Specifically, individual fish will be selected to represent the range of sizes (and presumed ages) of the captured fish and these will be frozen whole for laboratory age analysis using otoliths. Following these measurements, all live fish will be placed in recovery buckets containing aerated water for subsequent release.

3.2.3 Laboratory Processing

If required, ageing will be conducted by a qualified fish age determination laboratory. Ageing structures (otoliths) will be retrieved and embedded and hardened in epoxy resin, sectioned using a low-speed isomet diamond saw, mounted on a glass slide and aged under a compound microscope using transmitted light. For each otolith, the age and edge condition will be recorded along with a confidence rating for the age determination. For quality control purposes, 10% of the processed samples will be sent to a second fish ageing expert for independent age confirmation.

3.2.4 Data Analysis

Consistent with EEM technical guidance (Environment Canada 2002a), summary statistics including mean, median, minimum, maximum, standard deviation, standard error and sample size will be calculated for endpoints of length, weight and condition. Statistical differences in these test endpoints between reference and exposure areas will be made using either ANOVA or Analysis of Covariance (ANCOVA; Table 3.2) in a manner consistent with Environment Canada (2002a, 2005) guidance. Statistical differences in frequency distributions will be compared using a two-sample Kolmogorov-Smirnov (K-S) test (Bonar 2002; Gray et al. 2002; Environment Canada 2005) and statistical differences in relative abundances (including survival) will be compared using Chi-Square analysis (Table 3.2). All analyses will be performed in a manner consistent with technical guidance (Environment Canada 2002a, 2005).

3.3 Supporting Environmental Variables

A number of environmental measures and/or observations will be collected to support the benthic invertebrate community and fish population surveys. At each benthic invertebrate sampling station, substrate characteristics (e.g., size, relative composition, embeddedness etc.), water velocity and sampling depth will be recorded. Mean values for each of these parameters and wetted and bankfull width will be recorded at each fish survey sampling reach. Field-based water quality, including water temperature, dissolved oxygen, pH and conductivity, will be measured at the sediment-water interface at each benthic invertebrate station and at mid-column in each fish sampling reach. General habitat notes, including extent of canopy coverage, surrounding land use, general stream morphology etc., will also be recorded at each study area.

Water samples for chemical analysis will also be collected from each study area. During the fish survey, one sample will be collected from both the exposure (lower Minto Creek) and reference (unnamed Creek) area. During the benthic invertebrate survey, water samples will be collected from each benthic invertebrate sample station (i.e., five water samples per area). Water samples will be collected from approximately mid-depth into triple-rinsed bottles with care taken to ensure that the collection bottle faces upstream to avoid any potential influence of the sampler. Any required sample preservatives will be added immediately following collection. The samples will then be placed into a cooler, transported to the mine and stored in a refrigerator. Water samples will be shipped to an accredited laboratory for analysis of EEM-related parameters including hardness, alkalinity, aluminum,

Table 3.2: Endpoints and Statistical Procedures for the Minto Mine Fish Population Survey

Response		Endpoint	Statistical Procedure
Effects on Fish [a]	Survival	Length frequency distribution	Kolmogorov-Smirnov
	Energy Use	Size of Young-of-Year at end of growth period	ANOVA [c]
	Energy Storage	Condition (body weight against length)	ANCOVA [d]
Supporting Response Variables [b]	Survival	Age frequency distribution (if possible)	Kolmogorov-Smirnov
	Energy Use	Size of 1+ fish	ANOVA
		Size at Age (if possible)	ANCOVA
		Relative Abundance of Young-of-Year (if possible)	Chi-Square
		Young-of-Year Survival (if possible)	Chi-Square

[a] Endpoints to be used for determining "effects" as designated by statistically significant differences between exposure and reference areas (Environment Canada 2005)

[b] These analyses are for informational purposes and significant differences between exposure and reference areas are not necessarily used to designate an effect (Environment Canada 2005)

[c] ANOVA - Analysis of Variance

[d] ANCOVA - Analysis of Covariance

arsenic, cadmium, copper, iron, lead, mercury, molybdenum, nickel, zinc, total suspended solids, ammonia, nitrate and ^{226}radium (Environment Canada 2002a).

Statistical comparisons among respective effluent-exposed and reference areas for all field-based water quality measures will be conducted using ANOVA, with all necessary transformations completed to satisfy assumptions of normality and homogeneity of variance prior to analysis. Field-based and analytical water quality at the effluent-exposed area will be compared to respective reference area values as well as to applicable Canadian Environmental Quality Guidelines for the protection of aquatic life (CCME 2005). All field-based measures and analytical water quality data will also be used in Correlation Analysis with the benthic invertebrate community results.

3.4 Sublethal Toxicity Tests

The Minto Mine conducts sublethal toxicity testing of the final effluent twice per year. The suite of sublethal tests (including rainbow trout [fish], *Ceriodaphnia dubia* [invertebrate], *Selanastrum capricornutum* [algae] and *Lemna minor* [plant]) are performed by a Canadian Association for Environmental Analytical Laboratories (CAEAL) accredited laboratory. The results of all tests conducted up to the time of the EEM Interpretive Report preparation will be summarized and discussed therein.

3.5 Effluent Characterization and Water Quality Monitoring

The Minto Mine conducts effluent characterization four times per year to fulfill EEM requirements (Section 2.0). Similarly, receiving water quality is monitored four times per year at four stations, one in Minto Creek approximately one kilometre upstream of the main dam, one in Minto Creek at the toe of the main dam, one in Minto Creek approximately 200 m downstream of the main dam and one reference station in a north-flowing tributary to Minto Creek (see Section 2.0). Effluent characterization and water quality monitoring samples are shipped to a CAEAL-accredited laboratory for analysis of EEM-related parameters including hardness, alkalinity, aluminum, arsenic, cadmium, copper, iron, lead, mercury, molybdenum, nickel, zinc, total suspended solids, ammonia, nitrate and/or ^{226}radium using method detection limits and quality assurance as stipulated by Environment Canada (2002a). The results of all tests conducted up to the time of the EEM Interpretive Report preparation will be summarized and discussed therein.

4.0 SCHEDULE

The Minto Mine's first EEM biological survey is scheduled to be conducted in two periods in the spring/summer 2008. Specifically, the benthic invertebrate community survey is scheduled to be conducted in the summer (August) of 2008 and the fish survey is scheduled to be conducted in the spring (June) of 2008, with a potential second assessment conducted in the summer (August) of 2008 concurrent with the benthic invertebrate community survey. The timing of the benthic survey is appropriate because benthic invertebrate communities will be stable and organisms will be well developed. It is also consistent with both previous and on-going benthic sampling in Minto Creek. The timing of the fish survey is appropriate because previous fishing efforts documented the presence of fish during these periods (i.e., in June and August). With submission of benthic samples for analysis shortly after completion of the fieldwork, all laboratory results should be available in the late fall of 2008. Given that the Minto Mine triggered EEM on July 10, 2006 and that the first Study Design was submitted for July 10, 2007, the first Interpretive Report will be due on January 10, 2009 (i.e., 18 months after the submission of the Study Design). The final Interpretive Report will be submitted to Environment Canada in both electronic and hard copies.

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Minto Explorations Ltd.

Minto Project, Yukon

Environmental Effects Monitoring

FIRST STUDY DESIGN

Appendix A

Effluent Quality Data

(Stations W3 and GW Seep)

Sample ID	GW Seep																			Detection Limit[2]	Water Use License Standards	MMER Maximum Authorized Concentration in a Grab Sample
Sample Site Description	Ground Water Seep Below W3 Weir																					
Date Sampled	07-Feb-07	15-Feb-07	22-Feb-07	02-Mar-07	08-Mar-07	14-Mar-07	23-Mar-07	29-Mar-07	03-Apr-07	11-Apr-07	17-Apr-07	27-Apr-07	04-May-07	11-May-07	19-May-07	25-May-07	30-May-07	05-Jun-07	13-Jun-07	20-Jun-07			
Sampled by	SVB	JG	SVB	JG	JG	SVB	JG	JG	JG	JG	JG	SVB	JG	SVB		SVB	SVB	SVB	JG	JG			
Parameter [1]																							
Physical Tests																							
Electrical Conductivity (Lab) (µs/cm)	478	486	468	491	485	513	494	478	521	468	463	474	469	499	497	460	491	472	438	460	2.0		
Electrical Conductivity (Field) (µs/cm)	513	550	556	491	487	502	498	585	520	479	502	542	552	541		533	542						
Total Dissolved Solids	310	280	304	300	308	300	294	294	302	308	294	298	296	308	300	304	322	298	274	306	10		
Hardness	230	240	214	245	221	228	241	243	235	222	241	233	237	247	242	247	240	237	238	234	0.54		
pH (Lab)	7.05	7.4	7.59	7.99	7.81	7.53	7.78	7.66	7.77	7.48	7.72	7.78	7.91	7.64	7.57	7.60	7.69	7.61	7.70	7.45	0.010	6.5 to 9.0 pH units	
pH (Field)	7.40	7.33	7.38	6.5	6.70	7.28	7.15	7.23	7.38	6.38	7.29	7.35	6.86	7.04		6.57	7.11						
Total Suspended Solids (Lab)	<2	5	<2	10	<2	3	<2	<2	<2	4	14	8	55	48	<2	4	<2	<2	<2	<2	3.0	15 mg/L	30.00 mg/L
Total Suspended Solids (Field)				2			1	1	2			3											
Tempurature (field) (°C)	1.4	0.5	0.5	0.5	1.2	1.4	0.3	0	0.2	2	-2	0.7	0	0.2		1.4	1.8						
Turbidity	<0.1		0.2	3.3	0.2	0.2	1.2	<0.1	<0.1	1.2	3.8	2.3	6.2	0.5	<0.1	<0.1	0.2	0.1	0.4	0.4			
Dissolved Anions																							
Alkalinity-Total CaCO3	203	210	213	213	212	211	209	212	208	212	211	215	213	215	214	225	213	210	228	220	2.0		
Bromide Br																							
Chloride Cl	2.58		3.2	2.5	3.3	3.3	3.2	3.3	4.1	3	2.9	2	2	2	0.6	0.4	1.3	2.1	1.9	1.5	0.50		
Fluoride F																							
Sulphate SO4	41	46	46		46	46	44	46	44	45	45	48	45	48	47	46	45	46	44	43	0.50		
Nutrients																							
Ammonia Nitrogen N	<0.05	<0.002	<0.05	<0.05	<0.05	<0.05	0.005	<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	0.020	1.0 mg/l	
Nitrate Nitrogen N	0.64	0.7	0.7	0.56	0.6	0.6	0.6	0.6	0.7	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.8	1.1	1.3	0.0050		
Nitrite Nitrogen N	<0.03	<0.05	<0.05	<0.005	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.0010		
ortho-Phosphate	0.08		0.09	0.08	0.05	0.07	0.06	0.08	0.06	0.06	0.05	0.04	0.06	0.08	0.06	<0.01	0.04	0.05	0.06	0.03			
Total Dissolved Phosphate																							
Total Phosphorous			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	0.05	<0.05	0.08	0.1	0.05	<0.05	<0.05	<0.05	<0.05	<0.05			
Cyanides																							
Total Cyanide CN																					0.0050		2.00 mg/L
Total Metals (Trace)																							
Aluminum T-Al	0.084	0.34	0.101	0.193	0.055	0.12	0.092	0.052	0.062	0.984	0.282	0.959	0.397	1.24	0.032	0.054	0.158	0.035	0.019	0.03	0.0010	0.5 mg/L	
Antimony T-Sb	<0.0002	<0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0004	<0.0004	<0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00010		
Arsenic T-As	0.0003	<0.0004	<0.0002	<0.0002	<0.0002	<0.0002	0.0003	0.0002	<0.0002	0.0003	0.0002	0.0004	0.0004	0.0006	<0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00010		1.00 mg/L
Barium T-Ba	0.062	0.064	0.052	0.052	0.052	0.051	0.057	0.057	0.068	0.066	0.056	0.082	0.061	0.071	0.05	0.051	0.053	0.053	0.052	0.048	0.000050		
Beryllium T-Be	<0.0001	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00050		
Bismuth T-Bi	<0.0005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.001	<0.001	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00050		
Boron T-B	0.019	0.02	0.015	0.016	0.015	0.017	0.019	0.015	0.018	0.018	0.02	0.02	0.037	0.034	0.021	0.026	0.025	0.022	0.02	0.021	0.010		
Cadmium T-Cd	<0.00001	<0.00002	<0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	0.00002	0.00002	0.00002	0.00002	<0.00002	<0.00002	<0.00002	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.000050		
Calcium T-Ca	48.6	46	50.5	48.1	49.7	48.2	49.7	50.7	49.6	48.1	52.3	51.1	52.8	52.2	54	49.6	52.4	51.7	51.6	51.2	0.050		
Chromium T-Cr	0.0006	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	<0.0005	<0.0005	0.0009	0.0005	0.0014	<0.001	0.002	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00050		
Cobalt T-Co	<0.0001	0.0003	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	0.0005	0.0001	0.0005	0.0002	0.0006	<0.0002	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.00010		
Copper T-Cu (Lab)	0.001	<0.002	0.002	0.001	0.001	0.002	0.001	0.002	0.003	0.012	0.004	0.006	<0.002	0.003	<0.002		0.001	0.002	0.001	0.002	0.00010	0.01 mg/L	0.60 mg/L
Copper (On Site Hach)								0.0017	<0.0005	0.0012						0.001							
Iron T-Fe	<0.2	0.4	0.2	0.2	<0.1	0.1	0.1	<0.1	<0.1	1.1	0.3	1.1	0.5	1	<0.2	<0.1	0.1	<0.1	<0.1	<0.1	0.030	1.0 mg/L	
Lead T-Pb	0.0002	0.0002	0.0002	0.0001	0.0002	0.0002	0.0002	<0.0001	0.0004	0.0015	0.0001	0.0005	<0.0002	0.0003	<0.0002	0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.000050	0.002 mg/L	0.40 mg/L
Lithium T-Li	0.004	0.003	0.003	0.004	0.003	0.004	0.004	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.003	0.004	0.004	0.004	0.004	0.0050		
Magnesium T-Mg	52.7	24.2	27.4	26.3	27	26.3	26.8	26.8	26.6	25.7	26.7	27	27.5	28.5	28.2	25.2	26.4	26.2	27.5	25.2	0.10		
Manganese T-Mn	0.01	0.02	0.013	0.014	0.015	0.018	0.03	0.055	0.011	0.08	0.046	0.042	0.03	0.05	0.032	0.02	0.019	0.006	0.007	0.005	0.000050	0.2 mg/L	
Mercury T-Hg	<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	<0.0001	<0.0001	0.000020		
Molybdenum T-Mo	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.000050	0.002	
Nickel T-Ni	0.0054	<0.001	0.0009	<0.0005	0.0006	0.0008	0.0005	0.0007	<0.0005	0.0007	<0.0005	0.0013	<0.001	<0.001	<0.001	0.0012	<0.0005	<0.0005	<0.0005	0.0011	0.00050	0.065 mg/L	1.00 mg/L
Phosphorous T-P	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05			<0.05				<0.05	<0.05		<0.05		0.30		
Potassium T-K	2	2	2	2	1.9	1.9	1.9	2	2.4	2.1	2	2.1	2.1	2	2	2	2.1	2	2.1	1.9	2.0		
Selenium T-Se	0.0002	0.0004	0.0004	0.0006	<0.0002	0.0004	<0.0002	<0.0002	<0.0002	0.0004	0.0003	0.0007	0.0009	<0.0004	<0.0004	0.0008	0.0003	<0.0002	0.0003	0.0007	0.0010		
Silicon T-Si	6.26	6.47	6.57	6.43	6.53	6.28	6.64	6.67	6.5	7.31	6.91	7.02	7.67	8.91	6.68	6.1	6.48	6.32	6.71	6.41	0.050		
Silver T-Ag	<0.0001	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.000010		
Sodium T-Na	14	15	14.7	14.1	14.7	14	14.3	14.5	15.4	15	15.8	16	16	15	14	15.7	16.2	16.1	16.7	15.2	2.0		
Strontium T-Sr	0.701	0.672	0.682	0.704	0.697	0.759	0.689	0.713	0.724	0.704	0.736	0.769	0.691	0.736	0.705	0.748	0.731	0.762	0.683	0.715	0.00010		
Thallium T-Tl	<0.00005	<0.0001	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.0001	<0.0001	<0.0001	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00010		
Tin T-Sn	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.00010		
Titanium T-Ti	0.0059	0.019	0.0062	0.0113	0.0035	0.0074	0.0037	<0.0005	0.0037	0.0499	<0.0005	0.0189	0.018	0.0667	0.0021	0.0042	0.0049	<0.0005	0.0023	0.0019	0.010		
Uranium T-U	0.0023	0.0022	0.0023	0.0022	0.0023	0.0023	0.0022	0.0022	0.0024	0.0024	0.0024	0.0025	0.0024	0.0025	0.0024	0.0025	0.0026	0.0025	0.0024	0.0024	0.000010		
Vanadium T-V	0.0009	0.002	0.0009	0.0011	0.0007	0.0009	0.001	0.0008	0.0009	0.0032	0.0014	0.0034	0.002	0.0038	0.0007	0.0009	0.0009	0.0007	0.0006	0.0008	0.0010		
Zinc T-Zn	0.004	0.005	0.002	0.003	0.004	0.006	0.004	0.004	0.01	0.009	0.003	0.01	0.01	0.01	0.006	0.005	0.006	0.006	0.003	0.006	0.0010	0.03 mg/L	1.00 mg/L
Dissolved Metals (Trace)																							
Aluminum D-Al	<0.005		0.009	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	0.0010		
Antimony D-Sb	<0.0002		0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00010		
Arsenic D-As	0.0003		0.0003	0.0002	<0.0002	0.0002	<0.0002	0.0003	<0.0002	<0.0002	0.0002	0.0002	0.0002	<0.0002	0.0002	<0.0002	<0.0002	0.0004	<0.0002	0.0002	0.00010		
Barium D-Ba	0.06		0.057	0.055	0.049	0.054	0.055	0.054	0.06	0.052	0.052	0.053	0.055	0.05	0.051	0.05	0.054	0.05	0.048	0.048	0.000050		
Beryllium D-Be	<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	<0.0001	0.00050		
Bismuth D-Bi	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00050		
Boron D-B	0.019		0.018	0.02	0.017	0.018	0.017	0.016	0.018	0.017	0.02	0.018	0.018	0.018	0.019	0.017	0.018	0.019	0.018	0.022	0.010		
Cadmium D-Cd	0.00001		0.00002	<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	0.000050		
Calcium D-Ca	48.2		51.3	53.1	47.3	49.9	52.7	52.2	50.2	47.8	52	50.5	50.1	53.3	51.3	53.3	50.9	51.4	50.7	51.2	0.050		
Chromium D-Cr	0.0006		0.0014	<0.0005	<0.0005	0.0014	0.0006	0.0013	<0.0005	0.001	0.0007	<0.0005	0.0006	0.0007	<0.0005	0.0009	0.0011	0.001	0.0006	<0.0005	0.00050		
Cobalt D-Co	<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	<0.0001	0.00010		
Copper D-Cu	0.001		0.002	0.001	0.001	<0.001	0.001	0.001	0.002	0.001	0.001	<0.001	<0.001	<0.001	0.003	0.001	0.001	<0.001	0.001	0.003	0.00010		
Iron D-Fe	<0.01		0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.030		
Lead D-Pb	0.0003		0.0002	<0.0001	0.0004	<0.0001	<0.0001	0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	0.0001	0.000050		
Lithium D-Li	0.005		0.004	0.004	0.003	0.003	0.003	0.003	0.004	0.003	0.003	0.003	0.004	0.004	0.004	0.003	0.004	0.004	0.004	0.004	0.0050		
Magnesium D-Mg	26.5		28.1	27.4	24.9	27.6	26.7	27.3	26.7	25	27.1	26	27.1	27.5	27.7	27.6	25.9	26.8	27.2	25.8	0.10		
Manganese D-Mn	0.01		0.017	0.01	0.014	0.013	0.036	0.053	0.012	0.071	0.041	0.024	0.02	0.025	0.029	0.019	0.016	0.006	0.006	0.007	0.000050		
Mercury D-Hg	<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	0.000020		
Molybdenum D-Mo	0.002		0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.000050		
Nickel D-Ni	0.0053		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0015	0.00050		
Phosphorus D-P	<0.05		<0.05	<0.02	<0.02	<0.02	<0.02	<0.05	0.06	0.06	<0.02	0.05				<0.02	2.1	<0.02	0.02		0.30		
Potassium D-K	2		2.1	1.8	1.9	1.9	1.9	2	2.1	1.9	2	2	1.9	1.9	2	2	2	0.0009	2	2.1	2.0		
Selenium D-Se	<0.0002		0.0004	0.0005	<0.0002	0.0004	<0.0002	<0.0002	<0.0002	0.0003	0.0003	0.0006	0.0004	<0.0002	<0.0002	0.0004	0.0003	6.45	<0.0002	0.0003	0.0010		
Silicon D-Si	6.47		6.94	6.94	6.18	6.75	6.61	6.76	6.75	6.2	6.72	6.26	6.92	7.11	6.99	6.56	6.34	<0.0001	6.54	6.26	0.050		
Silver D-Ag	<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	16.9	<0.0001	<0.0001	0.000010		
Sodium D-Na	15.3		15.6	15.4	15	15.2	15.5	15.8	16	14.8	15.9	15.7	14.6	15.5	15.1	16.2	16.4	0.703	16.7	16	2.0		
Strontium D-Sr	0.742		0.731	0.724	0.716	0.688	0.717	0.691	0.716	0.762	0.698	0.71	0.71	0.739	0.691	0.728	0.696	15.2	0.668	0.734	0.00010		
Thallium D-Tl	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00010		
Tin D-Sn	<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	<0.001	0.00010		
Titanium D-Ti	0.0019		0.0011	0.0012	0.0013	0.0013	0.0014	0.0014	0.0017	0.0012	0.0014	<0.0005	0.0024	0.0017	0.0016	0.0013	0.0017	0.0017	0.0019	0.0016	0.010		
Uranium D-U	0.0023		0.0024	0.0023	0.0024	0.0023	0.0022	0.0021	0.0022	0.0023	0.0022	0.0022	0.0024	0.0024	0.0024	0.0024	0.0024	0.0023	0.0023	0.0022	0.000010		
Vanadium D-V	0.0007		0.0033	0.002	0.0007	0.0044	0.002	0.0036	0.0012	0.003	0.002	0.0013	0.002	0.0017	0.0021	0.001	0.0013	0.0027	0.0018	0.0014	0.0010		
Zinc D-Zn	0.004		0.004	0.003	0.004	<0.001	0.001	0.002	0.006	0.002	0.002	0.003	0.001	0.006	0.006	0.001	0.002	0.002	0.003	0.006	0.0010		
Organic Parameters																							
Dissolved Organic Carbon C	2		2.1	2		2	2.2	2.4	2.4	2.8	2.6	11.2			2.3				2.9		0.5		
Total Inorganic Carbon C	48		50.6	48.1		47.9	48.5														0.5		
Total Organic Carbon C	2.3		2.6	2.3		2.3	2.2														0.5		
Radiological Parameters																							
Radium-226	<0.005		<0.005	<0.005	<0.005	<0.005	0.006	<0.005	0.005	<0.005	<0.005	<0.005	0.005	0.005	<0.005	<0.005			<0.005		0.0050		1.11 Bq/L
Toxicity Testing[1]																							
96 HourTrout LT50 Bioassay (hrs)	> 96						> 96								> 96							100%	
Percent Survival	100						100								80							(pH non-adjusted)	
Designation	Non-Toxic						Non-Toxic								Non-Toxic								
48 Hour Daphnia magna LT50 (hrs)	> 48						> 48								> 48								
Percent Survival	100						93								100								
Designation	Non-Toxic						Non-Toxic								Non-Toxic								

Notes:

* Based on guideline for Hexavalent chromium (Cr(VI))

Sample ID	MINTO W-3																							
Sample Site Description	Minto Creek at Dam Site																							
Date Sampled	15-May-94	07-Jun-94	08-Jul-94	10-Aug-94	26-Sep-94	15-Jun-95	25-Jul-95	20-Sep-95	20-May-96	16-Jul-96	09-Sep-96	15-Oct-96	01-May-97	26-Aug-99	13-Oct-99	05-May-00	11-May-01	29-Jul-02	24-Aug-03	29-Jul-04	27-May-05	30-Jun-05	29-Jul-05	29-Aug-05	28-Sep-05
Sampled by																					JG, DG	JG	JG, DC	JG	
Parameter [1]																									
Physical Tests																									
Electrical Conductivity (Lab) (µs/cm)	125	209	249	382	262	337	296	248	240					360	300	58	100	159	207	330	188	341	322	267	238
Electrical Conductivity (Field) (µs/cm)																									
Total Dissolved Solids	86	138	150	238	158	248	200	199	178	162	204	209	119	246	205	127	116	200	153	217	141	224	198	182	174
Hardness	62.4	101	108	172	124	173	142	122	102	85.9	126.4	137.3	42.3	170		32.7	48.7	86.4	109	60	93.9		166	135	129
pH (Lab)	7.51	7.59	8.22	8.07	7.92	8.13	8	7.93	8.1	7.8	8	8.2	7.3	8.18	7.94	6.79	7	7.63	7.91	7.9	7.99	8.22	8.06	8.24	7.99
pH (Field)																									
Total Suspended Solids (Lab)	360	20	25	13	9	<1	6	3	13	99	12	2.5	130	5	<5	57	5	128	14	5	8.5	<3.0	25.7	7.5	8.0
Total Suspended Solids (Field)																									
Tempurature (field) (˚C)																									
Turbidity																									
Dissolved Anions																									
Alkalinity-Total CaCO3	53	92	99.7	16	117	148	139	123	108	56	108	128	26	148	112	18	40	67	98	142	78.7	153	143	122	101
Bromide Br																									
Chloride Cl	1.6	1	1.2	1.3	0.9	1	1.4	1.3	0.7	0.8	0.9	0.8									<0.50	0.86	<0.50	<0.50	<0.50
Fluoride F																									
Sulphate SO4	10.8	19.2	19.7	30.6	21.3	35.4	25.9	22.7	23	13	23	30	5	39.5		4.16	4.8	13.9	19.1	26.6	19.7	45.5	29.6	25.5	23.9
Nutrients																									
Ammonia Nitrogen N	0.016	0.027	0.027	<0.005	0.006	<0.005	<0.005	0.006							<0.001						<0.020	<0.020	<0.020	0.042	<0.020
Nitrate Nitrogen N	0.016	0.082	0.055	0.108	0.04	0.043	0.048	0.026	0.05	0.05	0.05	0.1	<0.1	0.07	0.12	<0.004	<0.05	0.023	0.073	0.03	0.0121	0.0519	0.0284	<0.0050	0.0132
Nitrite Nitrogen N	0.004	0.009	0.004	0.004	0.004	0.002	0.003	0.004	0.25	0.0015	0.0015	0.0015	<0.5	<0.05		<0.002	<0.5	<0.002	0.007	<0.1	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
ortho-Phosphate																									
Total Dissolved Phosphate																									
Total Phosphorous																									
Cyanides																									
Total Cyanide CN																						<0.0050	<0.0050	0.0091	0.0130
Total Metals (Trace)																									
Aluminum T-Al	8.76	0.32	0.343	0.176	0.162	0.026	0.065	0.053	0.49	1.8	0.09	0.02	1.16	0.22	0.12	1.65	0.311	2.99	0.05	0.59	0.152	0.0313	0.732	0.267	0.236
Antimony T-Sb	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01	0.01	0.01	0.01	<0.02	<0.005	<0.02	<0.0003	<0.0003	<0.0002	<0.0002	<0.0005	<0.00050	<0.00010	0.00010	<0.00050	<0.00050
Arsenic T-As	0.0044	0.0006	0.0011	0.0005	0.0004	0.0003	0.0032	0.0001	0.01	0.01	0.01	0.01	<0.02	<0.01	<0.02	0.0012	0.0003	0.002	0.0005	<0.0005	<0.00050	0.00037	0.00081	0.00054	0.00055
Barium T-Ba	0.269	0.064	0.066	0.071	0.054	0.059	0.053	0.05	0.0475	0.0883	0.0485	0.0527	0.0749	0.0624	0.0523	0.046	0.0286	0.136	0.051	0.075	0.042	0.0518	0.0667	0.060	0.055
Beryllium T-Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0001	0.0001	0.0001	0.0001	<0.0002	<0.00001	<0.0002	0.00003	<0.00002	0.0001	<0.0001	<0.0002	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010
Bismuth T-Bi	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.01	0.01	0.01	<0.02	<0.0004	<0.02	<0.0004	<0.0008	<0.0005	<0.0005	<0.001		<0.00050	<0.00050		
Boron T-B	0.36	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10					0.045	0.03	0.006	0.007	0.031	0.006	0.068	<0.10	<0.010	<0.010	<0.10	<0.10
Cadmium T-Cd	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00025	0.00025	0.00025	0.00025	<0.0005	<0.00006	<0.0005	0.00007	<0.0001	0.00006	<0.00001	0.00004	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017
Calcium T-Ca	22.1	24.8	26.5	41.6	31.4	42	34	29.6	23.8	21.5	30.7	33.4	11	39.5	35.8	9.2	11	21.9	25.7	34.9	20.9	39.1	37.3	30.8	28.7
Chromium T-Cr	0.018	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.004	0.0005	0.0005	0.002	0.00071	0.001	0.00216	0.00064	0.0051	<0.0005	0.0019	<0.0010	0.00050	0.00200	<0.0010	<0.0010
Cobalt T-Co	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.0005	0.0005	<0.001	0.00013	<0.001	0.00128	0.00016	0.0028	0.0002	0.0005	<0.00030	<0.00010	0.00062	<0.00030	0.00030
Copper T-Cu (Lab)	0.073	0.006	0.007	0.004	0.005	0.005	0.003	0.005	0.007	0.031	0.008	0.009	0.027	0.00781	0.01	0.0482	0.00996	0.025	0.007	0.006	0.0078	0.00374	0.0149	0.0086	0.0100
Copper (On Site Hach)																									
Iron T-Fe	16	1.21	1.38	0.66	1.07	0.046	0.196	0.446	0.902	3.97	0.376	0.219	3	0.297	0.195	3.13	0.57	6.26	0.4	0.7	0.320	0.081	1.32	0.698	0.794
Lead T-Pb	<0.001	<0.001	0.022	<0.001	<0.001	<0.001	<0.001	<0.001	0.0025	0.0025	0.0025	0.0025	<0.005	<0.0003	<0.005	0.0009	<0.0006	0.0016	<0.0001	0.0004	<0.00050	0.000292	0.000359	<0.00050	<0.00050
Lithium T-Li													<0.002		0.005						<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium T-Mg	9.38	9.57	9.64	16.6	11	15.8	13.4	11.2	11.9	7.83	12.1	13.1	3.61	16.8	13.6	3.35	4.13	9	10.5	15.6	9.03	17.6	17.2	13.2	12.0
Manganese T-Mn	0.649	0.097	0.131	0.143	0.168	0.027	0.028	0.064	0.0952	0.143	0.32	0.0229	0.217	0.0214	0.0143	0.126	0.0428	0.19	0.034	0.039	0.0230	0.00840	0.0641	0.0806	0.120
Mercury T-Hg	0.00003	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001											<0.0002	<0.0002	<0.000020			<0.000020	<0.000020
Molybdenum T-Mo	<0.001	0.001	<0.001	0.002	0.003	0.004	0.001	0.002	0.0025	0.0025	0.0025	0.0025	<0.005	0.0019	<0.005	0.00042	0.0005	0.001	0.001	<0.002	0.0011	0.00163	0.00190	0.0014	0.0012
Nickel T-Ni	0.025	0.002	0.003	0.002	0.001	<0.001	<0.001	0.002	0.001	0.007	0.001	0.001	0.005	0.0017	<0.002	0.0027	0.0014	0.0044	0.001	0.003	0.0017	0.00087	0.00257	0.0017	0.0018
Phosphorous T-P																						<0.30	<0.30		
Potassium T-K															1.1						<2.0	<2.0	<2.0	<2.0	<2.0
Selenium T-Se	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.01	0.01	0.01	0.01	<0.02	0.014	<0.02	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon T-Si	16	5.11	5.62	6.19	5.79	4.92	5.42	5.55	5.37	9.58	6.46	6.87	4.2	60.3	6.09			12.4	5.61	6.34		6.04	7.03		
Silver T-Ag	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0005	0.0005	0.0005	0.0005	<0.001	<0.00005	<0.001	0.00003	0.0002	<0.0001	<0.0001	<0.0002	<0.000020	<0.000010	<0.000030	0.000027	0.000029
Sodium T-Na															8.91						4.9	12.1	9.4	7.8	7.1
Strontium T-Sr	0.156	0.174	0.176	0.33	0.195	0.334	0.261	0.217	0.181	0.144	0.21	0.252	0.062	0.333	0.282	0.0485	0.0772	0.175	0.203	0.282		0.299	0.295		
Thallium T-Tl															<0.003						<0.00020	<0.00010	<0.00010	<0.00020	<0.00020
Tin T-Sn															<0.005						<0.00050	<0.00010	0.00011	<0.00050	<0.00050
Titanium T-Ti															0.003						<0.010	<0.010	0.045	<0.010	<0.010
Uranium T-U	0.00062	0.00033	0.00024	0.00072	0.00035	0.00117	0.00064	0.00035	0.03	0.03	0.03	0.03	<0.06		<0.06			<0.0005	<0.0005	<0.001	0.00035	0.000900	0.000778	0.00051	0.00039
Vanadium T-V	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.004	0.009	0.006	0.006	0.007	0.00096	<0.002	0.00599	0.00106	0.0088	0.0008	0.0005	<0.030	<0.0010	0.0032	<0.030	<0.030
Zinc T-Zn	0.037	<0.005	0.007	0.005	<0.005	<0.005	<0.005	<0.005	0.006	0.011	0.003	0.006	0.014	<0.0002	<0.001	0.0118	0.0061	0.016	0.004	0.024	<0.0050	<0.0020	<0.0070	<0.0050	<0.0050
Dissolved Metals (Trace)																									
Aluminum D-Al	0.078	0.039	0.045	0.023	0.026	0.018	0.022	0.03	0.005	0.06	0.04	0.03	0.14	0.0294	0.02	0.458	0.195	0.044	0.036	0.192	0.0267	0.0080	0.0113	0.0184	0.0257
Antimony D-Sb	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01	0.01	0.01	0.01	<0.02	<0.005	<0.02	<0.0003	<0.0003	<0.0002	<0.0002	<0.0002	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050
Arsenic D-As	0.0004	0.0004	0.0004	0.0004	0.0003	0.0003	0.0003	0.0004	0.01	0.01	0.01	0.01	<0.02	<0.01	<0.02	<0.0002	0.0003	0.0006	0.0005	0.0004	<0.00050	0.00034	0.00041	<0.00050	<0.00050
Barium D-Ba	0.048	0.061	0.058	0.067	0.054	0.059	0.048	0.05	0.04	0.0443	0.0473	0.0498	0.0297	0.0605	0.0523	0.022	0.0268	0.044	0.048	0.066	0.041	0.0507	0.0553	0.057	0.055
Beryllium D-Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0001	0.0001	0.0001	0.0001	<0.0002	<0.00001	<0.0002	0.00001	<0.00001	<0.0001	<0.0001	0.0001	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010
Bismuth D-Bi	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.01	0.01	0.01	0.01	<0.02	<0.0004	<0.02	<0.0004	<0.0004	<0.0005	<0.0005	<0.0005		<0.00050	<0.00050		
Boron D-B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10						0.019	0.01	<0.002	0.006	0.007	0.008	0.065	<0.10	<0.010	<0.010	<0.10	<0.10
Cadmium D-Cd	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.00025	0.00025	0.00025	0.00025	<0.0005	<0.0006	<0.0005	0.00009	<0.00006	<0.00001	<0.00001	0.00002	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017
Calcium D-Ca	15.7	24.7	26.5	41.6	31.4	42.9	34.7	30	22.6	20	30.6	32.1	10.2	40.9	35.8	8.5	11.9	21.9	25.6	34.9	22.0	38.5	38.0	31.8	30.4
Chromium D-Cr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.0005	0.0005	<0.001	0.00028	<0.001	0.00093	0.00031	0.0008	0.0006	0.0011	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010
Cobalt D-Co	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.001	0.0005	0.0005	<0.001	<0.0003	<0.001	0.00027	0.00012	0.0001	<0.0001	0.0004	<0.00030	<0.00010	0.00010	<0.00030	<0.00030
Copper D-Cu	0.008	0.005	0.007	0.004	0.004	0.003	0.004	0.005	0.004	0.01	0.007	0.006	0.015	0.00402	0.005	0.00866	0.00665	0.007	0.007	0.005	0.0066	0.00336	0.00478	0.0050	0.0057
Iron D-Fe	0.966	0.797	0.516	0.399	0.82	0.038	0.109	0.364	0.077	0.339	0.255	0.207	0.407	0.0368	0.09	0.53	0.231	6.26	0.33	0.7	0.116	0.042	0.134	0.306	0.421
Lead D-Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0025	0.0025	0.0025	0.0025	<0.005	<0.0003	<0.005	<0.0003	<0.0003	<0.0001	<0.0001	0.0002	<0.00050	0.000241	<0.000050	<0.00050	<0.00050
Lithium D-Li													<0.002		0.003						<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium D-Mg	5.65	9.5	9.64	16.6	11	16.1	13.5	11.3	10.9	6.8	11.9	12.8	3.14	16.5	13.6	2.79	4.6	9	10.9	15.6	9.48	17.4	17.3	13.6	12.8
Manganese D-Mn	0.188	0.086	0.112	0.131	0.168	0.025	0.014	0.059	0.0669	0.0249	0.0246	0.0223	0.0508	0.0132	0.0114	0.0464	0.0344	0.19	0.011	0.039	0.00940	0.00520	0.0311	0.0657	0.102
Mercury D-Hg																					<0.000020			<0.000020	<0.000020
Molybdenum D-Mo	<0.001	0.001	<0.001	0.002	0.001	<0.001	0.001	<0.001	0.0025	0.0025	0.0025	0.0025	<0.005	0.00172	<0.005	0.00021	0.00049	<0.001	0.001	0.002	<0.0010	0.00163	0.00158	0.0013	0.0011
Nickel D-Ni	0.001	0.001	0.002	0.001	<0.001	<0.001	<0.001	0.002	0.001	0.003	0.001	0.003	0.003	0.001	<0.002	0.0016	0.0014	0.0012	0.0008	0.0018	0.0014	0.00078	0.00115	0.0014	0.0014
Phosphorus D-P													<0.06									<0.30	<0.30		
Potassium D-K	0.85	0.88	0.64	1.26	0.81	1.5	1.29	1.14	1.5	0.4	0.7	0.8	0.8	1	1.1	1.7	1.7	<0.04	0.6	1.3	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium D-Se	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.01	0.01	0.01	0.01	<0.02	<0.004	<0.02	<0.0002	<0.0002	0.0002	<0.0002	<0.0002	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon D-Si	3.29	5.08	5.62	6.19	5.79	4.99	5.41	5.64	4.87	5.52	6.32	6.57	3.16	5.29	6.04			12.4		5.78		5.89	5.56		
Silver D-Ag	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0005	0.0005	0.0005	<0.001	<0.00005	<0.001	<0.00005	<0.00005	<0.0001	<0.0001	<0.0001	<0.000020	<0.000010	<0.000030	<0.000020	<0.000020
Sodium D-Na	3.43	6.08	5.7	11.4	6.66	11.6	9.51	8.83	7.87	5.25	7.47	8.12	1.99	10.1	8.91	1.7	2.5	5.1	6.5	9.4	5.2	11.7	9.7	8.0	7.7
Strontium D-Sr	0.102	0.17	0.176	0.33	0.195	0.337	0.269	0.221	0.184	0.127	0.208	0.243	0.058	0.337	0.282	0.0422	0.0769	0.149	0.185	0.299		0.297	0.279		
Thallium D-Tl															<0.003						<0.00020	<0.00010	<0.00010	<0.00020	<0.00020
Tin D-Sn															<0.005						<0.00050	<0.00010	<0.00010	<0.00050	<0.00050
Titanium D-Ti															<0.001						<0.010	<0.010	<0.010	<0.010	<0.010
Uranium D-U	0.00014	0.00026	0.0002	0.00068	0.0003	0.00115	0.0006	0.00035					<0.06		<0.06			<0.0005	<0.0005		0.00031	0.000903	0.000717	0.00045	0.00034
Vanadium D-V	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.001	0.001	0.006	0.005	<0.002	0.00031	<0.002	0.00055	0.00065	0.0008	0.0009		<0.030	<0.0010	<0.0010	<0.030	<0.030
Zinc D-Zn	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.004	0.003	0.0005	0.006	0.037	0.0007	<0.001	0.0083	0.0059	0.001	0.002		<0.0050	0.0116	0.0015	<0.0050	<0.0050
Organic Parameters																									
Dissolved Organic Carbon C	24.1	17.6																							
Total Inorganic Carbon C																									
Total Organic Carbon C		20.2	17.2	12.3	14.7	9.1	11.8	16.1																	
Radiological Parameters																									
Radium-226																						<0.0050	<0.0050	<0.0050	<0.0050
Toxicity Testing'																									
96 HourTrout LTSO Bioassay (hrs)																									
Percent Survival																									
Designation																									
48 Hour Daphnia magna LTSO (hrs)																									
Percent Survival																									
Designation																									

Notes:

[1] All units are in mg/L unless otherwise indicated

[2] Detection limit from October 2005 results except Mercury which is from September 2005 results

[3] Range is based on an average pH of 8.0 and a temperature range of 0 to 10ºC

* Based on guideline for Hexavalent chromium (Cr(VI))

Sample ID																								
Sample Site Description																								
Date Sampled	15-Oct-05	02-Mar-06	04-Apr-06	05-Apr-06	06-Apr-06	07-Apr-06	08-Apr-06	09-Apr-06	10-Apr-06	11-Apr-06	12-Apr-06	13-Apr-06	14-Apr-06	15-Apr-06	16-Apr-06	17-Apr-06	18-Apr-06	19-Apr-06	20-Apr-06	21-Apr-06	22-Apr-06	23-Apr-06	24-Apr-06	25-Apr-06	26-Apr-06
Sampled by	JG																							
Parameter [1]																								
Physical Tests																								
Electrical Conductivity (Lab) (µs/cm)	245	463	731	1270	661	539	434	391	400	424	479	551	533	575	822		756	473	462	426	427	341	271	212	211
Electrical Conductivity (Field) (µs/cm)																									
Total Dissolved Solids	176	279	487	940	442	354	288	252	256	276	305	361	316	363	554	585	504	294	285	266	266	210	182	165	174
Hardness	134.0	236	-	-	-	-																			
pH (Lab)	8.08	7.31	8.04	8.45	8.43	8.36	8.28	8.28	8.30	8.31	8.29	8.32	8.33	8.38	8.39	8.41	8.18	8.32	8.33	8.31	8.31	8.25	8.16	7.63	7.81
pH (Field)				8.50	8.40	N/A	7.70	8.50	8.45	8.5	8.5	8.5	8.6	8.6	8.55	8.6	8.6	8.6	8.5	8.45	8.5	8.55	8.45	8.6	8.4
Total Suspended Solids (Lab)	<3.0	<3.0	<3.0	18.6	3.6	5.6	6.4	6.4	8.9	5.4	6.9	4.4	<3.0	<3.0	3.4	<3.0	3.7	4.2	4.2	<3.0	7.7	12.7	11.7	16.1	6.6
Total Suspended Solids (Field)				15	2	4	0.0	0	1.0	8	4	4	2	2	0	0	7	4	4	9	3	14	32	24	12
Tempurature (field) (C)																									
Turbidity				15	2	4	0.0	0	1.0	8	4	4	2	2	0	0	7	4	4	9	3	14	32	24	12
Dissolved Anions																									
Alkalinity-Total CaCO3	106.0	193	336.0	585	287.0	240	190.0	164	165.0	177	197	224	220	239	364	368	337	208	201	178	182	152	103	084	075
Bromide Br			<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride Cl	<0.50	6.20	2.82	2.38	2.09	2.08	1.58	1.46	1.1	0.95	1.18	1.47	1.41	1.33	2.27	2.24	2.03	1.00	0.95	0.80	0.84	0.64	0.88	1.15	0.88
Fluoride F			0.513	0.87	0.519	0.42	0.336	0.34	0.314	0.32	0.360	0.387	0.402	0.405	0.532	0.570	0.574	0.369	0.356	0.315	0.292	0.233	0.238	0.203	0.167
Sulphate SO4	24.7	50.4	103.0	234.0	101.0	74.3	58.1	53.1	56.2	63.1	74.9	84.2	78.9	81.5	124	136	120	066	060	055	059	043	035	026	030
Nutrients																									
Ammonia Nitrogen N	0.023	0.07	0.018	0.016	0.0093	0.0073	0.01	0.0107	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0120	0.0300	0.0480	-	-	-	-	-	-	<0.020	-	-
Nitrate Nitrogen N	0.0393	1.6500	0.1160	<0.0050	<0.0050	0.0125	0.0640	<0.0050	0.0146	0.0225	0.0094	0.0061	<0.0050	0.249	0.0992	0.0694	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite Nitrogen N	<0.0010	<0.0010	0.0019	<0.0010	0.0016	0.0017	0.0017	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
ortho-Phosphate																									
Total Dissolved Phosphate																									
Total Phosphorous																									
Cyanides																									
Total Cyanide CN	0.014	0.0087	-	-	-	0.0081										0.0128							0.0127	-	-
Total Metals (Trace)																									
Aluminum T-Al	0.090	0.0059	0.034	0.3840	0.101	0.1560	0.323	0.3160	0.444	0.1990	0.173	0.280	0.0407	0.0423	0.0419	0.0653	0.1790	0.2040	0.2750	0.2170	0.2120	0.5360	0.8480	0.3940	0.3300
Antimony T-Sb	<0.00010	<0.00010	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic T-As	0.00045	0.00019	0.00061	0.00103	0.00055	0.00048	0.0005	0.00047	0.00049	0.00039	0.00038	0.00043	0.00033	0.00031	0.00046	0.00055	0.00064	0.00039	0.00041	0.00037	0.00035	0.00040	0.00057	0.00048	0.00045
Barium T-Ba	0.049	0.0798	0.123	0.1550	0.084	0.0683	0.058	0.0551	0.055	0.0551	0.0579	0.0705	0.0639	0.0659	0.0954	0.1020	0.0936	0.0564	0.0563	0.0533	0.0531	0.0483	0.0491	0.0522	0.0393
Beryllium T-Be	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth T-Bi	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron T-B	<0.010	<0.010	<0.010	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium T-Cd	<0.000050	<0.000050	<0.000050	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Calcium T-Ca	29.4	63.2	75.6	102.0	60.3	51.8	41.9	40.3	38.8	39.9	41.9	47.8	47.6	49.1	70.5	80.0	66.8	43.3	41.2	38.9	37.7	29.2	24.0	20.1	20.0
Chromium T-Cr	<0.00050	<0.00050	<0.00050	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt T-Co	0.00023	<0.00010	0.0002	0.00023	0.0001	0.00011	0.00023	0.0002	0.00023	0.00016	0.00015	0.00021	<0.00010	<0.00010	0.00015	0.00015	0.00027	0.00019	0.00016	0.00016	0.00016	0.00015	0.00029	0.00035	0.00012
Copper T-Cu (Lab)	0.0086	0.00171	0.0032	0.00542	0.0053	0.00629	0.0067	0.01000	0.0084	0.00768	0.00919	0.00966	0.00626	0.00613	0.00670	0.00687	0.00904	0.00565	0.00878	0.00818	0.00780	0.01180	0.02790	0.02680	0.03210
Copper (On Site Hach)				0.00030	0.0005	<0.00005	<0.00005	<0.00005	0.0006	0.00110	0.00200	0.00200	0.0003	0.0021	0.0027	0.0027	0.0004	0.0023	0.003	0.0029	0.0028	0.003	0.0033	0.0072	0.0057
Iron T-Fe	0.497	<0.030	0.279	0.357	0.133	0.129	0.354	0.325	0.430	0.271	0.178	0.291	<0.030	0.030	0.034	0.071	0.185	0.247	0.279	0.201	0.220	0.590	0.913	0.370	0.366
Lead T-Pb	<0.000050	<0.000050	<0.000050	0.000120	<0.000050	0.000057	0.000212	0.000142	0.000168	0.000096	0.000103	0.000113	<0.000050	<0.000050	0.000059	0.000074	0.000051	0.000153	0.000142	0.000198	0.000074	0.000195	0.000289	0.000078	0.000086
Lithium T-Li	<0.0050	<0.0050	0.0071	0.02	0.008	0.006	<0.0050	<0.0050	<0.0050	<0.0050	0.0051	0.0056	0.0058	0.0061	0.0088	0.0095	0.0076	0.0054	0.0055	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium T-Mg	12.50	18.7	45.80	104.0	44.80	36.2	28.80	24.5	25.60	28.3	26.4	31.3	30.7	33.5	51.2	62.4	51.4	31.5	31.9	28.6	28.4	22.8	17.4	10.5	11.2
Manganese T-Mn	0.1240	0.00158	0.3090	0.03450	0.0216	0.02160	0.0286	0.02770	0.0298	0.02890	0.0347	0.0475	0.0237	0.0261	0.0362	0.0371	0.0509	0.0342	0.0296	0.0325	0.0342	0.0451	0.0465	0.0112	0.0506
Mercury T-Hg			-	-	-	-																			
Molybdenum T-Mo	0.0013	0.00128	0.0033	0.00574	0.0045	0.00345	0.0027	0.00278	0.0026	0.00273	0.00365	0.00384	0.00400	0.00355	0.00481	0.00525	0.00470	0.00278	0.00268	0.00235	0.00239	0.00177	0.00187	0.00139	0.00109
Nickel T-Ni	0.0014	<0.00050	0.0009	<0.0010	<0.00050	<0.00050	0.0005	<0.00050	0.0005	<0.00050	<0.00050	0.00075	<0.00050	<0.00050	0.00084	0.00070	0.00080	<0.00050	<0.00050	<0.00050	0.00050	0.00067	0.00110	0.00087	0.00099
Phosphorous T-P	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium T-K	<2.0	<2.0	5.3	11.1	6.4	4.8	3.6	3.7	3.4	3.5	4.0	4.0	4.5	4.3	6.2	6.4	8.7	4.3	4.1	3.8	3.4	2.8	3.4	6.6	3.4
Selenium T-Se	<0.0010	<0.0010	<0.0010	0.0021	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon T-Si	5.86	6.15	11.4	20.00	12.1	10.10	7.78	7.39	7.1	7.11	7.28	7.95	8.16	8.73	12.2	13.3	12.4	08.0	08.0	07.1	06.7	05.8	06.1	04.2	04.5
Silver T-Ag	<0.000010	<0.000010	<0.000010	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000021	<0.000010	0.00001
Sodium T-Na	7.0	10.5	28.7	67.2	28.3	22.7	16.1	13.9	14.8	16.5	16.8	20.7	19.7	21.1	32.4	35.9	29.6	18.5	18.1	16.1	16.4	12.6	10.6	08.5	09.9
Strontium T-Sr	0.233	0.355	0.676	1.120	0.575	0.455	0.36	0.317	0.305	0.326	0.365	0.430	0.437	0.473	0.699	0.734	0.615	0.382	0.393	0.358	0.358	0.287	0.215	0.137	0.139
Thallium T-Tl	<0.00010	<0.00010	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin T-Sn	<0.00010	<0.00010	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00023	<0.00010	0.00019	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium T-Ti	<0.010	<0.010	<0.010	0.014	<0.010	<0.010	<0.010	0.014	0.018	0.01	<0.010	0.012	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.015	<0.010	0.012	0.022	0.046	0.015	0.016
Uranium T-U	0.00044	0.002770	0.002322	0.003930	0.00153	0.001130	0.00096	0.000809	0.00091	0.000979	0.00102	0.00129	0.00121	0.00135	0.00223	0.00245	0.00189	0.00108	0.00106	0.00095	0.00097	0.00082	0.00056	0.00023	0.00026
Vanadium T-V	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	0.0015	0.0015	0.0018	0.0011	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	0.0013	0.0011	0.0011	0.0011	<0.0010	<0.0010	0.0018	0.0024	0.0013	0.0011
Zinc T-Zn	<0.0010	0.0021	<0.0030	<0.0040	<0.0030	0.0016	0.0031	0.0025	0.0028	0.002	0.0027	0.0036	0.0016	0.0031	0.0029	<0.0030	0.0025	0.0031	0.0035	0.0031	0.0094	0.0031	0.0047	0.0023	0.0027
Dissolved Metals (Trace)																									
Aluminum D-Al	0.0223	0.0033	-	-	-	0.0122										0.0161							0.0710		
Antimony D-Sb	<0.00010	<0.00010	-	-	-	<0.00010										<0.00010							<0.00010		
Arsenic D-As	0.00043	0.00020	-	-	-	0.00042										0.00051							0.00033		
Barium D-Ba	0.048	0.0794	-	-	-	0.0653										0.1000							0.0369		
Beryllium D-Be	<0.00050	<0.00050	-	-	-	<0.00050										<0.00050							<0.00050		
Bismuth D-Bi	<0.00050	<0.00050	-	-	-	<0.00050										<0.00050							<0.00050		
Boron D-B	<0.010	<0.010	-	-	-	<0.010										<0.010							<0.010		
Cadmium D-Cd	<0.000050	<0.000050	-	-	-	<0.000050										<0.000050							<0.000050		
Calcium D-Ca	31.6	63.6	-	-	-	51.3										82.5							24.3		
Chromium D-Cr	<0.00050	<0.00050	-	-	-	<0.00050										<0.00050							<0.00050		
Cobalt D-Co	0.00016	<0.00010	-	-	-	<0.00010										0.00015							<0.00010		
Copper D-Cu	0.0061	0.00163	-	-	-	0.00428										0.00648							0.01350		
Iron D-Fe	0.390	<0.030	-	-	-	<0.030										<0.030							0.134		
Lead D-Pb	<0.000050	<0.000050	-	-	-	<0.000050										<0.000050							<0.000050		
Lithium D-Li	<0.0050	<0.0050	-	-	-	0.0056										0.0096							<0.0050		
Magnesium D-Mg	13.40	18.6	-	-	-	35.7										64.3							17.7		
Manganese D-Mn	0.11200	0.00139	-	-	-	0.01780										0.03540							0.03240		
Mercury D-Hg			-	-	-																				
Molybdenum D-Mo	0.00122	0.00127	-	-	-	0.00353										0.00504							0.00204		
Nickel D-Ni	0.0012	<0.00050	-	-	-	<0.00050										0.00065							0.00056		
Phosphorus D-P	<0.30	<0.30	-	-	-	<0.30										<0.30							<0.30		
Potassium D-K	<2.0	<2.0	-	-	-	4.8										6.6							3.3		
Selenium D-Se	<0.0010	<0.0010	-	-	-	<0.0010										<0.0010							<0.0010		
Silicon D-Si	6.16	6.08	-	-	-	9.83										13.50							4.58		
Silver D-Ag	<0.000010	<0.000010	-	-	-	<0.000010										<0.000010							<0.000010		
Sodium D-Na	7.5	10.4	-	-	-	22.4										36.7							10.9		
Strontium D-Sr	0.2	0.355	-	-	-	0.449										0.737							0.212		
Thallium D-Tl	<0.00010	<0.00010	-	-	-	<0.00010										<0.00010							<0.00010		
Tin D-Sn	<0.00010	<0.00010	-	-	-	<0.00010										0.00017							<0.00010		
Titanium D-Ti	<0.010	<0.010	-	-	-	<0.010										<0.010							<0.010		
Uranium D-U	0.00042	0.002790	-	-	-	0.001130										0.002440							0.000548		
Vanadium D-V	<0.0010	<0.0010	-	-	-	<0.0010										<0.0010							<0.0010		
Zinc D-Zn	0.0018	0.0088	-	-	-	0.0017										0.0017							0.0017		
Organic Parameters																									
Dissolved Organic Carbon C			-	-	-	9.9100										14.0000							13.9000		
Total Inorganic Carbon C			-	-	-	50.2000										89.3000							20.7000		
Total Organic Carbon C			-	-	-	10.6000										15.4000							51.9000		
Radiological Parameters																									
Radium-226	<0.0050	<0.0050	-	-	-	<0.0050										<0.0050							<0.005		
Toxicity Testing'																									
96 HourTrout LTSO Bioassay (hrs)						> 96										> 96							> 96	> 96	
Percent Survival						100										100							100	100	
Designation						Non-Toxic										Non-Toxic							Non-Toxic	Non-Toxic	
48 Hour Daphnia magna LTSO (hrs)																									
Percent Survival																									
Designation																									

Notes:

[1] All units are in mg/L unless otherwise indicated

[2] Detection limit from October 2005 results except Mercury which is from

[3] Range is based on an average pH of 8.0 and a temperature range of 0 t

* Based on guideline for Hexavalent chromium (Cr(VI))

Sample ID																									
Sample Site Description																									
Date Sampled	27-Apr-06	28-Apr-06	29-Apr-06	30-Apr-06	01-May-06	02-May-06	03-May-06	04-May-06	05-May-06	06-May-06	07-May-06	08-May-06	09-May-06	10-May-06	12-May-06	13-May-06	14-May-06	15-May-06	16-May-06	17-May-06	18-May-06	19-May-06	20-May-06	21-May-06	22-May-06
Sampled by																									
Parameter [1]																									
Physical Tests																									
Electrical Conductivity (Lab) (µs/cm)	215	186	220	199	199	155	143	-	077	076	-	069	-	082	-	-	093	-	-	105	-	-	125	-	-
Electrical Conductivity (Field) (µs/cm)																									
Total Dissolved Solids	168	174	177	159	170	137	126	-	100	102	-	122	-	118	-	-	116	-	-	131	-	-	126	-	-
Hardness	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH (Lab)	7.90	7.85	7.94	7.93	7.94	7.87	7.80	-	7.53	7.52	-	7.43	-	7.51	-	-	7.60	-	-	7.59	-	-	7.75	-	-
pH (Field)	8	7.9	8.5	8.4	8.3	8.2	8.2	8.2	8.2	8.3	8.3	7.8	7.8	7.9	7.9	7.9	7.4	7.4	7.7	7.6	7.8	7.8	7.6	7.8	7.8
Total Suspended Solids (Lab)	6.6	<3.0	4.1	3.1	4.6	4.9	30.9		40.4	82.9	-	18.4		13.8	-	-	46.8	-	-	7.1	-	-	6.1	-	-
Total Suspended Solids (Field)	11	13	9	10	7	8	21	15	16.3	37	24	18	15.7	16	10.3	-	16	7	13	5	9	6	10	8	7
Tempurature (field) (˚C)																									
Turbidity	11	13	9	10	7	8	21	15	16.3	37	24	18	15.7	16	10.3	-	16	7	13	5	9	6	10	8	7
Dissolved Anions																									
Alkalinity-Total CaCO3	084	073	087	078	082	057	057	-	<2.0	024	-	024	-	030	-	-	036	-	-	043	-	-	055	-	-
Bromide Br	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	-	<0.050	-	<0.050	-	-	<0.050	-	-	<0.050	-	-	<0.050	-	-
Chloride Cl	0.83	0.73	0.72	0.63	0.64	0.60	0.55	-	<0.50	<0.50	-	<0.50	-	<0.50	-	-	<0.50	-	-	<0.50	-	-	<0.50	-	-
Fluoride F	0.165	0.140	0.154	0.151	0.158	0.122	0.126	-	0.064	0.069	-	0.063	-	0.078	-	-	0.158	-	-	0.105	-	-	0.136	-	-
Sulphate SO4	029	024	029	025	025	018	015	-	006	006	-	004	-	005	-	-	007	-	-	008	-	-	010	-	-
Nutrients																									
Ammonia Nitrogen N	-	-	-	-	-	-	-	-	-	-	-	<0.020	-	-	-	-	0.0490	-	-	-	-	-	-	-	-
Nitrate Nitrogen N	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	-	<0.0050	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-
Nitrite Nitrogen N	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	-	<0.0010	-	<0.0010	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	-	-
ortho-Phosphate																									
Total Dissolved Phosphate																									
Total Phosphorous																									
Cyanides																									
Total Cyanide CN	-	-	-	-	-	-	-	-	-	-	-	0.0317	-	-	-	-	0.0235	-	-	-	-	-	-	-	-
Total Metals (Trace)																									
Aluminum T-Al	0.2690	0.2100	0.2130	0.2090	0.2250	0.2090	1.0200	-	1.0700	2.1300	-	0.7740	-	0.3160	-	-	1.6600	-	-	0.3570	-	-	0.0881	-	-
Antimony T-Sb	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	0.00016	0.00011	-	<0.00010	-	<0.00010	-	-	0.00016	-	-	<0.00010	-	-	<0.00010	-	-
Arsenic T-As	0.00042	0.00039	0.00040	0.00037	0.00037	0.00036	0.00076	-	0.00065	0.00101	-	0.00057	-	0.00045	-	-	0.00118	-	-	0.00056	-	-	0.00045	-	-
Barium T-Ba	0.0373	0.0368	0.0443	0.0412	0.0417	0.0368	0.0495	-	0.0397	0.0605	-	0.0400	-	0.0340	-	-	0.0650	-	-	0.0393	-	-	0.0340	-	-
Beryllium T-Be	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	-	<0.00050	-	<0.00050	-	-	<0.00050	-	-	<0.00050	-	-	<0.00050	-	-
Bismuth T-Bi	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	-	<0.00050	-	<0.00050	-	-	<0.00050	-	-	<0.00050	-	-	<0.00050	-	-
Boron T-B	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	-	<0.010	-	<0.010	-	-	<0.010	-	-	<0.010	-	-	<0.010	-	-
Cadmium T-Cd	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	-	<0.000050	-	0.000134	-	-	<0.000050	-	-	<0.000050	-	-	<0.000050	-	-
Calcium T-Ca	21.0	19.4	24.0	22.4	23.0	17.5	16.4	-	10.5	11.4	-	11.1	-	12.2	-	-	14.0	-	-	14.0	-	-	17.1	-	-
Chromium T-Cr	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00156	-	0.00162	0.00238	-	0.001	-	0.00074	-	-	0.00318	-	-	0.00067	-	-	<0.00050	-	-
Cobalt T-Co	0.00021	0.00019	0.00018	0.00017	0.00018	0.00019	0.00064	-	0.00071	0.00136	-	0.00057	-	0.00041	-	-	0.00130	-	-	0.00043	-	-	<0.00010	-	-
Copper T-Cu (Lab)	0.02970	0.03150	0.03320	0.03010	0.03040	0.03040	0.03670	-	0.03480	0.10100	-	0.04150	-	0.02130	-	-	0.01300	-	-	0.02240	-	-	0.01470	-	-
Copper (On Site Hach)	0.0062	0.0025	0.0063	0.0021	0.0058	0.0053	0.0062	0.007	0.005	0.012	0.006	0.005	0.004	0.005	0.0067	-	0.0047	0.0038	0.0041	n/r	0.0031	n/r	0.006	0.004	0.0012
Iron T-Fe	0.285	0.261	0.256	0.251	0.259	0.327	1.460	-	1.530	3.200	-	1.200	-	0.504	-	-	2.440	-	-	0.820	-	-	0.261	-	-
Lead T-Pb	0.000068	0.000091	0.000060	0.000078	0.000062	0.000117	0.000461	-	0.000461	0.000760	-	0.000285	-	0.000183	-	-	0.001160	-	-	0.000183	-	-	<0.000050	-	-
Lithium T-Li	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	-	<0.0050	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-
Magnesium T-Mg	11.8	10.6	13.1	11.7	11.7	08.1	07.8	-	04.3	04.8	-	04.0	-	04.3	-	-	04.3	-	-	05.8	-	-	06.8	-	-
Manganese T-Mn	0.0495	0.0396	0.0360	0.0357	0.0311	0.0302	0.0711	-	0.0925	0.1380	-	0.0599	-	0.0708	-	-	0.1350	-	-	0.0965	-	-	0.0107	-	-
Mercury T-Hg								-			-		-		-	-		-	-		-	-		-	-
Molybdenum T-Mo	0.00116	0.00089	0.00118	0.00113	0.00100	0.00080	0.00085	-	0.00047	0.00056	-	0.00041	-	0.00045	-	-	0.00058	-	-	0.00068	-	-	0.00096	-	-
Nickel T-Ni	0.00096	0.00110	0.00117	0.00110	0.00106	0.00119	0.00212	-	0.00223	0.00304	-	0.00212	-	0.00183	-	-	0.00460	-	-	0.00221	-	-	0.00187	-	-
Phosphorous T-P	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-	<0.30	<0.30	-	<0.30	-	<0.30	-	-	<0.30	-	-	<0.30	-	-	<0.30	-	-
Potassium T-K	3.1	3.1	3.2	3.0	2.9	2.6	2.8	-	2.1	2.4	-	2.1	-	2.0	-	-	<2.0	-	-	<2.0	-	-	<2.0	-	-
Selenium T-Se	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	-	<0.0010	-	<0.0010	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010	-	-
Silicon T-Si	04.5	04.3	04.9	04.7	04.8	04.0	05.2	-	04.2	06.2	-	03.7	-	03.2	-	-	06.0	-	-	03.6	-	-	03.3	-	-
Silver T-Ag	0.000016	0.00001	0.000012	0.00001	<0.000010	0.000013	0.000022	-	0.00002	0.00003	-	0.000017	-	0.000028	-	-	0.000023	-	-	0.000012	-	-	<0.000010	-	-
Sodium T-Na	09.9	07.5	07.7	05.4	05.3	03.4	03.3	-	<2.0	<2.0	-	<2.0	-	<2.0	-	-	02.1	-	-	03.4	-	-	03.5	-	-
Strontium T-Sr	0.146	0.137	0.174	0.165	0.162	0.124	0.119	-	0.068	0.074	-	0.064	-	0.075	-	-	0.100	-	-	0.092	-	-	0.115	-	-
Thallium T-Tl	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.00010	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-
Tin T-Sn	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.00010	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-
Titanium T-Ti	<0.010	0.011	0.011	0.012	<0.010	<0.010	0.048	-	0.047	0.122	-	0.04	-	0.01	-	-	0.067	-	-	0.016	-	-	<0.010	-	-
Uranium T-U	0.00027	0.00022	0.00032	0.00027	0.00020	0.00020	0.00024	-	0.00013	0.00019	-	0.00011	-	0.00011	-	-	0.00030	-	-	0.00018	-	-	0.00020	-	-
Vanadium T-V	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0035	-	0.0036	0.0075	-	0.003	-	0.0011	-	-	0.0056	-	-	0.0017	-	-	<0.0010	-	-
Zinc T-Zn	0.0028	0.0236	0.0035	0.0138	0.0037	0.0050	0.0053	-	0.0192	0.0137	-	0.0079	-	0.0051	-	-	0.0085	-	-	0.0029	-	-	<0.0010	-	-
Dissolved Metals (Trace)																									
Aluminum D-Al								-	-	-	-	0.1240	-	-	-	-	0.0846	-	-	-	-	-	-	-	-
Antimony D-Sb						-	-	-	-	-	-	<0.00010	-	-	-	-	<0.00010	-	-	-	-	-	-	-	-
Arsenic D-As						-	-	-	-	-	-	0.00031	-	-	-	-	0.00040	-	-	-	-	-	-	-	-
Barium D-Ba						-	-	-	-	-	-	0.0270	-	-	-	-	0.0323	-	-	-	-	-	-	-	-
Beryllium D-Be						-	-	-	-	-	-	<0.00050	-	-	-	-	<0.00050	-	-	-	-	-	-	-	-
Bismuth D-Bi						-	-	-	-	-	-	<0.00050	-	-	-	-	<0.00050	-	-	-	-	-	-	-	-
Boron D-B						-	-	-	-	-	-	<0.010	-	-	-	-	<0.010	-	-	-	-	-	-	-	-
Cadmium D-Cd						-	-	-	-	-	-	<0.000050	-	-	-	-	<0.000050	-	-	-	-	-	-	-	-
Calcium D-Ca						-	-	-	-	-	-	11.1	-	-	-	-	13.8	-	-	-	-	-	-	-	-
Chromium D-Cr						-	-	-	-	-	-	<0.00050	-	-	-	-	<0.00050	-	-	-	-	-	-	-	-
Cobalt D-Co						-	-	-	-	-	-	0.0002	-	-	-	-	0.00026	-	-	-	-	-	-	-	-
Copper D-Cu						-	-	-	-	-	-	0.01850	-	-	-	-	0.01460	-	-	-	-	-	-	-	-
Iron D-Fe						-	-	-	-	-	-	0.220	-	-	-	-	0.285	-	-	-	-	-	-	-	-
Lead D-Pb						-	-	-	-	-	-	0.000052	-	-	-	-	0.000070	-	-	-	-	-	-	-	-
Lithium D-Li						-	-	-	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-	-	-	-
Magnesium D-Mg						-	-	-	-	-	-	03.8	-	-	-	-	04.3	-	-	-	-	-	-	-	-
Manganese D-Mn						-	-	-	-	-	-	0.02550	-	-	-	-	0.09010	-	-	-	-	-	-	-	-
Mercury D-Hg						-	-	-	-	-	-		-	-	-	-		-	-	-	-	-	-	-	-
Molybdenum D-Mo						-	-	-	-	-	-	0.00032	-	-	-	-	0.00057	-	-	-	-	-	-	-	-
Nickel D-Ni						-	-	-	-	-	-	0.00136	-	-	-	-	0.00159	-	-	-	-	-	-	-	-
Phosphorus D-P						-	-	-	-	-	-	<0.30	-	-	-	-	<0.30	-	-	-	-	-	-	-	-
Potassium D-K						-	-	-	-	-	-	<2.0	-	-	-	-	<2.0	-	-	-	-	-	-	-	-
Selenium D-Se						-	-	-	-	-	-	<0.0010	-	-	-	-	<0.0010	-	-	-	-	-	-	-	-
Silicon D-Si						-	-	-	-	-	-	2.51	-	-	-	-	2.95	-	-	-	-	-	-	-	-
Silver D-Ag						-	-	-	-	-	-	<0.000010	-	-	-	-	<0.000010	-	-	-	-	-	-	-	-
Sodium D-Na						-	-	-	-	-	-	<2.0	-	-	-	-	02.3	-	-	-	-	-	-	-	-
Strontium D-Sr						-	-	-	-	-	-	0.057	-	-	-	-	0.084	-	-	-	-	-	-	-	-
Thallium D-Tl						-	-	-	-	-	-	<0.00010	-	-	-	-	<0.00010	-	-	-	-	-	-	-	-
Tin D-Sn						-	-	-	-	-	-	<0.00010	-	-	-	-	0.00027	-	-	-	-	-	-	-	-
Titanium D-Ti						-	-	-	-	-	-	<0.010	-	-	-	-	<0.010	-	-	-	-	-	-	-	-
Uranium D-U						-	-	-	-	-	-	0.000067	-	-	-	-	0.000123	-	-	-	-	-	-	-	-
Vanadium D-V						-	-	-	-	-	-	<0.0010	-	-	-	-	<0.0010	-	-	-	-	-	-	-	-
Zinc D-Zn						-	-	-	-	-	-	0.0057	-	-	-	-	0.0024	-	-	-	-	-	-	-	-
Organic Parameters																									
Dissolved Organic Carbon C					-	-	-	-	-	-	-	37.7000	-	-	-	-	29.7000	-	-	-	-	-	-	-	-
Total Inorganic Carbon C					-	-	-	-	-	-	-	1.8400	-	-	-	-	3.9900	-	-	-	-	-	-	-	-
Total Organic Carbon C					-	-	-	-	-	-	-	47.1000	-	-	-	-	32.6000	-	-	-	-	-	-	-	-
Radiological Parameters																									
Radium-226					<0.0050	-	-	-	-	-	-	<0.0050	-	-	-	-	0.009	-	-	-	-	-	-	-	-
Toxicity Testing'																									
96 HourTrout LTSO Bioassay (hrs)					> 96	-	-	-	-	-	-	> 96	-	-	-	-	> 96	-	-	-	-	-	-	-	-
Percent Survival					100	-	-	-	-	-	-	100	-	-	-	-	100	-	-	-	-	-	-	-	-
Designation					Non-Toxic	-	-	-	-	-	-	Non-Toxic	-	-	-	-	Non-Toxic	-	-	-	-	-	-	-	-
48 Hour Daphnia magna LTSO (hrs)												> 48					> 48								
Percent Survival												97					100								
Designation												??					Non-Toxic								

Notes:

[1] All units are in mg/L unless otherwise indicated

[2] Detection limit from October 2005 results except Mercury which is from

[3] Range is based on an average pH of 8.0 and a temperature range of 0 t

* Based on guideline for Hexavalent chromium (Cr(VI))

Sample ID																								
Sample Site Description																								
Date Sampled	23-May-06	24-May-06	25-May-06	26-May-06	27-May-06	28-May-06	29-May-06	30-May-06	31-May-06	01-Jun-06	02-Jun-06	03-Jun-06	07-Jun-06	08-Jun-06	15-Jun-06	16-Jun-06	21-Jun-06	22-Jun-06	23-Jun-06	24-Jun-06	25-Jun-06	28-Jun-06	06-Jul-06	07-Jul-06	08-Jul-06
Sampled by															Norwest							Norwest			
Parameter [1]																									
Physical Tests																									
Electrical Conductivity (Lab) (µs/cm)	161	-	-	166	-	-	120	-	-	-	136	-	143	-	323	-	-	-	382	-	-	334	-	319	
Electrical Conductivity (Field) (µs/cm)																									
Total Dissolved Solids	133	-	-	139	-	-	120	-	-	-	129	-	134	-	196	-	-	-	266	-	-	212	-	249	
Hardness	-	-	-	-	-	-	-	-	-	-	-	-	-	-	169	-	-	-	190	-	-	163	-	179	
pH (Lab)	7.89	-	-	7.71	-	-	7.64	-	-	-	7.42	-	7.59	-	7.95	-	-	-	7.83	-	-	7.88	-	7.93	
pH (Field)	7.7	7.8	7.7	7.8	7.8	7.8	7.6	8.1	7.8	7.8	7.7	-	-	-	-	-	-	7.7	7.2	7.2	7.5	-	-	-	7.6
Total Suspended Solids (Lab)	17.8	-	-	5.9	-	-	13.4	-	-	-	26.4	-	7.1	-	-	-	-	-	4.0	-	-	4.0	-	14.0	
Total Suspended Solids (Field)	9	7	7	6	6	11	8	7	9	4	8	-	-	-	1	-	-	3	4	1	0	4	3	1	0
Tempurature (field) (˚C)																									
Turbidity	9	7	7	6	6	11	8	7	9	4	8	-	-	-	-	-	-	3	4	1	0	-	3	1	0
Dissolved Anions																									
Alkalinity-Total CaCO3	068	-	-	074	-	-	055	-	-	-	069	-	070	-	134	-	-	-	164	-	-	138		158	
Bromide Br	<0.050	-	-	<0.050	-	-	<0.050	-	-	-	<0.050	-	<0.050	-	-	-	-	-		-	-	-			
Chloride Cl	<0.50	-	-	<0.50	-	-	<0.50	-	-	-	<0.50	-	<0.50	-	-	-	-	-		-	-	-			
Fluoride F	0.149	-	-	0.143	-	-	0.122	-	-	-	0.127	-	0.126	-	-	-	-	-		-	-	-			
Sulphate SO4	015	-	-	019	-	-	012	-	-	-	012	-	014	-	034	-	-	-	047	-	-	-		038	
Nutrients																									
Ammonia Nitrogen N	0.0120	-	-	-	-	-	-	-	-	-	0.0220	-	0.0430	-	0.0130	-	-	-	0.0070	-	-	<0.002		0.0050	
Nitrate Nitrogen N	<0.0050	-	-	0.0130	-	-	0.0075	-	-	-	<0.0050	-	0.0179	-	0.1200	-	-	-	<0.03	-	-	0.0250		0.0860	
Nitrite Nitrogen N	<0.0010	-	-	0.0015	-	-	<0.0010	-	-	-	<0.0010	-	0.0011	-	-	-	-	-		-	-	-			
ortho-Phosphate																									
Total Dissolved Phosphate																									
Total Phosphorous																									
Cyanides																									
Total Cyanide CN	0.0181	-	-	-	-	-	-	-	-	-	0.0214	-	0.0215	-	<0.001	-	-	-	<0.001	-	-	<0.001		0.001	
Total Metals (Trace)																									
Aluminum T-Al	0.2810	-	-	0.1250	-	-	0.1950	-	-	-	0.8470	-	0.1700	-	0.0320	-	-	-	0.0670	-	-	0.0650		0.1600	
Antimony T-Sb	<0.00010	-	-	0.00012	-	-	0.00039	-	-	-	0.00014	-	<0.00010	-	<0.0002	-	-	-	<0.0002	-	-	<0.0002		<0.001	
Arsenic T-As	0.00056	-	-	0.00051	-	-	0.00055	-	-	-	0.00079	-	0.00054	-	0.00040	-	-	-	0.00040	-	-	0.00040		<0.001	
Barium T-Ba	0.0431	-	-	0.0415	-	-	0.0360	-	-	-	0.0503	-	0.0404	-	0.0580	-	-	-	0.0680	-	-	0.0590		0.0740	
Beryllium T-Be	<0.00050	-	-	<0.00050	-	-	<0.00050	-	-	-	<0.00050	-	<0.00050	-	<0.0001	-	-	-	<0.0001	-	-	<0.0001		<0.0005	
Bismuth T-Bi	<0.00050	-	-	<0.00050	-	-	<0.00050	-	-	-	<0.00050	-	<0.00050	-	<0.0005	-	-	-	<0.0005	-	-	<0.0005		<0.002	
Boron T-B	<0.010	-	-	<0.010	-	-	<0.010	-	-	-	<0.010	-	<0.010	-	0.007	-	-	-	0.006	-	-	0.007		0.01	
Cadmium T-Cd	<0.000050	-	-	<0.000050	-	-	<0.000050	-	-	-	<0.000050	-	<0.000050	-	<0.00001	-	-	-	<0.00001	-	-	<0.00001		<0.00005	
Calcium T-Ca	19.5	-	-	21.7	-	-	16.7	-	-	-	18.8	-	19.6	-	36.5	-	-	-	45.2	-	-	38.1		45.2	
Chromium T-Cr	0.00061	-	-	0.00056	-	-	0.00071	-	-	-	0.00183	-	<0.00050	-	<0.0005	-	-	-	<0.0005	-	-	<0.0005		<0.002	
Cobalt T-Co	0.00035	-	-	0.00019	-	-	0.00018	-	-	-	0.00068	-	0.00017	-	<0.0001	-	-	-	<0.0001	-	-	<0.0001		<0.0005	
Copper T-Cu (Lab)	0.01440	-	-	0.01170	-	-	0.02200	-	-	-	0.02040	-	0.02790	-	0.00900	-	-	-	0.00500	-	-	0.01200		0.00800	
Copper (On Site Hach)	<0.001	<0.001	<0.001	0.0028	0.0046	0.0098	0.009	0.0096	<0.001	0.0015	<0.001	-	-	-	-	-	0.002	<0.0005	<0.0005	0.0028	0.0016	-	0.0018	0.003	<0.0005
Iron T-Fe	0.629	-	-	0.299	-	-	0.385	-	-	-	1.380	-	0.342	-	0.100	-	-	-	<0.1	-	-	0.200		0.100	
Lead T-Pb	0.000193	-	-	0.000084	-	-	0.000131	-	-	-	0.000386	-	0.000087	-	<0.0001	-	-	-	<0.0001	-	-	<0.0001		<0.0005	
Lithium T-Li	<0.0050	-	-	<0.0050	-	-	<0.0050	-	-	-	<0.0050	-	<0.0050	-	0.0020	-	-	-	0.0020	-	-	0.0020		<0.005	
Magnesium T-Mg	08.8	-	-	09.4	-	-	06.4	-	-	-	07.7	-	07.5	-	14.8	-	-	-	17.3	-	-	15.1		17.1	
Manganese T-Mn	0.0543	-	-	0.0187	-	-	0.0172	-	-	-	0.0641	-	0.0201	-	0.0110	-	-	-	0.0080	-	-	0.0100		0.0120	
Mercury T-Hg		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-			
Molybdenum T-Mo	0.00099	-	-	0.00087	-	-	0.00082	-	-	-	0.00092	-	0.00080	-	0.00200	-	-	-	0.00200	-	-	<0.005			
Nickel T-Ni	0.00211	-	-	0.00209	-	-	0.00238	-	-	-	0.00354	-	0.00212	-	0.00140	-	-	-	0.00110	-	-	0.00090		0.00300	
Phosphorous T-P	<0.30	-	-	<0.30	-	-	<0.30	-	-	-	<0.30	-	<0.30	-	-	-	-	-		-	-	-			
Potassium T-K	<2.0	-	-	<2.0	-	-	<2.0	-	-	-	<2.0	-	<2.0	-	1.3	-	-	-	1.4	-	-	1.3		1.3	
Selenium T-Se	<0.0010	-	-	<0.0010	-	-	<0.0010	-	-	-	<0.0010	-	<0.0010	-	0.0002	-	-	-	<0.0002	-	-	<0.0002		<0.001	
Silicon T-Si	04.1	-	-	04.1	-	-	04.0	-	-	-	05.1	-	04.5	-	05.0	-	-	-	05.6	-	-	05.5		05.6	
Silver T-Ag	<0.000010	-	-	0.000013	-	-	0.000017	-	-	-	0.000019	-	<0.000010	-	<0.0001	-	-	-	0.0002	-	-	<0.0001		<0.0005	
Sodium T-Na	05.4	-	-	05.7	-	-	04.3	-	-	-	04.7	-	04.6	-	09.6	-	-	-	11.0	-	-	10.2		11.6	
Strontium T-Sr	0.136	-	-	0.148	-	-	0.109	-	-	-	0.130	-	0.124	-	0.339	-	-	-	0.408	-	-	0.294		0.420	
Thallium T-Tl	<0.00010	-	-	<0.00010	-	-	<0.00010	-	-	-	<0.00010	-	<0.00010	-	<0.00005	-	-	-	<0.00005	-	-	<0.00005		<0.0002	
Tin T-Sn	<0.00010	-	-	<0.00010	-	-	0.00011	-	-	-	<0.00010	-	<0.00010	-	<0.001	-	-	-	<0.001	-	-	<0.001		<0.005	
Titanium T-Ti	0.01	-	-	<0.010	-	-	<0.010	-	-	-	0.036	-	<0.010	-	0.0019	-	-	-	0.0036	-	-	0.0034		0.0078	
Uranium T-U	0.00032	-	-	0.00028	-	-	0.00015	-	-	-	0.00025	-	0.00022	-	0.00100	-	-	-	0.00130	-	-	0.00110		<0.002	
Vanadium T-V	0.0016	-	-	<0.0010	-	-	0.0013	-	-	-	0.0033	-	0.0013	-	0.0009	-	-	-	0.0008	-	-	0.0007		0.0006	
Zinc T-Zn	0.0023	-	-	0.0018	-	-	<0.0050	-	-	-	0.0052	-	0.0016	-	<0.001	-	-	-	0.0010	-	-	0.0020		<0.005	
Dissolved Metals (Trace)																									
Aluminum D-Al	0.0383	-	-	-	-	-	-	-	-	-	0.0507	-	-	-	0.0090	-	-	-	0.0060	-	-	0.0150		<0.005	
Antimony D-Sb	<0.00010	-	-	-	-	-	-	-	-	-	<0.00010	-	-	-	<0.0002	-	-	-	<0.0002	-	-	<0.0002		<0.0002	
Arsenic D-As	0.00043	-	-	-	-	-	-	-	-	-	0.00049	-	-	-	0.00040	-	-	-	0.00040	-	-	0.00040		0.00040	
Barium D-Ba	0.0367	-	-	-	-	-	-	-	-	-	0.0351	-	-	-	0.0610	-	-	-	0.0650	-	-	0.0560		0.0670	
Beryllium D-Be	<0.00050	-	-	-	-	-	-	-	-	-	<0.00050	-	-	-	<0.0001	-	-	-	<0.0001	-	-	<0.0001		<0.0001	
Bismuth D-Bi	<0.00050	-	-	-	-	-	-	-	-	-	<0.00050	-	-	-	<0.0005	-	-	-	<0.0005	-	-	<0.0005		0.0007	
Boron D-B	<0.010	-	-	-	-	-	-	-	-	-	<0.010	-	-	-	0.004	-	-	-	0.004	-	-	0.004		0.007	
Cadmium D-Cd	<0.000050	-	-	-	-	-	-	-	-	-	<0.000050	-	-	-	<0.00001	-	-	-	<0.00001	-	-	<0.00001		<0.00001	
Calcium D-Ca	19.0	-	-	-	-	-	-	-	-	-	19.1	-	-	-	40.7	-	-	-	46.6	-	-	39.0		40.9	
Chromium D-Cr	<0.00050	-	-	-	-	-	-	-	-	-	<0.00050	-	-	-	<0.0005	-	-	-	0.0006	-	-	0.0005		0.0014	
Cobalt D-Co	0.00011	-	-	-	-	-	-	-	-	-	<0.00010	-	-	-	<0.0001	-	-	-	<0.0001	-	-	<0.0001		<0.0001	
Copper D-Cu	0.01020	-	-	-	-	-	-	-	-	-	0.01160	-	-	-	0.00500	-	-	-	0.00300	-	-	0.00800		0.00500	
Iron D-Fe	0.167	-	-	-	-	-	-	-	-	-	0.198	-	-	-	0.040	-	-	-	0.030	-	-	0.030		0.030	
Lead D-Pb	<0.000050	-	-	-	-	-	-	-	-	-	<0.000050	-	-	-	<0.0001	-	-	-	<0.0001	-	-	<0.0001		<0.0001	
Lithium D-Li	<0.0050	-	-	-	-	-	-	-	-	-	<0.0050	-	-	-	0.001	-	-	-	0.001	-	-	0.001		0.002	
Magnesium D-Mg	08.5	-	-	-	-	-	-	-	-	-	07.6	-	-	-	16.3	-	-	-	18.0	-	-	16.9		18.8	
Manganese D-Mn	0.02920	-	-	-	-	-	-	-	-	-	0.00826	-	-	-	<0.005	-	-	-	0.00600	-	-	<0.005		<0.005	
Mercury D-Hg		-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-		-	-				
Molybdenum D-Mo	0.00101	-	-	-	-	-	-	-	-	-	0.00085	-	-	-	0.00100	-	-	-	0.00200	-	-	0.00200		0.00200	
Nickel D-Ni	0.00152	-	-	-	-	-	-	-	-	-	0.00204	-	-	-	0.00090	-	-	-	0.00100	-	-	0.00120		0.00140	
Phosphorus D-P	<0.30	-	-	-	-	-	-	-	-	-	<0.30	-	-	-	-	-	-	-		-	-	-			
Potassium D-K	<2.0	-	-	-	-	-	-	-	-	-	<2.0	-	-	-	0.6	-	-	-	1.4	-	-	1.4		1.2	
Selenium D-Se	<0.0010	-	-	-	-	-	-	-	-	-	<0.0010	-	-	-	<0.0002	-	-	-	<0.0002	-	-	<0.0002		<0.0002	
Silicon D-Si	3.58	-	-	-	-	-	-	-	-	-	3.94	-	-	-	5.73	-	-	-	5.77	-	-	6.49		7.00	
Silver D-Ag	<0.000010	-	-	-	-	-	-	-	-	-	<0.000010	-	-	-	<0.0001	-	-	-	<0.0001	-	-	<0.0001		<0.0001	
Sodium D-Na	05.3	-	-	-	-	-	-	-	-	-	04.9	-	-	-	10.8	-	-	-	11.0	-	-	10.2		11.3	
Strontium D-Sr	0.134	-	-	-	-	-	-	-	-	-	0.124	-	-	-	0.323	-	-	-	0.405	-	-	0.304		0.387	
Thallium D-Tl	<0.00010	-	-	-	-	-	-	-	-	-	<0.00010	-	-	-	<0.00005	-	-	-	<0.00005	-	-	<0.00005		<0.00005	
Tin D-Sn	<0.00010	-	-	-	-	-	-	-	-	-	<0.00010	-	-	-	<0.001	-	-	-	<0.001	-	-	<0.001		<0.001	
Titanium D-Ti	<0.010	-	-	-	-	-	-	-	-	-	<0.010	-	-	-	0.0008	-	-	-	0.0007	-	-	0.0009		0.0013	
Uranium D-U	0.000286	-	-	-	-	-	-	-	-	-	0.000190	-	-	-	0.000900	-	-	-	0.001400	-	-	0.000800		0.001000	
Vanadium D-V	<0.0010	-	-	-	-	-	-	-	-	-	<0.0010	-	-	-	0.0012	-	-	-	0.0009	-	-	0.0009		0.0012	
Zinc D-Zn	<0.0010	-	-	-	-	-	-	-	-	-	0.0013	-	-	-	<0.001	-	-	-	0.0030	-	-	0.0020		0.0010	
Organic Parameters																									
Dissolved Organic Carbon C	21.5000	-	-	-	-	-	-	-	-	-	27.8000	-	28.4000	-	13.3000	-	-	-	5.9000	-	-	11.3000		9.8000	
Total Inorganic Carbon C	11.7000	-	-	-	-	-	-	-	-	-	9.5500	-	9.2600	-	36.2000	-	-	-	38.6000	-	-	36.2000		40.6000	
Total Organic Carbon C	22.8000	-	-	-	-	-	-	-	-	-	28.4000	-	26.8000	-	13.0000	-	-	-	7.7000	-	-	12.5000		8.9000	
Radiological Parameters																									
Radium-226	<0.0050	-	-	-	-	-	-	-	-	-	<0.0050	-	<0.0050	-	<0.005	-	-	-	<0.005	-	-	<0.005		0.005	
Toxicity Testing'																									
96 HourTrout LTSO Bioassay (hrs)	> 96	-	-	> 96	-	-	-	-	-	-	-	> 96	-	> 96	-	> 96	-	-		-	> 96	> 96		> 96	
Percent Survival	100	-	-	100	-	-	-	-	-	-	-	100	-	100	-	100	-	-		-	100	100		100	
Designation	Non-Toxic	-	-	Non-Toxic	-	-	-	-	-	-	-	Non-Toxic	-	Non-Toxic	-	Non-Toxic	-	-		-	Non-Toxic	Non-Toxic		Non-Toxic	
48 Hour Daphnia magna LTSO (hrs)	> 48			> 48	-	-	-	-	-	-	-	> 48	-	> 48	-	> 48	-	-		-	> 48	> 48		> 48	
Percent Survival	100			100	-	-	-	-	-	-	-	100	-	100	-	100	-	-		-	97	100		100	
Designation	Non-Toxic			Non-Toxic	-	-	-	-	-	-	-	Non-Toxic	-	Non-Toxic	-	Non-Toxic	-	-		-	Non-Toxic	Non-Toxic		Non-Toxic	

Notes:

[1] All units are in mg/L unless otherwise indicated

[2] Detection limit from October 2005 results except Mercury which is from

[3] Range is based on an average pH of 8.0 and a temperature range of 0 t

* Based on guideline for Hexavalent chromium (Cr(VI))

Sample ID																								
Sample Site Description																								
Date Sampled	**09-Jul-06**	**12-Jul-06**	**20-Jul-06**	**21-Jul-06**	**22-Jul-06**	**23-Jul-06**	**24-Jul-06**	**26-Jul-06**	**30-Jul-06**	**31-Jul-06**	**02-Aug-06**	**10-Aug-06**	**18-Aug-06**	**25-Aug-06**	**30-Aug-06**	**06-Sep-06**	**13-Sep-06**	**20-Sep-06**	**29-Sep-06**	**04-Oct-06**	**12-Oct-06**	**18-Oct-06**	**28-Oct-06**	**01-Nov-06**	**09-Nov-06**
Sampled by		S.VB	J.Gibson								SVB	SVB	JG	JG	JG	SVB	SVB	SVB	JG	SVB	JG	SVB	JG	SVB	JG
Parameter [1]																									
Physical Tests																									
Electrical Conductivity (Lab) (µs/cm)		372	378					405			422	430	360	413	406	416	407	423	434	413	430	335	456	445	469
Electrical Conductivity (Field) (µs/cm)																							484		490
Total Dissolved Solids														282	294				160		280	247	130	290	304
Hardness		183	208					209			163	202	213	204	192	210	215	216	210	203	210	216	224	226	234
pH (Lab)		7.70	7.92					7.93			8.00	7.82	7.89	7.94	7.86	7.92	7.96	8.02	7.74	7.93	7.61	8.19	7.44	7.1	7.49
pH (Field)	7.8		8.1	8.4	8.27	8.1	8.26	8.32	8.11	8.41		n/r	8.1	7.7	8.18	8.2	8.2	n/r	n/r	n/r	7.9	8.8	6.94	8.4	6.91
Total Suspended Solids (Lab)		<2	16.0					<2			18	6	26		<2	<2	4	2	<2	<2	<2	<1	14	<2	<2
Total Suspended Solids (Field)	2	6	1	5	10	5	5	9	65	47	10	12	31	60	4	3	4	3	2	4	2	1	1	1	0
Tempurature (field) (˚C)																							1.2		1.4
Turbidity	2		1	5	10	5	5	9	65	47												0.4	2.9	6.6	0.6
Dissolved Anions																									
Alkalinity-Total CaCO3		164	174					171			182	183	166	175	178	186	183	190	191	180	184	152	205	210	214
Bromide Br																									
Chloride Cl																						0.9	1.12	1.06	1.21
Fluoride F																									
Sulphate SO4		042						045			040	45	48	43	39	38	42.9	42	43	43	42		42	42	42
Nutrients																									
Ammonia Nitrogen N		0.0060	0.0060					0.0070			0.0160	0.013	0.009	0.02	0.004	0.003	0.006	0.004	0.006	0.073	0.006	<0.05	0.029	<0.05	0.071
Nitrate Nitrogen N		0.1100	<0.03					0.0400			0.1200	0.12	0.22	<0.03	<0.03	<0.03	0.008	<0.03	<0.03	<0.03	<0.03	0.05	0.25	0.23	0.23
Nitrite Nitrogen N																						<0.005	<0.03	<0.03	<0.03
ortho-Phosphate																						0.04		0.04	
Total Dissolved Phosphate																									
Total Phosphorous																						0.06		<0.05	
Cyanides																									
Total Cyanide CN		0.001	<0.001					0.001			0.001	0.001	<0.001	0.12	0.001	<0.001	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Total Metals (Trace)																									
Aluminum T-Al		0.0140	0.5940					0.1830			0.1380	0.306	0.818	0.19	0.064	0.05	0.16	0.138	0.03	0.081	0.047	0.006	0.114	0.96	0.031
Antimony T-Sb		<0.0002	<0.0002					<0.0002			<0.0002	<0.0002	<0.0004	<0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0004	<0.0004	<0.0002	<0.0002	<0.0002	0.005	0.0002
Arsenic T-As		0.00030	0.00060					0.00040			0.00060	0.0005	0.001	0.0004	0.0003	0.0004	0.0004	0.0005	0.0004	<0.0004	0.0002	0.0003	0.0004	0.009	0.0003
Barium T-Ba		0.0670	0.0800					0.0820			0.0860	0.087	0.083	0.086	0.075	0.076	0.079	0.078	0.079	0.075	0.078	0.084	0.082	1.9	0.075
Beryllium T-Be		<0.0001	<0.0001					<0.0001			<0.0001	<0.0001	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.002	<0.0001
Bismuth T-Bi		<0.0005	<0.0005					<0.0005			<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.0005	<0.01	<0.0005
Boron T-B		0.007	0.077					0.005			0.007	0.007	0.01	0.006	0.006	0.007	0.007	0.007	0.008	0.007	0.007	0.006	0.018	0.48	0.018
Cadmium T-Cd		<0.00001	<0.00001					<0.00001			<0.00001	<0.00001	0.00002	<0.00002	<0.00001	<0.00001	<0.00001	<0.00001	<0.00002	<0.00002	<0.00001	<0.00001	<0.00001	<0.00025	<0.00001
Calcium T-Ca		46.7	47.3					50.4			48.4	54.7	51.8	48.3	47.1	49.2	49.8	51.2	51.1	46.2	52	54.3	50.4	49.8	53
Chromium T-Cr		<0.0005	0.0006					<0.0005			<0.0005	<0.0005	0.0067	<0.001	0.0008	0.0007	0.0005	0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.0005	<0.01	<0.0005
Cobalt T-Co		<0.0001	0.00030					0.00020			0.00010	0.0006	0.0005	<0.0002	0.0001	0.0001	0.0001	0.0001	<0.0002	<0.0002	<0.0001	<0.0001	0.0002	0.004	0.0002
Copper T-Cu (Lab)		0.00400	0.01000					0.00500			0.00400	0.014	0.004	0.004	0.005	0.004	0.005	0.004	0.004	0.004	0.005	0.003	0.002	0.05	0.002
Copper (On Site Hach)	0.0011	<0.0001	<0.0005	0.0002	<0.00005	0.0003	0.0009	0.0013	0.0047	0.0014	0.0019	0.005	<0.0005	0.0011	<0.0005	0.0016	0.0014	0.0015	0.0015	0.0016	0.0007	0.0006	0.0007	0.0013	0.0006
Iron T-Fe		<0.1	0.700					0.300			0.300	0.4	1.2	0.3	0.1	0.1	0.3	0.2	<0.2	<0.2	<0.1	<0.1	0.2	0.1	0.1
Lead T-Pb		<0.0001	0.000200					0.000100			<0.0001	0.0002	0.0004	<0.0002	<0.0001	0.0001	0.0001	0.0001	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	0.003	0.0001
Lithium T-Li		0.0020	0.0020					0.0020			0.0020	0.002	<0.002	0.002	0.002	0.002	0.002	0.002	0.002	<0.002	0.002	0.002	0.004	0.09	0.004
Magnesium T-Mg		16.8	20.7					20.1			18.8	20.4	16	19	17.8	18.5	18.8	21.3	20.4	18	20.8	20.8	24.8	24	26.9
Manganese T-Mn		0.0080	0.0430					0.0210			0.0570	0.104	0.079	0.046	0.032	0.036	0.038	0.029	0.03	0.047	0.047	0.073	0.297	0.308	0.399
Mercury T-Hg																								<0.0001	<0.0001
Molybdenum T-Mo		0.00100	0.00200					0.00200			0.00200	0.002	0.005	<0.002	0.002	0.002	0.002	0.002	<0.002	<0.002	0.002	0.002	0.002	0.06	0.002
Nickel T-Ni		0.00100	0.00190					0.00090			0.00110	0.0014	0.0021	0.002	0.0014	0.0015	0.0014	0.0015	0.002	0.0025	0.0012	0.0013	<0.0005	0.03	0.0011
Phosphorous T-P																						0.06		<0.05	
Potassium T-K		1.4	1.6					1.7			1.6	1.8	2.1	1.7	1.4	1.5	1.5	1.7	1.6	1.4	1.4	1.4	1.9	1.8	1.9
Selenium T-Se		<0.0002	<0.0002					<0.0002			0.0003	0.0003	<0.0004	<0.0004	0.0002	0.0004	<0.0002	0.0004	<0.0004	0.0006	<0.0002	<0.0002	0.0002	0.008	0.0004
Silicon T-Si		05.9	06.2					07.0			06.4	6.65	9.38	6.38	6.58	6.3	7.18	6.78	5.96	5.76	6.36	6.56	6.34	6.23	6.72
Silver T-Ag		<0.0001	<0.0001					<0.0001			0.0002	<0.0001	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.002	<0.0001
Sodium T-Na		11.1	12.6					11.6			13.5	13.2	15	13	11.4	11.9	12.2	12.1	13	12	11.6	11.1	15.8	14.9	14.2
Strontium T-Sr		0.382	0.393					0.405			0.391	0.442	0.328	0.314	0.369	0.378	0.409	0.416	0.381	0.382	0.415	0.435	0.607	15.9	0.693
Thallium T-Tl		<0.00005	<0.00005					<0.00005			<0.00005	<0.00005	<0.0001	<0.0001	<0.00005	<0.00005	<0.00005	<0.00005	<0.0001	<0.0001	<0.00005	<0.00005	<0.00005	<0.001	<0.00005
Tin T-Sn		<0.001	<0.001					<0.001			<0.001	<0.001	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.001	<0.001	<0.001	<0.02	<0.001
Titanium T-Ti		0.0012	0.0244					0.0076			0.0062	0.0183	0.0415	<0.0010	0.0031	0.0027	0.0094	0.0078	0.002	0.0049	0.0023	0.0008	0.006	0.052	0.0021
Uranium T-U		0.00130	0.00120					0.00130			0.00160	0.0016	0.0021	<0.001	0.0011	0.0012	0.0013	0.0013	0.001	0.001	0.0012	0.0013	0.0022	0.058	0.0024
Vanadium T-V		0.0005	0.0022					0.0012			0.0013	0.0021	0.0048	0.001	0.0008	0.0007	0.001	0.001	0.0006	0.0009	0.0006	0.0005	0.0009	0.02	0.0007
Zinc T-Zn		0.0020	0.0030					0.0030			0.0020	0.004	0.004	0.005	0.002	0.002	0.003	0.003	0.003	0.002	0.001	0.002	0.003	0.05	0.004
Dissolved Metals (Trace)																									
Aluminum D-Al		<0.005	0.0070					<0.005			0.0170	0.021	0.022	0.009	0.007	<0.005	0.006	0.006	0.009	<0.005	0.007	0.005	<0.005	0.006	<0.005
Antimony D-Sb		<0.0002	<0.0002					<0.0002			<0.0002	<0.0002	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic D-As		0.00040	0.00030					0.00020			0.00050	0.0006	0.0007	0.0004	0.0004	0.0004	0.0003	0.0003	0.0004	0.0005	0.0004	0.0004	0.0004	0.0003	0.0002
Barium D-Ba		0.0700	0.0840					0.0820			0.0860	0.078	0.066	0.082	0.07	0.074	0.071	0.074	0.077	0.071	0.072	0.083	0.078	0.078	0.069
Beryllium D-Be		<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
Bismuth D-Bi		0.0007	<0.0005					<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron D-B		0.004	0.007					<0.002			0.006	0.008	0.01	0.004	0.005	0.005	0.007	0.006	0.004	0.006	0.006	0.007	0.017	0.016	0.02
Cadmium D-Cd		<0.00001	<0.00001					<0.00001			<0.00001	0.00001	0.00002	<0.00001	<0.00001	0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	0.00003	0.00001	<0.00001
Calcium D-Ca		42.6	48.6					51.5			45.7	50.1	56.6	48.1	46.9	51.7	50.6	52.2	51.3	49.4	51.7	54.8	48.4	48.5	51.6
Chromium D-Cr		0.0014	<0.0005					<0.0005			0.0007	0.0011	0.0067	0.0007	0.0016	0.0008	0.002	0.0007	0.0006	0.0006	<0.0005	<0.0005	0.0098	0.0008	0.0014
Cobalt D-Co		<0.0001	<0.0001					<0.0001			0.0002	0.0001	<0.0001	0.0002	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	0.0002	0.0002
Copper D-Cu		0.00400	0.00400					0.00200			0.00300	0.006	0.006	0.003	0.004	0.004	0.003	0.003	0.003	0.002	0.003	0.003	0.001	0.002	0.001
Iron D-Fe		0.020	0.040					0.030			0.080	0.04	0.03	0.04	0.05	0.05	0.05	0.06	0.03	0.06	0.05	0.03	0.06	0.05	<0.01
Lead D-Pb		<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
Lithium D-Li		0.002	0.001					<0.001			0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.004	0.004	0.003
Magnesium D-Mg		18.6	21.2					19.6			11.9	18.8	17.4	20.4	18.1	19.7	20.3	20.9	20	19.3	19.6	19.2	25	25.6	25.6
Manganese D-Mn		0.00500	0.01000					0.01200			0.13500	0.085	0.048	0.041	0.027	0.03	0.018	0.021	0.032	0.038	0.046	0.069	0.27	0.307	0.334
Mercury D-Hg																									
Molybdenum D-Mo		0.00200	0.00100					<0.001			0.00100	0.002	0.006	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.002	0.002	0.002
Nickel D-Ni		<0.0005	<0.0005					<0.0005			0.00080	0.0007	0.0007	0.0009	0.0007	0.001	0.0008	<0.0005	<0.0005	0.0006	0.0006	0.001	<0.0005	0.0025	0.0009
Phosphorus D-P																	1.6					0.06			
Potassium D-K		1.5	1.6					1.7			2.1	1.7	2.1	1.5	1.4	1.6		1.6	1.6	1.6	1.4	1.4	1.7	1.8	1.9
Selenium D-Se		<0.0002	<0.0002					<0.0002			<0.0002	<0.0002	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0004	<0.0002	0.0004	<0.0002	0.0006
Silicon D-Si		5.86	6.88					6.02			4.57	6.02	7.44	6.7	6.15	6.44	6.02	6.4	6.49	6.2	6.37	6.33	6.48	6.31	6.36
Silver D-Ag		<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
Sodium D-Na		11.0						13.0			13.6	13.3	16.1	12.2	11.4	12.7	13.4	12.1	13.2	12.7	12.6	11.9	14	13.9	15.4
Strontium D-Sr		0.408	0.294					0.301			0.284	0.389	0.35	0.31	0.322	0.4	0.372	0.379	0.401	0.384	0.392	0.424	0.574	0.654	0.634
Thallium D-Tl		<0.00005	<0.00005					<0.00005			<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin D-Sn		<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
Titanium D-Ti		0.001	0.001					0.0007			0.0018	0.0016	<0.0005	<0.0005	<0.0005	0.001	0.0012	<0.0005	0.0011	0.0012	0.0018	0.0009	0.0012	0.0013	0.0013
Uranium D-U		0.000800	0.001100					0.001000			0.002100	0.0018	0.0022	0.0009	0.0011	0.0011	0.0012	0.0013	0.0011	0.0011	0.0011	0.0012	0.0019	0.0022	0.0016
Vanadium D-V		0.002	0.0013					0.0007			0.0022	0.0021	0.0024	0.002	0.0018	0.0018	0.0016	0.0019	0.0006	0.0012	0.001	0.0011	0.0031	0.0007	0.0029
Zinc D-Zn		<0.001	<0.001					0.0010			0.0020	0.003	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.001	0.002	0.002	<0.001	0.005	0.002
Organic Parameters																									
Dissolved Organic Carbon C		7.9000	8.7000					8.7000			9.2000	8.7	8.4		8.2	8	8.4	7.5	7.4	8	7.7	8.3	4.1	5.2	8
Total Inorganic Carbon C		42.9000	45.3000					43.2000			44.6000	46	43.2	44	43.8	45	44	45.7	44.2	43.5	46.1	37.3	54.6	54.3	56
Total Organic Carbon C		8.9000	9.6000					8.6000			9.4000	8.5	9.9	9	8.4	9.1	8.3	7.8	8.1	7.9	8	7.8	4.3	5.1	7
Radiological Parameters																									
Radium-226		<0.005	<0.005					<0.005			<0.005	<0.005	<0.0050	<0.005	0.01	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.02	<0.0050	0.009	<0.0050	<0.0050
Toxicity Testing'																									
96 HourTrout LTSO Bioassay (hrs)		> 96	> 96					> 96			> 96	> 96	> 96	> 96	> 96	> 96	> 96	> 96	> 96	invalid	> 96	> 96	> 96	> 96	> 96
Percent Survival		100	100					100			100	100	100	100	100	100	90	100	90		100	100	100	100	100
Designation		Non-Toxic	Non-Toxic					Non-Toxic			Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic		Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic
48 Hour Daphnia magna LTSO (hrs)		> 48	> 48					> 48			> 48	> 48	> 48	> 48	> 48	> 48	> 48	> 48	> 48	> 48	> 48	> 48	> 48	> 48	> 48
Percent Survival		100	100					100			97	100	100	100	100	93	100	100	100	100	100	97	100	90	97
Designation		Non-Toxic	Non-Toxic					Non-Toxic			Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic	Non-Toxic

Notes:

[1] All units are in mg/L unless otherwise indicated

[2] Detection limit from October 2005 results except Mercury which is from

[3] Range is based on an average pH of 8.0 and a temperature range of 0 t

* Based on guideline for Hexavalent chromium (Cr(VI))

Sample ID																						Detection Limit[2]	Water Use License Standards	MMER Maximum Authorized Concentration in a Grab Sample
Sample Site Description																								
Date Sampled	**16-Nov-06**	**23-Nov-06**	**30-Nov-06**	**06-Dec-07**	**13-Dec-07**	**20-Dec-06**	**28-Dec-06**	**04-Jan-07**	**10-Jan-06**	**16-Jan-07**	**30-Jan-07**	**17-Apr-07**	**27-Apr-07**	**04-May-07**	**11-May-07**	**19-May-07**	**25-May-07**	**30-May-07**	**05-Jun-07**	**13-Jun-07**	**20-Jun-07**			
Sampled by	SVB	JG	SVB	JG	SVB	JG	SVB	JG	SVB	JG	SVB	JG	SVB	JG	SVB	JG	SVB	SVB	SVB	JG	JG			
Parameter [1]																								
Physical Tests																								
Electrical Conductivity (Lab) (µs/cm)	518	480	480	478	469	485	460	463	482	477	478	461	313	264	317	352	314	341	330	316	346	2.0		
Electrical Conductivity (Field) (µs/cm)	495		499	491	481		481	447	364		479	490	542	309	360	384	350	378	354	365	356			
Total Dissolved Solids	324	320	296	240	320	308	308	298	288	294	300	332	274	252	280	250	236	260	238	232	244	10		
Hardness	267	244	230	238	229	223	236	233		235	233	246	167	142	167	173	167	168	168	174	178	0.54		
pH (Lab)	7.22	8.29	7.45	8.15	8.28	7.46	7.5	7.63	8.36	7.44	8.25	7.91	7.92	7.97	7.91	7.8	7.91	7.89	7.88	7.91	7.75	0.010	6.5 to 9.0 pH units	
pH (Field)	7.01	7.94	7.48	6.85	8.29	7.94	8.11	7.57	6.62		7.30	7.45	7.35	7.85	7.27	7.42	7.49	7.41	7.70	7.63	7.41			
Total Suspended Solids (Lab)	<2	<2	20	5	33	3	14	18	4	<2	14	24	2	6	<2	10	34	13	9	6	6	3.0	15 mg/L	30.00 mg/L
Total Suspended Solids (Field)	1	1	1	0	1	0	2	1		1		14	12	3	9	10		13		8	13			
Tempurature (field) (C)	1.2		1.4	1.2	1.7		1.8	1.1	0.1		0.5	-0.1	0.7	0	0.5	0.7	3.3	6.1	5.4	6.7	14.2			
Turbidity	0.9	0.6	3.2	1.5	4.4	1.2	25	2.2	1.2	0.5	3.1	27	1.4	3.9	1.7	8.1	5	9.3	14	4.8	2.4			
Dissolved Anions																								
Alkalinity-Total CaCO3	248	202	215	204	208	210	206	193	204	212	207	203	130	106	118	128	127	126	128	144	147	2.0		
Bromide Br																								
Chloride Cl	1.46			1.13	1.28	1.5	1.9	2.18	2.39	2.3	2.47	4	2.5	1.7	1.9	2	1.8	1.7	1.9	1.9	1.7	0.50		
Fluoride F																								
Sulphate SO4	40	46	44	41	42	42	43	43	42	42	41	48	31	22.1	25.9	27.4	25	25	26	26	26	0.50		
Nutrients																								
Ammonia Nitrogen N	0.1	0.032	<0.05	0.017	<0.002	0.002	<0.002	<0.05	<0.05	0.011	0.005	<0.05	<0.05	0.07	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	0.020	1.0 mg/l	
Nitrate Nitrogen N	0.03	0.31	0.39	0.37	0.46	0.5	0.5	0.56	0.59	0.61	0.63	0.2	1.6	2.9	4	4.5	4.6	4.8	5.2	4.8	4.4	0.0050		
Nitrite Nitrogen N	<0.03		<0.005	<0.03	<0.1	<0.1	<0.1	<0.03	<0.03	<0.03	0.17	<0.05	<0.05	0.16	0.19	0.06	<0.05	<0.05	0.08	<0.05	<0.05	0.0010		
ortho-Phosphate	0.09		0.08	<0.01	0.06		0.014	0.015	0.06		<0.01	0.05	0.03	0.05	0.04	0.05	0.02	0.04	0.05	0.05	0.04			
Total Dissolved Phosphate												0.09							<0.02					
Total Phosphorous	0.06			<0.02	0.03	<0.02	0.02		<0.05	<0.05	0.03	<0.02	0.14	0.09	0.75	0.07	0.06	<0.05	<0.05	<0.05	<0.05			
Cyanides																								
Total Cyanide CN	0.14	0.002	0.006	0.002																		0.0050		2.00 mg/L
Total Metals (Trace)																								
Aluminum T-Al	0.008	0.064	0.505	0.213	0.516	0.13	0.49	0.562	0.226	0.063	0.658	1.46	0.212	0.31	0.17	0.485	1.14	0.708	0.62	0.36	0.579	0.0010	0.5 mg/L	
Antimony T-Sb	<0.0002	<0.0004	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0004	<0.0004	<0.0004	<0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00010		
Arsenic T-As	0.0002	<0.0004	0.0006	0.0004	0.0003	0.0006	0.0004	0.0004	<0.0002	0.0003	0.0003	0.0012	0.0005	0.0008	0.0009	0.0007	0.0005	0.0006	0.0007	0.0004	0.0006	0.00010		1.00 mg/L
Barium T-Ba	0.052	0.074	0.069	0.061	0.064	0.062	0.071	0.08	0.067	0.063	0.076	0.104	0.071	0.064	0.064	0.079	0.084	0.085	0.08	0.075	0.076	0.000050		
Beryllium T-Be	<0.0001	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00050		
Bismuth T-Bi	<0.0005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	<0.0005	<0.0005	0.0006	<0.0005	<0.001	<0.001	<0.001	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00050		
Boron T-B	0.007	0.02	0.022	0.017	0.02	0.017	0.019	0.017	0.015	0.02	0.02	0.016	0.009	0.058	0.075	0.01	0.017	0.013	0.014	0.016	0.016	0.010		
Cadmium T-Cd	<0.00001	<0.00002	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	<0.00001	0.00001	0.00001	<0.00001	0.00003	0.00003	0.00003	<0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.000050		
Calcium T-Ca	64.4	52.1	51.5	50.9	50.2	47.9	51.6	52.9	50.5	49.9	50.2	60.6	45.1	38.9	43.9	48.4	44.8	45.7	46	45.6	49.1	0.050		
Chromium T-Cr	<0.0005	<0.001	0.002	0.0007	0.0011	<0.0005	0.0005	0.0008	0.0006	<0.0005	<0.0005	0.0016	0.001	0.001	0.001	<0.001	0.0021	0.0014	0.0006	0.001	0.0012	0.00050		
Cobalt T-Co	0.0005	<0.0002	0.0012	0.0002	0.0002	<0.0001	0.0002	0.0003	<0.0001	<0.0001	0.0003	0.0009	0.0003	0.0004	0.0004	0.0006	0.0009	0.0007	0.0006	0.0004	0.0006	0.00010		
Copper T-Cu (Lab)	0.001	0.004	0.005	0.002	0.003	0.002	0.002	0.002	0.002	0.001	0.002	0.016	0.01	0.02	0.02	0.02	0.02	0.014	0.014	0.018	0.015	0.00010	0.01 mg/L	0.60 mg/L
Copper (On Site Hach)	0.0016	<0.0005	0.0014	<0.0005	0.0012					0.0013		0.0021								<0.001	<0.001			
Iron T-Fe	0.3	<0.2	0.7	0.3	0.6	0.2	0.6	0.6	0.3	<0.1	0.8	1.8	0.2	0.4	0.2	0.7	1.4	0.8	0.7	0.4	0.6	0.030	1.0 mg/L	
Lead T-Pb	<0.0001	0.0007	0.0031	0.0003	0.0003	<0.0001	0.0002	0.0002	0.0003	0.0002	0.0004	0.0004	<0.0002	<0.0002	<0.0002	0.0003	0.0004	0.0002	0.0003	0.0002	0.0002	0.000050	0.002 mg/L	0.40 mg/L
Lithium T-Li	0.002	0.004	0.004	0.004	0.004	0.003	0.004	0.004	0.004	0.004	0.005	0.002	<0.002	<0.002	<0.002	<0.002	0.002	0.002	0.002	0.002	0.002	0.0050		
Magnesium T-Mg	29.2	26.7	27.7	26.8	27.4	25.3	27.4	28	27.4	26.8	26.2	23.6	12	11	13	15	13	13.2	12.8	13.4	13.3	0.10		
Manganese T-Mn	2.26	0.14	0.021	0.018	0.023	0.012	0.027	0.024	0.013	0.012	0.02	0.692	0.054	0.057	0.062	0.11	0.088	0.06	0.062	0.038	0.048	0.000050	0.2 mg/L	
Mercury T-Hg		<0.00005	<0.00005	<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	0.000020		
Molybdenum T-Mo	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.002	0.003	0.002	0.002	0.002	0.003	0.002	0.003	0.000050		
Nickel T-Ni	0.0014	0.0023	0.0016	0.0015	0.0014	0.0007	<0.0005	0.0012	0.0007	<0.0005	0.0013	0.0023	0.002	0.0022	<0.001	0.0023	0.001	0.0016	0.0016	0.0008	0.0022	0.00050	0.065 mg/L	1.00 mg/L
Phosphorous T-P	0.06		<0.05		<0.01	<0.02	0.02	0.02	<0.05		0.03		0.14		0.75	0.07	0.06	<0.05	<0.05	<0.05	<0.05	0.30		
Potassium T-K	2	2	2.1	2.2	2	2	2.4	2.2	2	1.9	2	3	2.4	2.4	2.1	2	2.1	1.9	2	2	1.9	2.0		
Selenium T-Se	<0.0002	0.0005	0.0007	0.0003	0.0006	0.0003	0.0006	0.0006	<0.0002	<0.0002	0.0007	<0.0002	0.0007	0.001	<0.0004	<0.0004	0.0003	<0.0002	<0.0002	0.0003	0.0003	0.0010		
Silicon T-Si	7.4	6.45	7.58	7.12	6.2	5.92	7.82	8.18	6.75	6.65	6.56	10.1	5.46	5.74	5.17	6.4	7.16	6.76	6.26	6.08	6.64	0.050		
Silver T-Ag	<0.0001	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.000010		
Sodium T-Na	14	15	14.8	15.5	15.1	14.1	15.2	15.5	14.6	14.5	14.7	14.1	8.9	7.7	7.8	8.3	8.9	9.4	9.1	9.4	9	2.0		
Strontium T-Sr	0.345	0.689	0.728	0.654	0.711	0.663	0.753	0.768	0.673	0.642	0.823	0.459	0.308	0.236	0.301	0.323	0.344	0.324	0.348	0.355	0.355	0.00010		
Thallium T-Tl	<0.00005	<0.0001	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.0001	<0.0001	<0.0001	<0.0001	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00010		
Tin T-Sn	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.00010		
Titanium T-Ti	0.0007	0.0031	0.0377	0.0124	0.0268	0.0071	0.0258	0.0295	0.013	0.004	0.04	0.0264	<0.001	0.002	0.0071	0.019	0.0568	0.0365	0.0305	0.0155	0.0307	0.010		
Uranium T-U	0.0013	0.0025	0.0027	0.0025	0.0027	0.0024	0.0026	0.0027	0.0024	0.0024	0.0027	0.0014	0.0024	0.002	0.0023	0.002	0.0016	0.0015	0.0017	0.0018	0.002	0.000010		
Vanadium T-V	0.0004	0.0008	0.0021	0.0013	0.0022	0.001	0.0022	0.0025	0.0012	0.0008	0.0026	0.0045	0.001	0.002	0.001	0.0024	0.004	0.0026	0.0028	0.0018	0.0028	0.0010		
Zinc T-Zn	0.002	0.01	0.044	0.008	0.01	0.005	0.005	0.007	0.002	<0.001	0.007	0.007	0.01	0.01	0.007	0.02	0.009	0.008	0.006	0.007	0.005	0.0010	0.03 mg/L	1.00 mg/L
Dissolved Metals (Trace)																								
Aluminum D-Al	0.006	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	0.026	0.041	0.045	0.026	0.009	0.017	0.009	0.005	0.014	0.013	0.0010		
Antimony D-Sb	<0.0002	<0.0002	<0.0002	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00010		
Arsenic D-As	0.0006	0.0003	0.0003	0.0004	0.0004	0.0003	0.0003	0.0003	<0.0002		0.0005	0.0011	0.0005	0.0007	0.0005	0.0007	0.0004	0.0004	0.0006	0.0004	0.0006	0.00010		
Barium D-Ba	0.095	0.075	0.056	0.056	0.058	0.056	0.058	0.06	0.062		0.064	0.092	0.066	0.058	0.061	0.069	0.064	0.071	0.069	0.066	0.069	0.000050		
Beryllium D-Be	<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	<0.0001	<0.0001	0.00050		
Bismuth D-Bi	<0.0005	<0.0005	<0.0005	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00050		
Boron D-B	0.011	0.018	0.019	0.022	0.018	0.017	0.021	0.016	0.017		0.019	0.014	0.007	0.009	0.013	0.012	0.014	0.01	0.013	0.012	0.017	0.010		
Cadmium D-Cd	0.00002	0.00003	0.00005	0.00004	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001		<0.00001	0.00001	0.00002	0.00003	<0.00001	0.00001	<0.00001	<0.00001	0.00001	0.00001	<0.00001	0.000050		
Calcium D-Ca	63.1	53.3	49.3	50.9	47.6	47	50.2	48.8	51		49.3	59.3	46.1	38.6	45.7	45.8	45.1	43.9	47	47	49.1	0.050		
Chromium D-Cr	0.0009	0.0014	0.0014	0.0018	0.0006	0.0012	0.0005	<0.0005	0.0008		0.0008	0.0008	0.0005	0.0009	0.0008	0.0008	0.001	0.0012	0.0011	0.0008	0.0008	0.00050		
Cobalt D-Co	0.0008	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	0.0006	0.0002	0.0002	0.0003	0.0004	0.0003	0.0003	0.0003	0.0003	0.0003	0.00010		
Copper D-Cu	0.002	0.003	0.004	0.003	0.001	<0.001	<0.001	<0.001	<0.001		<0.001	0.008	0.007	0.014	0.018	0.016	0.014	0.012	0.012	0.014	0.014	0.00010		
Iron D-Fe	0.29	0.06	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	0.27	0.09	0.08	0.07	0.11	0.05	0.06	0.04	0.04	0.6	0.030		
Lead D-Pb	<0.0001	0.0002	0.0005	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002		0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	0.000050		
Lithium D-Li	0.003	0.003	0.004	0.004	0.003	0.003	0.004	0.004	0.004		0.004	0.002	0.002	0.001	0.002	0.002	0.001	0.001	0.001	0.002	0.002	0.0050		
Magnesium D-Mg	26.5	27	26	26.2	26.8	25.6	26.9	27	26.9		25.9	23.8	12.6	11.1	12.9	14.2	13.1	12.7	13.4	13.8	13.3	0.10		
Manganese D-Mn	2.16	0.136	0.006	0.006	0.008	0.007	0.016	0.007	0.008		0.006	0.785	0.05	0.048	0.057	0.094	0.058	0.05	0.05	0.031	0.048	0.000050		
Mercury D-Hg		<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	0.000020		
Molybdenum D-Mo	0.003	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.002		0.002	0.001	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.003	0.000050		
Nickel D-Ni	0.0008	<0.0005	<0.0005	0.0005	0.0006	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	0.0014	0.0015	0.0011	0.0006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0009	0.00050		
Phosphorus D-P					<0.02	<0.02	<0.02	<0.02	<0.02		<0.02		0.1				<0.02		1.9	<0.02	<0.05	0.30		
Potassium D-K	1.7	2	2	2	1.9	1.9	1.5	2	2		2	2.8	2.6	2.2	2.2	2	1.9	1.9	0.0004	1.9	1.9	2.0		
Selenium D-Se	<0.0002	0.0004	0.0004	0.0004	<0.0002	0.0004	0.0006	0.0004	<0.0002		0.0005	<0.0002	<0.0002	<0.0002	<0.0002	0.0003	<0.0002	<0.0002	5.26	<0.0002	<0.0002	0.0010		
Silicon D-Si	6.98	6.44	6.34	6.49	6.53	6.3	6.36	6.58	6.7		6.5	6.55	5.24	5.2	5.57	5.69	5.22	5.11	<0.0001	5.38	5.27	0.050		
Silver D-Ag	<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	9.7	0.0001	<0.0001	0.000010		
Sodium D-Na	15.3	16.3	15.9	15.8	15.2	14.2	16.6	14.7	15.1		15.9	14.1	9.6	7.2	8.3	8.6	8.9	9.6	0.325	9.7	9	2.0		
Strontium D-Sr	0.566	0.584	0.652	0.638	0.661	0.656	0.659	0.661	0.646		0.78	0.432	0.287	0.238	0.299	0.315	0.324	0.314	9	0.333	0.368	0.00010		
Thallium D-Tl	<0.00005	<0.00005	<0.00005	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00010		
Tin D-Sn	<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	<0.001	<0.001	0.00010		
Titanium D-Ti	0.0012	0.0012	0.0012	0.0021	0.0019	0.0012	0.0018	0.0014	0.0014		0.0014	0.0034	<0.0005	0.002	0.0017	0.0015	0.0015	0.0018	0.0018	0.0018	0.0014	0.010		
Uranium D-U	0.0024	0.0026	0.0022	0.0016	0.0023	0.0023	0.0022	0.0024	0.0023		0.0024	0.0013	0.0024	0.0021	0.0022	0.0018	0.0014	0.0014	0.0016	0.0016	0.0018	0.000010		
Vanadium D-V	0.0034	0.0031	0.0026	0.0053	0.0015	0.0022	0.0012	0.0007	0.0019		0.0024	0.0025	0.001	0.001	0.0014	0.0017	0.0021	0.0018	0.0022	0.0018	0.0024	0.0010		
Zinc D-Zn	0.002	0.002	0.005	0.004	0.012	0.003	0.001	0.006	0.001		<0.001	0.003	0.004	0.003	0.005	0.003	0.002	0.003	0.003	0.002	0.004	0.0010		
Organic Parameters																								
Dissolved Organic Carbon C	12.6	3.2	2.4	2.9	1.9	2.4	2.2	2.8	2.4		2.1	14.1	25.6			18.3				17.2		0.5		
Total Inorganic Carbon C	65.2	57.2	55.6	50	55.2	55.3	3	52.2	49.3	46.4	49.6											0.5		
Total Organic Carbon C	11	3.1	2.6	5.5	2.3	2	20	2.8	3.1		2.2											0.5		
Radiological Parameters																								
Radium-226	<0.0050	0.006	<0.005	<0.006	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005		0.0050		1.11 Bq/L
Toxicity Testing'																								
96 HourTrout LTSO Bioassay (hrs)	> 96	> 96			> 96							> 96				> 96			> 96				100%	
Percent Survival	100	100			100							100				90			90				(pH non-adjusted)	
Designation	Non-Toxic	Non-Toxic			Non-Toxic							Non-Toxic				Non-Toxic			Non-Toxic					
48 Hour Daphnia magna LTSO (hrs)	> 48	> 48			> 48							> 48				> 48			> 48					
Percent Survival	97	97			100							100				97			100					
Designation	Non-Toxic	Non-Toxic			Non-Toxic							Non-Toxic				Non-Toxic			Non-Toxic					

Notes:

[1] All units are in mg/L unless otherwise indicated

[2] Detection limit from October 2005 results except Mercury which is from

[3] Range is based on an average pH of 8.0 and a temperature range of 0 t

* Based on guideline for Hexavalent chromium (Cr(VI))

Minto Explorations Ltd.

Minto Project, Yukon

Environmental Effects Monitoring

FIRST STUDY DESIGN

Appendix B

Water Quality Data

(Stations W2, W4, W5 and W7)

Sample ID																							
Sample Site Description																							
Date Sampled	30-Sep-93	15-May-94	07-Jun-94	08-Jul-94	10-Aug-94	26-Sep-94	15-Jun-95	25-Jul-95	20-Sep-95	20-May-96	16-Jul-96	09-Sep-96	15-Oct-96	01-May-97	01-Aug-97	02-May-98	09-Aug-98	26-Aug-99	13-Oct-99	06-May-00	11-May-01	29-Jul-02	24-Aug-03	29-Jul-04
Sampled by																							
Parameter [1]																							
Physical Tests																							
Electrical Conductivity (Lab) (µs/cm)	197	94	175	173	270	205		184	136	210						127	247	225	220	61	100	181	200	243
Electrical Conductivity (Field) (µs/cm)																								
Total Dissolved Solids	137	67	123	117	183	128		125	127	162	138	144	186	115	157	100	179	174	161	117	99	220	153	180
Hardness	106	51.2	88.5	86.1	130	98.5		90.3	72.1	107			95.5	71.6	147.2	65.5	145	107		32	48.3	101	101	16
pH (Lab)	7.63	7.37	7.63	8.2	7.97	7.84		7.83	7.66	8.3	7.7	7.8	8.1	7.3	7.8	7.64	7.7	8.04	7.75	6.95	7	7.79	7.93	7.6
pH (Field)																								
Total Suspended Solids (Lab)	17	154	19	48	3	11		18	55	6	204	55	12	300	657	150	1	1	31	126	62	134	169	535
Total Suspended Solids (Field)																								
Tempurature (field) (˚C)																								
Turbidity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Anions																								
Alkalinity-Total CaCO3	93.7	41	79.8	80.9	132	91.9		89.8	72.5	105	59	64	81	30	70	54	123	112	97	25	46	82	96	114
Bromide Br																								
Chloride Cl	1	1.7	0.9	1.1	1.2	0.5		3.4	1.7	0.6	0.7	0.7	1											
Fluoride F																								
Sulphate SO4	13.4	7.9	14.2	12.8	20.1	13.8		12.5	9.9	16	7	5	10	4	6.3			11.7		2.9	3.6	9.78	10.6	12
Nutrients																								
Ammonia Nitrogen N	<0.005	<0.005	0.015	0.006	<0.005	<0.005		<0.005	<0.005										<.001					
Nitrate Nitrogen N	0.048	0.008	0.08	0.039	0.026	<0.005		0.009	0.045	0.05	0.05	0.2	0.05	0.1	0.31			<0.05	0.25	0.012	<0.05	0.037	0.073	0.09
Nitrite Nitrogen N	<0.001	0.005	0.004	0.004	0.002	0.002		0.003	0.004	0.025	0.0015	0.0015	0.0015	<0.5	<0.05			<0.05		<0.002	<0.5	0.001	0.007	<0.1
ortho-Phosphate	0.007	0.007	0.003	-	-	-	-	-	-															
Total Dissolved Phosphate	0.013	0.011	0.009	-	-	-	-	-	-															
Total Phosphorous	0.022	0.026	0.017	-	-	-	-	-	-															
Cyanides																								
Total Cyanide CN	0.018	0.01	0.02	0.006	0.011	0.011	0.006	0.018	<0.001															
Total Metals (Trace)																								
Aluminum T-Al	0.31	4.37	0.315	0.555	0.037	0.098	0.084	1.3	0.508	0.15	3.8	0.24	0.1	5.4	12.1	0.8	<0.2	0.141	0.35	1.95	1.29	2.32	0.052	22.8
Antimony T-Sb	0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01	0.01	0.01	0.01	<0.02	<0.02	<0.2	<0.2	<0.005	<0.02	<0.0003	<0.0003	0.0002	<0.0002	<0.002
Arsenic T-As	0.0004	0.0024	0.0005	0.0013	0.0003	0.0003	0.0003	0.001	0.0008	0.01	0.01	0.01	0.01	<0.02	<0.02	<0.2	<0.2	<0.01	<0.02	0.0018	0.001	0.0018	0.0007	0.0064
Barium T-Ba	0.052	0.134	0.054	0.061	0.064	0.042	0.058	0.053	0.051	0.0507	0.119	0.0545	0.0478	0.13	0.0412	0.06	0.06	0.05	0.0546	0.0613	0.048	0.12	0.057	0.431
Beryllium T-Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0001	0.0001	0.0001	0.0001	<0.0002	0.0015	<0.005	<0.005	<0.00001	<0.0002	0.00007	0.00004	<0.0001	<0.0001	<0.001
Bismuth T-Bi	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.01	0.01	0.01	0.01	<0.02	<0.02	<0.1	<0.1	<0.0004	<0.02	<0.0004	<0.0008	<0.0005	<0.0005	<0.005
Boron T-B	<0.10	0.39	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10							<0.1	<0.1	<0.002	0.04	0.01	0.018	0.052	0.006	0.12
Cadmium T-Cd	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00025	0.00025	0.00025	0.00025	<0.0005	0.0006	<0.001	<0.001	<0.00006	<0.0005	0.00013	<0.0001	0.0002	0.00001	0.00052
Calcium T-Ca	27.8	16.4	22.4	22.5	33.7	25.8	32.5	23.8	20.4	26.4	19.9	23.4	25.7	15.7	35.7	16.3	34.7	27.6	27.7	10.7	12.6	26	25.9	41.1
Chromium T-Cr	0.001	0.011	<0.001	0.02	<0.001	<0.001	<0.001	0.001	0.001	0.0005	0.008	0.001	0.001	0.01	0.025	<0.01	<0.01	0.0049	<0.001	0.00503	0.00264	0.0051	<0.0005	0.038
Cobalt T-Co	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.003	0.0005	0.0005	0.005	0.012	<0.01	<0.01	0.00019	<0.001	0.00196	0.00102	0.0022	0.0002	0.0164
Copper T-Cu (Lab)	0.004	0.03	0.004	0.005	0.002	0.003	0.003	0.005	0.004	0.004	0.021	0.008	0.01	0.027	0.07	<0.01	<0.01	<0.00003	0.012	0.0151	0.00852	0.013	0.004	0.033
Copper (On Site Hach)																								
Iron T-Fe	0.881	7.53	0.743	1.37	0.082	0.399	0.087	0.476	0.85	0.286	7.19	0.682	0.392	8.11	22	1.49	0.17	0.232	0.73	3.92	2.68	5.17	0.4	26.2
Lead T-Pb	<0.001	0.003	<0.001	0.008	<0.001	<0.001	<0.001	<0.001	<0.001	0.0025	0.0025	0.0025	0.0025	<0.005	<0.005	<0.05	<0.05	<0.0003	<0.005	0.0015	0.0009	0.0014	<0.0001	0.0086
Lithium T-Li														0.00	0.01	<0.01	<0.01		0.003					
Magnesium T-Mg	9.2	6.04	7.9	7.26	11.2	8.25	11.1	7.62	5.76	10.1	6.6	6.41	7.61	5.44	14.1	6	11.3	9.23	8.56	3.63	3.97	8.85	8.4	15
Manganese T-Mn	0.035	0.254	0.029	0.042	0.019	0.017	0.011	0.076	0.049	0.0155	0.199	0.0396	0.0186	0.248	0.635	0.088	0.034	0.0119	0.0502	0.137	0.0768	0.195	0.038	0.668
Mercury T-Hg	0.00001	0.00002	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00003	<0.00001														0.0001	<0.0002
Molybdenum T-Mo	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.005	<0.001	<0.001	0.0025	0.0025	0.0025	0.0025	<0.005	<0.005	<0.05	<0.03	0.00116	<0.005	0.0004	0.00042	0.001	<0.0002	<0.01
Nickel T-Ni	0.002	0.017	0.003	<0.001	0.001	0.001	<0.001	<0.001	0.003	0.001	0.01	0.004	0.003	0.014	0.041	<0.05	<0.05	0.0037	0.002	0.007	0.0039	0.0044	0.0013	0.036
Phosphorous T-P																								0.06
Potassium T-K																			1					
Selenium T-Se	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.01	0.01	0.01	0.01	<0.02	<0.02	<0.2	<0.2	<0.004	<0.02	0.0003	<0.0002	<0.0002	<0.0002	<0.002
Silicon T-Si														12.4	25.6				6.39					
Silver T-Ag	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0005	0.0005	0.0005	0.0005	<0.001	<0.001	<0.01	<0.01	<0.0005	<0.001	0.00007	0.00056	<0.0001	<0.0001	<0.001
Sodium T-Na																			5.46					
Strontium T-Sr	0.205	0.121	0.18	0.166	0.3	0.193	0.289	0.205	0.143	0.22	0.146	0.146	0.188	0.1	0.223	0.129	0.321	0.248	0.219	0.0647	0.0915	0.234	0.219	0.314
Thallium T-Tl																			<0.003					
Tin T-Sn																<0.03	<0.03		<0.005					
Titanium T-Ti																0.030	<0.01		0.01300					
Uranium T-U	0.00036	0.00039	0.00034	0.00026	0.00071	0.00046	0.00095	0.0005	0.00029	0.03	0.03	0.03	0.03	<0.06	<0.06				<0.06			0.0006	0.0006	<0.005
Vanadium T-V	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.002	0.014	0.007	0.006	0.02	0.05	<0.030	<0.030	0.00099	0.003	0.0072	0.0046	0.007	0.0018	0.062
Zinc T-Zn	<0.005	0.024	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.004	0.02	0.005	0.009	0.027	0.086	0.013	<0.005	0.0022	0.003	0.022	0.0212	0.014	0.006	0.125
Dissolved Metals (Trace)																								
Aluminum D-Al	0.034	0.063	0.033	0.042	0.019	0.02	0.019	0.029	0.049	0.005	0.05	0.06	0.03	0.07	0.05			0.0249	0.02	0.39	0.2	0.032	0.056	0.037
Antimony D-Sb	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01	0.01	0.01	0.01	<0.02	<0.02			<0.005	<0.02	<0.0003	<0.0003	<0.0002	<0.0002	<0.0002
Arsenic D-As	0.0004	0.0004	0.0004	0.0004	0.0003	0.0003	0.0003	0.0003	0.0004	0.01	0.01	0.01	0.01	<0.02	<0.02			<0.01	<0.02	<0.0002	0.0004	0.0008	0.0008	0.0007
Barium D-Ba	0.043	0.035	0.046	0.045	0.063	0.042	0.059	0.044	0.04	0.0486	0.0381	0.0362	0.0407	0.0283	0.328			0.0492	0.0448	0.0213	0.0306	0.051	0.057	0.069
Beryllium D-Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0001	0.0001	0.0001	0.0001	<0.0002	0.0004			<0.00001	<0.0002	0.00001	0.00001	<0.0001	<0.0001	<0.0001
Bismuth D-Bi	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.01	0.01	0.01	0.01	<0.02	<0.02			0.0007	<0.02	0.0012	0.0013	<0.0005	<0.0005	<0.0005
Boron D-B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10									0.019	0.01	<0.002	0.007	0.009	0.006	0.008
Cadmium D-Cd	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00025	0.00025	0.00025	0.00025	<0.0005	<0.0005			<0.00006	<0.0005	0.00006	<0.00006	<0.00001	<0.00001	<0.00001
Calcium D-Ca	27.5	13.1	22.4	22.5	33.7	25.8	32.4	23.8	19.7	26.3	16.9	19.8	22.6	10.9	20.3			27.8	27.5	8.6	12.8	26	26	41.1
Chromium D-Cr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.0005	0.0005	<0.001	<0.001			0.00049	<0.001	0.00094	0.00037	0.0009	0.0008	0.0011
Cobalt D-Co	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.0005	0.0005	<0.001	0.001			<0.00003	<0.001	0.00023	0.00049	0.0001	0.0001	0.0003
Copper D-Cu	0.003	0.006	0.004	0.005	0.002	0.003	0.003	0.003	0.003	0.0001	0.006	0.004	0.005	0.006	0.005			0.00296	0.003	0.00457	0.00487	0.004	0.004	0.002
Iron D-Fe	0.397	0.531	0.366	0.393	0.063	0.286	0.032	0.118	0.249	0.64	0.301	0.231	0.185	0.338	0.416			0.136	0.139	0.305	0.283	5.17	0.38	26.2
Lead D-Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0025	0.0025	0.0025	0.0025	<0.005	<0.005			<0.0003	<0.005	<0.0003	<0.0003	<0.0001	0.0001	<0.0001
Lithium D-Li																			0.002					
Magnesium D-Mg	9.06	4.15	7.9	7.26	11.2	8.25	11.1	7.62	5.56	9.94	4.78	5.38	6.58	2.78	5.65			9.08	8.44	2.53	3.97	8.85	8.7	15
Manganese D-Mn	0.009	0.041	<0.005	0.007	0.019	0.01	0.006	0.012	0.021	0.0054	0.0176	0.0161	0.0112	0.0323	0.0817			0.00772	0.0087	0.0307	0.0436	0.195	0.006	0.668
Mercury D-Hg																								
Molybdenum D-Mo	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0025	0.0025	0.0025	0.0025	<0.005	<0.005			0.00099	<0.005	0.00025	0.00052	<0.001	<0.001	0.001
Nickel D-Ni	<0.001	0.002	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.001	0.004	0.001	0.001	0.003	0.004			0.0015	<0.002	0.0018	0.0173	0.0012	0.0012	0.0018
Phosphorus D-P														<0.06	0.27									
Potassium D-K	0.72	0.79	0.81	0.67	1.16	0.79	1.37	1.14	0.98	1.8	0.8	0.7	0.7	1.6	0.05			0.9	1	1.9	1.6	1.1	0.9	5.4
Selenium D-Se	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.01	0.01	0.01	0.01	<0.02	<0.02			<0.004	<0.02	<0.0002	<0.0002	0.0002	<0.0002	<0.0002
Silicon D-Si	5.85	3.07	4.9	5.32	5.49	5.64	4.7	5.07	5.98	5.51	5.67	6.87	7.2	3.61	5.48			5.07	5.96			12.5	6.77	9.59
Silver D-Ag	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0005	0.0005	0.0005	0.0005	<0.0001	<0.0001			<0.00005	<0.001	0.00008	<0.00005	<0.0001	<0.0001	<0.0001
Sodium D-Na	5.53	2.46	4.47	4.23	6.83	5.05	7.75	5.02	3.87	7.09	3.66	3.52	4.32	2.05	3.78			5.7	5.46	1.9	2.5	5.7	5.8	9
Strontium D-Sr	0.202	0.096	0.18	0.166	0.3	0.193	0.288	0.205	0.136	0.22	0.126	0.124	0.164					0.242	0.218	0.0491	0.0882	0.209	0.197	0.227
Thallium D-Tl																			<0.003					
Tin D-Sn																			<0.005					
Titanium D-Ti																			<0.001					
Uranium D-U	0.00033	0.00013	0.00032	0.00024	0.00062	0.00035	0.00095	0.00048	0.00024	0.03	0.03	0.03	0.03	<0.06	<0.06				<0.06			<0.0005	<0.0005	0.0009
Vanadium D-V	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.001	0.001	0.005	0.004	<0.002	0.004			0.00079	<0.002	0.00084	0.00114	0.0011	0.0024	0.0019
Zinc D-Zn	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.004	0.002	0.0005	0.009	0.007	0.01			0.0014	0.002	0.007	0.0055	<0.001	0.003	0.001
Organic Parameters																								
Dissolved Organic Carbon C		30.3	21.4																					
Total Inorganic Carbon C																								
Total Organic Carbon C			21.4	20.7	12.3	18.5		16.9	19.6															
Radiological Parameters																								
Radium-226																								

Notes:

[1] All units are in mg/L unless otherwise indicated

[2] Detection limit from October 2005 results except Mercury which is from September 2005 results

[3] Range is based on an average pH of 8.0 and a temperature range of 0 to 10ºC

[4] Based on guideline for Hexavalent chromium (Cr(VI))

Sample ID																							
Sample Site Description																							
Date Sampled	**27-May-05**	**30-Jun-05**	**28-Jul-05**	**30-Aug-05**	**28-Sep-05**	**15-Oct-05**	**05-Apr-06**	**06-Apr-06**	**07-Apr-06**	**08-Apr-06**	**09-Apr-06**	**10-Apr-06**	**11-Apr-06**	**12-Apr-06**	**13-Apr-06**	**14-Apr-06**	**15-Apr-06**	**16-Apr-06**	**17-Apr-06**	**18-Apr-06**	**19-Apr-06**	**20-Apr-06**	**21-Apr-06**	**22-Apr-06**
Sampled by	JG, DG	JG	JG, DC	JG		JG																	
Parameter [1]																							
Physical Tests																							
Electrical Conductivity (Lab) (µs/cm)	198	287	305	268	243	249	173	161	507	519	576	507	471	462	468	465	478	496	602	520	458	442	423	348
Electrical Conductivity (Field) (µs/cm)																								
Total Dissolved Solids	138	190	194	193	170	179	122	158	354	342	394	337	309	293	296	196	303	304	393	334	292	278	281	222
Hardness	99.8		153	138	134	137	-	-	-															
pH (Lab)	8.06	8.17	8.01	8.26	7.90	8.11	8.11	8.10	8.20	8.25	8.34	8.34	8.34	8.23	8.33	8.37	8.38	8.37	8.39	8.20	8.34	8.35	8.33	8.31
pH (Field)							8.1	8.50	N/A	8.10	8.30	8.50	8.50	8.40	8.40	8.4	8.6	8.4	8.5	8.4	8.5	8.5	8.45	8.45
Total Suspended Solids (Lab)	20.5	<3.0	<3.0	3.5	9.0	5.5	120.0	102.0	106.0	4.1	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	22.4	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Suspended Solids (Field)							230.00	265.0	104.0	5.4	10.0	12.0	3.0	2.0	2.0	1	0	8	1	2	0	2	3	3
Tempurature (field) (˚C)																								
Turbidity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Anions																								
Alkalinity-Total CaCO3	89.3	140	146	143	115	120	086	084	239	261	273	245	224	210	218	218	222	235	286	246	222	235	203	165
Bromide Br							<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride Cl	<0.50	1.23	0.66	0.53	0.72	0.88	0.81	0.65	2.60	1.50	1.79	1.57	1.37	1.32	1.32	1.29	1.32	1.48	002	001	001	001	001	001
Fluoride F							0.31	0.33	0.57	0.75	0.80	0.65	0.62	0.587	0.578	0.565	0.569	0.579	0.73	0.64	0.57	0.59	0.55	0.45
Sulphate SO4	12.8	22.1	19.0	12.6	11.6	14.0	02.9	02.9	49.1	43.6	63.1	55.8	47.8	44.4	44.5	44.4	44.9	46.3	58.2	49.3	39.5	38	36.3	27
Nutrients																								
Ammonia Nitrogen N	0.026	<0.020	<0.020	0.029	<0.020	<0.020	0.0067	0.0093	0.006	0.01	0.0133	0.016	0.0087	<0.0050	<0.0050	<0.0050	<0.0050	0.0173	000	-	-	-	-	-
Nitrate Nitrogen N	0.0565	0.0621	0.0124	0.0141	0.0458	0.133	0.0169	0.023	0.1160	0.076	0.0426	0.016	0.0134	0.0088	<0.0050	0.0102	<0.0050	<0.0050	000	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite Nitrogen N	0.0015	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	0.0011	0.0012	0.0012	0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
ortho-Phosphate																								
Total Dissolved Phosphate																								
Total Phosphorous																								
Cyanides																								
Total Cyanide CN		<0.0050	<0.0050	0.0053	0.0106	0.0101			0.0176										0.0102					
Total Metals (Trace)																								
Aluminum T-Al	0.362	0.0111	0.0127	0.0475	0.133	0.0972	5.890	7.2800	1.870	0.1490	0.031	0.0277	0.026	0.0222	0.0249	0.0214	0.0177	0.222	0.017	0.013	0.017	0.025	0.027	0.028
Antimony T-Sb	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	0.00046	0.00052	0.00022	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic T-As	0.00075	0.00045	0.00046	0.00063	0.00069	0.00061	0.00557	0.00632	0.00238	0.00086	0.00076	0.00064	0.00057	0.00053	0.00052	0.00053	0.00053	0.00056	0.00065	0.00061	0.00059	0.00053	0.00054	0.00047
Barium T-Ba	0.058	0.0569	0.0576	0.060	0.057	0.0528	0.143	0.1600	0.131	0.0886	0.097	0.0822	0.076	0.0703	0.0712	0.0709	0.0734	0.0815	0.0951	0.0839	0.0749	0.0748	0.0716	0.0592
Beryllium T-Be	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bismuth T-Bi		<0.00050	<0.00050			<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron T-B	<0.10	<0.010	<0.010	<0.10	<0.10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium T-Cd	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000050	0.000139	0.000167	0.000057	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Calcium T-Ca	24.8	37.5	39.1	35.4	34.3	34.1	31.1	32.3	69.4	66.0	69.7	61.1	56.1	48.6	49.8	49.4	51.1	54.6	70.0	61.7	55.0	52.5	51.0	38.3
Chromium T-Cr	0.0012	<0.00050	<0.00050	<0.0010	<0.0010	0.00059	0.0107	0.01270	0.00383	0.00085	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt T-Co	0.00043	<0.00010	<0.00010	<0.00030	<0.00030	0.00018	0.00385	0.00428	0.00147	0.00018	0.00011	0.00010	<0.00010	<0.00010	0.00010	<0.00010	<0.00010	0.00026	<0.00010	<0.00010	0.00011	0.00012	0.00013	0.00013
Copper T-Cu (Lab)	0.0049	0.00207	0.00245	0.0026	0.0039	0.00404	0.0197	0.02100	0.0084	0.00150	0.0013	0.00126	0.0012	0.00125	0.00146	0.00139	0.00162	0.00453	0.00190	0.00152	0.00146	0.00185	0.00175	0.00184
Copper (On Site Hach)							0.0089	0.00470	0.0160	0.00070	0.0004	0.01300	0.0150	0.0015	0.0015	0.0002	0.0007	0.0011	0.0001	0.001	0.0015	0.0017	0.004	0.018
Iron T-Fe	0.778	0.052	0.079	0.373	0.674	0.436	8.8000	10.400	<0.030	0.206	0.073	0.076	0.069	0.057	0.073	0.054	0.057	0.262	0.085	0.091	0.087	0.104	0.083	0.082
Lead T-Pb	<0.00050	<0.000050	<0.000050	<0.00050	<0.00050	0.000078	0.00333	0.003940	0.00114	0.000088	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000137	<0.000050	<0.000050	<0.000050	0.000060	<0.000050	<0.000050
Lithium T-Li	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0053	0.0059	0.0057	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium T-Mg	8.37	12.5	13.1	11.6	11.0	10.8	10.6	11.0	29.7	28.3	32.5	28.8	26.7	22.2	22.2	22.2	22.3	23.2	31.3	29.0	24.4	23.5	23.0	18.3
Manganese T-Mn	0.0505	0.00785	0.0140	0.0250	0.0543	0.0368	0.1930	0.2100	0.1060	0.0485	0.0447	0.0387	0.0394	0.0410	0.0453	0.0384	0.0431	0.0468	0.0428	0.0369	0.0442	0.0481	0.0490	0.0459
Mercury T-Hg	<0.000020			<0.000020	<0.000020				-															
Molybdenum T-Mo	<0.0010	0.00103	0.00134	0.0011	<0.0010	0.000916	0.00239	0.002260	0.00183	0.001340	0.00149	0.001410	0.00147	0.00152	0.00178	0.00156	0.00157	0.00163	0.00201	0.00164	0.00136	0.00137	0.00125	0.00115
Nickel T-Ni	0.0026	0.00105	0.00107	0.0016	0.0020	0.00164	0.0102	0.01190	0.0044	0.00054	<0.00050	<0.00050	<0.00050	<0.00050	0.00059	<0.00050	0.00052	0.00081	0.00057	<0.00050	0.00051	0.00054	0.00056	0.00058
Phosphorous T-P		<0.30	<0.30			<0.30	0.3300	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium T-K	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	4.4	4.7	<2.0	4.6	4.8	4	3.6	3.6	3.4	3.7	3.7	3.6	4.4	4.1	3.8	3.7	4.0	3.3
Selenium T-Se	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon T-Si	5.48	5.32				5.95	14.3	18.90	5.56	10.80	10.9	9.37	8.56	7.57	7.59	8.20	8.41	8.60	10.80	9.73	8.38	8.08	7.85	6.54
Silver T-Ag	<0.000020	<0.000010	<0.000010	<0.000020	<0.000020	<0.000010	0.00007	0.000092	0.000025	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium T-Na	4.8	8.7	8.7	6.9	6.0	6.0	2.8	3.0	18.6	17.7	22.9	19.3	17.3	15.7	15.6	15.3	15.3	15.5	20.4	17.8	15.1	14.8	14.5	11.2
Strontium T-Sr		0.304	0.338			0.267	0.191	0.190	0.599	0.565	0.601	0.514	0.483	0.461	0.470	0.474	0.497	0.525	0.662	0.587	0.514	0.523	0.488	0.389
Thallium T-Tl	<0.00020	<0.00010	<0.00010	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin T-Sn	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	0.00042	0.00049	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00031	<0.00010	<0.00010	<0.00010	<0.00010
Titanium T-Ti	0.016	<0.010	<0.010	<0.010	<0.010	<0.010	0.266	0.379	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium T-U	0.00054	0.00108	0.00136	0.00082	0.00059	0.000756	0.00184	0.001850	0.00342	0.002720	0.00301	0.002280	0.00206	0.00194	0.00192	0.00192	0.00198	0.00215	0.00277	0.00235	0.00211	0.00197	0.00170	0.00125
Vanadium T-V	<0.030	<0.0010	<0.0010	<0.030	<0.030	0.0010	0.0199	0.0236	0.0068	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc T-Zn	<0.0050	<0.0010	<0.0010	<0.0050	<0.0050	0.0011	0.0258	0.0324	0.0113	0.0020	0.0028	0.0015	0.0018	0.0015	0.0025	0.0014	0.0023	0.0033	0.0019	0.0010	0.0015	0.0021	0.0048	0.0026
Dissolved Metals (Trace)																								
Aluminum D-Al	0.0163	0.0073	0.0071	0.0119	0.0141	0.0129	-	-	0.0549										0.0082					
Antimony D-Sb	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	-	-	0.00011										<0.00010					
Arsenic D-As	<0.00050	0.00044	0.00044	0.00058	0.00059	0.00053	-	-	0.00106										0.00063					
Barium D-Ba	0.050	0.0574	0.0604	0.059	0.055	0.0492	-	-	0.108										0.093					
Beryllium D-Be	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	-	-	<0.00050										<0.00050					
Bismuth D-Bi		<0.00050	<0.00050			<0.00050	-	-	<0.00050										<0.00050					
Boron D-B	<0.10	<0.010	<0.010	<0.10	<0.10	<0.010	-	-	<0.010										<0.010					
Cadmium D-Cd	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000050	-	-	<0.000050										<0.000050					
Calcium D-Ca	25.6	36.9	39.6	35.7	35.2	35.9	-	-	68.8										70.1					
Chromium D-Cr	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	-	-	<0.00050										<0.00050					
Cobalt D-Co	<0.00030	<0.00010	<0.00010	<0.00030	<0.00030	<0.00010	-	-	0.00017										<0.00010					
Copper D-Cu	0.0033	0.00210	0.00208	0.0024	0.0025	0.00271	-	-	0.0032										0.0017					
Iron D-Fe	0.164	0.039	0.050	0.234	0.338	0.246	-	-	0.106										0.063					
Lead D-Pb	<0.00050	<0.000050	<0.000050	<0.00050	<0.00050	<0.000050	-	-	<0.000050										<0.000050					
Lithium D-Li	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	<0.0050										<0.0050					
Magnesium D-Mg	8.72	12.3	13.2	11.7	11.2	11.5	-	-	31.4										31.4					
Manganese D-Mn	0.00507	0.00684	0.0140	0.0152	0.0341	0.0208	-	-	0.0429										0.0420					
Mercury D-Hg	<0.000020			<0.000020	<0.000020		-	-																
Molybdenum D-Mo	<0.0010	0.00108	0.00127	0.0010	<0.0010	0.000859	-	-	0.00173										0.002					
Nickel D-Ni	0.0015	0.00102	0.00112	0.0015	0.0017	0.00141	-	-	0.0010										<0.00050					
Phosphorus D-P		<0.30	<0.30			<0.30	-	-	<0.30										<0.30					
Potassium D-K	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	-	6.7										4.4					
Selenium D-Se	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-	<0.0010										<0.0010					
Silicon D-Si		5.40	5.31			6.19	-	-	11.6										10.8					
Silver D-Ag	<0.000020	<0.000010	<0.000010	<0.000020	<0.000020	<0.000010	-	-	<0.000010										<0.000010					
Sodium D-Na	5.0	8.6	8.7	7.0	6.2	6.3	-	-	20.2										20.2					
Strontium D-Sr		0.307	0.341			0.256	-	-	0.6										0.7					
Thallium D-Tl	<0.00020	<0.00010	<0.00010	<0.00020	<0.00020	<0.00010	-	-	<0.00010										<0.00010					
Tin D-Sn	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	-	-	<0.00010										<0.00010					
Titanium D-Ti	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	<0.010										<0.010					
Uranium D-U		0.00110	0.00127	0.00077	0.00055	0.000713	-	-	0.00368										0.00273					
Vanadium D-V		<0.0010	<0.0010	<0.030	<0.030	<0.0010	-	-	<0.0010										<0.0010					
Zinc D-Zn		0.0015	0.0011	<0.0050	<0.0050	<0.0010	-	-	0.0015										0.0012					
Organic Parameters																								
Dissolved Organic Carbon C									18										11.1					
Total Inorganic Carbon C									59.4										67.3					
Total Organic Carbon C									21.7										12.5					
Radiological Parameters																								
Radium-226		<0.0050	<0.0050	<0.0050	0.0070	<0.0050	-	-	<0.0050										<0.0050					

Notes:

[1] All units are in mg/L unless otherwise indicated

[2] Detection limit from October 2005 results except Mercury which is from September 2005 results

[3] Range is based on an average pH of 8.0 and a temperature range of 0 to 10ºC

[4] Based on guideline for Hexavalent chromium (Cr(VI))

Sample ID	MINTO HW-2																						
Sample Site Description	Minto Creek at Lower Road Crossing																						
Date Sampled	23-Apr-06	24-Apr-06	25-Apr-06	26-Apr-06	27-Apr-06	28-Apr-06	29-Apr-06	30-Apr-06	01-May-06	02-May-06	03-May-06	04-May-06	05-May-06	06-May-06	07-May-06	08-May-06	09-May-06	10-May-06	11-May-06	12-May-06	13-May-06	14-May-06	15-May-06	16-May-06
Sampled by																							
Parameter [1]																							
Physical Tests																							
Electrical Conductivity (Lab) (µs/cm)	268	212	151	161	165	149	156	161	169	139	117	-	076	074	-	081	-	083	-	-	-	081	-	-
Electrical Conductivity (Field) (µs/cm)																								
Total Dissolved Solids	170	140	128	139	146	073	144	148	161	129	102	-	086	088	-	094	-	101	-	-	-	103	-	-
Hardness												-			-		-		-	-	-			
pH (Lab)	8.24	8.15	7.75	7.82	7.89	7.88	7.93	7.97	7.99	7.95	7.86	-	7.63	7.60	-	7.65	-	7.65	-	-	-	7.61	-	-
pH (Field)	8.45	8.55	8.5	8.6	8.1	8.1	8.3	8.5	8.3	8.3	8.2	-	8	8.4	8.3	8.3	7.8	7.7	-	7.9	7.8	7.5	7.7	7.7
Total Suspended Solids (Lab)	03.7	04.2	22.1	14.1	20.6	20.6	17.6	17.6	23.1	51.4	116.0	-	141.0	110.0	-	40.9	-	98.3	-	-	-	232.0	-	-
Total Suspended Solids (Field)	6	9	14	17	13	11	11	10	12	10	13	-	23	26	15	15	27	23	-	23	24	115	49	22
Tempurature (field) (˚C)																								
Turbidity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Anions																								
Alkalinity-Total CaCO3	135	103	077	078	075	071	077	075	080	065	050	-	032	027	-	034	-	035	-	-	-	032	-	-
Bromide Br	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	-	<0.050	-	<0.050	-	-	-	<0.050	-	-
Chloride Cl	001	001	001	001	1.13	1.07	1.05	1.01	0.98	0.81	0.73	-	<0.50	<0.50	-	<0.50	-	<0.50	-	-	-	<0.50	-	-
Fluoride F	0.33	0.28	0.19	0.19	0.18	0.17	0.18	0.18	0.19	0.16	0.14	-	0.11	0.11	-	0.11	-	0.11	-	-	-	0.14	-	-
Sulphate SO4	18.7	13.4	8.41	9.62	10.1	08.7	08.7	08.7	09.3	07.9	05.4	-	02.9	02.6	-	02.9	-	03.4	-	-	-	03.2	-	-
Nutrients																								
Ammonia Nitrogen N	-	000	-	-	-	-	-	-	-	-	-	-	-	-	-	0.023	-	-	-	-	-	0.05	-	-
Nitrate Nitrogen N	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	-	<0.0050	-	0.0082	-	-	-	0.0083	-	-
Nitrite Nitrogen N	000	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0015	<0.0010	-	<0.0010	<0.0010	-	<0.0010	-	0.0013	-	-	-	0.0012	-	-
ortho-Phosphate																								
Total Dissolved Phosphate																								
Total Phosphorous																								
Cyanides																								
Total Cyanide CN		0.0129	-	-		-	-	-	-	0.0236	-	-	-	-	-	0.0270	-	-	-	-	-	0.0232	-	-
Total Metals (Trace)																								
Aluminum T-Al	0.046	0.071	0.314	0.549	0.357	0.424	0.295	0.222	0.503	0.808	1.640	-	1.830	1.630	-	0.667	-	1.130	-	-	-	4.650	-	-
Antimony T-Sb	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	0.00014	-	<0.00010	-	0.00015	-	-	-	0.00024	-	-
Arsenic T-As	0.00043	0.00044	0.00052	0.00060	0.00056	0.00054	0.00058	0.00055	0.00065	0.00071	0.00116	-	0.00120	0.00121	-	0.00067	-	0.00090	-	-	-	0.00242	-	-
Barium T-Ba	0.0455	0.0389	0.0360	0.0422	0.041	0.038	0.039	0.040	0.046	0.048	0.064	-	0.063	0.060	-	0.040	-	0.055	-	-	-	0.123	-	-
Beryllium T-Be	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	-	<0.00050	-	<0.00050	-	-	-	<0.00050	-	-
Bismuth T-Bi	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	-	<0.00050	-	<0.00050	-	-	-	<0.00050	-	-
Boron T-B	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	-	<0.010	-	<0.010	-	-	-	<0.010	-	-
Cadmium T-Cd	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	0.000051	<0.000050	-	<0.000050	-	<0.000050	-	-	-	0.000096	-	-
Calcium T-Ca	30.6	25.5	19.1	20.1	20.6	19.0	21.1	21.7	22.5	18.4	16.9	-	11.9	12.3	-	12.4	-	14.3	-	-	-	15.4	-	-
Chromium T-Cr	<0.00050	<0.00050	<0.00050	0.00071	0.00056	0.00054	0.00058	<0.00050	0.00101	0.0015	0.00297	-	0.00334	0.00295	-	0.00135	-	0.00218	-	-	-	0.00862	-	-
Cobalt T-Co	0.00014	0.00016	0.00035	0.00040	0.00039	0.00035	0.00032	0.00032	0.00041	0.00069	0.0014	-	0.00171	0.00144	-	0.00062	-	0.00103	-	-	-	0.00336	-	-
Copper T-Cu (Lab)	0.00137	0.00164	0.00501	0.00833	0.0064	0.0070	0.0064	0.0055	0.0069	0.0086	0.0106	-	0.0119	0.0222	-	0.0080	-	0.0323	-	-	-	0.0191	-	-
Copper (On Site Hach)	0.005	0.0006	0.0002	0.0015	0.0023	0.003	0.0014	0.0072	0.003	0.0003	u/d	-	<0.001	0.001	0.001	0.001	0.004	0.005	-	0.0022	0.0049	0.0026	0.0027	0.0018
Iron T-Fe	0.112	0.126	0.492	0.691	0.582	0.596	0.434	0.400	0.690	1.310	2.710	-	3.010	2.880	-	1.140	-	1.760	-	-	-	7.230	-	-
Lead T-Pb	<0.000050	<0.000050	0.000166	0.000251	0.000294	0.000193	0.000131	0.000125	0.000179	0.000362	0.000816	-	0.000926	0.000845	-	0.000329	-	0.00053	-	-	-	0.0022	-	-
Lithium T-Li	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	-	<0.0050	-	<0.0050	-	-	-	<0.0050	-	-
Magnesium T-Mg	13.8	11.1	07.4	07.4	07.5	07.0	07.5	07.7	08.2	06.7	05.8	-	04.1	04.1	-	04.0	-	05.3	-	-	-	05.7	-	-
Manganese T-Mn	0.0471	0.0425	0.0767	0.0653	0.0628	0.0492	0.0648	0.0682	0.0501	0.0921	0.1960	-	0.1890	0.1650	-	0.0706	-	0.1740	-	-	-	0.2660	-	-
Mercury T-Hg												-			-		-		-	-	-			
Molybdenum T-Mo	0.00088	0.00077	0.00064	0.00079	0.00067	0.000612	0.000511	0.000607	0.00073	0.000586	0.000524	-	0.000382	0.000375	-	0.000392	-	0.000699	-	-	-	0.000593	-	-
Nickel T-Ni	0.00057	0.00073	0.00118	0.00170	0.0014	0.0015	0.0015	0.0013	0.0018	0.0025	0.0042	-	0.0048	0.0044	-	0.0027	-	0.0034	-	-	-	0.0095	-	-
Phosphorous T-P	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	-	<0.30	<0.30	-	<0.30	-	<0.30	-	-	-	<0.30	-	-
Potassium T-K	3.0	3.1	2.8	3.3	2.7	2.6	2.6	2.5	2.5	2.3	2.3	-	2.1	2	-	<2.0	-	<2.0	-	-	-	<2.0	-	-
Selenium T-Se	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	-	<0.0010	-	<0.0010	-	-	-	<0.0010	-	-
Silicon T-Si	5.30	4.67	4.03	4.59	4.55	4.64	4.69	4.67	5.3	5.4	6.33	-	5.61	5.32	-	3.68	-	4.84	-	-	-	11.7	-	-
Silver T-Ag	<0.000010	<0.000010	0.000012	0.000016	0.000012	0.000014	<0.000010	0.000024	0.000014	0.000015	0.000018	-	0.000018	0.000025	-	0.000014	-	0.000029	-	-	-	0.000037	-	-
Sodium T-Na	08.1	06.2	03.8	04.0	4.6	4.4	4.4	4.2	4.2	3.2	2.6	-	<2.0	<2.0	-	<2.0	-	2.4	-	-	-	2.3	-	-
Strontium T-Sr	0.273	0.218	0.136	0.149	0.145	0.128	0.146	0.153	0.171	0.135	0.126	-	0.0854	0.0827	-	0.0816	-	0.0969	-	-	-	0.111	-	-
Thallium T-Tl	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.00010	-	<0.00010	-	-	-	<0.00010	-	-
Tin T-Sn	<0.00010	<0.00010	<0.00010	<0.00010	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.00010	-	<0.00010	-	-	-	<0.00010	-	-
Titanium T-Ti	<0.010	<0.010	0.012	0.021	0.014	0.016	0.012	0.01	0.018	0.034	0.072	-	0.072	0.07	-	0.032	-	0.042	-	-	-	0.157	-	-
Uranium T-U	0.00079	0.00048	0.00030	0.00031	0.00033	0.00026	0.00031	0.00033	0.00036	0.00030	0.00036	-	0.00029	0.00030	-	0.00020	-	0.00020	-	-	-	0.00069	-	-
Vanadium T-V	<0.0010	<0.0010	0.0012	0.0018	0.0015	0.0015	0.0011	0.001	0.0017	0.0028	0.0055	-	0.0062	0.006	-	0.0026	-	0.0039	-	-	-	0.0147	-	-
Zinc T-Zn	0.0024	0.0026	0.0091	0.0124	0.0052	<0.0050	0.0089	0.0082	0.0048	0.0059	0.0101	-	0.0105	0.0099	-	0.0062	-	0.0073	-	-	-	0.0223	-	-
Dissolved Metals (Trace)																								
Aluminum D-Al		0.0119								-	-	-	-	-	-	0.0654	-	-	-	-	-	0.0626	-	-
Antimony D-Sb		<0.00010								-	-	-	-	-	-	<0.00010	-	-	-	-	-	<0.00010	-	-
Arsenic D-As		0.00038								-	-	-	-	-	-	0.00038	-	-	-	-	-	0.00055	-	-
Barium D-Ba		0.037								-	-	-	-	-	-	0.026	-	-	-	-	-	0.031	-	-
Beryllium D-Be		<0.00050								-	-	-	-	-	-	<0.00050	-	-	-	-	-	<0.00050	-	-
Bismuth D-Bi		<0.00050								-	-	-	-	-	-	<0.00050	-	-	-	-	-	<0.00050	-	-
Boron D-B		<0.010								-	-	-	-	-	-	<0.010	-	-	-	-	-	<0.010	-	-
Cadmium D-Cd		<0.000050								-	-	-	-	-	-	<0.000050	-	-	-	-	-	<0.000050	-	-
Calcium D-Ca		25.4								-	-	-	-	-	-	12.2	-	-	-	-	-	12.8	-	-
Chromium D-Cr		<0.00050								-	-	-	-	-	-	<0.00050	-	-	-	-	-	<0.00050	-	-
Cobalt D-Co		0.00011								-	-	-	-	-	-	0.00015	-	-	-	-	-	0.00026	-	-
Copper D-Cu		0.0013								-	-	-	-	-	-	0.0054	-	-	-	-	-	0.0058	-	-
Iron D-Fe		0.054								-	-	-	-	-	-	0.194	-	-	-	-	-	0.425	-	-
Lead D-Pb		<0.000050								-	-	-	-	-	-	0.000091	-	-	-	-	-	0.000064	-	-
Lithium D-Li		<0.0050								-	-	-	-	-	-	<0.0050	-	-	-	-	-	<0.0050	-	-
Magnesium D-Mg		10.9								-	-	-	-	-	-	03.8	-	-	-	-	-	03.8	-	-
Manganese D-Mn		0.0378								-	-	-	-	-	-	0.0209	-	-	-	-	-	0.0594	-	-
Mercury D-Hg										-	-	-	-	-	-		-	-	-	-	-		-	-
Molybdenum D-Mo		0.000729								-	-	-	-	-	-	0.000307	-	-	-	-	-	0.000441	-	-
Nickel D-Ni		0.0006								-	-	-	-	-	-	0.0014	-	-	-	-	-	0.0017	-	-
Phosphorus D-P		<0.30								-	-	-	-	-	-	<0.30	-	-	-	-	-	<0.30	-	-
Potassium D-K		3.1								-	-	-	-	-	-	<2.0	-	-	-	-	-	<2.0	-	-
Selenium D-Se		<0.0010								-	-	-	-	-	-	<0.0010	-	-	-	-	-	<0.0010	-	-
Silicon D-Si		4.54								-	-	-	-	-	-	2.69	-	-	-	-	-	3.11	-	-
Silver D-Ag		<0.000010								-	-	-	-	-	-	<0.000010	-	-	-	-	-	<0.000010	-	-
Sodium D-Na		6.1								-	-	-	-	-	-	<2.0	-	-	-	-	-	2.1	-	-
Strontium D-Sr		0.2								-	-	-	-	-	-	0.1	-	-	-	-	-	0.1	-	-
Thallium D-Tl		<0.00010								-	-	-	-	-	-	<0.00010	-	-	-	-	-	<0.00010	-	-
Tin D-Sn		<0.00010								-	-	-	-	-	-	<0.00010	-	-	-	-	-	<0.00010	-	-
Titanium D-Ti		<0.010								-	-	-	-	-	-	<0.010	-	-	-	-	-	<0.010	-	-
Uranium D-U		0.00048								-	-	-	-	-	-	0.00012	-	-	-	-	-	0.00015	-	-
Vanadium D-V		<0.0010								-	-	-	-	-	-	<0.0010	-	-	-	-	-	<0.0010	-	-
Zinc D-Zn		0.0018								-					-	0.0024	-	-	-	-	-	<0.0010	-	-
Organic Parameters																								
Dissolved Organic Carbon C		14								-	-	-	-	-	-	25	-	-	-	-	-	21.6	-	-
Total Inorganic Carbon C		18.5								-	-	-	-	-	-	4.33	-	-	-	-	-	4.03	-	-
Total Organic Carbon C		16.4								-	-	-	-	-	-	32.7	-	-	-	-	-	34.2	-	-
Radiological Parameters																								
Radium-226		<0.005								-	-	-	-	-	-	<0.0050	-	-	-	-	-	0.0070	-	-

Notes:

[1] All units are in mg/L unless otherwise indicated

[2] Detection limit from October 2005 results except Mercury which is from September 2005 results

[3] Range is based on an average pH of 8.0 and a temperature range of 0 to 10ºC

[4] Based on guideline for Hexavalent chromium (Cr(VI))

Sample ID																							
Sample Site Description																							
Date Sampled	17-May-06	18-May-06	19-May-06	20-May-06	21-May-06	22-May-06	23-May-06	25-May-06	26-May-06	27-May-06	28-May-08	29-May-06	31-May-06	01-Jun-06	02-Jun-06	03-Jun-06	07-Jun-06	15-Jun-06	23-Jun-06	28-Jun-06	07-Jul-06	12-Jul-06	12-Jul-06	30-Jul-06
Sampled by																		Norwest		Norwest		SVB	Duplicate	
Parameter [1]																								
Physical Tests																								
Electrical Conductivity (Lab) (µs/cm)	116	-	-	136	-	-	166	-	193	-	-	148	-	-	159	-	179	248	300	286	259	298	-	-
Electrical Conductivity (Field) (µs/cm)																								
Total Dissolved Solids	115	-	-	115	-	-	129	-	145	-	-	119	-	-	140	-	142	166	222	170	204		-	-
Hardness		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	139	154	142	140	143	-	-
pH (Lab)	7.69	-	-	7.81	-	-	7.93	-	7.71	-	-	7.66	-	-	7.19	-	7.92	8.11	7.92	8.05	7.91	7.93	-	-
pH (Field)	7.8	7.9	7.8	7.8	7.8	7.9	7.8	7.9	8	7.9	7.9	7.9	8	7.9	-	7.8	-	-	7.1	-	-	-	-	-
Total Suspended Solids (Lab)	59.6	-	-	28.1	-	-	22.1	-	11.4	-	-	79.9	-	-	257.0	-	47.1	-	<2	7.0	<2	<2	-	-
Total Suspended Solids (Field)	10	14	19	13	10	12	11	7	6	9	50	40	7	85	-	8	-	-	3	-	-	-	-	1
Tempurature (field) (˚C)																								
Turbidity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Anions																								
Alkalinity-Total CaCO3	063	-	-	071	-	-	072	-	094	-	-	082	-	-	092	-	083	117	132	133	135	132		
Bromide Br	<0.050	-	-	<0.050	-	-	<0.050	-	<0.050	-	-	<0.050	-	-	<0.050	-	<0.050	-		-				
Chloride Cl	0.57	-	-	0.54	-	-	0.55	-	0.54	-	-	<0.50	-	-	<0.50	-	<0.50	-		-				
Fluoride F	0.16	-	-	0.18	-	-	0.21	-	0.23	-	-	0.19	-	-	0.21	-	0.21							
Sulphate SO4	05.4	-	-	07.6	-	-	10.7	-	13.2	-	-	08.8	-	-	09.1	-	10.6	19.0	20.9	22.8	21.7			
Nutrients																								
Ammonia Nitrogen N	-	-	-	-	-	-	0.0147	-	-	-	-	-	-	-	0.04	-	0.038	0.01	0.01	0.003	0.009	0.008		
Nitrate Nitrogen N	0.0171	-	-	0.0237	-	-	0.0368	-	0.0463	-	-	0.0415	-	-	0.0567	-	0.0716	0.1000	0.0500	0.0500	0.0760	0.0900		
Nitrite Nitrogen N	0.0016	-	-	<0.0010	-	-	<0.0010	-	0.0016	-	-	0.0014	-	-	0.0024	-	0.0013	-		-				
ortho-Phosphate																								
Total Dissolved Phosphate																								
Total Phosphorous																								
Cyanides																								
Total Cyanide CN	-	-	-	-	-	-	0.0149	-	-	-	-	-	-	-	0.0184	-	<0.0050	<0.001	<0.001	0.0010	0.0010	0.0010		
Total Metals (Trace)																								
Aluminum T-Al	0.621	-	-	0.415	-	-	0.307	-	0.362	-	-	1.710	-	-	5.130	-	0.997	0.084	0.031	0.223	0.040	0.022	0.012	
Antimony T-Sb	<0.00010	-	-	<0.00010	-	-	<0.00010	-	0.00017	-	-	0.00021	-	-	0.00038	-	0.00015	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	
Arsenic T-As	0.00093	-	-	0.00080	-	-	0.00078	-	0.00076	-	-	0.00147	-	-	0.00296	-	0.00114	0.00060	0.00030	0.00060	<0.001	0.00040	0.00040	
Barium T-Ba	0.050	-	-	0.047	-	-	0.049	-	0.052	-	-	0.073	-	-	0.142	-	0.061	0.057	0.063	0.062	0.065	0.062	0.064	
Beryllium T-Be	<0.00050	-	-	<0.00050	-	-	<0.00050	-	<0.00050	-	-	<0.00050	-	-	<0.00050	-	<0.00050	<0.0001	<0.0001	<0.0001	<0.0005	<0.0001	<0.0001	
Bismuth T-Bi	<0.00050	-	-	<0.00050	-	-	<0.00050	-	<0.00050	-	-	<0.00050	-	-	<0.00050	-	<0.00050	<0.0005	<0.0005	<0.0005	<0.002	<0.0005	<0.0005	
Boron T-B	<0.010	-	-	<0.010	-	-	<0.010	-	<0.010	-	-	<0.010	-	-	<0.010	-	<0.010	0.006	0.004	0.007	0.01	0.006	0.006	
Cadmium T-Cd	<0.000050	-	-	<0.000050	-	-	<0.000050	-	<0.000050	-	-	<0.000050	-	-	0.000135	-	<0.000050	<0.00001	<0.00001	<0.00001	<0.00005	<0.00001	<0.00001	
Calcium T-Ca	17.2	-	-	18.6	-	-	22.1	-	26.3	-	-	22.1	-	-	26.7	-	23.6	32.7	37.8	36.4	39.6	39.8	41.4	
Chromium T-Cr	0.00142	-	-	0.00104	-	-	0.00082	-	0.00102	-	-	0.00361	-	-	0.0104	-	0.00238	0.0007	<0.0005	<0.0005	<0.002	<0.0005	<0.0005	
Cobalt T-Co	0.00088	-	-	0.00062	-	-	0.00044	-	0.00035	-	-	0.00131	-	-	0.00364	-	0.00079	<0.0001	<0.0001	0.0001	<0.0005	<0.0001	<0.0001	
Copper T-Cu (Lab)	0.0081	-	-	0.0075	-	-	0.0065	-	0.0055	-	-	0.0121	-	-	0.0214	-	0.0104	0.0040	0.0030	0.0030	<0.005	0.0020	0.0050	
Copper (On Site Hach)	n/r	n/r	n/r	n/r	n/r	<0.001	<0.001	<0.001	0.0021	0.0048	0.00129	0.0081	<0.001	0.0098	-	0.004	-		0.0009	-				0.0005
Iron T-Fe	1.740	-	-	1.220	-	-	0.917	-	0.707	-	-	2.890	-	-	8.090	-	1.750	0.200	<0.1	0.400	<0.1	<0.1	<0.1	
Lead T-Pb	0.000478	-	-	0.00034	-	-	0.000261	-	0.00019	-	-	0.000846	-	-	0.00264	-	0.000457	<0.0001	<0.0001	0.0001	<0.0005	<0.0001	<0.0001	
Lithium T-Li	<0.0050	-	-	<0.0050	-	-	<0.0050	-	<0.0050	-	-	<0.0050	-	-	<0.0050	-	<0.0050	0.002	0.002	0.001	<0.005	0.002	<0.0001	
Magnesium T-Mg	05.8	-	-	06.5	-	-	08.0	-	09.5	-	-	07.8	-	-	10.0	-	07.8	10.7	11.6	11.5	12.0	11.7	11.8	
Manganese T-Mn	0.1010	-	-	0.0821	-	-	0.0678	-	0.0573	-	-	0.1390	-	-	0.2940	-	0.0631	0.0080	0.0200	0.0180	0.0130	0.0140	0.0160	
Mercury T-Hg		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-				
Molybdenum T-Mo	0.000502	-	-	0.000702	-	-	0.000907	-	0.00107	-	-	0.000943	-	-	0.00119	-	0.00104	0.001	0.001	0.001	<0.005	<0.001	<0.001	
Nickel T-Ni	0.0033	-	-	0.0029	-	-	0.0024	-	0.0023	-	-	0.0054	-	-	0.0115	-	0.0039	0.0017	0.0013	0.0011	0.0030	0.0012	0.0014	
Phosphorous T-P	<0.30	-	-	<0.30	-	-	<0.30	-	<0.30	-	-	<0.30	-	-	<0.30	-	<0.30			-				
Potassium T-K	<2.0	-	-	<2.0	-	-	<2.0	-	<2.0	-	-	<2.0	-	-	<2.0	-	<2.0	1.1	1.2	1.1	1.2	1.3	1.4	
Selenium T-Se	<0.0010	-	-	<0.0010	-	-	<0.0010	-	<0.0010	-	-	<0.0010	-	-	<0.0010	-	<0.0010	0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	
Silicon T-Si	4.55	-	-	4.31	-	-	4.55	-	4.71	-	-	6.97	-	-	13.1	-	6.22	5.21	5.13	5.83	5.67	5.62	5.74	
Silver T-Ag	<0.000010	-	-	0.000012	-	-	<0.000010	-	<0.000010	-	-	0.000031	-	-	0.000066	-	0.000015	<0.0001	0.0002	<0.0001	<0.0005	<0.0001	<0.0001	
Sodium T-Na	3.6	-	-	4.2	-	-	5.2	-	6.1	-	-	5.0	-	-	5.7	-	4.8	7.4	7.9	7.7	9.1	8.7	8.7	
Strontium T-Sr	0.111	-	-	0.133	-	-	0.157	-	0.212	-	-	0.17	-	-	0.206	-	0.179	0.306	0.344	0.29	0.37	0.355	0.367	
Thallium T-Tl	<0.00010	-	-	<0.00010	-	-	<0.00010	-	<0.00010	-	-	<0.00010	-	-	<0.00010	-	<0.00010	<0.00005	<0.00005	<0.00005	<0.0002	<0.00005	<0.00005	
Tin T-Sn	<0.00010	-	-	<0.00010	-	-	<0.00010	-	0.00019	-	-	0.00027	-	-	<0.00010	-	0.00013	<0.001	<0.001	<0.001	<0.005	<0.001	<0.001	
Titanium T-Ti	0.023	-	-	0.014	-	-	0.011	-	0.014	-	-	0.063	-	-	0.195	-	0.039	0.0041	0.0016	0.0192	<0.002	0.0009	0.0008	
Uranium T-U	0.00036	-	-	0.00039	-	-	0.00052	-	0.00073	-	-	0.00057	-	-	0.00099	-	0.00055	0.00100	0.00110	0.00140	<0.002	0.00140	0.00140	
Vanadium T-V	0.0034	-	-	0.0026	-	-	0.0022	-	0.0021	-	-	0.0065	-	-	0.0173	-	0.0045	0.0014	0.0008	0.0016	<0.0005	0.0006	0.0006	
Zinc T-Zn	0.0049	-	-	0.0032	-	-	0.0039	-	<0.0050	-	-	0.0084	-	-	0.022	-	0.0054	0.001	0.002	0.002	<0.005	0.002	0.002	
Dissolved Metals (Trace)																								
Aluminum D-Al	-	-	-	-	-	-	0.0234	-	-	-	-	-	-	-	0.0318	-	-	0.0090	0.0100	0.0080	<0.005	<0.005			
Antimony D-Sb	-	-	-	-	-	-	<0.00010	-	-	-	-	-	-	-	0.00013	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002			
Arsenic D-As	-	-	-	-	-	-	0.00054	-	-	-	-	-	-	-	0.00074	-	-	0.00060	0.00040	0.00060	0.00060	0.00050			
Barium D-Ba	-	-	-	-	-	-	0.040	-	-	-	-	-	-	-	0.043	-	-	0.057	0.064	0.058	0.065	0.063			
Beryllium D-Be	-	-	-	-	-	-	<0.00050	-	-	-	-	-	-	-	<0.00050	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Bismuth D-Bi	-	-	-	-	-	-	<0.00050	-	-	-	-	-	-	-	<0.00050	-	-	<0.0005	<0.0005	<0.0005	0.0007	0.0007			
Boron D-B	-	-	-	-	-	-	<0.010	-	-	-	-	-	-	-	<0.010	-	-	0.003	0.002	0.004	0.006	0.006			
Cadmium D-Cd	-	-	-	-	-	-	<0.000050	-	-	-	-	-	-	-	<0.000050	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001			
Calcium D-Ca	-	-	-	-	-	-	23.1	-	-	-	-	-	-	-	23.0	-	-	36.3	40.8	33.0	34.7	36.1			
Chromium D-Cr	-	-	-	-	-	-	<0.00050	-	-	-	-	-	-	-	<0.00050	-	-	<0.0005	0.0006	0.0007	0.0012	0.0012			
Cobalt D-Co	-	-	-	-	-	-	<0.00010	-	-	-	-	-	-	-	0.00018	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Copper D-Cu	-	-	-	-	-	-	0.0049	-	-	-	-	-	-	-	0.0038	-	-	0.0020	0.0020	0.0030	0.0020	0.0020			
Iron D-Fe	-	-	-	-	-	-	0.253	-	-	-	-	-	-	-	0.463	-	-	0.040	0.050	0.030	0.020	0.020			
Lead D-Pb	-	-	-	-	-	-	<0.000050	-	-	-	-	-	-	-	0.000063	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
Lithium D-Li	-	-	-	-	-	-	<0.0050	-	-	-	-	-	-	-	<0.0050	-	-	0.001	0.001	<0.001	0.002	0.002			
Magnesium D-Mg	-	-	-	-	-	-	08.1	-	-	-	-	-	-	-	07.7	-	-	11.7	12.6	11.4	12.9	12.9			
Manganese D-Mn	-	-	-	-	-	-	0.0027	-	-	-	-	-	-	-	0.0399	-	-	<0.005	0.0160	<0.005	0.0080	0.0100			
Mercury D-Hg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-				
Molybdenum D-Mo	-	-	-	-	-	-	0.000977	-	-	-	-	-	-	-	0.000913	-	-	0.001	0.001	0.001	0.001	0.002			
Nickel D-Ni	-	-	-	-	-	-	0.0017	-	-	-	-	-	-	-	0.0018	-	-	0.0010	0.0014	0.0011	0.0016	0.0006			
Phosphorus D-P	-	-	-	-	-	-	<0.30	-	-	-	-	-	-	-	<0.30	-	-			-				
Potassium D-K	-	-	-	-	-	-	<2.0	-	-	-	-	-	-	-	<2.0	-	-	0.4	1.4	1.1	1.1	1.4		
Selenium D-Se	-	-	-	-	-	-	<0.0010	-	-	-	-	-	-	-	<0.0010	-	-	<0.0002	0.0002	<0.0002	<0.0002	<0.0002		
Silicon D-Si	-	-	-	-	-	-	4.14	-	-	-	-	-	-	-	4.19	-	-	5.8	5.54	5.49	6.5	5.69		
Silver D-Ag	-	-	-	-	-	-	<0.000010	-	-	-	-	-	-	-	<0.000010	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		
Sodium D-Na	-	-	-	-	-	-	4.7	-	-	-	-	-	-	-	5.4	-	-	8.4	8.2	7.9	8.3	8.9		
Strontium D-Sr	-	-	-	-	-	-	0.2	-	-	-	-	-	-	-	0.2	-	-	0.3	0.3	0.3	0.4	0.4		
Thallium D-Tl	-	-	-	-	-	-	<0.00010	-	-	-	-	-	-	-	<0.00010	-	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		
Tin D-Sn	-	-	-	-	-	-	<0.00010	-	-	-	-	-	-	-	<0.00010	-	-	<0.001	<0.001	<0.001	<0.001	<0.001		
Titanium D-Ti	-	-	-	-	-	-	<0.010	-	-	-	-	-	-	-	<0.010	-	-	0.0006	0.0006	0.0006	0.0009	0.0007		
Uranium D-U	-	-	-	-	-	-	0.00048	-	-	-	-	-	-	-	0.00048	-	-	0.00090	0.00120	0.00120	0.00120	0.00090		
Vanadium D-V	-	-	-	-	-	-	<0.0010	-	-	-	-	-	-	-	0.0015	-	-	0.0012	0.001	0.0011	0.0034	0.0019		
Zinc D-Zn	-	-	-	-	-	-	<0.0010	-	-	-	-	-	-	-	0.0012	-	-	<0.001	0.004	<0.001	0.002	0.001		
Organic Parameters																								
Dissolved Organic Carbon C	-	-	-	-	-	-	18.5	-	-	-	-	-	-	-	18.4	-	20.9	12.6	7.7	10.7	9.6	9.6		
Total Inorganic Carbon C	-	-	-	-	-	-	13.5	-	-	-	-	-	-	-	13.8	-	14.4	31	32.6	33.9	35.4	36.3		
Total Organic Carbon C	-	-	-	-	-	-	20	-	-	-	-	-	-	-	29.5	-	23.9	12	9.7	13.4	9.2	10		
Radiological Parameters																								
Radium-226	-	-	-	-	-	-	<0.0050	-	-	-	-	-	-	-	0.0100	-	<0.0050	<0.005	<0.005	<0.005	<0.005	<0.005		

Notes:

[1] All units are in mg/L unless otherwise indicated

[2] Detection limit from October 2005 results except Mercury which is from September 2005 results

[3] Range is based on an average pH of 8.0 and a temperature range of 0 to 10ºC

[4] Based on guideline for Hexavalent chromium (Cr(VI))

Sample ID																		Detection Limit[2]	CCME Guidelines Water: Freshwater Aquatic Life
Sample Site Description																			
Date Sampled	02-Aug-06	18-Aug-06	23-Aug-06	30-Aug-06	06-Sep-06	13-Sep-06	20-Sep-06	28-Sep-06	04-Oct-06	12-Oct-06	18-Oct-06	28-Oct-06	17-Apr-07	25-Apr-07	19-May-07	30-May-07	20-Jun-07		
Sampled by	SVB	JG	JG	JG	SVB	SVB	SVB	JG	SVB	JG	SVB	JG	JG	SVB	JG	SVB	JG		
Parameter [1]																			
Physical Tests																			
Electrical Conductivity (Lab) (µs/cm)	319	311	406	317	322	320	317	329	321	319	443	323	400	089	240	264	283	2.0	
Electrical Conductivity (Field) (µs/cm)													446		384	266	288		
Total Dissolved Solids			294	220				124		202	187	298	320	136	172	186	188	10	
Hardness	010	170	192	154	161	167	164	161	160	158	160	163	216	052	116	127	149	0.54	
pH (Lab)	7.86	7.86	7.86	7.87	7.93	7.99	7.87	7.64	8.32	7.54	8.20	7.77	8.34	7.44	8.03	8.1	7.95	0.010	6.5 - 9.0
pH (Field)								-					8.32		7.62	7.63	7.64		6.5 - 9.0
Total Suspended Solids (Lab)	<2	<2	<2	<2	2.0	<2	<2	<2	<2	<2	<1	<2	101	98	<2	<2	<2	3.0	
Total Suspended Solids (Field)	-	-	-	-	-	-	-	-					42.0						
Tempurature (field) (˚C)													-1.0		0.7	3.9	7.1		
Turbidity	-	-	-	-	-	-	-	-			0.5	1.2	100.0	19.0	0.6	0.3	0.7		
Dissolved Anions																			
Alkalinity-Total CaCO3	152	144	178	150	149	156	150	151	152	146	194	151	197	044	104	116	137	2.0	
Bromide Br																			
Chloride Cl											1.30	1.42	2.70	1.40	0.9	1	1.1	0.50	
Fluoride F																			
Sulphate SO4	20.9	19.8	39.0	13.9	21.3	22.0	22.3	20.9	23.7	20.9		22.0	32.0	03.4	15.1	19.6	21.4	0.50	
Nutrients																			
Ammonia Nitrogen N	0.006	0.005	0.004	0.005	0.004	0.008	0.006	0.008	0.053	0.006	<0.05	0.01	<0.05	<0.05	<0.05	<0.05	<0.05	0.020	1.04 - 2.33[3]
Nitrate Nitrogen N	0.0600	0.0400	<0.03	<0.03	<0.03	0.0030	<0.03	<0.03	0.0400	0.0400	0.0800	0.0600	<0.1	<0.1	0.6	0.8	0.9	0.0050	
Nitrite Nitrogen N											<0.005	<0.03	<0.05	<0.05	<0.05	<0.05	<0.05	0.0010	0.06
ortho-Phosphate											0.04		0.1	0.03	0.04	0.03	0.04		
Total Dissolved Phosphate																			
Total Phosphorous											0.08		0.17	0.2	0.05	<0.05	<0.05		
Cyanides																			
Total Cyanide CN	0.0010	0.0010	0.0010	<0.001	<0.001	0.0010	0.0010	0.0010	<0.001	<0.001		<0.001						0.0050	
Total Metals (Trace)																			
Aluminum T-Al	0.016	0.010	0.064	0.013	0.012	0.015	0.012	0.020	0.010	0.055	0.007	0.080	3.550	2.880	0.079	0.041	0.065	0.0010	0.005 - 0.1
Antimony T-Sb	<0.0002	<0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0004	<0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0004	<0.0004	<0.0002	<0.0002	0.00010	
Arsenic T-As	0.00060	0.00060	0.00030	0.00040	0.00040	0.00040	0.00040	0.00050	0.00050	0.00030	0.00030	0.00040	0.00220	0.00100	0.0005	0.0003	0.0004	0.00010	0.005
Barium T-Ba	0.066	0.068	0.075	0.060	0.060	0.062	0.060	0.062	0.060	0.060	0.065	0.071	0.127	0.078	0.048	0.056	0.063	0.000050	
Beryllium T-Be	<0.0001	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002	<0.0001	<0.0001	0.00050	
Bismuth T-Bi	<0.0005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	0.00050	
Boron T-B	0.006	0.008	0.006	0.006	0.006	0.007	0.006	0.008	0.007	0.006	0.005	0.006	0.008	0.004	0.007	0.007	0.008	0.010	
Cadmium T-Cd	<0.00001	<0.00002	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00002	<0.00002	<0.00001	<0.00001	<0.00001	0.00007	0.00005	<0.00002	<0.00001	<0.00001	0.000050	0.000017
Calcium T-Ca	39.5	40.5	47.1	39.9	41.0	42.2	40.2	41.3	38.0	40.4	41.2	43.6	56.5	17.0	30.6	33	39.2	0.050	
Chromium T-Cr	<0.0005	0.001	0.0008	<0.0005	<0.0005	<0.0005	<0.0005	<0.001	0.001	<0.0005	<0.0005	<0.0005	0.0059	0.0049	<0.001	<0.0005	0.0008	0.00050	0.001[4]
Cobalt T-Co	<0.0001	<0.0002	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	0.0024	0.002	<0.0002	0.0001	0.0001	0.00010	
Copper T-Cu (Lab)	0.0020	0.0020	0.0050	0.0020	0.0040	0.0020	0.0020	0.0030	0.0020	0.0020	0.0020	0.0020	0.0120	0.0090	0.003	0.003	0.003	0.00010	0.002 - 0.004
Copper (On Site Hach)													0.0011						
Iron T-Fe	<0.1	<0.2	0.100	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	0.100	<0.1	0.100	5.100	3.700	0.2	<0.1	0.1	0.030	0.3
Lead T-Pb	<0.0001	<0.0002	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0002	<0.0002	<0.0001	0.0001	<0.0001	0.0014	0.001	<0.0002	<0.0001	<0.0001	0.000050	0.001 - 0.007
Lithium T-Li	0.002	<0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.006	0.002	<0.002	0.001	0.002	0.0050	
Magnesium T-Mg	12.4	13.0	17.8	12.8	13.0	13.5	14.0	13.0	12.0	13.5	13.7	13.5	22.9	04.8	10	10.9	11.7	0.10	
Manganese T-Mn	0.0130	<0.01	0.0320	0.0110	0.0180	0.0150	0.0190	0.0100	0.0100	0.0220	0.0250	0.0350	0.1890	0.2000	0.02	0.006	0.007	0.000050	
Mercury T-Hg													<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.000020	0.0001
Molybdenum T-Mo	0.001	<0.002	0.002	0.001	0.001	0.001	0.001	<0.002	<0.002	0.001	0.001	0.001	0.001	<0.002	<0.002	0.001	0.001	0.000050	0.073
Nickel T-Ni	0.0012	0.0020	0.0014	0.0013	0.0013	0.0013	0.0016	0.0020	0.0024	0.0013	0.0014	0.0013	0.0066	0.0061	0.002	0.0007	0.0013	0.00050	0.025 - 0.15
Phosphorous T-P											0.0800			0.2000		<0.05		0.30	
Potassium T-K	1.3	1.4	1.4	1.2	1.3	1.3	1.3	1.2	1.2	1.2	1.3	1.6	5.5	2.6	1	1.5	1.3	2.0	
Selenium T-Se	0.0002	<0.0004	0.0002	0.0003	0.0003	<0.0002	0.0004	<0.0004	0.0008	<0.0002	<0.0002	<0.0002	0.0004	<0.0004	<0.0004	<0.0002	<0.0002	0.0010	0.001
Silicon T-Si	5.66	5.65	6.58	5.73	5.65	5.97	5.66	5.43	5.31	4.5	5.81	5.92	14	8.92	5.21	4.35	5.2	0.050	
Silver T-Ag	0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002	<0.0001	<0.0001	0.000010	0.0001
Sodium T-Na	9.7	9.0	11.4	9.2	9.5	9.8	8.6	8.8	8.6	8.1	8.6	10.2	15.3	3.5	6	7.6	8.4	2.0	
Strontium T-Sr	0.401	0.346	0.369	0.405	0.399	0.409	0.398	0.371	0.368	0.385	0.445	0.43	0.555	0.12	0.252	0.302	0.339	0.00010	
Thallium T-Tl	<0.00005	<0.0001	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.0001	<0.0001	<0.00005	<0.00005	<0.00005	<0.00005	<0.0001	<0.0001	<0.00005	<0.00005	0.00010	0.0008
Tin T-Sn	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.001	<0.001	0.00010	
Titanium T-Ti	0.0008	0.002	0.0031	0.0009	0.0008	0.0008	0.0008	<0.001	0.001	0.0034	<0.0005	0.004	0.129	0.116	<0.001	0.0019	0.003	0.010	
Uranium T-U	0.00150	0.00100	0.00110	0.00160	0.00180	0.00180	0.00160	0.00200	0.00200	0.00150	0.00190	0.00210	0.00170	<0.001	0.001	0.0014	0.0015	0.000010	
Vanadium T-V	0.0007	0.0008	0.0008	0.0009	0.0007	0.0007	0.0006	0.0007	0.0008	0.0007	0.0005	0.0006	0.0123	0.0084	0.001	0.0008	0.0012	0.0010	
Zinc T-Zn	<0.001	0.002	0.002	<0.001	0.001	0.002	0.001	0.004	<0.002	<0.001	0.002	0.003	0.025	0.023	0.007	0.006	0.004	0.0010	0.03
Dissolved Metals (Trace)																			
Aluminum D-Al	<0.005	<0.005	0.0070	0.0070	<0.005	0.0050	<0.005	0.0080	<0.005	0.0060	0.0060	0.0070	0.0320	0.0580	0.008	<0.005	0.016	0.0010	
Antimony D-Sb	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00010	
Arsenic D-As	0.00050	0.00050	0.00040	0.00050	0.00050	0.00040	0.00040	0.00040	<0.0002	0.00040	0.00030	0.00040	0.00080	0.00040	0.0005	0.0004	0.0005	0.00010	
Barium D-Ba	0.065	0.059	0.070	0.060	0.060	0.057	0.059	0.061	0.059	0.058	0.064	0.067	0.071	0.028	0.048	0.053	0.061	0.000050	
Beryllium D-Be	<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	0.00050	
Bismuth D-Bi	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00050	
Boron D-B	0.006	0.005	0.005	0.006	0.005	0.007	0.005	0.004	0.004	0.005	0.005	0.006	0.005	0.003	0.005	0.004	0.008	0.010	
Cadmium D-Cd	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00003	0.00002	0.00002	<0.00001	<0.00001	<0.00001	0.000050	
Calcium D-Ca	03.8	44.8	46.9	40.0	42.2	40.7	42.4	42.1	41.8	41.6	42.7	42.0	51.0	14.5	29.4	32.6	39.6	0.050	
Chromium D-Cr	0.0006	0.0009	0.0016	0.0009	0.0006	0.001	0.0007	0.0005	0.0005	<0.0005	0.0005	0.0069	0.0017	<0.0005	0.0011	0.0008	<0.0005	0.00050	
Cobalt D-Co	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0002	0.0002	<0.0001	<0.0002	<0.0001	<0.0001	0.00010	
Copper D-Cu	0.0020	0.0020	0.0040	0.0020	0.0030	0.0020	0.0020	0.0020	<0.001	0.0020	0.0020	0.0020	0.0020	0.0030	0.003	0.004	0.003	0.00010	
Iron D-Fe	0.020	0.060	0.050	0.060	0.050	0.060	0.060	0.040	0.050	0.030	0.020	0.020	0.050	0.140	0.13	0.03	0.05	0.030	
Lead D-Pb	<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	0.0003	<0.0001	<0.0001	<0.0001	0.000050	
Lithium D-Li	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.003	<0.001	0.001	0.002	0.001	0.0050	
Magnesium D-Mg	00.9	14.2	18.1	13.1	13.6	13.8	14.1	13.5	13.5	13.2	13.1	14.0	21.5	03.9	10.4	10.8	12.1	0.10	
Manganese D-Mn	0.0080	0.0120	0.0270	0.0130	0.0180	0.0120	0.0200	0.0130	0.0120	0.0180	0.0250	0.0280	0.0460	0.0450	0.01	<0.005	0.006	0.000050	
Mercury D-Hg														<0.0001	<0.0001	<0.0001	<0.0001	0.000020	
Molybdenum D-Mo	<0.001	0.001	0.002	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	0.000050	
Nickel D-Ni	0.0007	0.0010	0.0007	0.0005	0.0010	0.0009	<0.0005	0.0006	0.0008	0.0008	0.0011	0.0009	0.0011	0.0014	0.0008	<0.0005	<0.0005	0.00050	
Phosphorus D-P						1.3000					0.0800		0.0700	0.0900				0.30	
Potassium D-K	0.8	1.2	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.3	1.4	1.4	5.2	2.3	1.3	1.4	1.4	2.0	
Selenium D-Se	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	0.0010	
Silicon D-Si	3.79	6.22	6.15	5.77	5.75	5.27	5.76	6.13	6.02	6.05	5.82	6.07	9.97	3.46	5.29	4.33	5.05	0.050	
Silver D-Ag	<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	0.000010	
Sodium D-Na	9.1	10.8	11.4	9.3	9.8	9.6	8.9	9.5	8.7	8.3	9.7	8.8	14.7	3.2	6.3	7.5	9	2.0	
Strontium D-Sr	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.1	0.248	0.29	0.351	0.00010	
Thallium D-Tl	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00010	
Tin D-Sn	<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	0.00010	
Titanium D-Ti	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.0007	<0.0005	0.0006	0.0008	0.0008	0.0005	0.0009	0.0028	<0.0005	0.001	0.001	0.001	0.010	
Uranium D-U	0.00150	0.00140	0.00110	0.00160	0.00160	0.00160	0.00180	0.00150	0.00150	0.00150	0.00180	0.00170	0.00140	<0.0005	0.001	0.0013	0.0014	0.000010	
Vanadium D-V	0.0015	0.0009	0.0018	0.0016	0.0019	0.0015	0.0015	0.0016	0.0012	0.0009	0.0009	0.0021	0.0043	0.0007	0.0014	0.001	0.0014	0.0010	
Zinc D-Zn	<0.001	0.002	0.002	<0.001	0.001	0.001	0.002	0.002	<0.001	<0.001	0.002	0.002	0.008	0.009	0.001	0.002	0.002	0.0010	
Organic Parameters																			
Dissolved Organic Carbon C	9	9.4	8.2	7.9	8.5	8.1	7.8	7.7	8.2	8.1	7.5	7.7	21	27	13.6	10.2	10.4	0.5	
Total Inorganic Carbon C	36.5	38.3	43.8	38.2	37.6	37.8	37.6	36.7	37.8	37.3	47.6	39.1						0.5	
Total Organic Carbon C	8.5	8.8	8.4	8.6	8.2	8.7	8.3	8.4	7.8	8.2	8.2	7.9						0.5	
Radiological Parameters																			
Radium-226	<0.005	<0.0050	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.005	<0.005	<0.005						0.0050	

Notes:

[1] All units are in mg/L unless otherwise indicated

[2] Detection limit from October 2005 results except Mercury which is from September 2005 results

[3] Range is based on an average pH of 8.0 and a temperature range of 0 to 10ºC

[4] Based on guideline for Hexavalent chromium (Cr(VI))

Sample ID	MINTO W-4													
Sample Site Description	Yukon Receiving Waters, 100 m Upstream Mouth of Minto Creek												Detection Limit[2]	CCME Guidelines Water: Freshwater Aquatic Life
Date Sampled	15-May-94	07-Jun-94	08-Jul-94	10-Aug-94	26-Sep-94	27-May-05	30-Jun-05	29-Jul-05	30-Aug-05	28-Sep-05	15-Oct-05	02-Jun-06		
Sampled by						JG, DG	JG	JG, DC	JG		JG			
***Parameter*[1]**														
Physical Tests														
Electrical Conductivity (Lab) (µs/cm)	142	145	142	132	66.3	148	135	129	143	151	154	142	**2**	
Electrical Conductivity (Field) (µs/cm)														
Total Dissolved Solids	94	88	90	8	74	80	81	71	80	94	94	90	**10**	
Hardness	70.4	71.9	69.7	65.8	62	72.2	-	66.6	69.7	79.2	77.4		**0.54**	
pH (Lab)	7.89	7.79	8.3	7.95	7.92	8.03	8.08	7.93	8	7.4	8.05	7.6	**0.01**	**6.5 - 9.0**
pH (Field)														
Total Suspended Solids	-	63	18	11	6	79	19.5	7.2	5.5	6	3	49.9	**3**	
Tempurature (field) (˚C)														
Turbidity	-	17.5	8.26	5.32	3.06	-	-	-	-	-	-			
Dissolved Anions														
Alkalinity-Total CaCO3	63.7	65.3	64	60.6	54.5	67.1	56.9	63.8	69.9	67.4	73.8	65.5	**2**	
Bromide Br												<0.050		
Chloride Cl	1	0.5	0.6	0.6	<0.5	<0.50	0.63	<0.50	<0.50	<0.50	<0.50	<0.50	**0.5**	
Fluoride F	0.11	0.1	0.09	0.18	0.11	-	-	-	-	-	-	0.091		
Sulphate SO4	11.1	8.6	8.4	8.3	8.4	9.64	9.2	8.06	9.12	9.71	10.1	9.13	**0.5**	
Organic Parameters														
Dissolved Organic Carbon	10.4	3.27	-	-	-	-	-	-	-	-	-			
Total Organic Carbon	-	3.4	2.1	1.7	1.7	-	-	-	-	-	-			
Nutrients														
Ammonia Nitrogen N	<0.005	<0.005	<0.0005	<0.005	<0.005	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	**0.02**	**1.04 - 2.33[3]**
Nitrate Nitrogen N	0.023	0.024	0.007	<0.005	0.005	0.0339	0.0375	<0.0050	0.0142	0.0299	0.0337	0.0422	**0.005**	
Nitrite Nitrogen N	0.002	0.004	0.003	0.002	0.002	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.001**	**0.06**
ortho-Phosphate	0.001	0.024	0.015	0.004	0.004	-	-	-	-	-	-			
Total Dissolved Phosphate	0.008	0.032	0.016	0.005	0.006	-	-	-	-	-	-			
Total Phosplate	0.06	0.062	0.026	0.017	0.017	-	-	-	-	-	-			
Cyanides														
Total Cyanide CN	0.014	0.002	<0.001	<0.001	<0.001	-	-	-	-	-	-		**0.005**	
Total Metals (Trace)														
Aluminum T-Al	0.684	0.624	0.154	0.166	0.108	1.14	0.177	0.127	0.0732	0.0781	0.0557	1.29	**0.001**	**0.005 - 0.1**
Antimony T-Sb	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	0.00015	**0.0001**	
Arsenic T-As	0.001	0.0007	<0.0001	0.0005	0.0003	0.00104	0.00057	0.00051	0.00066	<0.00050	0.00046	0.00118	**0.0001**	**0.005**
Barium T-Ba	0.055	0.045	0.037	0.032	0.026	0.053	0.0344	0.0315	0.039	0.042	0.0387	0.0583	**0.00005**	
Beryllium T-Be	<0.005	<0.045	<0.005	<0.005	<0.005	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050	**0.0005**	
Bismuth T-Bi	<0.10	<0.005	<0.10	<0.10	<0.10	-	<0.00050	<0.00050	-	-	<0.00050	<0.00050	**0.0005**	
Boron T-B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.010	<0.010	<0.10	<0.10	<0.010	<0.010	**0.01**	
Cadmium T-Cd	<0.0002	<0.10	<0.0002	<0.0002	<0.0002	<0.000050	<0.000050	<0.000050	0.000081	<0.00017	<0.000050	<0.000050	**0.00005**	**0.000017**
Calcium T-Ca	20.4	<0.0002	20.9	19.2	18.3	19.9	19	18.8	18.9	21.6	22	21.3	**0.05**	
Chromium T-Cr	0.003	20.2	<0.001	<0.001	<0.001	0.0026	0.00065	0.00091	<0.0010	<0.0010	<0.00050	0.00272	**0.0005**	**0.001***
Cobalt T-Co	<0.001	0.001	<0.001	<0.001	<0.001	0.00088	0.00018	<0.00010	<0.00030	<0.00030	<0.00010	0.00082	**0.0001**	
Copper T-Cu	0.004	0.002	0.001	<0.001	0.001	0.0037	0.00126	0.00104	0.0017	<0.0010	0.00089	0.00537	**0.0001**	**0.002 - 0.004**
Iron T-Fe	1.03	0.561	0.21	0.179	0.102	1.49	0.3	0.184	0.136	0.14	0.102	1.7	**0.03**	**0.3**
Lead T-Pb	0.005	<0.001	0.016	<0.001	<0.001	0.00059	0.000292	0.000116	<0.00050	<0.00050	<0.000050	0.000635	**0.00005**	**0.001 - 0.007**
Lithium T-Li	-	-	-	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.005**	
Magnesium T-Mg	5.91	5.52	4.9	4.37	3.95	5.78	4.82	4.38	5.2	5.92	6.1	6.64	**0.1**	
Manganese T-Mn	0.045	0.03	0.014	0.01	0.005	0.0536	0.0143	0.0103	0.00838	0.00869	0.0074	0.0497	**0.00005**	
Mercury T-Hg	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.000020	-	-	<0.000020	<0.000020	-		**0.00002**	**0.0001**
Molybdenum T-Mo	<0.001	<0.001	<0.001	0.001	<0.001	<0.0010	0.000985	0.00136	0.0012	0.0011	0.00111	0.000987	**0.00005**	**0.073**
Nickel T-Ni	0.003	0.001	0.001	<0.001	<0.001	0.0033	0.00093	0.00057	0.0014	<0.0010	0.00051	0.00371	**0.0005**	**0.025 - 0.15**
Phosphorous T-P	-	-	-	-	-	-	<0.30	<0.30	-	-	<0.30	<0.30	**0.3**	
Potassium T-K	-	-	-	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	**2**	
Selenium T-Se	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.001**	**0.001**
Silicon T-Si	-	-	-	-	-	-	3.11	2.38	-	-	3.28	5.2	**0.05**	
Silver T-Ag	3.79	3.56	3.24	2.54	2.34	<0.000020	<0.000010	<0.000010	<0.000020	<0.000020	<0.000010	0.000014	**0.00001**	**0.0001**
Sodium T-Na	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<2.0	<2.0	<2.0	2.4	2.6	2.4	3	**2**	
Strontium T-Sr	0.117	0.094	0.087	0.087	0.077	-	0.0795	0.083	-	-	0.121	0.124	**0.0001**	
Thallium T-Tl	-	-	-	-	-	<0.00020	<0.00010	<0.00010	<0.00020	<0.00020	<0.00010	<0.00010	**0.0001**	**0.0008**
Tin T-Sn	-	-	-	-	-	<0.00050	<0.00010	0.00021	<0.00050	<0.00050	<0.00010	0.0001	**0.0001**	
Titanium T-Ti	-	-	-	-	-	0.057	<0.010	<0.010	<0.010	<0.010	<0.010	0.065	**0.01**	
Uranium T-U	0.00078	0.0006	0.00054	0.00058	0.00076	0.00092	0.000751	0.000714	0.0009	0.00091	0.001	0.00114	**0.00001**	
Vanadium T-V	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0010	<0.0010	<0.030	<0.030	<0.0010	0.0043	**0.001**	
Zinc T-Zn	0.013	<0.005	<0.005	<0.005	<0.005	0.006	<0.0030	<0.0030	<0.0050	<0.0050	<0.0010	0.0086	**0.001**	**0.03**
Dissolved Metals (Trace)														
Aluminum D-Al	0.035	0.02	0.023	0.013	0.007	0.0108	0.009	0.02	0.0087	0.0099	0.0072	0.0343	**0.001**	
Antimony D-Sb	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	<0.00010	**0.0001**	
Arsenic D-As	0.0004	0.0003	<0.0001	0.0005	0.0003	<0.00050	0.00044	0.00043	<0.00050	<0.00050	0.00042	0.00048	**0.0001**	
Barium D-Ba	0.039	0.037	0.033	0.029	0.026	0.032	0.0296	0.0283	0.038	0.042	0.0378	0.0366	**0.00005**	
Beryllium D-Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050	**0.0005**	
Bismuth D-Bi	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.00050	<0.00050	-	-	<0.00050	<0.00050	**0.0005**	
Boron D-B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.010	<0.010	<0.10	<0.10	<0.010	<0.010	**0.01**	
Cadmium D-Cd	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000050	<0.000050	**0.00005**	
Calcium D-Ca	19.2	19.7	20.1	19.2	18.3	20.3	18.7	19.3	19.2	21.8	21.2	20.7	**0.05**	
Chromium D-Cr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050	**0.0005**	
Cobalt D-Co	<0.001	<0.001	<0.001	<0.001	<0.001	<0.00030	<0.00010	<0.00010	<0.00030	<0.00030	<0.00010	<0.00010	**0.0001**	
Copper D-Cu	0.002	0.001	<0.001	<0.001	0.001	<0.0010	0.00069	0.00101	0.001	<0.0010	0.00069	0.00169	**0.0001**	
Iron D-Fe	0.075	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.053	**0.03**	
Lead D-Pb	<0.001	<0.001	0.002	<0.001	<0.001	<0.00050	0.00007	<0.000050	<0.00050	<0.00050	<0.000050	<0.000050	**0.00005**	
Lithium D-Li	-	-	-	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.005**	
Magnesium D-Mg	5.47	5.52	4.75	4.37	3.95	5.19	4.55	4.49	5.27	6.01	5.91	6.06	**0.1**	
Manganese D-Mn	0.007	0.005	<0.005	<0.005	<0.005	0.00271	0.00148	0.000691	0.0029	0.00397	0.00433	0.0051	**0.00005**	
Mercury D-Hg	-	-	-	-	-	<0.000020	-	-	<0.000020	<0.000020	-		**0.00002**	
Molybdenum D-Mo	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	0.00106	0.0012	0.0012	0.0011	0.00114	0.00087	**0.00005**	
Nickel D-Ni	0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.00050	0.00053	<0.0010	<0.0010	<0.00050	0.0008	**0.0005**	
Phosphorus D-P	-	-	-	-	-	-	<0.30	<0.30	-	-	<0.30	<0.30	**0.3**	
Potassium D-K	0.89	0.72	0.76	0.68	0.74	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	**2**	
Selenium D-Se	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.001**	
Silicon D-Si	2.83	3.4	2.96	2.47	2.25	-	2.75	2.25	-	-	3.11	3.03	**0.05**	
Silver D-Ag	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.000020	<0.000010	<0.000010	<0.000020	<0.000020	<0.000010	<0.000010	**0.00001**	
Sodium D-Na	2.35	2.2	1.53	1.37	1.48	<2.0	<2.0	<2.0	2.5	2.7	2.3	2.9	**2**	
Strontium D-Sr	0.113	0.09	0.085	0.087	0.077	-	0.0752	0.0798	-	-	0.121	0.112	**0.0001**	
Thallium D-Tl	-	-	-	-	-	<0.00020	<0.00010	<0.00010	<0.00020	<0.00020	<0.00010	<0.00010	**0.0001**	
Tin D-Sn	-	-	-	-	-	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	<0.00010	**0.0001**	
Titanium D-Ti	-	-	-	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	**0.01**	
Uranium D-U	0.00064	0.0006	0.00045	0.00058	0.00063	0.00079	0.000702	0.000703	0.00087	0.00089	0.001	0.000996	**0.00001**	
Vanadium D-V	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0010	<0.0010	<0.030	<0.030	<0.0010	<0.0010	**0.001**	
Zinc D-Zn	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	0.0018	0.0017	<0.0050	<0.0050	0.0015	0.0017	**0.001**	
Radiological Parameters														
Radium-226	-	-	-	-	-	-	-	-	-	-	-	-	**0.005**	

Notes:

[1] All units are in mg/L unless otherwise indicated

[2] Detection limit from October 2005 results except Mercury which is from September 2005 results

[3] Range is based on an average pH of 8.0 and a temperature range of 0 to 10ºC

[4] Based on guideline for Hexavalent chromium (Cr(VI))

Sample ID	MINTO W-5												
Sample Site Description	Yukon Receiving Waters, 100m Downstream Mouth of Minto Creek											Detection Limit[2]	CCME Guidelines Water: Freshwater Aquatic Life
Date Sampled	15-May-94	07-Jun-94	08-Jul-94	10-Aug-94	26-Sep-94	27-May-05	30-Jun-05	29-Jul-05	30-Aug-05	28-Sep-05	15-Oct-05		
Sampled by						JG, DG	JG	JG, DC	JG		JG		
Parameter[1]													
Physical Tests													
Electrical Conductivity (Lab) (µs/cm)	158	144	141	134	136	147	134	133	142	154	153	**2**	
Electrical Conductivity (Field) (µs/cm)													
Total Dissolved Solids	101	88	91	82	79	90	77	80	90	93	91	**10**	
Hardness	75.4	72.4	69.9	66.2	68.8	72.9		68.3	71.5	81.8	81.4	**0.54**	
pH (Lab)	7.93	7.4	8.1	7.96	7.89	8.02	8.05	7.85	8.01	7.78	8.02	**0.01**	**6.5 - 9.0**
pH (Field)													
Total Suspended Solids	51	52	14	9	5	79.5	21.5	6.2	7	10	3.5	**3**	
Tempurature (field) (˚C)													
Turbidity	30.1	19.4	7.03	4.74	2.34	-	-	-	-	-	-		
Dissolved Anions													
Alkalinity-Total CaCO3	70.9	65.2	66.4	63.9	58.5	62.8	59.7	64.4	69.1	73.1	72.9	**2**	
Chloride Cl	0.9	0.5	0.5	<0.5	<0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.5**	
Fluoride F	0.1	0.1	0.09	0.16	0.11	-	-	-	-	-	-		
Sulphate SO4	10.6	8.9	8	8.2	7.9	9.51	8.9	8.23	9.14	9.88	10.1	**0.5**	
Organic Parameters													
Dissolved Organic Carbon	5.49	2.72	-	-	-	-	-	-	-	-	-		
Total Organic Carbon	-	3.2	2.5	1.8	1.6	-	-	-	-	-	-		
Nutrients													
Ammonia Nitrogen N	<0.005	<0.005	<0.005	<0.005	<0.005	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	**0.02**	**1.04 - 2.33[3]**
Nitrate Nitrogen N	0.022	0.023	0.006	<0.005	0.006	0.0346	0.0074	0.0057	0.0165	0.0252	0.0353	**0.005**	
Nitrite Nitrogen N	0.001	0.004	0.003	0.002	0.002	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.001**	**0.06**
ortho-Phosphate	<0.001	0.008	0.015	0.004	0.003	-	-	-	-	-	-		
Total Dissolved Phosphate	0.003	0.011	0.017	0.005	0.005	-	-	-	-	-	-		
Total Phosphorous	0.094	0.056	0.033	0.011	0.014	-	-	-	-	-	-		
Cyanides													
Total Cyanide CN	0.004	0.003	0.002	0.001	<0.001	-	-	-	-	-	-	**0.005**	
Total Metals (Trace)													
Aluminum T-Al	0.74	0.557	0.18	0.153	0.028	1.14	0.161	0.0658	0.146	0.0849	0.0632	**0.001**	**0.005 - 0.1**
Antimony T-Sb	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	**0.0001**	
Arsenic T-As	0.001	0.0008	0.0011	0.0005	0.0003	0.00104	0.00057	0.00051	0.00072	0.00051	0.00046	**0.0001**	**0.005**
Barium T-Ba	0.058	0.045	0.038	0.033	0.031	0.051	0.0341	0.0326	0.042	0.041	0.0392	**0.00005**	
Beryllium T-Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	**0.0005**	
Bismuth T-Bi	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.00050	<0.00050	-	-	<0.00050	**0.0005**	
Boron T-B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.010	<0.010	<0.10	<0.10	<0.010	**0.01**	
Cadmium T-Cd	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.000050	<0.000050	<0.000050	0.000038	<0.000017	<0.000050	**0.00005**	**0.000017**
Calcium T-Ca	22.6	20.3	20.5	19.2	20.5	20.1	18.9	19.2	19.4	22.2	21.8	**0.05**	
Chromium T-Cr	0.003	0.001	<0.001	<0.001	<0.001	0.0027	0.00066	<0.00050	<0.0010	<0.0010	<0.00050	**0.0005**	**0.001[4]**
Cobalt T-Co	<0.001	<0.001	<0.001	<0.001	<0.001	0.00087	0.00018	<0.00010	<0.00030	<0.00030	<0.00010	**0.0001**	
Copper T-Cu	0.004	0.002	0.001	0.003	<0.001	0.0038	0.00115	0.00093	0.0014	0.0012	0.00087	**0.0001**	**0.002 - 0.004**
Iron T-Fe	1.18	0.56	0.24	0.15	0.098	1.5	0.271	0.127	0.242	0.185	0.103	**0.03**	**0.3**
Lead T-Pb	0.004	<0.001	0.002	<0.001	<0.001	0.00066	0.000149	0.000087	<0.00050	<0.00050	<0.000050	**0.00005**	**0.001 - 0.007**
Lithium T-Li	-	-	-	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.005**	
Magnesium T-Mg	6.28	5.54	4.99	4.42	4.33	5.75	4.69	4.7	5.38	5.91	6.06	**0.1**	
Manganese T-Mn	0.047	0.029	0.015	0.01	<0.005	0.0531	0.014	0.00844	0.0115	0.0173	0.0077	**0.00005**	
Mercury T-Hg	0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.000020	-	-	<0.000020	<0.000020	-	**0.00002**	**0.0001**
Molybdenum T-Mo	<0.001	0.001	<0.001	0.001	<0.001	<0.0010	0.00103	0.00119	0.0011	0.0011	0.00111	**0.00005**	**0.073**
Nickel T-Ni	0.003	0.001	0.001	<0.001	<0.001	0.0033	0.00089	0.00056	<0.0010	<0.0010	<0.00050	**0.0005**	**0.025 - 0.15**
Phosphorous T-P	-	-	-	-	-	-	<0.30	<0.30	-	-	<0.30	**0.3**	
Potassium T-K	-	-	-	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	**2**	
Selenium T-Se	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.001**	**0.001**
Silicon T-Si	3.73	3.56	3.3	2.57	2.51	-	3.02	2.54	-	-	3.28	**0.05**	
Silver T-Ag	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.000030	0.000012	<0.000010	<0.000020	<0.000020	<0.000010	**0.00001**	**0.0001**
Sodium T-Na	-	-	-	-	-	<2.0	<2.0	<2.0	2.5	2.4	2.4	**2**	
Strontium T-Sr	0.116	0.095	0.091	0.088	0.087	-	0.0786	0.0885	-		0.12	**0.0001**	
Thallium T-Tl	-	-	-	-	-	<0.00020	<0.00010	<0.00010	<0.00020	<0.00020	<0.00010	**0.0001**	**0.0008**
Tin T-Sn	-	-	-	-	-	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	**0.0001**	
Titanium T-Ti	-	-	-	-	-	0.057	<0.010	<0.010	<0.010	<0.010	<0.010	**0.01**	
Uranium T-U	0.00071	0.00065	0.00057	0.0006	0.00073	0.00096	0.000731	0.000756	0.00092	0.00082	0.000999	**0.00001**	
Vanadium T-V	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0010	<0.0010	<0.030	<0.030	<0.0010	**0.001**	
Zinc T-Zn	0.013	<0.005	<0.005	<0.005	<0.005	0.0058	<0.0020	0.0031	<0.0050	<0.0050	<0.0010	**0.001**	**0.03**
Dissolved Metals (Trace)													
Aluminum D-Al	0.019	0.021	0.019	0.018	<0.005	0.0117	0.0148	0.008	0.0087	0.009	0.0072	**0.001**	
Antimony D-Sb	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	**0.0001**	
Arsenic D-As	0.0004	0.0003	0.0002	0.0005	0.0003	<0.00050	0.00046	0.00044	<0.00050	<0.00050	0.00042	**0.0001**	
Barium D-Ba	0.04	0.035	0.033	0.032	0.029	0.034	0.0305	0.0307	0.039	0.04	0.0378	**0.00005**	
Beryllium D-Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	**0.0005**	
Bismuth D-Bi	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.00050	<0.00050	-	-	<0.00050	**0.0005**	
Boron D-B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.010	<0.010	<0.10	<0.10	<0.010	**0.01**	
Cadmium D-Cd	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000050	**0.00005**	
Calcium D-Ca	20.9	20.1	20.1	19.2	20.5	20.3	19.3	19.5	19.7	22.7	22.4	**0.05**	
Chromium D-Cr	<0.001	0.001	<0.001	<0.001	<0.001	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	**0.0005**	
Cobalt D-Co	<0.001	<0.001	<0.001	<0.001	<0.001	<0.00030	<0.00010	<0.00010	<0.00030	<0.00030	<0.00010	**0.0001**	
Copper D-Cu	0.002	0.001	<0.001	<0.001	<0.001	<0.0010	0.00105	0.00084	0.001	<0.0010	0.00071	**0.0001**	
Iron D-Fe	0.044	0.096	0.031	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.053	0.031	**0.03**	
Lead D-Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.00050	0.000257	<0.000050	<0.00050	<0.00050	<0.000050	**0.00005**	
Lithium D-Li	-	-	-	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.005**	
Magnesium D-Mg	5.66	5.43	4.81	4.42	4.31	5.4	4.7	4.75	5.39	6.1	6.19	**0.1**	
Manganese D-Mn	0.007	0.006	<0.005	<0.005	<0.005	0.00345	0.00197	0.00139	0.00296	0.0108	0.00414	**0.00005**	
Mercury D-Hg	-	-	-		-	<0.000020	-	-	<0.000020	<0.000020	-	**0.00002**	
Molybdenum D-Mo	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	0.00108	0.00116	0.0012	0.0011	0.00112	**0.00005**	
Nickel D-Ni	0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	**0.0005**	
Phosphorus D-P	-	-	-	-	-	-	<0.30	<0.30	-	-	<0.30	**0.3**	
Potassium D-K	0.91	0.72	0.74	0.69	0.79	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	**2**	
Selenium D-Se	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	**0.001**	
Silicon D-Si	2.7	3.26	3.04	2.53	2.38	-	2.83	2.49	-		3.26	**0.05**	
Silver D-Ag	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.000020	<0.000010	<0.000010	<0.000020	<0.000020	<0.000010	**0.00001**	
Sodium D-Na	2.16	2	1.63	1.44	1.59	<2.0	<2.0	<2.0	2.5	2.5	2.5	**2**	
Strontium D-Sr	0.11	0.095	0.088	0.088	0.086	-	0.0774	0.0878	-	#VALUE!	0.121	**0.0001**	
Thallium D-Tl	-	-	-	-	-	<0.00020	<0.00010	<0.00010	<0.00020	<0.00020	<0.00010	**0.0001**	
Tin D-Sn	-	-	-	-	-	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	**0.0001**	
Titanium D-Ti	-	-	-	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	**0.01**	
Uranium D-U	0.0007	0.00065	0.00047	0.00057	0.00067	0.00081	0.00069	0.00076	0.00086	0.0008	0.001	**0.00001**	
Vanadium D-V	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0010	<0.0010	<0.030	<0.030	<0.0010	**0.001**	
Zinc D-Zn	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	0.005	<0.0010	<0.0050	<0.0050	0.0014	**0.001**	
Radiological Parameters													
Radium-226	-	-	-	-	-	-	-	-	-	-	-	**0.005**	

Notes:

Data not entered for May 94 to Sept 94

[1] All units are in mg/L unless otherwise indicated

[2] Detection limit from October 2005 results except Mercury which is from September 2005 results

[3] Range is based on an average pH of 8.0 and a temperature range of 0 to 10ºC

[4] Based on guideline for Hexavalent chromium (Cr(VI))

Sample ID	MINTO W-7																			
Sample Site Description	North Flowing Tributary to Minto Creek, 0.8 km Downstream Dam Site																			
Date Sampled	07-Jun-94	08-Jul-94	10-Aug-94	27-May-05	30-Jun-05	29-Jul-05	30-Aug-05	28-Sep-05	15-Oct-05	02-Jun-06	08-Jun-06	15-Jun-06	23-Jun-06	28-Jun-06	07-Jul-06	12-Jul-06	20-Jul-06	26-Jul-06	02-Aug-06	10-Aug-06
Sampled by				JG, DG	JG	JG, DC	JG		JG				SVB				J. Gibson		S.VB	SVB
Parameter [1]																				
Physical Tests																				
Electrical Conductivity (Lab) (µs/cm)	121	133	199	152	233	323	211	190	194	099		193	246	213	205	238	233	259	256	259
Electrical Conductivity (Field) (µs/cm)																				
Total Dissolved Solids	97	93	128	116	153	197	148	142	145	104		114	176	120	184					
Hardness	64.9	67.1	101	76.6		167	109	107	106			100	122	107	110		130	128	128	126
pH (Lab)	7.18	7.84	7.71	7.95	7.87	7.18	8.19	8.02	6.75	7.61		7.86	7.78	7.90	7.91	7.77	7.88	7.87	7.79	7.80
pH (Field)																				
Total Suspended Solids (Lab)													328.00							
Total Suspended Solids (Field)	79	13	5	30.5	14.0	19.7	3.0	361	7.5	705				103	003	<2	002	009	004	
Tempurature (field) (˚C)																				
Turbidity	16.0	3.76	0.57	-	-	-	-	-	-											<2
Dissolved Anions																				
Alkalinity-Total CaCO3	55.4	64.9	99.8	68.4	117	146	113	95.9	107	49.4		95.0	130.0	106.0	120.0	120.0	122.0	121.0	125.0	125.0
Bromide Br										<0.050										
Chloride Cl	1.0	1.2	1.1	<0.50	0.92	<0.50	<0.50	<0.50	<0.50	<0.50										
Fluoride F	0.17	0.16	0.35	-	-	-	-	-	-	0.155										
Sulphate SO4	10.4	9.7	11.6	6.18	10.2	29.9	6.02	5.62	7.47	2.98		10.50	15.10		10.80		10.50	11.60	10.00	10.00
Nutrients																				
Ammonia Nitrogen N	0.007	0.009	<0.005	<0.020	<0.020	<0.020	0.020	<0.020	0.021	0.062		0.027	0.028	0.01	0.011	0.014	0.012	0.016	0.015	0.014
Nitrate Nitrogen N	0.063	0.048	0.06	0.0824	0.172	0.169	0.0226	0.0586	0.102	0.0449		0.1800	0.2300	0.1120	0.2050	0.1800	0.1900	0.1800	0.1500	0.1600
Nitrite Nitrogen N	0.005	0.004	0.002	0.0018	0.0017	<0.0010	<0.0010	<0.0010	<0.0010	0.0015										
ortho-Phosphate	0.008	0.010	0.007	-	-	-	-	-	-											
Total Dissolved Phosphate	0.014	0.013	0.011	-	-	-	-	-	-											
Total Phosphorous	0.083	0.026	0.011	-	-	-	-	-	-											
Cyanides																				
Total Cyanide CN	0.009	0.013	0.008	-	-	-	-	-	-											
Total Metals (Trace)																				
Aluminum T-Al	0.556	0.120	0.029	0.489	0.153	0.506	0.0436	1.65	0.0738	11.40	0.65	1.48	5.09	1.69	0.10	0.08	0.06	0.10	0.06	0.03
Antimony T-Sb	>0.0001	>0.0001	<0.0001	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	0.00037	<0.00010	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic T-As	0.0006	0.0008	0.0003	0.00063	0.00049	0.00055	0.00053	0.00149	0.00052	0.00496	0.00078	0.00080	0.00220	0.00100	0.00040	0.00040	0.00050	0.00050	0.00060	0.00050
Barium T-Ba	0.066	0.045	0.058	0.054	0.0641	0.0700	0.064	0.113	0.0530	0.264	0.059	0.082	0.167	0.090	0.070	0.067	0.065	0.072	0.070	0.072
Beryllium T-Be	<0.055	<0.005	<0.005	<0.0010	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth T-Bi	<0.10	<0.10	<0.10	-	<0.00050	<0.00050	-	-	<0.00050	<0.00050	<0.00050	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron T-B	<0.10	<0.10	<0.10	<0.10	<0.010	<0.010	<0.10	<0.10	<0.010	<0.010	<0.010	0.006	0.005	0.006	0.005	0.005	0.029	0.004	0.006	0.005
Cadmium T-Cd	<0.0002	<0.0002	<0.0002	<0.000050	<0.000050	<0.000050	<0.000017	0.000061	<0.000050	0.000237	<0.000050	0.000020	0.000080	0.000030	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Calcium T-Ca	17.0	17.5	26.4	19.3	29.7	42.4	27.8	27.8	25.5	23.9	20.4	25.4	34.5	27.4	31.2	31.0	31.8	33.9	32.9	34.6
Chromium T-Cr	0.002	0.001	<0.001	0.0016	0.00065	0.00127	<0.0010	0.0037	0.00062	0.0234	0.0016	0.0032	0.0091	0.0031	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt T-Co	0.001	<0.001	<0.001	0.00049	0.00024	0.00042	<0.00030	0.00233	0.00018	0.00916	0.00078	0.00110	0.00370	0.00100	<0.0001	<0.0001	<0.0001	0.00010	<0.0001	0.00040
Copper T-Cu (Lab)													0.01000							
Copper T-Cu (On Site Hach)	0.003	0.002	0.001	0.0031	0.00162	0.0101	0.0015	0.0061	0.00147	0.0225	0.0040	0.0040		0.0040	0.0010	0.0010	0.0010	0.0010	0.0010	<0.001
Iron T-Fe	1.11	0.411	0.138	0.776	0.358	0.894	0.363	3.42	0.370	17.20	1.09	1.70	7.20	2.50	0.20	0.20	0.20	0.30	0.10	0.10
Lead T-Pb	<0.001	<0.001	<0.001	<0.00050	0.000134	0.000332	<0.00050	0.00110	0.000061	0.00547	0.00045	0.00060	0.00200	0.00070	<0.0001	<0.0001	<0.0001	0.00010	<0.0001	<0.0001
Lithium T-Li	-	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0079	<0.0050	0.002	0.005	0.002	0.001	0.001	0.001	0.001	0.001	0.001
Magnesium T-Mg	5.92	5.70	8.46	6.82	10.1	14.2	9.67	9.57	8.77	10.70	7.12	8.80	12.50	9.30	10.10	9.50	11.20	11.70	10.80	11.30
Manganese T-Mn	0.082	0.016	0.044	0.0519	0.0514	0.0468	0.0368	0.314	0.0473	0.589	0.065	0.079	0.226	0.086	0.035	0.035	0.042	0.051	0.033	0.040
Mercury T-Hg	0.00001	<0.00001	<0.00001	<0.000020	-	-	<0.000020	<0.000020	-											
Molybdenum T-Mo	<0.001	>0.001	<0.001	0.0010	0.00119	0.00121	0.0011	<0.0010	0.000959	0.000988	0.000843	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Nickel T-Ni	0.004	0.003	0.002	0.0030	0.00141	0.00174	0.0016	0.0068	0.00176	0.0275	0.0040	0.0052	0.0117	0.0042	0.0019	0.0014	0.0011	0.0009	0.0010	0.0009
Phosphorous T-P					<0.30	<0.30	-	-	<0.30	0.7700	<0.30									
Potassium T-K	-	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	1.1	1.6	1.1	1	1	0.9	1.1	1	1.1
Selenium T-Se	<0.0005	<0.0005	<0.0005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0002	0.0004	<0.0002	0.0002	0.0002	<0.0002	<0.0002	0.0005	<0.0002
Silicon T-Si	4.84	5.16	5.5	-	5.85	6.39	-	-	6.09	22.4	5.27	7.24	12.3	8.36	5.57	5.73	5.72	6.21	5.94	5.82
Silver T-Ag	<0.0001	<0.0001	<0.0001	<0.000020	<0.000010	<0.000020	<0.000020	<0.000020	<0.000010	0.000069	<0.000010	<0.0001	0.0003	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001
Sodium T-Na	-	-	-	3.9	6.8	7.7	5.9	4.9	5.1	4.5	4.4	5.8	7.0	6.0	7.4	6.5	6.4	6.5	6.9	7.2
Strontium T-Sr	0.171	0.179	0.283	-	0.279	0.287	-	-	0.240	0.204	0.174	0.276	0.367	0.267	0.329	0.323	0.334	0.362	0.342	0.362
Thallium T-Tl	-	-	-	<0.00020	<0.00010	<0.00010	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin T-Sn	-	-	-	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	0.00036	<0.00010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium T-Ti	-	-	-	0.022	<0.010	0.027	<0.010	0.060	<0.010	0.378	0.015	0.069	0.257	0.082	0.004	0.004	0.003	0.006	0.004	0.002
Uranium T-U	0.00035	0.00016	0.00034	0.00047	0.000769	0.00120	0.00058	0.00079	0.000547	0.00201	0.00053	0.00080	0.00140	0.00110	0.00110	0.00100	0.00120	0.00120	0.00100	0.00090
Vanadium T-V	<0.030	<0.030	<0.030	<0.030	0.0013	0.0024	<0.030	<0.030	<0.0010	0.0379	0.0035	0.0062	0.0173	0.0064	0.001	0.0009	0.0008	0.0011	0.001	0.0009
Zinc T-Zn	<0.005	<0.005	<0.005	<0.0050	<0.0020	<0.0050	<0.0050	0.0101	0.0017	0.0484	0.0048	0.0060	0.0220	0.0060	<0.001	0.0150	0.0020	0.0020	0.0010	0.0020
Dissolved Metals (Trace)																				
Aluminum D-Al	0.055	0.057	0.021	0.0236	0.0086	0.0096	0.0156	0.0186	0.0155	0.0714		0.0130	0.0110	0.4070	<0.005	0.0060	0.0060	0.0080	0.0080	0.0090
Antimony D-Sb	<0.0001	<0.0001	<0.0001	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	<0.00010		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic D-As	0.0002	0.0002	0.0003	<0.00050	0.00042	0.00035	0.00051	0.00054	0.00048	0.00062		0.00040	0.00050	0.00080	0.00060	0.00050	0.00040	0.00040	0.00042	0.00050
Barium D-Ba	0.044	0.044	0.058	0.045	0.0609	0.0610	0.062	0.055	0.0502	0.034		0.063	0.067	0.079	0.067	0.064	0.068	0.072	0.070	0.073
Beryllium D-Be	<0.005	<0.005	<0.005	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth D-Bi	<0.10	<0.10	<0.10	-	<0.00050	<0.00050	-	-	<0.00050	<0.00050		<0.0005	<0.0005	<0.0005	0.0007	0.0007	<0.0005	<0.0005	<0.0005	<0.0005
Boron D-B	<0.10	<0.10	<0.10	<0.10	<0.010	<0.010	<0.10	<0.10	<0.010	<0.010		0.003	0.002	0.002	0.005	0.005	0.004	<0.002	0.004	0.005
Cadmium D-Cd	<0.0002	<0.0002	<0.0002	<0.000050	<0.000050	<0.000050	<0.000017	<0.000017	<0.000050	<0.000050		<0.00001	<0.00001	0.00003	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Calcium D-Ca	16.6	17.5	26.4	19.5	30.0	41.3	27.8	27.4	27.1	14.4		26.9	31.8	22.8	26.5	26.9	33.0	33.4	33.3	32.9
Chromium D-Cr	<0.001	<0.001	<0.001	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	0.00055		<0.0005	0.0007	0.0015	0.0011	0.001	0.0007	<0.0005	<0.0005	0.0007
Cobalt D-Co	<0.001	<0.001	<0.001	<0.00030	<0.00010	<0.00010	<0.00030	<0.00030	0.00011	0.00033		0.0001	0.0001	0.0009	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Copper D-Cu	0.003	0.002	0.001	0.0018	0.00119	0.00404	0.0014	0.0016	0.00127	0.0021		0.0010	<0.001	0.0030	0.0010	0.0010	<0.001	0.0020	0.0010	0.0010
Iron D-Fe	0.281	0.237	0.126	0.136	0.070	0.105	0.292	0.320	0.253	0.546		0.090	0.090	0.060	0.060	0.060	0.110	0.100	0.070	0.080
Lead D-Pb	<0.001	<0.001	<0.001	<0.00050	<0.000050	<0.000050	<0.00050	<0.00050	<0.000050	0.000054		<0.0001	<0.0001	0.0005	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001
Lithium D-Li	-	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050		<0.001	<0.001	<0.001	0.001	0.001	0.001	<0.001	<0.001	0.001
Magnesium D-Mg	5.71	5.70	8.46	6.77	10.2	15.6	9.70	9.32	9.35	4.85		8.90	10.40	9.20	10.70	10.50	11.70	10.90	11.00	10.80
Manganese D-Mn	0.058	0.012	0.044	0.0193	0.0415	0.0244	0.0315	0.0414	0.0383	0.0882		0.0440	0.0430	0.0110	0.0230	0.0220	0.0420	0.0440	0.0330	0.0390
Mercury D-Hg	-	-	-	<0.000020	-	-	<0.000020	<0.000020	-											
Molybdenum D-Mo	<0.001	<0.001	<0.001	<0.0010	0.00124	0.00127	0.0010	<0.0010	0.000925	0.000697		0.001	0.001	<0.001	0.002	0.001	0.001	<0.001	<0.001	0.001
Nickel D-Ni	0.002	0.003	0.001	0.0016	0.00093	0.00095	0.0015	0.0018	0.00146	0.0022		0.0010	0.0013	0.0036	0.0015	0.0007	0.0006	0.0021	0.0006	0.0006
Phosphorus D-P	-	-	-	-	<0.30	<0.30	-	-	<0.30	<0.30								1.0000		
Potassium D-K	0.60	0.59	0.83	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		<0.4	1.1	0.8	0.8	0.9	1		1.1	1
Selenium D-Se	<0.0005	<0.0005	<0.0005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010		0.0002	0.0003	<0.0002	<0.0002	0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Silicon D-Si	4.32	5.16	5.5	-	5.72	5.47	-	-	6.44	4.19		5.35	5.5	6.48	6.8	5.36	6.34	5.35	5.87	5.9
Silver D-Ag	<0.0001	<0.0001	<0.0001	<0.000020	<0.000010	<0.000010	<0.000020	<0.000020	<0.000010	<0.000010		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium D-Na	3.01	3.04	5.23	3.9	6.9	8.8	5.9	5.3	5.5	3.8		5.9	5.9	6.2	6.7	6.6	6.7	7.0	7.2	7.2
Strontium D-Sr	0.166	0.179	0.283	-	0.284	0.277	-	-	0.230	0.1		0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.3
Thallium D-Tl	-	-	-	<0.00020	<0.00010	<0.00010	<0.00020	<0.00020	<0.00010	<0.00010		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin D-Sn	-	-	-	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	<0.00010		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium D-Ti	-	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010		0.0007	0.0006	0.0117	0.0007	0.0005	<0.0005	<0.0005	0.0005	0.0006
Uranium D-U	0.00025	0.00014	0.00031	0.00036	0.000759	0.000994	0.00055	0.00038	0.000515	0.00022		0.00070	0.00100	0.00090	0.00050	0.00070	0.00100	0.00100	0.00100	0.00100
Vanadium D-V	<0.030	<0.030	<0.030	<0.030	<0.0010	<0.0010	<0.030	<0.030	<0.0010	0.0017		0.0011	0.001	0.0029	0.0013	0.0018	0.0016	0.0007	0.0013	0.0015
Zinc D-Zn	<0.005	<0.005	<0.005	<0.0050	0.0064	0.0020	<0.0050	<0.0050	<0.0010	<0.0010		<0.001	0.002	0.005	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Organic parameters																				
Dissolved Organic Carbon	22.6	-	-	-	-	-	-	-	-											
Total Inorganic Carbon																				
Total Organic Carbon	25.2	24.7	13.6	-	-	-	-	-	-											
Radiological Parameters																				
Radium-226	-	-	-	-	-	-	-	-	-											

[1]Notes:

Data not entered for May 94 to Sept 94

[2] All units are in mg/L unless otherwise indicated

[3] Detection limit from October 2005 results except Mercury which is from September 2005 results

[4] Range is based on an average pH of 8.0 and a temperature range of 0 to 10ºC

[a] Based on guideline for Hexavalent chromium (Cr(VI))

Sample ID													
Sample Site Description												Detection Limit[a]	CCME Guidelines Water: Freshwater Aquatic Life
Date Sampled	18-Aug-06	23-Aug-06	30-Aug-06	06-Sep-06	13-Sep-06	20-Sep-06	28-Sep-06	04-Oct-06	12-Oct-06	05-Jun-05	20-Jun-07		
Sampled by	JG	JG	JG	SVB	SVB	SVB	JG	SVB	JG	SVB	JG		
Parameter [1]													
Physical Tests													
Electrical Conductivity (Lab) (µs/cm)	251	261	258	258	254	263	266	258	266	208	230	**2.0**	
Electrical Conductivity (Field) (µs/cm)													
Total Dissolved Solids		180	200				182		164	162	164	**10**	
Hardness	115	129	132	130	130	132	129	126	132	108	110	**0.54**	
pH (Lab)	7.86	7.92	7.79	7.88	7.84	7.85	7.26	7.94	7.39	7.98	7.84	**0.010**	**6.5 - 9.0**
pH (Field)													
Total Suspended Solids (Lab)	4.00		<2	4.00	5.00	3.00		2.00	4.00	76.00	6.00		
Total Suspended Solids (Field)												**3.0**	
Tempurature (field) (˚C)													
Turbidity										002	001		
Dissolved Anions													
Alkalinity-Total CaCO3	121.0	131.0	129.0	129.0	128.0	127.0	128.0	122.0	130.0	118.0	116.0	**2.0**	
Bromide Br													
Chloride Cl										0.7	0.6	**0.50**	
Fluoride F													
Sulphate SO4	10.70	11.00	10.50	10.30	10.00	11.00	11.00	10.90	11.30	11.00	12.20	**0.50**	
Nutrients													
Ammonia Nitrogen N	0.014	0.027	0.012	0.011	0.011	0.008	0.011	0.079	0.024	<0.05	<0.05	**0.020**	**1.04 - 2.33[3]**
Nitrate Nitrogen N	0.1200	0.1200	0.1100	0.0800	0.0940	0.1100	0.0800	0.1000	0.1200	<0.1	0.3000	**0.0050**	
Nitrite Nitrogen N										<0.05	<0.05	**0.0010**	**0.06**
ortho-Phosphate										0.15	0.05		
Total Dissolved Phosphate													
Total Phosphorous										0.14	<0.05		
Cyanides													
Total Cyanide CN												**0.0050**	
Total Metals (Trace)													
Aluminum T-Al	0.33	0.05	0.05	0.05	0.03	0.07	0.04	0.08	0.26	1.56	0.17	**0.0010**	**0.005 - 0.1**
Antimony T-Sb	<0.0004	<0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0004	<0.0004	<0.0002	<0.0002	<0.0002	**0.00010**	
Arsenic T-As	0.00060	0.00040	0.00050	0.00040	<0.0002	0.00050	<0.0004	0.00040	0.00040	0.00080	0.00040	**0.00010**	**0.005**
Barium T-Ba	0.077	0.069	0.070	0.070	0.037	0.070	0.073	0.074	0.076	0.084	0.066	**0.000050**	
Beryllium T-Be	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	**0.00050**	
Bismuth T-Bi	<0.001	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.0005	**0.00050**	
Boron T-B	0.007	0.007	0.005	0.006	0.004	0.006	0.007	0.005	0.006	0.009	0.007	**0.010**	
Cadmium T-Cd	<0.00002	<0.00002	<0.00001	<0.00001	<0.00001	<0.00001	<0.00002	<0.00002	<0.00001	0.000030	<0.00001	**0.000050**	**0.000017**
Calcium T-Ca	30.7	31.8	30.8	31.1	32.2	32.4	32.5	31.6	33.5	26.4	30.2	**0.050**	
Chromium T-Cr	0.0010	<0.001	0.0008	0.0008	<0.0005	<0.0005	<0.001	<0.001	0.0007	0.0031	0.0005	**0.00050**	**0.001[4]**
Cobalt T-Co	0.00030	<0.0002	<0.0001	0.00010	<0.0001	0.00010	<0.0002	<0.0002	0.00020	0.00120	0.00020	**0.00010**	
Copper T-Cu (Lab)	0.00300	<0.002	<0.001	0.00100	<0.001	0.00100	<0.002	<0.002	0.00200	0.00300	0.00200		
Copper T-Cu (On Site Hach)												**0.00010**	**0.002 - 0.004**
Iron T-Fe	0.70	<0.2	0.10	0.10	<0.2	0.20	<0.2	<0.2	0.50	2.00	0.20	**0.030**	**0.3**
Lead T-Pb	0.00030	<0.0002	<0.0001	0.00020	<0.0001	0.00010	<0.0002	<0.0002	0.00020	0.00060	0.00010	**0.000050**	**0.001 - 0.007**
Lithium T-Li	<0.002	<0.002	0.001	0.001	<0.001	0.001	<0.002	<0.002	0.001	0.002	0.001	**0.0050**	
Magnesium T-Mg	10.00	10.00	10.30	10.30	11.00	11.70	11.00	11.00	11.80	10.20	9.80	**0.10**	
Manganese T-Mn	0.047	0.039	0.035	0.035	0.033	0.042	0.037	0.038	0.063	0.126	0.044	**0.000050**	
Mercury T-Hg										<0.0001	<0.0001	**0.000020**	**0.0001**
Molybdenum T-Mo	<0.002	<0.002	0.001	0.001	<0.001	0.001	<0.002	<0.002	0.001	0.001	0.002	**0.000050**	**0.073**
Nickel T-Ni	0.0020	0.0010	0.0013	0.0013	0.0007	0.0014	0.0020	0.0020	0.0015	0.0033	0.0016	**0.00050**	**0.025 - 0.15**
Phosphorous T-P												**0.30**	
Potassium T-K	1.1	1.2	1	1	0.9	0.9	1.1	0.9	1	1.1	1	2.0	
Selenium T-Se	<0.0004	<0.0004	<0.0002	0.0004	0.0002	0.0004	0.0004	0.0006	<0.0002	<0.0002	0.0003	**0.0010**	**0.001**
Silicon T-Si	6.29	5.49	5.49	5.74	6.36	5.89	5.35	5.75	6.51	7.47	5.45	**0.050**	
Silver T-Ag	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	**0.000010**	**0.0001**
Sodium T-Na	6.6	6.7	6.7	6.8	7.1	6.6	6.9	7.0	6.6	5.8	7.2	**2.0**	
Strontium T-Sr	0.283	0.335	0.309	0.332	0.187	0.347	0.328	0.347	0.35	0.275	0.304	**0.00010**	
Thallium T-Tl	<0.0001	<0.0001	<0.00005	<0.00005	<0.00005	<0.00005	<0.0001	<0.0001	<0.00005	<0.00005	<0.00005	**0.00010**	**0.0008**
Tin T-Sn	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.001	<0.001	<0.001	**0.00010**	
Titanium T-Ti	0.021	<0.0010	0.003	0.003	0.001	0.004	0.002	0.004	0.012	0.078	0.006	**0.010**	
Uranium T-U	<0.001	0.00100	0.00110	0.00110	0.00060	0.00110	0.00100	0.00100	0.00110	0.00140	0.00140	**0.000010**	
Vanadium T-V	0.002	0.0009	0.0008	0.0009	0.0005	0.0009	0.0009	0.001	0.0014	0.0054	0.0016	**0.0010**	
Zinc T-Zn	0.0030	0.0040	0.0030	0.0010	<0.001	0.0050	0.0080	<0.002	0.0060	0.0090	0.0040	**0.0010**	**0.03**
Dissolved Metals (Trace)													
Aluminum D-Al	0.0070	0.0120	0.0130	0.0050	0.0080	0.0070	0.0110	<0.005	0.0070		0.0140	**0.0010**	
Antimony D-Sb	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002		<0.0002	**0.00010**	
Arsenic D-As	0.00040	0.00040	0.00040	0.00050	0.00030	0.00050	0.00040	0.00030	0.00040		0.00040	**0.00010**	
Barium D-Ba	0.067	0.071	0.067	0.068	0.064	0.069	0.071	0.068	0.067		0.060	**0.000050**	
Beryllium D-Be	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	**0.00050**	
Bismuth D-Bi	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	**0.00050**	
Boron D-B	0.005	0.005	0.004	0.005	0.005	0.005	0.003	0.004	0.005		0.005	**0.010**	
Cadmium D-Cd	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00028	<0.00001	<0.00001	<0.00001		<0.00001	**0.000050**	
Calcium D-Ca	27.8	32.4	33.6	33.5	32.3	33.5	33.3	32.6	34.0		29.6	**0.050**	
Chromium D-Cr	0.0006	0.0006	0.0008	0.0008	0.0009	0.0007	0.0008	<0.0005	<0.0005		0.0006	**0.00050**	
Cobalt D-Co	<0.0001	0.0002	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	**0.00010**	
Copper D-Cu	0.0020	0.0010	0.0020	0.0020	0.0010	0.0010	0.0010	<0.001	0.0010		0.0020	**0.00010**	
Iron D-Fe	0.100	0.080	0.100	0.100	0.110	0.090	0.080	0.110	0.090		0.050	**0.030**	
Lead D-Pb	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	**0.000050**	
Lithium D-Li	0.001	0.001	0.002	0.002	0.002	0.002	0.001	0.001	0.001		0.001	**0.0050**	
Magnesium D-Mg	11.00	11.70	11.70	11.20	11.40	11.60	11.10	10.90	11.40		9.80	**0.10**	
Manganese D-Mn	0.0350	0.0370	0.0380	0.0360	0.0300	0.0400	0.0350	0.0350	0.0430		0.0310	**0.000050**	
Mercury D-Hg											<0.0001	**0.000020**	
Molybdenum D-Mo	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001		0.001	**0.000050**	
Nickel D-Ni	0.0010	0.0009	0.0012	0.0010	0.0009	<0.0005	0.0008	0.0007	0.0006		<0.0005	**0.00050**	
Phosphorus D-P					0.9000							**0.30**	
Potassium D-K	1.2	0.9	1.2	0.8		1	1.1	1.1	1.1		1	**2.0**	
Selenium D-Se	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	<0.0002	<0.0002	0.0003		<0.0002	**0.0010**	
Silicon D-Si	6.25	6.32	5.84	6.02	5.56	5.74	5.97	5.93	6.08		5.02	**0.050**	
Silver D-Ag	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	**0.000010**	
Sodium D-Na	6.6	6.7	7.7	7.5	7.4	6.6	7.4	7.3	7.4		7.4	**2.0**	
Strontium D-Sr	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.3		0.3	**0.00010**	
Thallium D-Tl	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		<0.00005	**0.00010**	
Tin D-Sn	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	**0.00010**	
Titanium D-Ti	<0.0005	0.0005	0.0008	0.0005	0.0006	<0.0005	<0.0005	0.0007	0.0006		0.0009	**0.010**	
Uranium D-U	0.00110	0.00110	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00110		0.00120	**0.000010**	
Vanadium D-V	0.001	0.0017	0.0008	0.0018	0.0014	0.0015	0.0015	0.0011	0.0009		0.0016	**0.0010**	
Zinc D-Zn	0.003	0.003	0.005	0.002	0.001	<0.001	0.002	0.001	0.002		0.004	**0.0010**	
Organic parameters													
Dissolved Organic Carbon													
Total Inorganic Carbon													
Total Organic Carbon													
Radiological Parameters													
Radium-226												**0.0050**	

Notes:

Data not entered for May 94 to Sept 94

[1] All units are in mg/L unless otherwise indicated

[2] Detection limit from October 2005 results except Mercury which is from September 2005 results

[3] Range is based on an average pH of 8.0 and a temperature range o 0 to 10ºC

[4] Based on guideline for Hexavalent chromium (Cr(VI))

Minto Explorations Ltd.

Minto Project, Yukon

Environmental Effects Monitoring

FIRST STUDY DESIGN

Appendix C

Integrated Environmental Evaluation

Volume II – Environmental Setting

(Hallam Knight Piesold, 1994)

MINTO EXPLORATIONS LIMITED

MINTO PROJECT

VOLUME II

ENVIRONMENTAL SETTING

Prepared for

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December 1994

VOLUME II - FOREWORD

This Initial Environmental Evaluation (IEE) concerning the Minto Project has been prepared in accordance with requirements of the new Canadian Environmental Assessment Act (CEAA) and in support of an Application to the Yukon Territorial Water Board for a Water Licence. The IEE comprises a total of four volumes, as follows, this being Volume II:

- **Volume I - Development Plan**

  The Development Plan includes specifics on project history, geology, mineralization, ore reserves, conceptual mine plan, mill, waste disposal and ancillary facilities. This component of the report comprises a condensation of the Feasibility Study.

- **Volume II - Environmental Setting**

  The Environmental Setting contains all field acquired data and field studies, and provides a detailed description of the terrestrial, aquatic and atmospheric conditions present in the proposed mine site area.

- **Volume III - Socioeconomic Description and Impact Assessment**

  The Socioeconomic Description and Impact Assessment is divided into two Parts. Part A is devoted to a description of the socioeconomic fabric of the region, including Regional Districts, Municipalities and specific communities that may be affected by the project.

  Part B, the "Archaeological Assessment", reviews the potential archaeological and heritage resources in the vicinity of the project and assesses any impact the proposed development will have on these areas.

- **Volume IV - Environmental Impact Assessment**

  This volume of the report will contain comprehensive descriptions of:

  - Waste Management Plans,
  - Dangerous Goods, Hazardous and Special Waste Handling,
  - Water Management Plans,
  - Spill Contingencies and Emergency Response Plans,
  - Construction and Operational Monitoring Plans, and

- Reclamation and Closure Plans.

This volume of the report deals with potential impacts on the environment, and will provide recommendations in areas where positive impacts can be enhanced and negative impacts mitigated.

MINTO EXPLORATIONS LTD.
MINTO PROJECT

ENVIRONMENTAL SETTING

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SECTION 1.0 - SUMMARY

1.1 STUDY AREA

Minto Explorations Ltd. is proposing to develop the Minto Property located approximately 150 miles (240 km) northwest of Whitehorse, Yukon Territory, on the west side of the Yukon River (Figure 1.1). The property has geologic ore reserves of 7.22 million tonnes with grades of 1.87% copper, 0.015 oz. gold per ton and 0.24 oz. silver per ton. The ore body is located in the upper reaches of the Minto Creek watershed, approximately 10 km upstream of the Yukon River confluence, at an elevation of 2660 to 2900 ft. Minto Creek is a small creek, with a mainstem length of 17 km which drains northeast and discharges to the Yukon River.

The property is currently accessible by helicopter or boat across the Yukon River. A winter tote road was constructed along the west side of the Yukon River in 1974 but is suitable for winter travel only.

1.2 MINE PLAN OVERVIEW

The proposed Minto Project would entail an open pit and underground operations, waste rock stockpiles, a tailings storage facility, ore crushing facilities and a conventional copper flotation mill. These facilities will occupy an area of approximately 345 acres (141 ha). A general layout of the mine site is presented in Figure 1.2. The mill will be designed to process 1500 dry short tons (1360 t) per day for 350 days per year (525,000 tons per year). Ore will be treated by conventional flotation to produce copper concentrate containing from 33% to 38% copper. The tailings impoundment will be located within the Minto Creek valley, approximately 2800 ft (850 m) east of the mill and has a capacity of 11 million tons. Concentrate will be trucked on a daily basis, to Whitehorse, weather permitting. Details concerning the project are presented in the summary fact sheet (Table 1.1).

1.3 SUMMARY

1.3.1 Physiography and Soils

The Minto area is considered part of the Pelly River Ecoregion and lies within the Dawson Range on the west side of the Klondike Plateau. Erosion surfaces are dissected by narrow stream valleys. The topography is gently rolling with relief up to 2000 ft (600 m). The orebody is located beneath a small stream valley, known as Minto Creek, and extends beneath the toe of the south-facing slope on the left hand side of the creek. The bottom of the valley in the region of the orebody is at an elevation of approximately 2650 ft (922 m). On either side of Minto Creek, the topography rises at slopes generally of approximately 20^0 to the rounded tops of the surrounding hills which are at a maximum elevation of 3250 ft (1131 m). The site is located within the discontinuous widespread permafrost subzone and extensive areas within the general region are underlain by permafrost. Permafrost is extensively distributed throughout the site with the majority located on north aspect slopes. Within the area of the open pit, overburden has been measured to be as thick as 280 feet (85.3 m) with permafrost extending to a depth of 60 feet (18.3 m).

The area west of the Yukon River and north of Carmacks, including the Minto area, was not covered during the last continental glaciation (Wisconsin Drift) and as a result, glacial till soils are not present. However, a study by Bostock (1966) on the glaciation of central Yukon indicates that two older drifts, the Klaza and Reid Advances may have partially encroached on the upper region of Minto Creek. Gravel deposits, terraces and few erratics indicate that glaciation extended above 3000 ft (1044 m), from south of the mouth of Dark Creek, north to Wolverine Creek. Due to the lack of glaciation, bedrock exposure is poor and generally limited to the tops of ridges where it forms blocky, castellated outcrops.

Soils in the Minto area have developed from saprolite, colluvial and fluvial parent materials. Where drainage is impeded, gleysols or gleyed brunisols tend to develop. On well drained materials, eutric or dystric brunisols predominate, although some podzols may also occur. Regosols may occur on recent fluvial deposits.

The predominant bedrock type in the development area is granodiorite; derived materials are generally coarse textured, basic, well to moderately drained, and have low inherent fertility. Organic content in soils is expected to be low except in the upper few centimetres.

Overburden within the plant site consist predominantly of micaceous, organic, silty sand and of sand and fine gravel, derived predominantly through in situ weathering of the upper surface of the bedrock. Bedrock is encountered at depths of 2 to 11 feet (0.7 to 3.8 m) below surface. Overburden in the vicinity of the proposed open pit has a maximum thickness of 280 feet (97.4 m). Soils consist of frozen micaceous silt and fine sand with varying amounts of organic constituents throughout. Overburden in the vicinity of the tailings storage facility also consists of frozen silts and sands and is approximately 200 feet (96 m) in thickness. Overburden material is described as consisting of 30% fine gravels, 40% coarse sands and 10% medium sands. In all cases, the overburden is covered by a moss and topsoil layer. Bedrock below these layers is granodiorite.

To assist in the development of a reclamation plan soil samples were collected from the proposed open pit, mill site, tailings storage facility and waste rock stockpile areas for detailed analyses. The capacity of a soil to absorb nutrients is limited by the clay fraction and the amount of organic matter in the soil. Most samples were primarily sand with gravel or silt with sand. Clay content was low and averaged 12.5%. Organic content was low in most samples (0.7 to 3.1%) except for two in the vicinity of the proposed tailings storage facility and one in the area of the waste rock stockpile. Soil texture can be described as fine sandy loam to silty loam over loamy sand or gravel.

Soil samples ranged from being slightly acidic (pH 6.4) to moderately acidic (pH 4.5), and had an average pH of 5.7. For ideal growing conditions, soils should have a pH of between 6.0 and 6.5. Liming of the soils in order to increase the pH will likely be necessary in several areas of the proposed development, especially in the open pit and tailings storage facility. Due to low organic content, low clay content and an acidic pH, cation exchange capacity values are low, ranging from 8.6 to 54.6 meq/100 g soil.

Open pit and mill site soil samples have moderate salinity (1.02 to 2.60 mmhos/cm). Soils with low salinity are classified as favourable for purposes of reclamation.

Levels of total nitrogen were high and ranged from 0.03 to 0.47%. Total sulphur content of the soil samples ranged from low (<0.00%1) in the mill site area to high (0.10%) in the location of the proposed tailings facility. Levels of total phosphorous were extremely variable and ranged from 2.9 to 71 ppm.

Levels of potassium ranged from low in the tailings storage area (20 ppm) to moderate in the mill area (150 ppm). Exchangeable cations ranged from 0.06 to 0.40 meq/100g. Levels of sodium were low to moderate and ranged from 5.0 to 30.0 ppm; exchangeable cations ranged from 0.02 to 0.21. Levels of calcium were high ranged from 650 to 4800 ppm; exchangeable cations ranged from 4.0 to 24.5 meq/100 g. Total magnesium in soil samples ranged from low in the open pit area (120 ppm) to high in the vicinity of the tailings storage facility (510 ppm); exchangeable cations ranged from 1.03 to 4.25 meq/100 g.

Levels of harmful metals were in the soil samples were very low. Molybdenum content was below detection limits in all soil samples (<0.5 ug/g). Levels of lead were also below detection limits (<1.5 ug/g) in ten of eleven samples; one sample from the proposed tailings storage facilities area had a lead content of 5.6 ug/g. Total mercury levels ranged from 0.005 to 0.08 ug/g.

The Minto Project area was assessed for its natural hazards potential. South aspect scree slopes in lower Minto Creek and extensive regions of burn, combined with steep slopes, thin overburden layers and solifluction may result in some north aspect slopes being unstable during the spring thaw and summer months. However, the potential for the occurrence of an avalanche are very low due to the minimal snow fall in the area. Due to the dry climate and frequent electrical storm events that occur in the summer months, forest fires are very common in the Minto area. Many areas which were previously burned are in varying degrees of seral succession of vegetation. Two burns have occurred in the Minto Creek watershed between 1950 and 1980, and two further burns since 1980.

For the Minto Project, a ground motion of 0.083 g and 0.196 m/s would have a 10% probability of being exceeded in 50 years. Such a probability places the site within Acceleration Zone 3 and Velocity Zone 4. The mine site is regarded as having a moderate to low probability of experiencing a major earthquake.

1.3.2 Meteorologyy

A number of regional meteorological stations are operated in the vicinity of the Minto Project by Atmospheric Environment Services. Historical records from these stations have been used in combination with site specific data to provide an understanding of the weather patterns at the project site.

Meteorological monitoring studies at the Minto Project site utilize manual snow survey equipment and a manual weather station measuring precipitation and temperature data.

Temperatures at the proposed mine site are typical of northern inland climates, with a low average temperature and extreme temperature ranges. Daily mean temperatures are generally below freezing during any month of the year. Annual mean temperature has been estimated at -7.3°C, and mean monthly temperatures range from estimate of -30.9°C in January to 12.1°C in July.

Precipitation levels can be described as moderate, with the annual precipitation estimated as 378 mm. Approximately 58.5% of precipitation falls as snow, with the remaining 41.5% as rain. July is the wettest month of the year, receiving approximately 3.5%. On average, measurable precipitation occurs approximately 120 days per annum.

The 1:10 year wet and dry annual precipitation values have been estimated as 451 mm and 305 mm, respectively. Intensity-duration-frequency curves have been generated for the site and the probable maximum 24 hour precipitation has been estimated as 183 mm.

Pond evaporation at the site exceeds annual precipitation and is estimated as 409 mm.

Snowpack levels were recorded at the site during the winter of 1993-94 and compared to regional values. The 1993-94 season was found to be a below average snowpack year with a very early melt period. It is estimated that on average 80% of snowmelt occurs in April with the raining 20% in May.

1.3.3 Hydrology

The Minto Project lies within the Minto Creek watershed, a tributary to the Yukon River. Hydrological investigations were established on site in September 1993, to quantify all surface flow potentially affected by project development. The program consisted of the installation of three staff gauges and an automatic water level recorder. The staff gauges are located at different points on the creek and the water level recorder is located near the most downstream gauge. Staff gauge calibrations and manual water level recordings were taken to produce stage-discharge curves and hydrographs.

Several regional streamflow stations are maintained in the area by Water Survey of Canada and Indian and Northern Affairs Canada. Historical records from these stations were used in combination with site specific data to determine hydrologic specific for the project area.

Mean annual runoff was calculated for the entire Minto Creek basin and for two sub-basins of interest. Annual runoff values were generated with precipitation data and with rainfall runoff coefficients and snowmelt runoff values based on historical flow records for Big Creek. The distribution of runoff was estimated by combining rainfall and snowmelt distributions. Minto Creek appears to experience substantial streambed infiltration losses in its lower reaches and thus the annual flow is estimated to be only 0.05 m^3/s, or 1.1 $L/s/km^2$. In contrast, annual runoff for two small sub-basins in the upper catchment are estimated to be 4.2 $L/s/km^2$ and 3.6 $L/s/km^2$.

Monthly variation of runoff indicates that freshet occurs in late April/early May and that low flows occur in mid-winter. Minto Creek freezes solid for an extended period during the winter, reducing flows to zero.

The 1:10 year wet and dry annual runoff values were estimated for the two sub-basins of interest. Monthly distributions for both high and low flow years are assumed to be the same as during an average year.

Estimates of extreme creek flows were generated with a variety of techniques ranging from regional frequency analysis to site specific rainfall\runoff models. Results of the various analyses

were compared and reasonable estimates were developed. The 1:200 year peak instanteous flow for the two sub-basins are estimated to be 6.0 m^3/s and 1.6 m^3/s.

1.3.4 Water and Sediment Quality

Initial surface water quality studies were conducted in the Minto Creek area in 1975 and 1976 by Environment Canada and in 1976 by B.C. Research. Current baseline water quality monitoring studies, conducted for Minto Explorations Ltd. in 1993 and 1994, were designed to define the water quality of watercourses draining the working areas of the Minto property.

Environment Canada sample sites were located on Minto Creek, Big Creek, Wolverine Creek and an un-named creek now designated "Creek B", and B.C. Research sample sites were located within the Minto Creek watershed, including an un-named creek now designated "Creek A", and on the Yukon River adjacent to the confluence with Minto Creek. In general, surface waters in the Minto Creek watershed appeared to be of good quality and the data suggested that surface drainage was likely confined to a shallow active layer, presumed to be due to the presence of humic material. The levels of physical parameters, anions, nutrients, and dissolved and total metals in Minto Creek surface water samples were generally low except for copper and iron, both of which consistently exceeded federal Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of aquatic life.

Recent baseline water quality monitoring sites, selected based on their relation to the deposit and current mine development plans, were located directly on Minto Creek and its primary tributaries, and on the Yukon River adjacent to the confluence with Minto Creek. Water quality in the Minto Creek basin is generally neutral to slightly basic, moderately hard, moderately high in total suspended and dissolved solids, and moderately to highly conductive. Anions and nutrients were generally moderate to moderately high and concentrations of cyanide or cyanogen-like compounds in background water quality were also found to be relatively high. The majority of metal concentrations were also moderate to moderately high with aluminum, copper and iron naturally exceeding CCME guidelines for the protection of aquatic life. The highest concentrations of metals occurred at sample sites adjacent to and directly downstream of the deposit. Water quality during

spring freshet was generally higher in total suspended solids, turbidity and total metals, but lower in conductivity, total dissolved solids, hardness, pH, anions and nutrients.

In comparison to Minto Creek, water quality in the Yukon River was slightly lower for most parameters, though mean values for aluminum and iron, and occasionally other metals, such as copper and lead, exceeded CCME guidelines, which is common in large rivers in which high levels of suspended solids occur. The data indicates that Minto Creek does not currently impact Yukon River water quality.

Tests for the proportion of metals which may be complexed with the humic and fulvic acids in the water column indicated that water from Minto Creek increases in complexing capacity from 74.05% at the top of the watershed to 88.13% near the creek mouth. Although the complexing capacity for copper is high in the Minto Creek watershed, its capacity for complexing other metals is negligible. This is due to high levels of alkali earth metals, such as calcium, which have an affinity with humic acid and readily bind with it, outcompeting metals other than copper in the water column. Consequently, close to 100% of the aluminum, iron and lead are unbound.

Data from groundwater samples collected in 1994 from monitoring wells within the deposit area indicated that, although several well-volumes of groundwater were removed, there was still a high level of particulate matter in the samples. Most physical parameters, anions, nutrients, and dissolved and total metals levels were similar to surface water quality results from Minto Creek adjacent to the deposit, although some parameters, such as alkalinity, fluoride and sulphate were much higher.

Fine stream sediments were collected in triplicate from the Minto Creek mainstem. The samples were analysed for moisture, total metals including antimony, arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, silver and zinc, and grain size. Sediments in Minto Creek are composed mostly of sand, with some gravel and minimal fractions of silt and clay. Levels of antimony, cadmium, mercury, molybdenum and silver were low at all sites. Levels of arsenic were high, with a maximum level of 4.44 ppm detected at the bottom of the Minto Creek watershed. Levels of chromium and zinc were highest below the ore body, with average values of 23.3 and 48.53, respectively. Levels of copper were elevated in the vicinity of the deposit.

1.3.5 Fisheries Resources

Based on an assessment of Minto Creek completed by the Yukon Fisheries Protection Authorization the creek has been classified as Type II habitat, salmonid rearing stream. From an assessment of topographic maps and site habitat assessment, this Type II habitat is found in the lower 1.5 km of creek immediately above the Yukon River. Upstream of this, steep slopes prevent further upstream migration. The possibility of overwintering habitat is questionable, as the creek freezes completely during the winter and no flows are present within the watershed. A survey of Minto Creek conducted by Environment Canada concluded that the absence of fish in the watershed was likely due to the intermittent nature of the creek.

Fish sampling and fish habitat assessments were conducted on the drainage systems surrounding the mine site including Minto Creek (local name, ungazetted), Creek A (unnamed), Creek B (unnamed) and Dark Creek. Creeks were surveyed to identify areas of spawning, overwintering and rearing and areas that present barriers to fish migration.

During the initial survey of the Minto Creek watershed conducted in June 1994 a canyon was observed approximately 2 km upstream of the creek mouth. This portion of Minto Creek has a steep gradient (21%) and was considered a fish barrier. Two sites were established above the barrier to confirm that a resident population did not exist in the upper reaches of the creek. Fish were not captured or observed at these sites throughout the period of study. Upper portions of Minto Creek provide extremely poor habitat due to the effects of forest fire. Extensive amounts of burnt trees and debris clutter the creek. In addition, a thick layer of fine sediments overlays the creek substrate. The water is extremely turbid and the creek banks are unstable. Immediately below the barrier the quality of the fish habitat improves substantially. Both adult and juvenile arctic grayling were captured at this site. This area has not been burnt and therefore, water quality, creek substrate and creek cover flows provide optimal grayling habitat. One km further downstream, the creek flows were dramatically decreased. Slimy sculpins were intermittently observed at this site.

During summer low flows the lower 1.5 km of Minto Creek was traversed. Approximately 150 m downstream of the road crossing Minto Creek dries up completely and remains dry until 100 m upstream of the Yukon River confluence and is comprised mainly of backwater from the Yukon River. The water at the Yukon River confluence was static and turbid and the creek bottom was heavily sedimented. Slimy sculpins, round whitefish and a juvenile northern pike were observed at this site.

Extensive portions of unnamed Creek A were dry throughout survey. This system has two confluences (Y-fork) with the Yukon River, but neither had any flow; one was dry and the other was glaciated. A length of approximately 1 km between the sample site and the confluence with the Yukon River consisted of intermittent surface and subsurface flows. Fish were not observed or captured during the survey. Several wood frogs were noted.

While surveying unnamed Creek B, a waterfall was noted approximately 500 m upstream of the Yukon River confluence. In addition, several log jams were also observed; the lowest block was positioned approximately 100 m upstream of the creek mouth. Below this barrier, the creek provides good rearing habitat for arctic grayling. Fish were not found in the upper portion of the watershed.

The Dark Creek watershed was evaluated during the September 1994 fisheries survey. A tributary located on the south perimeter of the Minto Property was examined for fisheries potential. This stream did not appear to provide good fish habitat. Due to recent forest fires, the water quality of the creek was poor. In addition, extensive LOD was present in the creek and created an abundance of small fish barriers. Fish were not observed or captured at this site. Immediately downstream of the above mentioned tributary, Dark Creek appeared to provide good fish habitat. Extensive cover was available due to deep water and undercut banks. Juvenile Arctic grayling and slimy sculpins were captured.

Fish muscle and liver tissue were analyzed in order to determine baseline levels of accumulated metals. Metal concentrations for muscle tissue were below present Health and Welfare Canada, Food and Drug Regulations, Division 15: maximum consumption concentrations for fish protein of 3.5 ppm arsenic, 0.5 ppm lead and 0.5 ppm mercury of wet weight.

It is difficult to compare metal values between sites because of species variations and the fact that often entire body analysis was necessary. Levels of antimony in liver, muscle and entire fish analyses were below detection limits in all but one sample (whitefish liver), and silver levels were mostly below detection, except in whitefish liver and arctic grayling muscle from sites at the Yukon River confluence. The highest levels of copper, mercury and zinc were detected in arctic grayling muscle tissue from the mouth of Creek B. The highest level of arsenic was detected from a total fish analyses of slimy sculpins from the mouth of Minto Creek.

1.3.6 Benthic Macroinvertebrates

Benthic macroinvertebrate samples were collected in triplicate at six water quality sampling stations on the Minto Creek watershed using a Hess sampler in August 1994. Densities ranged from a low of 2,637 organisms/m^2 in the mid-reaches of Minto Creek to a high of 20,140 organisms/m^2 on a Minto Creek tributary. The number of taxa collected at each site ranged from 31 to 44. These values are comparable to other creeks in the area.

In general, benthic communities in Minto Creek contain a large proportion of facultative species in comparison to sensitive and tolerant species. Facultative species may predominate the other stations due to the influence of burns in the upper watershed and the higher organic component in the substrate.

In general, all sites contained a well rounded representation of sensitive, facultative and tolerant species. In comparison to a number of other creeks, Minto Creek carried a relatively low quantity of caddisflies. Dipteran taxa were well represented in the facultative group, but overall, facultative species contained a large proportion of other insects and invertebrates. These included aphids, springtails, spider mites, copepods, ostracods, round worms, segmented worms and the odd terrestrial anomaly of beetle, butterfly and snail. Copepod populations as found in Minto Creek indicate that the creek contains a fairly large quantity of pool habitat, where standing water and nutrients allow for copepod reproduction and growth.

Benthic macroinvertebrate communities in Minto Creek were relatively stable (high diversity, richness and equitability) and capable of compensating for limited water quality changes without resulting in large community changes.

1.3.7 Periphyton

Replicate samples of periphyton were collected from several locations coincidental with water quality stations in the Minto Creek watershed during the peak period of growth, in August 1994. Samples from most sites contained very little periphyton material, which likely indicates a relatively unproductive stream or a stream subject to scouring from high flows during freshet. Mean chlorophyll "a" values ranged from 0.079 to 0.392 ug/cm^2. The highest mean concentration of chlorophyll "a" was detected at P5 at the top of the Minto Creek watershed in an area of disturbance. Diatoms comprised 30 to 99% of the periphyton samples. Species composition was similar to other creeks observed in the southwest Yukon. High proportions of the diatoms *Nitzschia* spp. were found in mid and lower reaches of Minto Creek. *Nitzschia* species, in abundance, often are associated with organic or nutrient enrichment. Although periphyton abundance was low, *Nitzschia* predominance may indicate locations with a potential sensitivity to enrichment.

1.3.8 Vegetation

The Minto Project area lies within the Pelly River Ecoregion. Black and white spruce form the most common forest types. Paper birch occurs on cooler sites and aspen and balsam poplar occupy disturbed areas. Lodgepole pine frequently invades burnt-over areas, but is often in competition with deciduous trees on moist to wet sites. The tree line occurs at elevations of 1350 to 1500 m. Feathermoss dominates the understory vegetation of nearly closed coniferous stands, but as trees become less dense, willows and ericaceous shrubs become prevalent. Sedge or sphagnum tussocks are common in wetlands and under black spruce. Sagewort grassland, with several forbs, and sometimes aspen, occurs on steep south-facing slopes. Shrub birch and willow occur in the subalpine and extend well above the treeline. Ericaceous shrubs and prostrate willows dominate the alpine vegetation, except on rocky terrain, where lichens are more prevalent.

The Minto Project area has been burned by four separate forest fires over the last 40 years. Consequently, much of the vegetation in this region is in varying stages of regenerative growth. The most recent fire occurred in 1980 and burnt 4550 ha, including the top of the Minto Creek watershed.

1.3.9 Wildlife Resources

The Minto Project area appears to provide some good summer and winter moose habitat, but no key moose habitat has been mapped for the region. Approximately 40 moose/1000 km^2 exist in the Minto area. In addition, moose have been observed congregating in the area of the Ingersoll Islands downstream of the Minto Creek mouth, as it is a safe place for calving.

Caribou are not known to occur in the immediate project area, but key winter range habitat has been identified for woodland caribou west of the project, in the headwaters of Big Creek, approximately 15 km from the project.

A population of Dall sheep were observed on the east bank of the Yukon River between Minto Landing and the Pelly River confluence. This area has been mapped as key winter range habitat for these animals. Results of the aerial sheep survey approximated the herd at: 13 ewes, 4 rams and 5 lambs.

Although mule deer key habitat has not been designated in the vicinity of the Minto Project two pellet groups were observed in the area. Mule deer were not sighted on the Minto Property.

Black bears and grizzly bears were observed in the project area. Although wolves were not observed, tracks were noted at the mouth of Minto Creek. Sign of varying hare and red squirrel were observed throughout the project area.

Birds are not known to use this area for any length of time, mainly due to the lack of suitable wetlands in the area. A key habitat area for ducks and waterfowl lies approximately 30 km east of the project in the area of the Wilczek lakes used for nesting and moulting in the summer.

Spruce grouse and sharp-tailed grouse were observed in the project area. The Yukon River main valley is known as exceptional riparian cliff habitat for birds of prey, notably peregrine falcons and golden eagles. One pair of peregrine falcons is known to utilize the Yukon River near the Minto Project area.

Although the area surrounding the project is too cold and dry for many reptiles and amphibians, wood frogs were observed in the vicinity of the Minto Project.

1.3.10 Land Capability and Historical Use

Minto Explorations Ltd. holds the DEF Claims previously held by Falconbridge Limited, the DEF Leases, Minto Leases and the Minto Claims (held previously by ASARCO Inc. and Teck Corporation). Other mining in the area includes placer mining in the Big Creek watershed immediately south of the Project and in Williams Creek, where an open pit copper mine is presently proposed.

Very little forestry potential exists in the vicinity of the Minto Project due to a short growing season, lack of commercially significant tree species and poor access across the Yukon River. In addition, most of the area has been badly burnt and salvageable timber is unsuitable use in pulp and paper manufacturing. However, timber within the burnt areas could be salvaged for use as firewood and Minto Explorations Ltd. are examining the viability of harvesting these areas for this purpose.

The agricultural potential of the Minto Project area is very low due to harsh winter conditions, a short growing season, permafrost and extremely xeric soils. The soils are low in nutrition due to forest fires. Due to the steep slopes, there is little range potential at the proposed mine.

Traplines at the Minto Project include RTC 145 held by Mr. Glen Bullied, RTC 146 held by Mr. Tommy McGinty and RTC 136 registered to Mr. Heinz Sauer. Traplines on the perimeter of the Minto Property which could also be potentially affected by the proposed development are RTC 147 and RTC 142 registered to Ms. Kathleen Sam and Mr. David Silverfox, respectively. Hunting and

guiding in the area is within outfitter concession #13 held by Mr. Rod Hardie of Yukon Hunting and Guiding Ltd., Whitehorse, YT.

Summer canoeing between Whitehorse or Carmacks and Dawson City is very popular, with 693 users registered during 1992. In addition, the annual Yukon Quest Dog Sled race parallels the Yukon River and crosses lower Minto Creek. Hunting and fishing are the main recreational uses of the area surrounding the project.

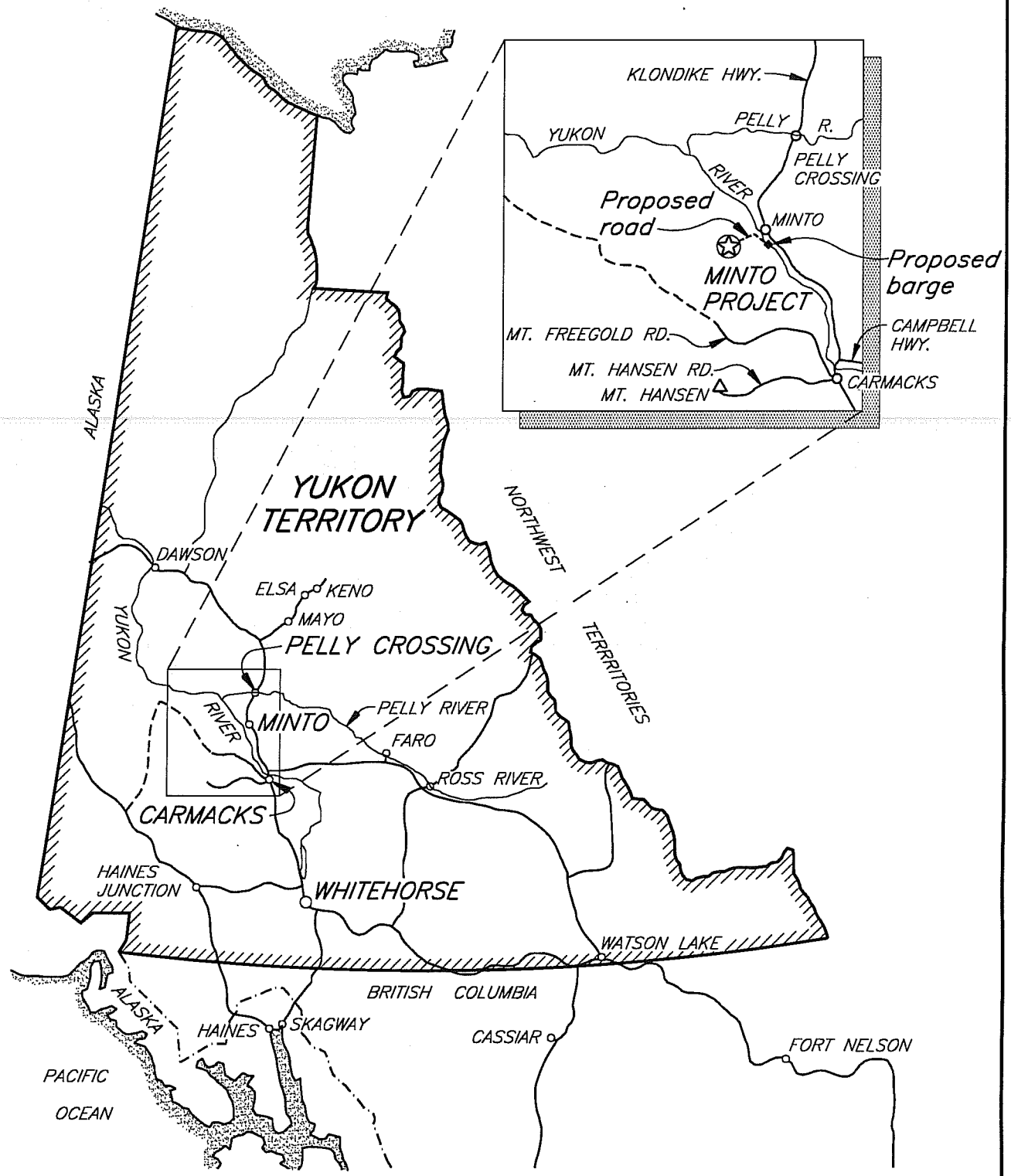
Four historic sites were identified during an archaeological impact assessment. However, three of these sites occur on the east side of the Yukon River opposite the project area. The one site which occurs on the west side of the Yukon River is located near the mouth of Minto Creek and will not be impacted by the proposed development. No sites were detected or are believed to likely exist in the vicinity of open pit or mill site or on the west shore of the Yukon River in the vicinity of the proposed barge landing.

Minto Explorations Ltd.
Minto Project

Table 1.1
Summary Fact Sheet

PROPERTY	Minto Property
PROJECT	Minto Project
OWNER	Minto Explorations Ltd.
OPERATOR	Minto Explorations Ltd., 6411 Imperial Avenue, West Vancouver, B.C., V7W 2J5 Head Office Telephone: (604)921-7570; Fax: (604)921-9446 Contact: H. Lutz Klingmann, P.Eng., President
LOCATION	Latitude 62° 36' north, longitude 137° 15'west 47 miles (75 km) north northwest of Carmacks, Yukon Territory, approximately 5 miles (8.8 km) west of the Yukon River.
ACCESS	Boat access from Minto Landing or helicopter. Barge landing proposed upstream of the project, in addition to a 10 km access road along the south shore of the Yukon River.
GEOLOGY	Chalcopyrite and bornite are present as fine-grained to coarse fracture fillings, veinlets and interstitial particles hosted in granodiorite which ranges in composition from quartz diorite to quartz monzonite and exhibits varying degrees of foliation. Host rocks exhibit some degree of alteration, initially of hydrothermal and later of contact metasomatic origin. Waste rock does not have the potential for acid rock drainage.
METALS	Copper, gold and silver, in terms of economic importance
MINERAL INVENTORY	7.22 million tons grading 1.87 % copper, 0.015 ounces gold/ton and 0.24 ounces silver/ton.
MINEABLE RESERVES	5.5 million tonnes grading 2.21 % copper, 0.019 ounces gold/ton and 0.28 ounces silver/ton.
MINE	1,500 tons per day mining from both an open pit and underground operation. Waste rock will be deposited in the upper portion of a small valley draining into the tailings impoundment.
MILL	Ore will be treated by conventional flotation to produce concentrate containing from 33% to 38% copper. Tailings will be impounded behind a dam located in the Minto Creek valley below the waste rock disposal area.
INFRASTRUCTURE	Camp on site for 50 employees.

MINTO EXPLORATIONS LTD.
MINTO PROJECT
LOCATION MAP

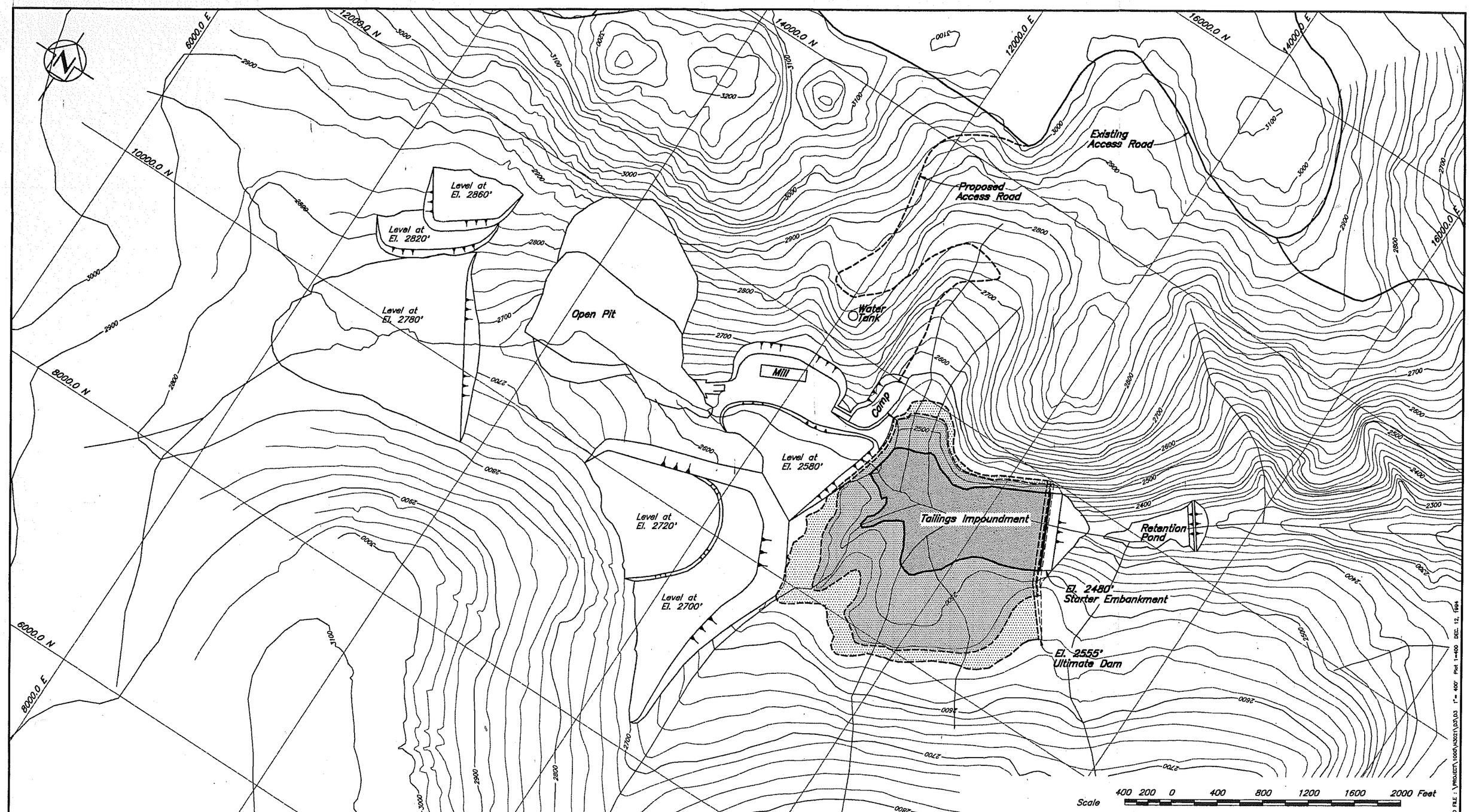


Dec. 8, 1994

HALLAM KNIGHT PIESOLD LTD.
ENVIRONMENTAL CONSULTANTS

FIGURE 1.1

CAD FILE: \PROJECT\1000\H3021\FIG\A1 Plot 1=1



CAD FILE : \PROJECT\1000\H3021\03\03 1" = 400' Plot 1=400 DEC. 12, 1994

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

HALLAM KNIGHT PIESOLD LTD.
ENVIRONMENTAL CONSULTANTS – VANCOUVER, B.C.

MINTO EXPLORATIONS LTD.

MINTO PROJECT

DESIGNED	–
DRAWN	VY
CHECKED	–
APPROVED	

MINE SITE LAYOUT MAP

DATE	SCALE AS SHOWN	DRG. NO.	REV.
–		FIGURE 1.2	–

SECTION 2.0 - PHYSIOGRAPHY, SOILS AND NATURAL HAZARDS

2.1 PHYSIOGRAPHY

The Minto area is considered part of the Pelly River Ecoregion (Oswald and Senyck, 1977) and lies within the Dawson Range on the west side of the Klondike Plateau. Erosion surfaces are dissected by narrow stream valleys. The topography is gently rolling with relief up to 2000 ft (600 m). The orebody is located beneath a small stream valley, known as Minto Creek, and extends beneath the toe of the south-facing slope on the left hand side of the creek. The bottom of the valley in the region of the orebody is at an elevation of approximately 2650 ft (922 m). On either side of Minto Creek, the topography rises at slopes generally less than 20^0 to the rounded tops of the surrounding hills which are at a maximum elevation of 3250 ft (1131 m). The site is located within the discontinuous widespread permafrost subzone and extensive areas within the general region are underlain by permafrost.

The area west of the Yukon River and north of Carmacks, including the Minto area, was not covered during the last continental glaciation (Wisconsin Drift) and as a result, glacial till soils are not present. However, a study by Bostock (1966) on the the glaciation of central Yukon indicates that two older drifts, the Klaza and Reid Advances may have partially encroached on the upper region of Minto Creek. Gravel deposits, terraces and few erratics indicate that glaciation extended above 3000 ft (1044 m), from south of the mouth of Dark Creek, north to Wolverine Creek. Due to the lack of glaciation, bedrock exposure is poor and generally limited to the tops of ridges where it forms blocky, castellated outcrops.

Soils in the Minto area have developed from saprolite, colluvial and fluvial parent materials. Where drainage is impeded, gleysols or gleyed brunisols tend to develop. On well drained materials, eutric or dystric brunisols will predominate, although some podzols may also occur. Regosols may occur on recent fluvial deposits.

The predominant bedrock type in the development area is granodiorite; derived materials are generally coarse textured, basic, well to moderately drained, and have low inherent fertility. Organic content in soils is expected to be low except in the upper few centimetres.

2.2 SURFICIAL GEOLOGY AND LANDFORMS

Much of the area of the central Carmacks map-area is underlain by plutonic rocks of the Klotassin Suite. These are predominantly of granodioritic to quartz dioritic composition. Potash fledspar porphyroblasts are commonly randomly oriented in the granodiorite although locally some planar fabric is present. The granodiorite generally displays a foliation, defined by preferred orientation of mafic minerals, that varies considerably in intensity and locally attains a gneissic compositional layering. However, the Klotassin granodiorite in the immediate Minto deposit area is dominantly non- to weakly-foliated (Adapted from Minto Explorations Ltd. prospectus prepared by Pearson, Hofman and Assoc. Ltd.)

The granodiorite is cut by aplite, granite pegmatite and alaskite dikes, that are probably related to the Eocene Nisling Range Alaskite and coeval Mount Nansen Group volcanics. Augite andesite and foliated hornblende-biotite-feldspar porphry dikes, likely feeders for the Carmacks volcanics, also cut the granodiorite.

A northwest-trending belt of volcanic rocks, considered to be the equivalent to the Upper Triassic Lewes River Group is exposed along the Yukon River, crossing the Carmacks map-area diagonally. These rocks are mainly porphyritic andesite and basalt, locally with significant amounts of tuff, agglomerate and breccia.

The predominant metamorphic rocks in the central Carmacks map-area are classified by Tempelman-Kluit (1975) as the "schist-gneiss" and Pelly Gneiss. The "schist-gneiss" includes undifferentiated banded hornblende gneiss and garnetiferous amphibolite, with chlorite-quartz schist and minor graphitic schist. This unit is considered by Tempelman-Kluit (1976) to be partly metavolcanic and partly metasedimentary in origin. The Pelly Gneiss is dominantly a strongly

foliated, chlorite-biotite-quartz-feldspar schist, probably a sheared and metamorphosed plutonic rock (Tempelman-Kluit, 1974b, 1976).

A large exposure of basaltic and andesite flows, flow breccias and tuffs of the Carmacks Group unconformly overlies Klotassin granodiorite immediately to the south of the Minto property. At the base of these volcanics is a section of poorly-indurated sandstone, shale and conglomerate, inter-bedded with lapilli and ash tuffs; these rocks are considered to represent immature channel-fill deposits (Tempelman-Kluit, 1976).

The Yukon River Fold Belt (Tempelman-Kluit, 1974b) is the northern part of Snag map-area which continues southeastwards through the Minto area. In the Snag map-area the schistosity of the belt trends uniformly to the northwest, but with variable dips. Foliation in the Minto area has similar trends but dips of foliation are more consistent, usually ranging from 45° to 75° to the northeast except in the Minto deposit area where foliation dips are much shallower. Recognizable folds in Snag map-area are open, asymmetrical structures with a southwestward vergence. Hinges are sharp and schistosity on the limbs dips uniformly. The folds have amplitudes of approximately 10,000 ft (3048 m) and wavelengths of 1 mile (1609 m). These structures are thought to have formed in the Late Triassic. Smaller folds, approximately 200 ft (61 m) across, are parasitic upon the major structures. Small-scale, isoclinal folds, in places gently refolded, are present in both the "schist-gneiss" and Pelly Gneiss units and within the Minto deposit itself.

Sinclair (1974, 1977) noted that copper occurrences in foliated rocks within the Klotassin granodiorite of the Minto area are limited to a belt of 3 miles (4827 m) wide and trending N25° to 30°W. Within this belt, the foliated rocks display a synformal structure which appears to close to the northwest; to the southeast this is obscured by the cover of Carmacks Group volcanics. The Minto deposit occurs in a flat-lying body of foliated rocks near the hinge of this synform.

2.3 OVERBURDEN

2.3.1 Geotechnical Investigations

Overburden composition was determined during geotechnical investigations completed by Golder (1976). Overburden within the plantsite consist predominantly of micaceous, organic, silty sand and of sand and fine gravel, derived predominantly through in situ weathering of the upper surface of the bedrock. Bedrock is encountered at depths of 2 to 11 feet (0.7 to 3.8 m) below ground surface (Golder 1976).

Overburden in the vicinity of the proposed open pit has a maximum thickness of 280 feet (97.4 m). Soils consist of frozen micaceous silt and fine sand with varying amounts of organic constituents throughout. Occasional seams of peat, and of fine gravel were also observed. Overburden in the vicinity of the area of the waste rock stockpiles is of the same class, kind and maximum depth as that observed in the proposed open pit. Overburden in the vicinity of the tailings storage facility also consists of frozen silts and sands and is approximately 200 feet (96 m) in thickness. In all cases, the overburden is covered by a moss and topsoil layer. Bedrock below these layers is granodiorite.

2.3.2 Particle Size Distribution

Grain size distribution was determined for the sand and gravel components of the residual overburden (Golders 1976). Results indicate that overburden material is a fairly even mix of sand and gravel with 100% less than 3/4" sieve size, and 80% of material falling between the -4 and -60 sieve size. The material can be described as consisting of 30% fine gravels, 40% coarse sands and 10% medium sands.

2.4 SOILS

On the basis of regional mapping (Agriculture Canada 1992) and site test pitting (Golder 1976), soils in the mine site area are dominated by Eutric Brunisols originating from colluvial parent material. Soil texture is fine sandy loam to silty loam over loamy sand or gravel (Agriculture Canada 1992). The soils, on a well drained slope of 16 to 30%, display a dissected surface form. Surface texture is silty loam and is non-calcareous with >3 m depth on average to the water table. The subdominant soil landscape in this zone is of fluvioglacial parent material, and is also well drained but has a terraced surface form and associated slopes of 4 to 9%. Surface texture is loamy sand and weakly calcareous. There is a very shallow lithic layer with some loamy morainal till soil inclusions.

Soils near the outlet of Minto Creek adjacent to the Yukon River are characterized by orthic eutric brunisols. Texture is fine sandy loam, loamy sand, fluvial composition with undulating surface expressions. Average slope range from 2 to 5%. White River volcanic ash present in the region is absent on the Minto Project property (DEF memo, 1971), but is present near the outlet of Minto Creek.

According to dominant morphological features and vegetation, well draining soils on south facing slopes are gravelly sandy loam and are expected to be moderately alkaline and have moderate to high organic matter content and nutrients. Areas with moderate to poor drainage, dominated by lodgepole pine and black spruce, respectively, are expected to be more acidic with low to very low nutrient content. Lodgepole pine areas are expected to have much lower quantities of organic matter than the poorer drained areas of black spruce stands (Kennedy 1993).

2.4.1 Soil Classifications

To assist in the development of a reclamation plan, a total of eleven 10-kg soil samples were collected from the proposed open pit, mill site, tailings storage facility and waste rock stockpile areas in August 1994 (Figure 2.1, Table 2.1). The samples were submitted to Pacific Soils

Analytical Inc. and analyzed for general parameters and nutrient availability to describe soil composition and to identify any potential limitations to plant regrowth, as follows:

- texture (% gravels, sand, silt and clay)
- % organic matter
- cation exchange capacity
- pH
- lime requirement (if pH 6.0 or less)
- salts concentrations
- % total nitrogen
- % total sulphur
- available P, K, Ca, Mg, Cu, Zn, Fe, Mn, Al, Na
- exchangeable cations (Ca, Mg, Na, K)
- toxic metals (Pb, Hg and Mo)

The results of the soils analyses are presented in the following subsections

2.4.2 Texture

The capacity of a soil to absorb nutrients is limited by the clay fraction and the amount of organic matter in the soil. Most samples were primarily sand with gravel or silt with sand (Table 2.2). Clay content was low and averaged 12.5%. Organic content was low in most samples (0.7 to 3.1%) except for two in the vicinity of the proposed tailings storage facility and one in the waste rock stockpile.

2.4.3 Reaction

Reaction is defined as the degree of acidity or alkalinity of the soil and is expressed as pH. Soil samples collected in the proposed development area of the Minto Project had an average pH of 5.7 and ranged from being slightly (pH 6.4) to moderately acidic (pH 4.50).

For ideal growing conditions, soils should have a pH of between 6.0 and 6.5. At pH values below 5.0 some soil metals become soluble and can be toxic to plants. However, a higher pH ranges and high levels of calcium, soils have a lower capability of retaining other nutrients.

Liming of the soils in order to increase the pH will likely be necessary in several areas of the proposed development, especially in the open pit and tailings storage facility.

2.4.4 Cation Exchange Capacity

Cation exchange capacity (CEC) is an index of the inherent nutrient holding capacity of the soil and is greatly influenced by organic matter content, amount and type of clay present and soil pH. CEC is defined as the total amount (meq/100 g soil) of exchangeable cations that a soil can absorb. Generally, finer textured soils have higher CEC. If the soil has low organic content, low clay content and an acidic pH, as do most of the Minto Project samples, CEC values are low, ranging from 8.6 to 54.6 meq/100 g soil (Table 2.3).

2.4.5 Salinity

Salinity is defined as the amount of soluble salts in the soil, and is expressed as electrical conductivity (EC) of soil saturation extract in mmhos/cm at 25°C. Salinity affects the suitability of soil for plant production, as well as stability in construction and corrosivity in concrete and metals. According to Kennedy (1993) EC values less than 1 are considered low. Soil samples from the waste rock storage area and the tailings storage facility have low salinity. Open pit and mill site soil samples have moderate salinity (1.02 to 2.60 mmhos/cm) (Table 2.4). Soils with low salinity are classified as favourable for purposes of reclamation (Christie 1980).

2.4.6 Plant Nutrients

Soil samples obtained from the open pit were analyzed for total nitrogen and sulphur levels as well as concentrations of available nutrients (P, K, Ca, Mg, Cu, Zn, Fe, Mn, Al and Na). Plants acquire 16 elements from the surrounding soil.

Based on reclamation guidelines for Yukon, soils containing greater than 0.0005% nitrogen are classed as high nitrogen soils (Kennedy 1993). Soils at the Minto Project had high nitrogen content and ranged from 0.03% to 0.47% (Table 2.4).

Total sulphur contents of the soil samples ranged from low (<0.001%) in the mill site to high in the location of the proposed tailings facility (0.096%).

Levels of total phosphorous were variable in the collected soil samples. Soils from the waste rock storage areas (2.9 to 4.2 ppm) and the tailings storage facility were relatively low except for one sample from the tailings storage facility that was extremely high (71 ppm). Soil samples from the open pit and mill site were variable and ranged from 5.3 to to 27 ppm and 4.7 to 20 ppm, respectively.

Levels of calcium were high (Herman, pers.comm.) in 10 of 11 samples and ranged from 1100 to 4800 ppm. One sample from the open pit area had a low calcium level (650 ppm). Exchangeable cations ranged from 4.0 to 24.5 meq/100 g.

Levels of potassium in soils from the Minto Project ranged from low (20 ppm) in the tailings storage area to moderate (150 ppm) in the mill area (Kennedy, 1993) (Table 2.4). Exchangeable cations ranged from 0.06 to 0.40 meq/100 g. Although sodium is not a required nutrient for plants it may be used by the plant if the soil is low in potassium. Sodium levels were also low to moderate and ranged from 5.0 to 30.0 ppm. Exchangeable cations ranged from 0.02 to 0.21.

The magnesium content of most soils supporting growth ranges from 175 to 250 ppm (Herman, pers.comm.). Levels of total magnesium in Minto Project soil samples ranged from low in the open pit area (120 ppm) to high in the vicinity of the tailings storage facility (510 ppm) (Table 2.4). Exchangeable cations ranged from 1.03 to 4.25 meq/100 g (Table 2.3).

Micro nutrients or trace elements are those taken up by plants in minute quantities, and include iron, copper, manganese, zinc and aluminum.

Although most soils are high in iron, most of it is chemically bound in insoluble minerals, such as silicates and anhydrous oxides. Most agricultural crops require less than 0.5 ppm of soluble iron for normal growth. Soils from the Minto Project area were high in total iron and ranged from 60 to 855 ppm (Table 2.4).

The copper content of most soils ranges from 5 to 50 ppm, but most of it is not available to plants because it is tightly bound in silicate minerals or organic complexes. Excessive copper in soils may depress iron uptake by plants, resulting in iron deficiency. Copper levels in 9 of 11 soil samples were very low, ranging from 0.90 to 44 ppm. Two samples were high in copper: an open pit sample and a sample from the waste rock storage area had copper levels of 810 and 73 ppm, respectively.

Most soils that support plant life have manganese levels of 30 to 100 ppm. Soils in the Minto Project area had variable levels of manganese: low levels were detected in the mill site and open pit areas (6 to 17 ppm) and extremely high levels were detected in the waste rock storage area (855 ppm).

Zinc content of most soils range from 10 to 300 ppm. Zinc levels collected from the Minto Project area were low in zinc and ranged from 0.9 to 9.8 ppm.

Levels of aluminum in the Minto Project area were high and ranged from 310 to 750 ppm.

2.4.7 Toxic Metal Levels

Soil sub-samples were submitted to CanTest Ltd. and analyzed for available lead, mercury and molybdenum, three metals that are known to impede plant development. Samples were leached with 0.1 N hydrochloric acid solution and shaken for approximately 30 minutes. Resulting solutions were analyzed for lead and molybdenum using a Jarrell Ash Model #975 Inductively Coupled Argon Plasma Spectograph (ICAP). Samples for mercury analysis were digested using a combination of trace metal pure grades of nitric and hydrochloric acids. The resulting solutions were then analyzed for mercury by Cold Vapour generation atomic absorption.

Levels of lead and molybdenum in the soil samples were low. All samples were below the detection limits for mercury (<0.5 ug/g) and all but one sample was below detection levels for lead (<1.5 ug/g) in ten of eleven samples. Total mercury levels were low and ranged from 0.005 to 0.08 ug/g.

2.5 NATURAL HAZARDS AND SLOPE CLASSIFICATION

2.5.1 Debris Flow

Solifluction is slow downward movement (mud flow or creep) of water-saturated, near-surface soil and surface vegetation from higher to lower elevations. Solifluction areas on the Minto Project site are underlain at shallow depth by permafrost, which retards subsurface drainage. The active layer becomes saturated with surface and shallow subsurface drainage from the adjacent slopes. When subjected to these conditions, the active layer creeps during the spring and summer months, even on very gentle slopes. This slow downslope creep of the saturated surface mantle is commonly referred to as solifluction. Figure 2.2 shows the areas of active solifluction recorded by Golder during the 1976 site assessment.

2.5.2 Slope Stability

South aspect scree slopes in lower Minto Creek. Minimal vegetative layer consisting of grasses and some low growing shrubs such as kinnikinnick, juniper and soopalallie. Active erosion was observed in these areas. Extensive regions of burn, combined with steep slopes, thin overburden layers and solifluction may result in some north aspect slopes being unstable during the spring thaw and summer months.

2.5.3 Avalanche Hazard

The Minto Project is within an area that receives very low levels of precipitation. Regionally, snowfall averages 185 mm annually. The potential for the occurrence of an avalanche are very low.

2.5.4 Forest Fires

Due to the dry climate and frequent electrical storm events that occur in the summer months, forest fires are very common in the Minto area. Many areas are in varying degrees of seral succession of vegetation. Two burns have occurred in the Minto Creek watershed between 1950 and 1980, and two further burns since 1980.

2.6 PERMAFROST

The Minto Project lies in the southern boundary of the discontinuous permafrost zone. From site investigations by Golder (1976) it was determined that permafrost is extensively distributed throughout the site with the majority located on north aspect slopes. Within the area of the open pit, overburden has been measured to be as thick as 280 feet (85.3 m) with permafrost extending to a depth of 60 feet (18.3 m). A significant percentage of the permafrost is clear segregated ice with water content close to the liquid limit and will not be suitable as construction material. Permafrost of the same sort is found within the proposed tailings and waste rock storage areas. Construction will have to be managed properly using flexible dam design and thermal blankets of sand and gravel in order to avoid failures.

2.7 SEISMICITY

A review of historical information on seismicity for the mine site was obtained from the Earth Physics Branch of Energy Mines and Resources Canada, Pacific Geoscience Centre at Sidney,

B.C. A record of the experienced shock intensity for the proposed mine site (62.36°N, 137.15°W) in terms of ground acceleration as percentage of gravity was obtained from their computer program.

A new method, the Cornell-McGuire method, of expressing an estimate of earthquake probability has been introduced (Basham et al, 1982, 1985; and Heidebrecht et al, 1983) in terms of exceeding peak horizontal ground velocity and acceleration on an annual basis and within a 50 year period. This method replaces the 1970 zoning map of the National Building Code (NRCC, 1985). The acceleration and velocity mapping provides for seven zones (as opposed to four zones), and a change in the probability of exceedence from 0.01 per annum on the 1970 map to 10% in 50 years, mathematically equivalent to a probability of exceedence of 0.0021 as compared to the previous value of 0.01. Acceleration and velocity zone maps are shown in Figure 2.3 and probabilities for the mine site are given in Table 2.5.

For the Minto Project, a ground motion of 0.083 g and 0.196 m/s would have a 10% probability of being exceeded in 50 years. Such a probability places the site within Acceleration Zone 3 and Velocity Zone 4. A zone schedule is presented in Table 2.6. In cases where calculated values place a site within an Acceleration Zone and a Velocity Zone that is greater than a difference of one, the acceleration zone is increased by one, however, this is not necessary for this site. The mine site is regarded as having a moderate to low probability of experiencing a major earthquake.

The values of acceleration listed for the proposed mine site are for firm soils or the soil-bedrock interface. The physical effect on overburden soil would be an amplification of motion from rock to the overlying ground surface. For soft soils, a factor of 1.5 and 2.0 are generally used for design values.

Minto Explorations Ltd.
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Table 2.1
1994 Soil Samples

S-1 **10035 E 11950 N** **2890 m elevation**

1" dry moss; pine trees around site
2" plant roots; burned vegetation
4" soil sample: very coarse sand

S-2 **10200 E 11470 N** **2760 m elevation**

1" dry moss; pine and birch trees around site
1" plant roots
8" soil sample: loam

S-3 **10410 E 10865 N** **2625 m elevation**

1" moss, grass and small shrub cover; pine and poplar trees in area
4" plant roots, soil
8" soil sample: loam

S-4 **11930 E 11540 N** **2610 m elevation**

1" dry moss
1" plant roots, burned vegetation
5" soil sample: coarse sand

S-5 **12045 E 11135 N** **2515 m elevation**

6" moss
6" black organic soil
5" soil sample, permafrost thawed to sample depth: very coarse sand

S-6 **13420 E 11990 N** **2600 m elevation**

1" dry moss, grasses
6" sample: coarse sand

Table 2.1 (continued)
1994 Soil Samples

S-7 **13525 E 11400 N** **2440 m elevation**

12" moss
12" organic soil
3" soil sample (frozen): clay loam

S-8 **8625 E 11050 N** **2820 m elevation**

6" moss
12" soil sample; silt, mixed with some organic soil: silt loam

S-9 **11600 E 10200 N** **2620 m elevation**

2" moss, grass and wild rose bushes
2" organic soil, roots
6" soil sample: loam

S-10 **12300 E 9050 N** **2650 m elevation**

6" moss, horsetails
4" organic soil
6" soil sample - permafrost level: silty clay loam

S-11 **13500 E 10300 N** **2510 m elevation**

4" moss
8" organic soil
5" soil sample: medium sand

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Table 2.2
Soil Analyses
Gravel, Sand, Silt and Clay
Organic Content

Sample Number & Location	GRAVEL Fine (0.5 in)	SAND Very Coarse (2.0 mm)	SILT #2 (0.053 mm)	CLAY #2 (2.0 u)	Organic Material (%)	pH	Dolomite Lime Required to Achieve pH 6.5 (tonnes/ha)
S1–open pit	49.10	35.20	13.30	2.40	0.81	5.00	5.00
S2–open pit	24.90	26.60	36.80	11.70	1.30	4.50	10.00
S3–open pit	28.00	38.40	27.50	6.10	1.10	6.00	0.00
S4–mill site	25.30	46.70	17.90	10.10	0.90	5.00	10.00
S5–mill site	41.80	38.90	12.20	7.10	1.60	6.20	0.00
S6–tailings storage facility	17.60	62.40	15.00	5.00	0.69	5.50	5.00
S7–tailings storage facility	8.30	21.60	40.80	29.30	15.60	5.70	43.00
S8–tailings storage facility	5.80	24.00	54.80	15.40	4.20	6.40	0.00
S9–waste rock dump	5.10	33.70	48.50	12.70	2.80	6.00	0.00
S10–waste rock dump	0.00	11.00	59.80	29.20	9.30	6.00	0.00
S11–waste rock dump	36.40	38.30	16.50	8.80	3.10	6.00	0.00

Note: Values are reported as % on a weight basis

(\H3021\Soils\GRNSZ.WK3)

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Table 2.3
Soil Analyses
Exchangeable Cations and
Cation Exchange Capacity

Sample Number & Location	Exchangeable Cations (meq/100 g)				Cation Exchange Capacity (CEC) (meq/100 g)
	Calcium Ca	Magnesium Mg	Sodium Na	Potassium K	
S1–open pit	4.00	1.03	0.04	0.33	9.40
S2–open pit	8.25	3.25	0.12	0.13	18.20
S3–open pit	7.25	2.50	0.10	0.08	11.00
S4–mill site	7.25	2.75	0.08	0.40	16.90
S5–mill site	12.30	2.75	0.09	0.13	15.30
S6–tailings storage facility	5.50	1.13	0.02	0.25	8.60
S7–tailings storage facility	24.50	4.25	0.21	0.23	54.60
S8–tailings storage facility	16.80	3.25	0.12	0.06	28.40
S9–waste rock dump	12.30	3.25	0.13	0.07	18.00
S10–waste rock dump	22.50	3.25	0.10	0.16	38.60
S11–waste rock dump	9.75	2.05	0.08	0.08	28.40

Note: Values are reported as % on a weight basis

(\H3021\Soils\GRNSZ.WK3)

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Minto Project

Table 2.4
Soil Sample Analyses
Available Nutrients

Sample Number and Location	Available Phosphorous P (ppm)	Salts (mmhos/cm)	Total Nitrogen N (%)	Total Sulphur S (%)	AVAILABLE NUTRIENTS (ppm)								
					Sodium Na	Potassium K	Calcium Ca	Magnesium Mg	Copper Cu	Zinc Zn	Iron Fe	Manganese Mn	Aluminum Al
S1–open pit	27.00	2.00	0.05	0.01	10.00	120.00	650.00	120.00	810.00	0.90	60.00	12.00	310.00
S2–open pit	5.30	2.60	0.04	0.00	25.00	50.00	1450.00	380.00	44.00	1.20	120.00	17.00	500.00
S3–open pit	12.00	1.52	0.03	0.00	20.00	30.00	1400.00	290.00	11.00	1.50	110.00	70.00	375.00
S4–mill site	20.00	1.02	0.03	<.001	20.00	150.00	1250.00	325.00	6.00	0.90	95.00	6.00	345.00
S5–mill site	4.70	1.30	0.04	0.00	20.00	45.00	2000.00	320.00	10.00	2.50	100.00	87.00	360.00
S6–tailings storage facility	71.00	1.06	0.03	<.001	20.00	95.00	1100.00	125.00	0.90	2.50	90.00	36.00	355.00
S7–tailings storage facility	7.60	1.04	0.47	0.10	5.00	90.00	4800.00	510.00	11.00	9.80	820.00	550.00	630.00
S8–tailings storage facility	3.30	0.58	0.13	0.02	20.00	20.00	3250.00	375.00	2.30	1.70	115.00	58.00	510.00
S9–waste rock dump	2.90	0.38	0.10	0.01	30.00	20.00	2150.00	310.00	13.00	2.90	140.00	66.00	520.00
S10–waste rock dump	3.60	0.90	0.30	0.07	25.00	60.00	4300.00	360.00	73.00	7.40	855.00	95.00	750.00
S11–waste rock dump	4.20	0.52	0.11	0.01	20.00	25.00	2000.00	240.00	31.00	3.00	175.00	38.00	385.00

* Lime requirement determined only when soil pH <6.0

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Minto Explorations Ltd.
Minto Project

Table 2.5

Seismic Zones for a Probability of 10 percent in 50 Years

Acceleration of Velocity Seismic Zone Z_a, Z_v	Range of Peak Horizontal Acceleration (g) or Peak Horizontal Velocity (m/s) For Probability of 10% in 50 Years		Zonal Acceleration and Velocity (Z_a, Z_v)
	Equal to	Less than	
0	0.00	0.04	0.00
1	0.04	0.08	0.05
2	0.08	0.11	0.10
3	0.11	0.16	0.15
4	0.16	0.23	0.20
5	0.23	0.32	0.30
6*	0.32 or greater	-	0.40

* Zone 6: Nominal Value of 0.04; Site specific studies suggested for important projects

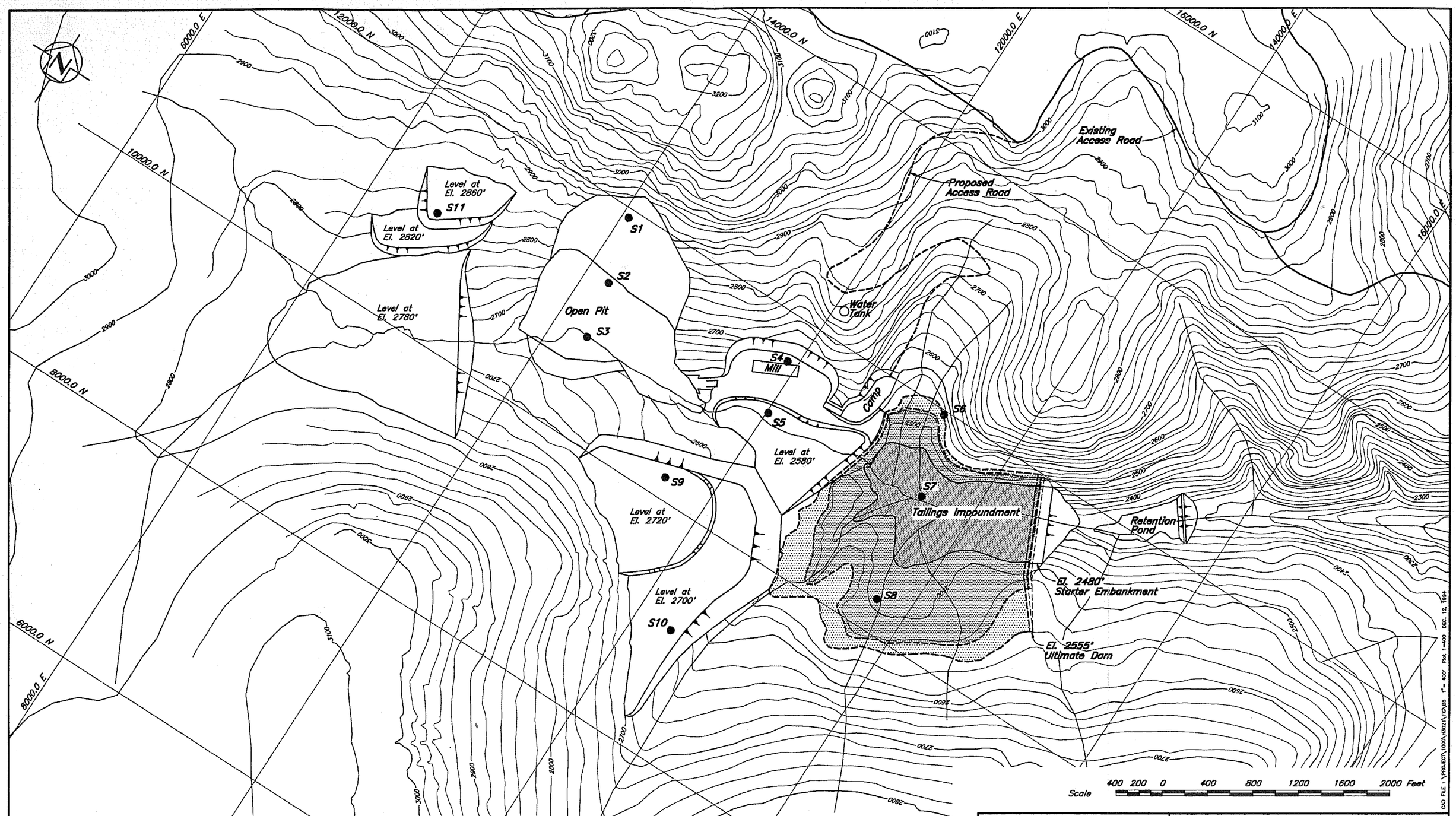
** For NBCC applications, when $Z_v = 0$ and $Z_a > 0$, the values of Z_v and v should be taken as Zone 1 and 0.05, respectively.

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Minto Explorations Ltd.
Minto Project

Table 2.6
Probabilistic Ground Motion
(at 62° 36' N, 137° 15'W)

Probability of Exceedence Per Annum	0.010	0.005	0.0021	0.001
Probability of Exceedence in 50 Years	40%	22%	10%	5%
Peak Horizontal Ground Acceleration (G)	0.50	0.064	0.083	0.100
Peak Horizontal Ground Velocity (m/s)	0.115	0.146	0.196	0.235

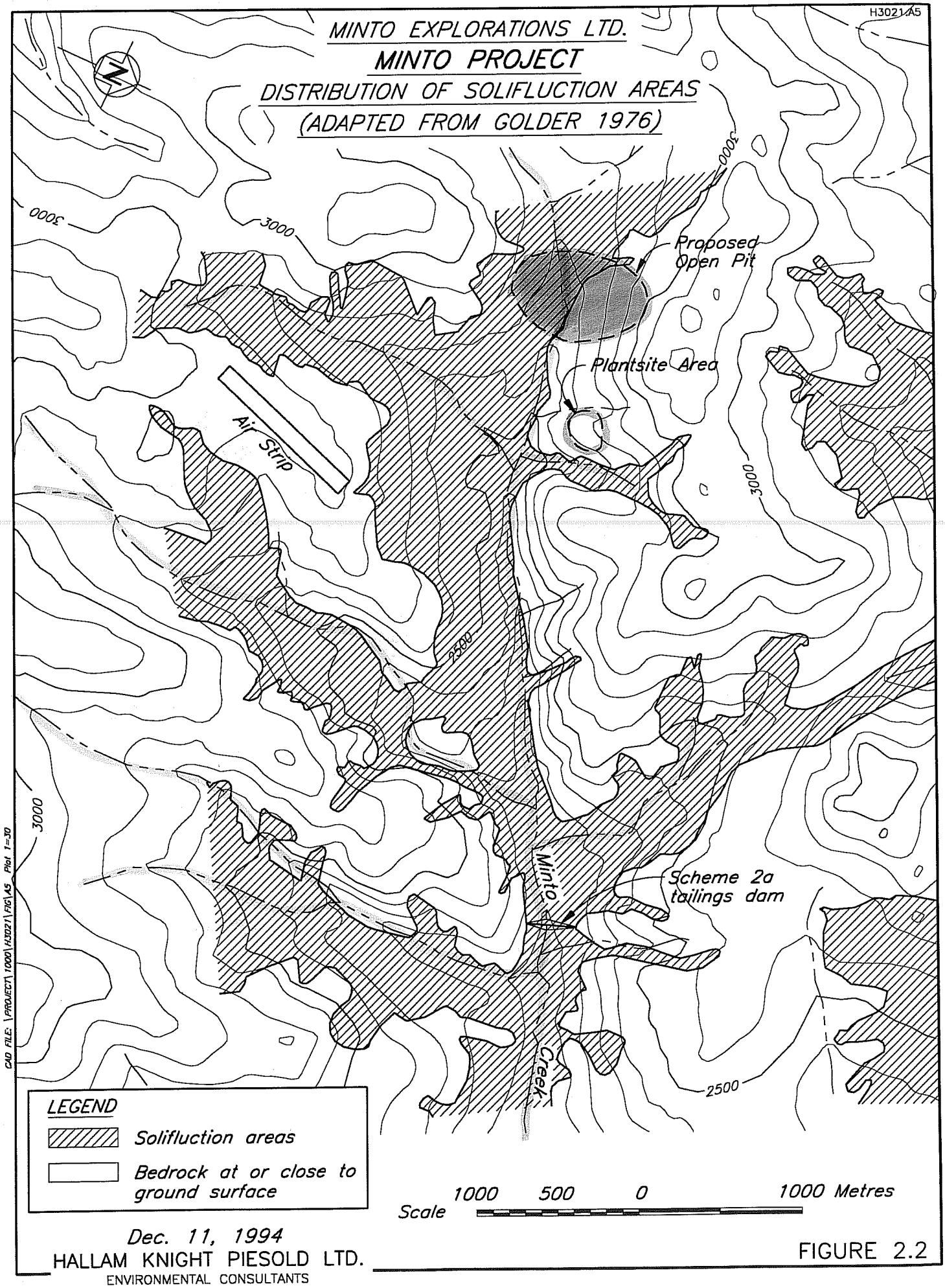


CAD FILE : \PROJECTS\1000\A3021\MG183 I"= 400' Plot 1=400 DEC. 12, 1994

HALLAM KNIGHT PIESOLD LTD. ENVIRONMENTAL CONSULTANTS – VANCOUVER, B.C.		MINTO EXPLORATIONS LTD.
	DESIGNED –	MINTO PROJECT
	DRAWN VY	
	CHECKED –	SOIL SAMPLE SITES
	APPROVED	

DRG. NO.	DESCRIPTION	REV.	DATE	DESCRIPTION	APPROVED	REV.	DATE	DESCRIPTION	APPROVED
REFERENCE DRAWINGS		REVISIONS				REVISIONS			

DATE	–	SCALE AS SHOWN	DRG. NO. FIGURE 2.1	REV. –



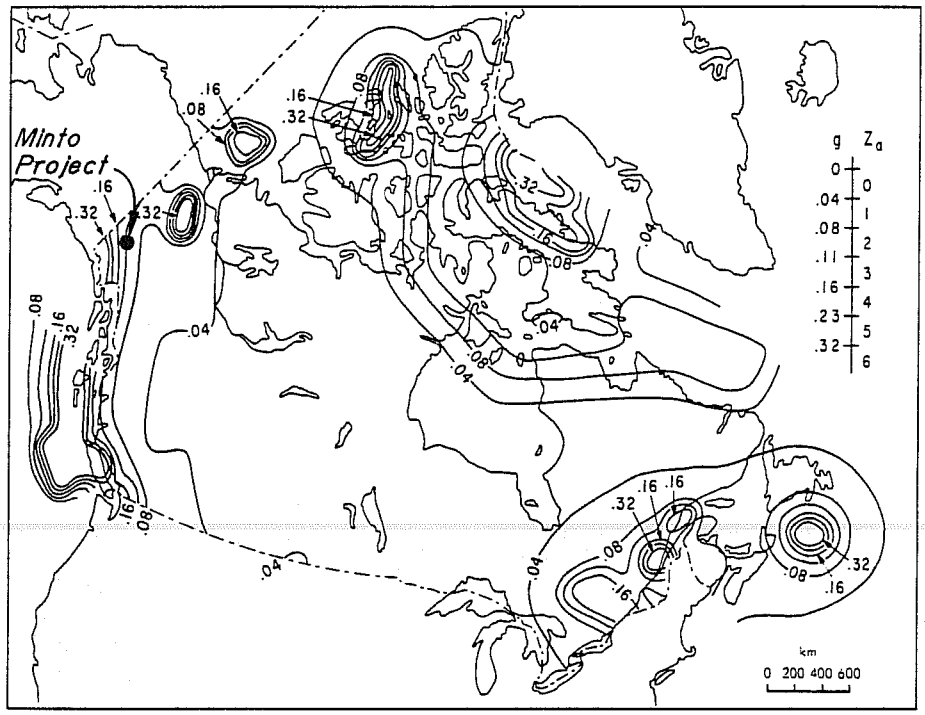
Dec. 11, 1994

HALLAM KNIGHT PIESOLD LTD.
ENVIRONMENTAL CONSULTANTS

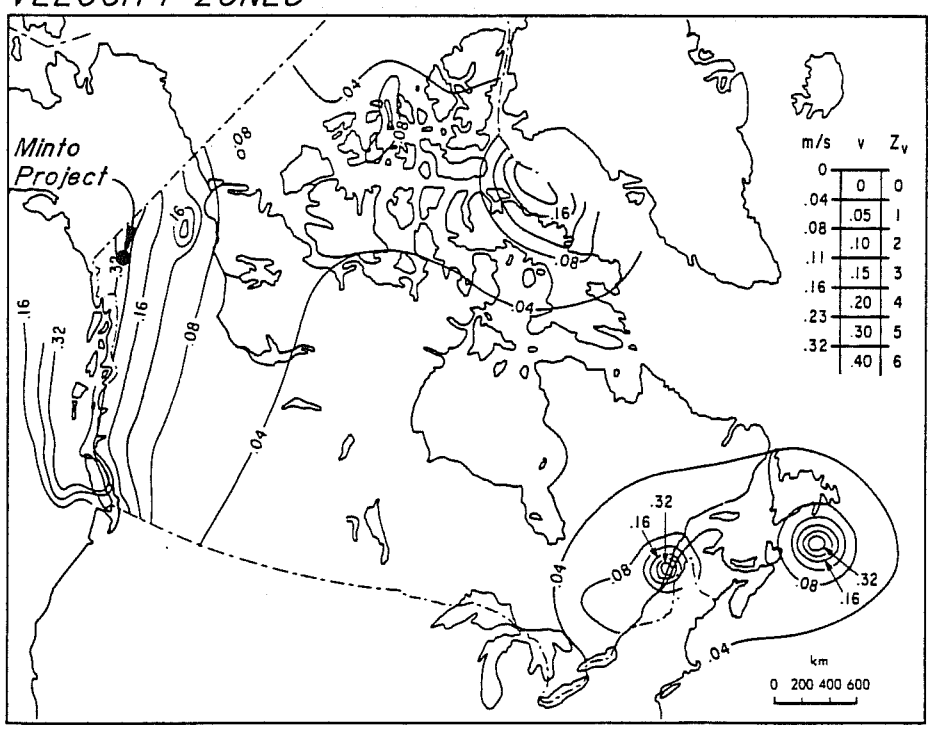
FIGURE 2.2

MINTO EXPLORATIONS LTD.
MINTO PROJECT
SEISMICITY

ACCELERATION ZONES



VELOCITY ZONES



Dec. 6, 1994

HALLAM KNIGHT PIESOLD LTD.
ENVIRONMENTAL CONSULTANTS

FIGURE 2.3

SECTION 3.0 - METEOROLOGY

3.1 GENERAL

The Minto Creek basin is located in an area characterized by moderate annual precipitation totals and extreme variations in temperature. Average annual precipitation is approximately 300 mm to 400 m, with July being the wettest month. Almost half of the annual precipitation falls as snow as daily temperatures are below freezing from October through May. Average monthly temperatures range from a low of approximately -30°C in January to a high of approximately 12°C in July.

A basic meteorological station was established at the site in late September 1993 and intermittent temperature and precipitation data is available for September and October, 1993, and June, July and August, 1994. The station is situated in the exploration camp at an approximate elevation of 2900 ft (884 m).

3.2 TEMPERATURE

Intermittent temperature recordings were taken at the site in September and October, 1993, and June, July and August, 1994. Much of this data is summarized in Table 3.1, with concurrent regional data provided for comparison. A number of regional stations are operated in the area by Atmospheric Environment Services (AES). The two closest and most relevant stations are those at Pelly Ranch (Fort Selkirk) and Carmacks, located approximately 20 km northwest and 80 km southeast of the site, respectively.

As Pelly Ranch is the closest station, its records were chosen as the basis for generating long-term monthly temperature values for the Minto Project area. Values for the Minto Project area were estimated by adjusting Pelly Ranch values by a lapse rate of between 6 and 8°C per 1000 m of elevation (ie. less 3°C for 420 m). This lapse rate is based on the standard lapse rate for B.C. of

6°C per 1000 m for moist air and 10°C per 1000 m for dry air. Estimated average monthly temperature values are shown in Table 3.2. As can be seen, July is the warmest month, with an average daily temperature of approximately 12.1°C, while January is the coldest month with an average daily temperature of approximately -30.9°C.

3.3 MEAN ANNUAL PRECIPITATION

Intermittent precipitation recordings were taken at the site in September and October, 1993, and June, July and August, 1994. Much of this data is summarized in Table 3.3, with concurrent regional data provided for comparison. Since there is insufficient site specific data to generate an estimate of mean annual precipitation, long-term synthetic data was generated for the site by adjusting Pelly Ranch data by an orographic factor of + 8% per 100 m of elevation gain. The mean annual precipitation for Pelly Ranch is estimated at 298.9 mm, at elevation 454 m. Therefore, the mean annual precipitation for the Minto Project area, at the proposed tailings pond elevation of 760 m, is estimated to be 378 mm.

Pelly Ranch data was chosen over other AES data as the basis for the analysis for the following reasons:

- the close proximity of the station and the site.
- a reasonable correlation between station and site precipitation records.
- a reasonable correlation between station precipitation and site runoff (see Figure 3.1).

The orographic factor was obtained from "Climate of Yukon" (Wahl et al., 1987) and is based on a detailed study of precipitation for the Mayo-Elsa and Faro-Anvil regions. Although it is stated in the text that this relationship may not apply in other areas of the Yukon, it is the best data available and was selected as a reasonable value on that basis.

3.4 MONTHLY PRECIPITATION DISTRIBUTION

Because site precipitation data covers only a few months and gives little indication of long-term average monthly precipitation, it was assumed that the monthly precipitation distribution for the project area is the same as that for Pelly Ranch. However, the proportions of precipitation that fall as rain and snow were adjusted to account for the fact that as the Minto Project area is at a higher elevation, and therefore slightly cooler (about 2°C based on a lapse rate of between 6°C and 10 °C per 1000m), a greater percentage of precipitation falls as snow.

On the basis of temperature differences between Pelly Ranch and the Minto Project area, it is projected that precipitation on the Minto Project area falls mainly as snow in October and entirely as snow between November and March. Precipitation records at Pelly Ranch indicate that on average 61.7% of precipitation falls as rain and 38.3% falls as snow. In comparison, an estimated 58.5% of precipitation falls as rain and 41.5% falls as snow at the Minto Project area. Long-term monthly precipitation data was generated in the same fashion as the annual precipitation estimate. Monthly precipitation values for Pelly Ranch, Carmacks and the Minto Site are given in Table 3.4. As can be seen, July is generally the wettest month and March the driest.

3.5 WET AND DRY YEAR PRECIPITATION

Wet and dry year return period precipitation values were estimated by assuming an underlying normal distribution with a mean of 378 mm and a standard deviation of 57 mm. A curve fitting exercise was undertaken with the Pelly Ranch data and it was found to follow a normal distribution. The standard deviation value was determined with a coefficient of variation of 0.15, which was calculated from 34 years of Pelly Ranch data (1952-1991). Various wet and dry year return precipitation values are given in Table 3.5. These values were calculated with the formula:

return period flow = mean $\pm$ (standard deviation x distribution coefficient).

3.6 EXTREME 24 HOUR PRECIPITATION

Return period precipitation values are presented in the form of intensity-duration-frequency (IDF) curves (see Figure 3.2 and Table 3.6). These curves were generated from data in the "Rainfall Frequency Atlas of Canada (RFAC)" (Environment Canada, 1985). These curves were compared with IDF curves generated for Pelly Ranch by AES, and the two sets of curves closely agree. However, since the RFAC values are slightly higher for long duration storms, they were selected as a conservative measure.

3.7 SNOW PACK

John Gibson and Associates operated three snow course sites in the Minto Creek watershed during the 1993/1994 winter. These sites are located near the headwaters of the basin at elevations of 914 m, 823 m and 823 m. The results of this snow course program are shown in Table 3.7, along with concurrent data for three regional stations operated by Indian and Northern Affairs Canada (INAC). The snow pack records recorded at Mt. Nansen most closely correspond to the site records, and therefore Mt. Nansen long-term records were used to estimate long-term average snow melt values for the Minto Project area. It is estimated that on average approximately 80% of the snow pack melts in April with the remaining 20% melting in May.

3.8 COMBINED RAINFALL AND SNOWMELT DISTRIBUTION

For the purpose of water balance modelling, it is necessary to estimate the water inflow to a pond (ie. tailings pond) due to direct precipitation. Approximately 40% of annual precipitation falls as snow during the months of September through to May. However, during this period temperatures are very cold and consequently very little snowmelt occurs. Therefore, it was assumed that 100% of snowfall accumulates as snow pack and does not contribute to pond water until the spring melt. Distribution of direct precipitation was therefore estimated by combining rainfall and snowmelt distribution values. These values are shown in Table 3.8.

3.9 EVAPORATION

No evaporation records are available for the Minto Site. However, lake evaporation values are recorded at the AES meteorological station at Pelly Ranch. Lake evaporation values for the Minto Project area were estimated by applying an orographic adjustment factor to long-term Pelly Ranch values. Pelly Ranch data indicates a mean annual evaporation value of 454.1 mm, at elevation 454 m, with measurable evaporation only occurring during the months of May through to September. The Ministry of Environment's Manual of Operational Hydrology Manual in B.C. (Coulson et al, 1991) suggests a reduction of evaporation with elevation equal to 10% per 350 m rise in elevation. As the climates of B.C. and the Yukon are very similar, this adjustment factor was adopted. Based on the above values , the mean annual evaporation for the Minto Project area, at the proposed tailings pond elevation 760 m, is estimated to be 409 mm. Monthly evaporation values are shown in Table 3.9. Maximum evaporation occurs in July with little or no evaporation during the months of October through April.

Table 3.1
Minto Explorations Ltd.
Minto Project
September, October Temperature (°C)

Sept '93	Pelly Ranch	Carmacks	Site
1	17.5	18.5	
2	12.0	16.0	
3	10.5	M	
4	9.0	10.5	
5	10.5	M	
6	14.3	15.5	
7	13.5	M	
8	10.3	10.0	
9	9.8	10.5	
10	7.8	M	
11	10.8	M	
12	3.8	4.8	
13	10.8	M	
14	9.3	8.0	
15	7.0	8.3	
16	10.5	9.8	
17	4.5	M	
18	0.5	1.0	
19	2.8	M	
20	3.8	4.8	
21	10.8	8.0	
22	1.5	2.3	
23	-2.8	-2.0	
24	0.3	M	
25	-3.5	-0.5	
26	1.8	3.5	
27	2.5	2.8	
28	3.0	5.5	
29	4.3	4.5	
30	0.8	2.5	0.5
Average	0.8	2.5	0.5

Oct '93	Pelly Ranch	Carmacks	Site
1	10.5	9.8	10.0
2	4.5	4.5	5.5
3	-1.8	1.0	-0.5
4	-2.0	1.5	-1.0
5	2.0	-1.0	-5.0
6	-0.3	-1.3	
7	3.5	1.5	
8	5.3	6.0	
9	5.0	M	
10	1.8	M	
11	4.0	M	
12	0.8	3.0	
13	2.5	3.0	
14	-0.5	2.0	
15	1.0	0.3	
16	3.8	M	
17	5.8	5.5	
18	1.5	2.5	
19	-4.0	-1.5	
20	-3.3	-0.5	
21	-8.8	-6.5	
22	-6.0	-3.0	
23	-3.3	M	
24	-5.5	-9.5	
25	-2.0	-6.0	
26	-0.3	-1.5	
27	-1.0	-2.3	
28	2.0	0.5	
29	3.5	3.0	
30	2.5	M	
31	-3.8	-4.0	
Average	2.6	3.2	1.8

Notes:
1) Averages are for concurrent days of data only.
2) M = missing data.

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Table 3.1(cont'd)
Minto Explorations Ltd.
Minto Project
June, July Temperature (°C)

June '94	Pelly Ranch	Carmacks	Site
1	11.3	11.0	
2	12.5	10.3	
3	10.8	12.0	
4	9.5	M	
5	11.8	M	
6	14.0	13.5	11.0
7	11.0	14.5	13.5
8	12.0	13.8	14.5
9	13.8	15.5	17.5
10	15.3	15.5	14.5
11	13.5	M	15.0
12	15.5	15.8	14.5
13	15.8	15.3	16.5
14	15.5	16.3	16.5
15	16.8	18.3	18.0
16	16.5	17.8	16.5
17	16.0	14.8	14.0
18	14.0	M	11.5
19	13.5	M	11.0
20	13.0	12.5	11.0
21	15.0	16.5	15.0
22	18.0	17.8	16.0
23	16.0	16.8	13.0
24	15.5	15.5	15.0
25	11.0	11.5	10.0
26	9.0	M	5.5
27	10.5	11.5	9.0
28	9.8	10.8	8.5
29	12.8	11.8	10.0
30	14.8	13.8	14.0
Average	13.9	14.7	13.3

July '94	Pelly Ranch	Carmacks	Site
1	15.3	M	
2	14.3	M	14.0
3	14.5	M	13.0
4	15.0	14.5	17.0
5	12.3	14.0	M
6	12.5	12.0	9.0
7	13.5	11.3	11.0
8	13.5	M	9.0
9	14.8	M	12.0
10	17.3	M	17.5
11	18.3	M	17.5
12	20.3	20.0	20.5
13	21.3	20.5	17.0
14	21.5	19.8	20.5
15	17.3	M	18.0
16	16.5	M	14.0
17	15.3	M	17.0
18	17.5	16.5	15.5
19	15.8	16.0	14.5
20	12.0	12.0	12.5
21	14.8	14.8	10.0
22	15.5	M	15.0
23	16.3	M	17.0
24	17.8	M	17.0
25	18.8	M	19.5
26	18.5	19.8	21.0
27	13.8	14.5	17.0
28	18.8	18.5	14.5
29	18.3	M	19.0
30	18.3	M	
31	20.8	M	
Average	16.4	16.2	15.5

Notes:
1) Averages are for concurrent days of data only.
2) M = missing data.

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Table 3.2
Minto Explorations Ltd.
Minto Project
Mean Monthly Temperature Data (mm)

Long-term regional values

Station	Years of Record	Elev. (m)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pelly Ranch	1961 - 1990	454	-27.9	-21.7	-11.9	-0.2	7.5	13	15.1	12.5	6.5	-2.3	-16.7	-25.5	-4.3
Carmacks	1963 - 1990	525	-28.6	-18.2	-11.6	-0.1	7.2	12.9	14.8	12.5	6.9	-1.6	-14.7	-24.7	-3.8
Minto Site (est.)	N/A	870	-30.9	-24.7	-14.9	-3.2	4.5	10.0	12.1	9.5	3.5	-5.3	-19.7	-28.5	-7.3

Notes:

1) Carmacks March and April values taken from climate normals for 1951 to 1980.

2) Minto site data estimated by adjusting Pelly Ranch data by a lapse rate of between 6 and 8 °C/1000 m (less 3°C for 420m).

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Table 3.3
Minto Explorations Ltd.
Minto Project
September, October Precipitation (mm)

Sept '93	Pelly Ranch	Carmacks	Site
1	0.0	0.0	
2	0.0	0.8	
3	0.0	0.0	
4	0.0	0.0	
5	0.0	0.0	
6	0.0	0.0	
7	1.0	3.6	
8	0.2	0.0	
9	1.8	1.2	
10	2.0	C	
11	0.0	C	
12	2.0	21.2	
13	0.0	0.0	
14	0.0	0.0	
15	0.0	0.0	
16	4.6	0.0	
17	3.4	4.8	
18	0.0	0.0	
19	0.0	0.0	
20	0.0	0.0	
21	0.0	0.0	
22	0.0	0.0	
23	0.0	0.0	
24	0.0	0.0	
25	1.2	1.0	
26	1.8	4.0	
27	0.0	0.0	
28	0.0	0.0	
29	0.0	0.0	
30	0.8	1.2	1.9
Total	0.8	1.2	1.9

Oct '93	Pelly Ranch	Carmacks	Site
1	1.8	0.0	0.0
2	0.0	0.0	2.8
3	0.0	2.0	0.0
4	1.4	0.0	4.3
5	0.0	0.0	0.0
6	0.0	0.0	
7	0.0	0.0	
8	4.6	0.0	
9	0.0	0.0	
10	0.4	1.0	
11	0.0	0.0	
12	0.0	0.2	
13	0.0	0.0	
14	0.0	0.0	
15	3.0	0.0	
16	2.0	0.0	
17	1.2	0.0	
18	0.0	0.0	
19	7.0	4.5	
20	3.5	5.0	
21	0.8	0.6	
22	0.0	C	
23	0.0	2.0	
24	0.0	0.0	
25	0.4	3.0	
26	0.0	0.0	
27	0.8	0.0	
28	1.2	1.5	
29	0.0	0.0	
30	0.0	0.0	
31	0.0	1.0	
Total	3.2	2.0	7.1

Notes:
1) Totals are for concurrent days of data only.
2) C = precipitation occurred, amount unknown, value accumulated in next days value.

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Table 3.3 (cont'd)
Minto Explorations Ltd.
Minto Project
June, July Precipitation (mm)

June '94	Pelly Ranch	Carmacks	Site
1	0.0	1.2	
2	0.0	0.0	
3	0.0	0.0	
4	0.6	0.0	
5	0.0	0.0	
6	0.0	2.8	
7	0.0	0.0	0.0
8	0.0	0.0	0.0
9	0.0	0.2	0.0
10	6.6	1.5	1.8
11	0.0	0.0	1.0
12	0.0	0.0	0.0
13	0.0	0.0	0.0
14	0.0	0.0	0.0
15	0.0	0.0	0.0
16	0.2	2.0	0.0
17	0.0	C	0.0
18	5.4	C	1.0
19	0.4	6.8	7.9
20	0.0	3.0	0.9
21	0.2	0.5	0.0
22	0.0	0.2	0.5
23	0.0	0.0	1.7
24	12.2	C	0.0
25	21.6	C	19.6
26	6.0	7.0	10.8
27	0.0	0.4	0.0
28	0.4	0.0	0.2
29	0.0	1.8	0.0
30	0.0	0.0	0.0
Total	53.0	23.4	45.4

July '94	Pelly Ranch	Carmacks	Site
1	0.4	0.0	
2	0.0	0.0	12.0
3	0.0	3.0	0.0
4	1.2	0.2	0.0
5	8.6	2.0	4.7
6	0.0	4.4	6.8
7	2.2	1.5	4.6
8	0.0	0.0	0.0
9	0.0	0.0	0.0
10	0.0	0.0	0.0
11	0.0	0.0	0.0
12	0.0	0.5	0.0
13	0.0	0.0	0.0
14	0.0	0.0	0.0
15	0.0	0.0	0.0
16	0.0	0.0	0.0
17	0.0	0.0	2.0
18	0.0	0.0	0.0
19	9.6	0.0	0.0
20	14.0	4.8	1.8
21	0.0	0.0	16.0
22	0.0	0.0	
23	0.0	0.0	
24	0.0	0.0	
25	0.0	0.0	
26	0.2	0.8	
27	0.0	0.2	
28	0.0	0.0	
29	0.0	0.0	
30	0.0	C	
31	0.0	8.0	
Total	35.6	16.4	47.9

Notes:
1) Totals are for concurrent days of data only.
2) C = precipitation occurred, amount unknown, value accumulated in next days value.

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Table 3.4
Minto Explorations Ltd.
Minto Project
Precipitation Data

Regional Values

Precipitation Station	Years of Record	Elevation	Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pelly Ranch	1961 - 1990	454 m	rain (mm)	0	0	0.3	3.3	22.8	37	51.7	33.8	26.7	8.3	0.5	0	184.4
			% precip.	0.0%	0.0%	0.1%	1.1%	7.6%	12.4%	17.3%	11.3%	8.9%	2.8%	0.2%	0.0%	61.7%
			snow (mm)	19.8	15.3	10.2	7.8	0.2	0	0	0.1	1.1	16.1	22.7	21.2	114.5
			% precip.	6.6%	5.1%	3.4%	2.6%	0.1%	0.0%	0.0%	0.0%	0.4%	5.4%	7.6%	7.1%	38.3%
			precip.(mm)	19.8	15.3	10.5	11.1	23	37	51.7	33.9	27.8	24.4	23.2	21.2	298.9
			% precip.	6.6%	5.1%	3.5%	3.7%	7.7%	12.4%	17.3%	11.3%	9.3%	8.2%	7.8%	7.1%	100.0%
	1994	454 m	precip.(mm)						53.6	36.2	8.6	21.6				
Carmacks	1963 - 1990	525m	rain	0	0	0.2	1.1	18.3	34.5	55.1	39.3	29.5	5.2	0.4	0	183.6
			% precip.	0.0%	0.0%	0.1%	0.4%	6.6%	12.5%	19.9%	14.2%	10.7%	1.9%	0.1%	0.0%	66.4%
			snow	17.9	12.3	6.8	5.7	1.8	0	0	0.1	1.1	14	17.9	15.3	92.9
			% precip.	6.5%	4.4%	2.5%	2.1%	0.7%	0.0%	0.0%	0.0%	0.4%	5.1%	6.5%	5.5%	33.6%
			precip.(mm)	17.9	12.3	7	6.8	20.1	34.5	55.1	39.4	30.6	19.2	18.3	15.3	276.5
			% precip.	6.5%	4.4%	2.5%	2.5%	7.3%	12.5%	19.9%	14.2%	11.1%	6.9%	6.6%	5.5%	100.0%

Estimated Site Values

Precipitation Station	Years of Record		Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Minto Site	long - term	760 m	rain (mm)	0	0	0	0	29	47	65	43	34	4	0	0	221
			% precip.	0.0%	0.0%	0.0%	0.0%	7.6%	12.4%	17.3%	11.3%	8.9%	1.0%	0.0%	0.0%	58.5%
			snow (mm)	25	19	13	14	0	0	0	0	2	27	29	27	157
			% precip.	6.6%	5.1%	3.5%	3.7%	0.1%	0.0%	0.0%	0.0%	0.4%	7.2%	7.8%	7.1%	41.5%
			precip.(mm)	25	19	13	14	29	47	65	43	35	31	29	27	378
			% precip.	6.6%	5.1%	3.5%	3.7%	7.7%	12.4%	17.3%	11.3%	9.3%	8.2%	7.8%	7.1%	100.0%

Notes:

1) Precipitation estimate for elevation 760 m.

2) Estimate made by modifying Pelly Ranch Data: Data from Canadian Climate Normals: 1961 - 1990
Annual Precipitation : mean annual value for Pelly Ranch plus orographic allowance (8% per 100m) ie. 299 mm x 1.08^((760-454)/100) = 378 mm. Orographic allowance from text "Climate of Yukon".
Precipitation Distribution : Precipitation distribution same as Pelly Ranch, however proportion falling as rain and snow has been altered slightly. Minto site is approximately 2 °C colder than Pelly Ranch. Assume no rain in March, April and November, and less rain in October.

Table 3.5
Minto Explorations Ltd.
Minto Project
Wet and Dry Year Precipitation

Annual Precipitation:

mean =	378 mm
standard deviation =	57 mm

Return Period	Precipitation (mm)
1:10 year dry (mean - 1.282 s.d.)	305
1:20 year dry (mean - 1.645 s.d.)	285
1:10 year wet (mean + 1.282 s.d.)	451
1:20 year wet (mean + 1.645 s.d.)	471
1:50 year wet (mean + 2.054 s.d.)	494
1:100 year wet (mean + 2.326 s.d.)	510
1:200 year wet (mean + 2.575 s.d.)	524

Notes:

1) Precipitation estimates for elevation 760 m. Estimates for other elevations can be made by increasing values 8% per 100 m increase in elevation..
2) Mean value estimated from Pelly Ranch data (Climate Normals 1961-1990) plus an orographic allowance.
3) Standard deviation estimated from a C.V. value of 0.15, calculated with 34 years of Pelly Ranch data (1952 - 1991).

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Table 3.6
Minto Explorations Ltd.
Minto Project
Minto Site IDF Curves

Developed from the "Rainfall Frequency Atlas of Canada".

Duration	Mean	St. Dv.	Factor	Year
5 min	3	2	-0.164	2
10 min	4.1	2.2	0.719	5
15 min	4.2	3	1.305	10
30 min	6.1	2.5	1.635	15
1 hr	8.1	4	1.866	20
2 hr	10	4	2.044	25
6 hr	15	6	2.592	50
12 hr	20	6.1	3.137	100
24 hr	20	7	3.679	200
			18.1741	PMP

Return Period Rainfall Amounts (mm)

Duration	2 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	50 yrs	100 yrs	200 yrs	PMP
5 min	2.7	4.4	5.6	6.3	6.7	7.1	8.2	9.3	10.4	39.0
10 min	3.7	5.7	7.0	7.7	8.2	8.6	9.8	11.0	12.2	43.7
15 min	3.7	6.4	8.1	9.1	9.8	10.3	12.0	13.6	15.2	58.2
30 min	5.7	7.9	9.4	10.2	10.8	11.2	12.6	13.9	15.3	51.1
1 hr	7.4	11.0	13.3	14.6	15.6	16.3	18.5	20.6	22.8	80.2
2 hr	9.3	12.9	15.2	16.5	17.5	18.2	20.4	22.5	24.7	82.1
6 hr	14.0	19.3	22.8	24.8	26.2	27.3	30.6	33.8	37.1	123.1
12 hr	23.7	30.5	35.0	37.5	39.2	40.6	44.8	48.9	53.1	162.4
24 hr	23.6	31.3	36.4	39.3	41.3	42.9	47.7	52.4	57.2	182.6

* Calculations include an orographic factor = 1.25 for durations of 12 hours and more.

Rainfall Intensity (mm/hr)

Duration	2 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	50 yrs	100 yrs	200 yrs	PMP
5 min	32.1	53.3	67.3	75.2	80.8	85.1	98.2	111.3	124.3	468.3
10 min	22.4	34.1	41.8	46.2	49.2	51.6	58.8	66.0	73.2	262.4
15 min	14.8	25.4	32.5	36.4	39.2	41.3	47.9	54.4	60.9	233.0
30 min	11.4	15.8	18.7	20.4	21.5	22.4	25.2	27.9	30.6	102.3
1 hr	7.4	11.0	13.3	14.6	15.6	16.3	18.5	20.6	22.8	80.2
2 hr	4.7	6.4	7.6	8.3	8.7	9.1	10.2	11.3	12.4	41.0
6 hr	2.3	3.2	3.8	4.1	4.4	4.5	5.1	5.6	6.2	20.5
12 hr	2.0	2.5	2.9	3.1	3.3	3.4	3.7	4.1	4.4	13.5
24 hr	1.0	1.3	1.5	1.6	1.7	1.8	2.0	2.2	2.4	7.6

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Table 3.7
Minto Explorations Ltd.
Minto Project
Snowmelt Data

1994 Snow Survey Summary

Station Name	Elevation (m)	Approx. Dist. from Site (km)	1994 Snowpack Data (mm)								% Snow Melt		
			March 1		April 1		May 1		May 15		March	April	May
			snow	water eq.	snow	water eq.	snow	water eq.	snow	water eq.			
Minto #1	914	n/a	53.4	98.0	55.9	112.0	0.0	0.0	0.0	0.0	0%	100%	0%
Minto #2	823	n/a	52.1	86.5	51.7	93.0	0.0	0.0	0.0	0.0	0%	100%	0%
Minto #3	823	n/a	51.0	84.0	43.0	78.0	0.0	0.0	0.0	0.0	7%	93%	0%
Mt. Nansen	1021	50 SW	48.0	73.0	52.0	73.0	0.0	0.0	0.0	0.0	0%	100%	0%
Casino Creek	1065	50 SE	51.0	83.0	61.0	83.0	22.0	56.0	0.0	0.0	0%	33%	67%
Mt. Berdoe	1035	90 NW	56.0	97.0	60.0	110.0	9.0	51.0	0.0	0.0	0%	54%	46%

Long-term Snow Survey Summary

Station Name	Elevation (m)	Years of Record	Water Equivalent (mm)				% Snow Melt		
			March 1	April 1	May 1	May 15	March	April	May
Mt. Nansen	1021	18	70.0	77.0	16.0	0.0	0%	79%	21%
Casino Creek	1065	16	107.0	126.0	128.0	74.0	0%	0%	100%
Mt. Berdoe	1035	19	97.0	110.0	61.0	20.0	0%	45%	55%

Estimated Long-term Minto Site Snow Melt Distribution

Station Name	% Snow Melt		
	March	April	May
Minto	0%	80%	20%

Notes:

1) Mt. Nansen, Casino Creek and Mt. Berdoe data from Yukon Territory Snow Survey Bulletin.

2) All May 15th snow pack is assumed to melt by the end of May.

3) Estimate of long-term Minto Creek values is based upon long-term Mt. Nansen records.

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Table 3.8
Minto Explorations Ltd.
Minto Project
Estimated Rainfall and Snowmelt Distributions

Total Annual Precipitation at elevation 760 m (tailings pond location) = 378 mm

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Location	Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Minto Site	Rainfall	0	0	0	0	29	47	65	43	34	4	0	0	221
	% rainfall	0.0%	0.0%	0.0%	0.0%	13.0%	21.2%	29.6%	19.3%	15.2%	1.7%	0.0%	0.0%	100.0%
	% precipitation	0.0%	0.0%	0.0%	0.0%	7.6%	12.4%	17.3%	11.3%	8.9%	1.0%	0.0%	0.0%	58.5%
	Snowmelt	0	0	0	125	31	0	0	0	0	0	0	0	157
	% snowmelt	0.0%	0.0%	0.0%	80.0%	20.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	% precipitation	0.0%	0.0%	0.0%	33.2%	8.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	41.5%
	Total Precipitation	0	0	0	125	60	47	65	43	34	4	0	0	378
	% precipitation	0.0%	0.0%	0.0%	33.2%	15.9%	12.4%	17.3%	11.3%	8.9%	1.0%	0.0%	0.0%	100.0%

Notes:

1) For water balance modeling, the total precipitation values should be used to represent water inflow due to direct precipitation on a pond.

2) Values are suitable for both tailings pond and decant pond locations.

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Table 3.9
Minto Explorations Ltd.
Minto Project
Mean Monthly Pond Evaporation (mm)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pelly Ranch	0	0	0	0	105	121.3	111.2	80	36.6	0	0	0	454.1
Minto Site	0	0	0	0	96	110	101	73	33	0	0	0	409

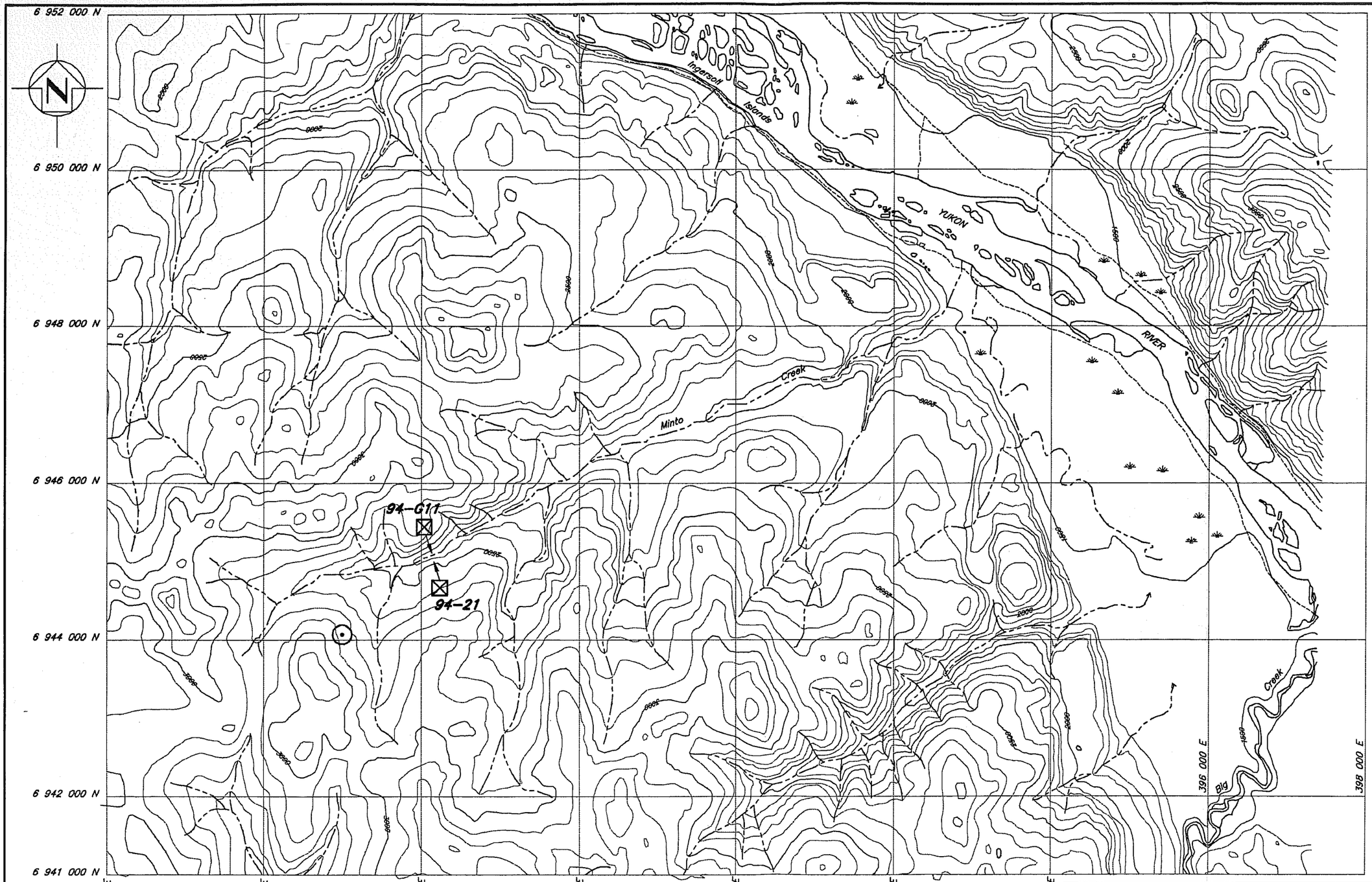
Notes:

1) Pelly Ranch values from 28 years of data collected from AES station 2100880, at elevation 454 m.

2) Minto site data generated by reducing Pelly Ranch values by 9%. Minto tailings pond site approximately at elevation 760 m.
MOE Manual of Operational Hydrology in B.C. suggests a 10% reduction in evaporation values per 350 m rise in elevation. ie. 760 - 454 = 306 and 306/350 x 10% = 9%

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LEGEND

- Thermistor
- Meteorological Monitoring Station

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

HALLAM KNIGHT PIESOLD LTD.
ENVIRONMENTAL CONSULTANTS – VANCOUVER, B.C.

DESIGNED	BAS
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CHECKED	BAS
APPROVED	

MINTO EXPLORATIONS LTD.

MINTO PROJECT

THERMISTOR AND METEOROLOGICAL STATION LOCATIONS

DATE DEC. 7, 1994 | SCALE AS SHOWN | PROJ. NO. H3021 | FIGURE 3.1

CAD FILE \PROJECT\1000\H3021\APPLICNT\B1 1:25000 Plot 1=25 DEC. 7, 1994

Minto Explorations Ltd.
Minto Project
Minto Creek Hydrograph and Regional Precipitation - June, July 1994

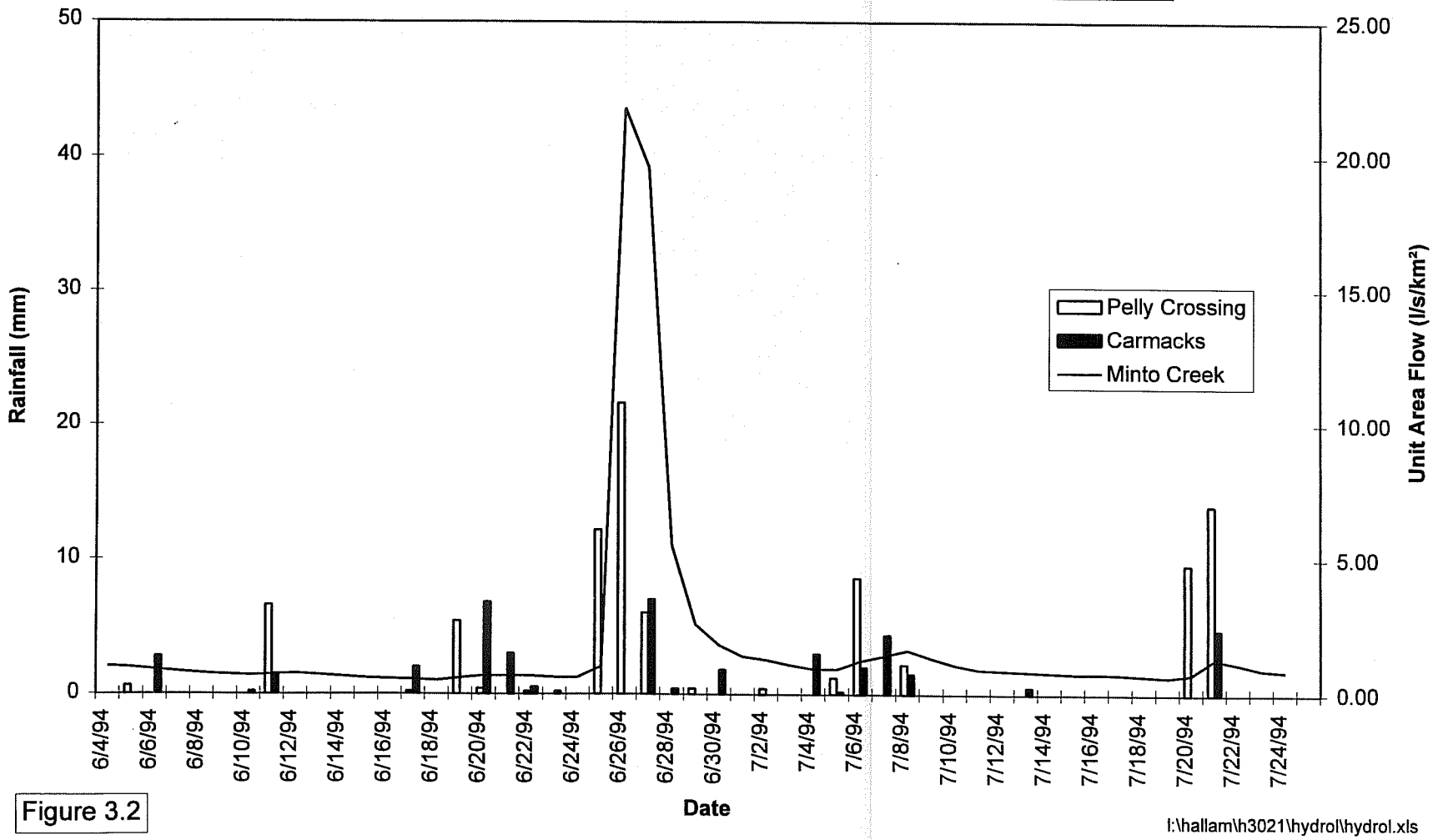


Figure 3.2

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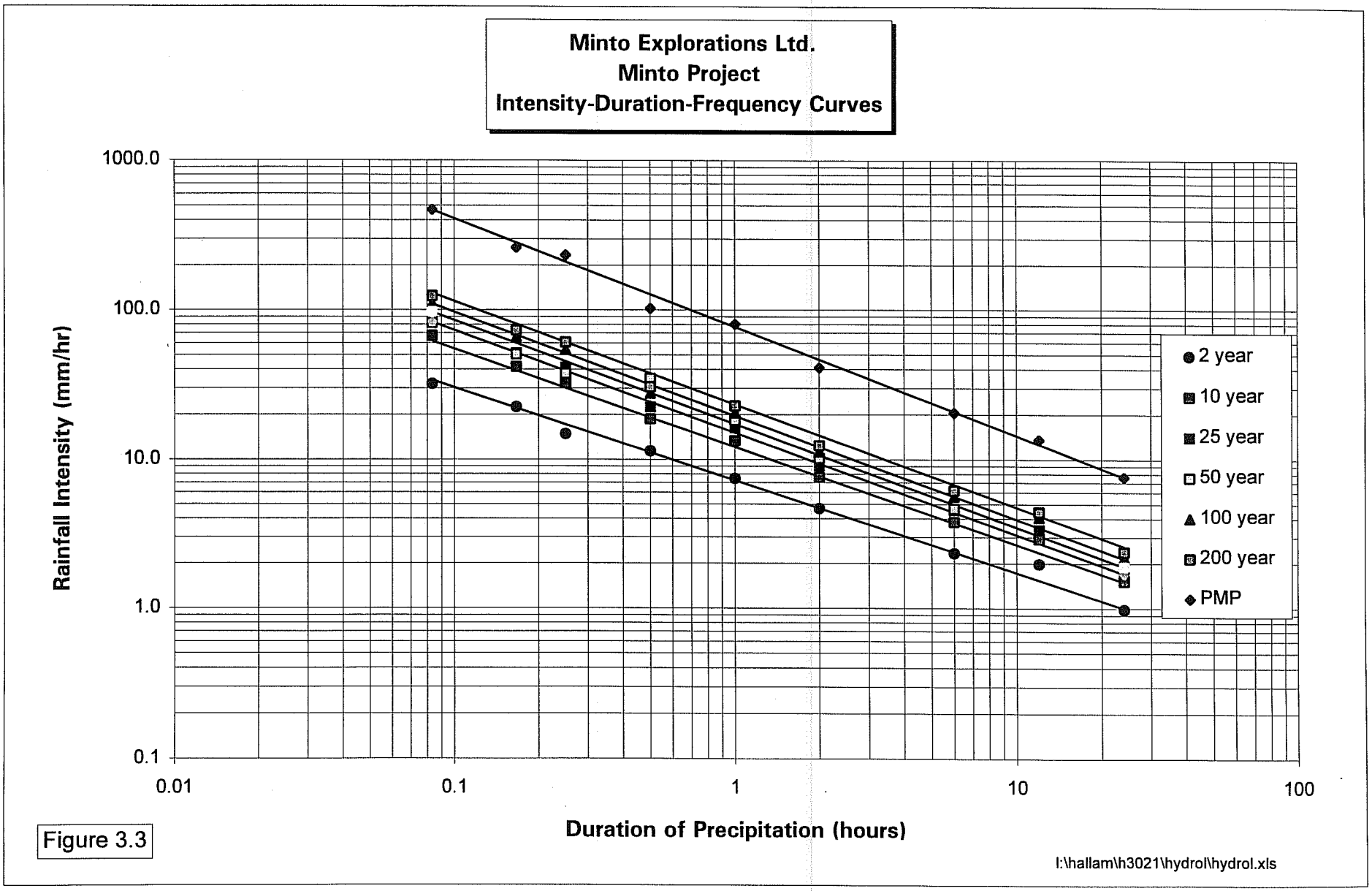

Minto Explorations Ltd.
Minto Project
Intensity-Duration-Frequency Curves
Rainfall Intensity (mm/hr)
1000.0
100.0
10.0
1.0
0.1
0.01
0.1
1
10
100
Duration of Precipitation (hours)
2 year
10 year
25 year
50 year
100 year
200 year
PMP
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Figure 3.3

SECTION 4.0 - AQUATIC RESOURCES

4.1 DESCRIPTION OF WATERSHED

The Minto Project lies within the Minto Creek watershed, a tributary to the Yukon River. Minto Creek has a mainstem length of 17 km and an average channel width of 2 m and flows northeast into the Yukon River. A creek profile is presented in Figure 4.1.

Immediately south of Minto Creek lies an unnamed drainage of approximately 7 km in length. This ephemeral system has an average channedl width of 0.5 m and flows northwest into the Yukon River. Approximately 3 km southwest of the Minto Creek watershed lie the headwaters of Dark Creek, a major tributary to Big Creek. Dark Creek has a mainstem length of 56.5 km and flows southeast into Big Creek. Big Creek flows northeast and confluences with the Yukon River approximately 6.5 km upstream of Minto Creek. North of Minto Creek lies a second unnamed drainage that has a mainstem length of 9.6 km and flows north northeast in the Yukon River approximately 8 km downstream of Minto Creek.

4.2 SURFACE HYDROLOGY

4.2.1 General

Streamflows in the Yukon are generally characterized by peak flows in the spring and low flows in the winter. Maximum discharges typically occur during the spring as the result of snow melt or-rain-on-snow events, with flows gradually decreasing following the disappearance of snow. Sizeable flood events may also occur in the late summer due to intense rainstorms. These rainfall events are particularly significant on small basins. The smallest discharges of the year occur in mid-winter. Major icing develops on all rivers and many streams freeze entirely, reducing their winter flows to zero.

4.2.2 Regional Streamflow Stations

Streamflow values are recorded at a number of locations throughout the Yukon by Water Survey of Canada (WSC) and INAC. Those stations most relevant to the Minto Creek basin are shown in Table 4.1. Also included are short-term records for Minto and Williams Creek. Williams Creek is located approximately 40 km to the southeast of Minto Creek and its basin is of similar size, aspect and elevation. The Williams Creek data is very short-term and incomplete and thus provides little insight into Minto Creek flows.

4.2.3 Site Streamflow Records

In September of 1993, staff gauges were installed at three sites on Minto Creek. These sites, which are designated H1, H2 and H3, are shown on Figure 4.2. H1 is located in the upper reaches of the catchment, immediately upstream of the proposed tailings main embankment. H3 is located approximately 1.5 km downstream from H1, and H2 is located near the creek mouth. Flow measurements for gauge calibration have been taken at all three sites on five occasions, and the results are shown in Table 4.2. In addition, a continuous data logger was installed at H2 and began operation on June 4, 1994. The hydrograph for the period of June 4 to September 26, 1994 is shown on Figure 4.3.

Streamflow records indicate that H1 has more flow than H3 and that on a unit area basis, H1 has approximately 4 times the flow of H2. This is highly unusual as one would expect the total flow volume to increase as one progressed downstream, and for the unit area flows to decrease slightly. The most likely explanation for these results is that there is significant streambed infiltration between stations H1 and H2.

Another possible explanation, which may be acting in conjunction with possible infiltration, is that the basin upstream of H1 may be serving as a large storage reservoir which acts to attenuate flows. There is possibly a large gravel deposit or something similar which temporarily stores rainfall, snowmelt and discontinuous permafrost melt. This water is then slowly released during the

summer period. If this is the case, then the flows in the creek would not be proportional to catchment size as a large proportion of the base flow would be provided by the reservoir. All available flow records are for non-freshet periods and therefore may be so influenced. This idea is supported by the fact that the basin area upstream of H1 is very marshy in the spring and early summer and experiences severe glaciation in the winter.

A further possible explanation is that the flows are so low that there may be some error in their measurement. This likely does not account for all the irregularity, but may have some significance. Additional flow measurements in the future will help to determine if this is in fact the case, and will be used to redefine flow estimates.

4.2.4 Mean Annual Runoff

Determining runoff estimates for the Minto Creek basin is extremely difficult due to the paucity of site-specific and relevant regional data. Flow records for Minto Creek cover the period of June through September, 1994. Since this short period of record does not include the freshet and gives little indication of long-term runoff values and patterns, regional streamflow records were used to generate synthetic long-term records for the site. Unfortunately, regional data in the Yukon is available for only a few rivers and all have drainage basins much larger than Minto Creek. To further complicate matters, the climate and hydrology of the Yukon are extremely basin specific, with adjacent basins sometimes exhibiting dramatically different runoff regimes. Due to extremely cold and lengthy winters, much of the Yukon freezes solid for several months each year, resulting in a significant snowmelt component of runoff. In addition, total runoff volumes and distributions are very dependent on basin elevations on account of freezing levels and orographic influences.

Clearly, there are many factors which influence runoff and consequently considerable uncertainty is associated with deriving runoff estimates. The reader will note that many references are made throughout this text to the fact that streamflow values are best estimates, based on accepted hydrological practices and sound engineering judgement, and are believed to be reasonably precise given their intended use. The numerous references are not intended to undermine the validity of the estimates but to make the reader aware of the uncertainty involved in their determination. As more site specific data becomes available, estimated values can be refined.

The following describes the procedures used to estimate runoff values for various locations on Minto Creek.

Regional discharge values were used to estimate Minto Creek long-term average annual runoff. After examining all available flow records it was determined that Big Creek is the most representative basin with long-term records (WSC station 09AH003), since it is located adjacent to the Minto Creek basin. Therefore, runoff estimates were made by using Big Creek data to determine rainfall runoff coefficients and snowmelt runoff values. Mean annual flow for Big Creek is estimated as 143 mm (7.96 m^3/s).

Big Creek drains a basin with an area of 1750 km^2, a mean elevation of approximately 1150 m and maximum elevations in excess of 1900 m. In contrast, Minto Creek drains a basin with an area of approximately 42 km^2, a mean elevation of approximately 760 m and maximum elevations up to 1000 m. In particular, for the water balance model, the areas of interest are in the upper reaches of the catchment. The drainage basin above the proposed tailings impoundment has an area of approximately 9.6 km^2 and a mean elevation of approximately 885 m. The basin draining into the proposed water decant pond has an area of approximately 1.1 km^2 and a mean elevation of approximately 790 m. The locations of these basins are shown on Figure 4.2.

Studies in the area have shown that during the winter, precipitation only increases with elevation up to the treeline, and then it may begin to decrease. The treeline elevation for this area in the Yukon is somewhere between 1350 m and 1500 m. Therefore, as the Big Creek basin has both a mean elevation higher than the areas of interest in the Minto basin (ie. increased precipitation) and a substantial area above the tree line (ie. decreased precipitation), it seems reasonable to assume that the snowfall component of the runoff of the two basins is likely very similar, and therefore, it was assumed to be the same for both basins.

Runoff and concurrent estimated rainfall records for Big Creek and the Minto Project area were examined in order to determine the percentage of runoff due to rainfall or snowfall (see Table 4.3). These values indicate that during the rainfall-only months of July, August and September, Big Creek has an average runoff coefficient of approximately 33%. During the snowmelt months of April, May and June, the total precipitation for Big Creek is estimated to be 116 mm, while the

total runoff is estimated to be 69 mm. Applying a runoff coefficient of 33% to 116 mm results in 38 mm of rainfall runoff. Consequently, 31 mm of runoff is due to snowmelt.

To check this runoff estimating technique, annual runoff for Big Creek was determined by adding 31 mm of snowmelt runoff to rainfall runoff computed by multiplying annual rainfall by 33%. Annual rainfall for Big Creek is estimated as 300 mm (assuming an orographic factor of 8% per 100 m of elevation and 58.5% of annual precipitation falling as rain) and therefore annual rainfall runoff is estimated as 100 mm. Total runoff is therefore estimated as 131 mm, which is 92% of the measured runoff of 143 mm, while it is understood that this is a slightly simplistic approach, the results were in close agreement and serve to provide the basis for reasonable approximations.

The rainfall component of runoff for Minto Creek was calculated by multiplying annual rainfall by a runoff coefficient. The 33% value of Big Creek was adopted for Minto Creek. Runoff coefficient values calculated from Minto Creek data were not used because there is no long-term data available for Minto Creek and because it is believed that a significant portion of runoff is lost due to streambed infiltration. Applying 33% to annual rainfall estimates of 221 mm for the decant pond basin, and 256 mm for the tailings pond basin, generated rainfall runoff estimates of 73 mm and 85 mm, respectively.

As stated previously, the snowmelt component of runoff for the Minto Creek basin was assumed to be 31 mm, the same as for the Big Creek basin. As the decant pond basin has approximately the same elevation as the entire Minto Creek basin, it follows that 31 mm is a reasonable estimate for its snowmelt runoff. Snowmelt runoff for the tailings pond basin, on the other hand, was increased to 34 mm to account for orographic effects.

Total annual runoff values for the proposed decant pond and tailings pond locations were calculated by adding snowmelt runoff to rainfall runoff. Consequently, annual runoff was estimated to be 104 mm for the decant pond basin and 119 mm for the tailings pond basin.

As an additional check on these calculations, estimated Minto Creek runoff values were compared with actual values. As Minto Creek has a very unusual flow pattern, some allowances had to be made to account for this. In order to compare estimated and actual values of creek flows at H2,

the estimated values had to be modified. This was achieved by assuming that 75% of rainfall runoff (H2/H1 ratio of unit area flows) and 50% of snowmelt runoff (during freshet the flows will overwhelm the infiltrating capacity of the streambed and therefore losses will not be as high) is lost to infiltration. In addition, the flow values were adjusted by the ratio of 1994 precipitation to long-term precipitation. The results of these calculations are shown in Table 4.4, and the actual and estimated values are very close.

4.2.5 Monthly Runoff Distributions

Since site streamflow data is limited, and as the only regional streamflow stations service basins of much greater size and with much greater relief than Minto Creek, available streamflow records did not provide an adequate basis for estimating runoff distribution. Consequently, rainfall and snowmelt records were used to estimate the runoff distribution. For the basins draining into the proposed tailings impoundment and water decant pond, the monthly runoff distribution was estimated to be the result of combining estimated rainfall and snowmelt distributions. The rainfall and snowmelt distributions were assumed to be the same as those used for estimating the distribution of direct precipitation. The estimated monthly distribution of runoff for Minto Creek is shown in Table 4.5.

4.2.6 Wet and Dry Year Return Period Runoff

Wet and dry year return period runoff values were estimated for both the proposed tailings impoundment and decant pond locations. The estimates were made by assuming that annual runoff values have an underlying normal distribution. The tailings pond distribution was assumed to have a mean of 168 mm and a standard deviation of 57 mm, while that of the decant pond was assumed to have a mean of 141 mm and a standard deviation of 48 mm. The standard deviation values were determined with a coefficient of variation value of 0.15, which was calculated from 18 years of Big Creek data. Estimates of return period runoff are given in Table 4.6. Monthly distributions during both high and low flow years are assumed to be the same as the distribution during an average year. This assumption is substantiated by the results of Table 4.7. This table compares wet, dry and average year distributions for Big Creek. As can be seen, the values have large

standard deviations and thus the wet and dry distributions do not significantly differ from the average distribution.

4.2.7 Seven Day Average Low Flow

During visits to the Minto Site on March 1 and April 1, 1994, Minto Creek at H2 was found to be dry and frozen solid. As the long-term average winter temperatures for the Minto Creek basin are estimated at values considerably below freezing, it is reasonable to assume that the complete freezing of the creek is an annual occurrence. Therefore, the seven day average low flow is estimated to be 0 m^3/s.

4.2.8 Peak Instantaneous Flows

As there are no peak flow records for the Minto Creek basin, return period flows were derived by using four streamflow estimating procedures for comparative purposes, and the results of the analyses are shown in Table 4.8. Peak daily and peak instantaneous flows were estimated for basins draining into the proposed tailings impoundment and the proposed water decant pond.

The first approach was to use a regional procedure developed for INAC by Janowicz (1989). Janowicz developed his method through a regional flood frequency analysis of flow data from 86 stations operated in the Yukon by INAC and WSC. This technique allows return period discharges to be estimated on the basis of watershed area and stream channel gradient. It should be noted that this method may tend to underestimate peak flows for small catchments as it is based upon data from large catchments which tend to not respond in as "peaky" a fashion. In addition, the method only distinguishes between basins with slopes of less than or greater than 4.5%, and does not account for degrees of steepness beyond this. Details of this analysis are shown in Table 4.9.

The second approach was to estimate discharges on the basis of the rational method. This approach is recommended in the "Manual of Operational Hydrology in B.C. (MOHBC)" (Coulson et al, 1991) for basins with areas less than 25 km^2. This method is based on the rational formula:

$$Qp = 0.28CIA$$

where, Qp = peak flow in m^3/s
C = runoff coefficient
I = rainfall intensity in mm/hour

Values for the various inputs to the rational formula are shown in Table 4.9. Rainfall intensity values were taken from the site IDF curve with times of concentration determined as the average of values calculated with the Hathaway formula and with the Tc chart in the MOHBC. Runoff coefficients were estimated based on values presented in the MOHBC. A basic runoff coefficient of 0.65 was selected for the tailings pond basin, as the basin can generally be described as moderate to steep sloped (s = 7% to 20%) and forested (pine) to agricultural (firekill with minimum regrowth). The coefficient was then increased by 0.1 to account for snowmelt and an additional 0.02 and 0.05 for various longer return periods. In contrast, a higher basic coefficient of 0.85 was selected for the decant pond basin to reflect the basin's steep slopes and forested (black spruce)/impermeable (exposed rock and scree) makeup.

It should be noted that the rational method is very simplistic and tends to overestimate values, particularly as runoff coefficients are very general and do not account for soil types. However, this method is useful as it is quick and simple and provides an upper bound.

The third approach was to base estimates on values generated by frequency analyses of peak flow data for Big Creek and Thistle Creek (Table 4.10). All flood frequency values were generated with Environment Canada's Consolidated Frequency Analysis software CFA88. Flood frequency values were derived by averaging the 3 Parameter Lognormal and Log Pearson Type III values. The Extreme Value and Wakeby estimates were discarded as they produced the high and low values for the longer return periods. Estimates for Minto Creek were made by adjusting the Big Creek and Thistle Creek values by catchment area ratios raised to the power of 0.8 (ie. for Minto tailings pond from Big Creek values: $(9.56/1750)^{0.8} = 0.015$).

As with the first and second approaches, this technique has its shortfalls. Although it attempts to account for differing basin sizes, it does not account for various other significant basin

characteristics such as slope and surface cover. When the model creek is very similar to the target creek, this is not a significant concern. However, in this case, the model creeks are not particularly representative of the areas of interest in the Minto basin, and therefore the method may tend to underestimate the peak flows.

The final approach was to use the HEC-1 computer program, a hydrologic package developed by the Hydrologic Engineering Centre of the U.S. Army Corps of Engineers. This model is the recognized industry standard in North America for generating runoff hydrographs from precipitation data. Inputs to the HEC-1 model include precipitation, precipitation distribution, and various physical characteristics of the watershed. The input parameters were estimated from regional data and site characteristics. A summary of the input parameters is given in Table 4.11. Two key inputs which require some explanation are precipitation and curve number.

Precipitation values were taken from the IDF curve data for 24 hour storm events and the Type I distribution was selected to reflect the changing rainfall intensities throughout the storm period. The fact that the model does not account for a rainfall on snow event is a source of error in this analyses while it is possible to try to account for snow, it is difficult, and the quality of the results does not warrant the effort. However, it may not be too significant a shortfall as peak discharges for small steep basins (< 25 km^2) are usually due to rainfall only events, even though rainfall on snow events generate the largest storm volumes. Nevertheless, because of this, the HEC-1 values may underestimate the peak flows (Table 4.12).

The curve number (CN) values selected for the tailings pond and decant pond basins are 62 and 81, respectively. These values were selected on the basis of the following:

tailings pond: gravely-sand to silty-sand
permeability 10^{-1} to 10^{-5} cm/s
fair hydrologic condition
30% lodgepole pine with deep litter, CN = 55
70% 14 year old firekill with min. regrowth, CN = 65

decant pond: silty-sand to sandy-silt
permeability 10^{-4} to 10^{-5} cm/s
fair hydrologic condition
50% scree slope with little vegetation, CN = 86
50% partially burnt spruce, CN = 75

It should be noted that the HEC-1 analysis produced greater flows for the decant pond basin than for the tailings pond basin, even though its area was much smaller. This is not an error but simply a function of a much higher runoff curve number and much shorter time of concentration. Little confidence can be placed in these calculated peak flow values until the model can be calibrated with site data. However, the results do serve to demonstrate that the ratios of the peak flows for the two basins are not simply proportional to the ratio of catchment areas, as is supposed by the Janowicz and regional approaches.

Initially, only the Janowicz and rational approaches were adopted, but as their results differ so dramatically, the other two approaches were added. The additional calculations indicate that the results of the Janowicz method are more likely to be correct than those of the rational method. The regional frequency analyses generated slightly higher values than Janowicz for the lower return periods and almost identical values for the higher return periods. The HEC-1 analysis indicates consistently lower values than the Janowicz method for the tailings basin, and very similar values for the decant basin.

Clearly, there is considerable uncertainty associated with the peak flow estimates. Site peak flow data is required to more confidently define return period peak flow values. Specifically, flow recordings at H1 are needed. However, until such time that this data is collected, the values based on the frequency analysis of Big Creek data shall serve as minimum estimates. These values are likely on the low side for the tailings pond basin and on the very low side for the decant pond basin. In turn, the values based on the rational formula shall serve as an upper bound and these values are likely extremely high. Actual values are somewhere between the high and low estimates, and likely closer to the low end, particularly for the tailings pond basin. Conservative "best guess" peak flow values are presented in Table 4.8. These values were generated by increasing the regional-Big Creek / tailings pond estimate by 25% and the regional-Big Creek /

decant pond estimate by 100%. All values shall have to be re-estimated for detailed engineering design.

Table 4.1
Minto Explorations Ltd.
Minto Project
Regional Streamflow Records

Description	Station No.	Years of Record	Measurement Period	Distance Between Sites (km)	Basin Area (km^2)	Approx. Mean Basin Elev. (m)	Period Runoff (mm)		Mean Annual Runoff			
							June 6, 1993 to July 24, 1993	June 6, 1994 to July 24, 1994	1993		Long-Term	
									(m^3/s)	(mm)	(m^3/s)	(mm)
Big Salmon River	09AG001	30	year round	220 SE	6760	1300	98.6		72	336	68.79	321
South Big Salmon River	09AG003	11	year round	220 SE	515	2000	77.3		4.08	250	4.21	258
Big Creek Near the Mouth	09AH003	17	year round	25 S	1750	1150	26.8		7.64	138	7.96	143
Nordenskiold River	09AH004	10	year round	130 SE	6370	1000	15.7		18.8	93	16.26	80
Thistle Creek	29CD001	8	thaw	120 NW	210	750						88
Scroggie Creek	29DD003	9	thaw	80 NW	730	750						68
Williams Creek	W-4	2	thaw	35 SE	22.26	850	5.4	7.6		32.4*		
Minto Creek	H-2	1	thaw	n/a	42.18	775		7.9				

Notes:

1) Data for stations 09AG001 to 09AH004 supplied by Water Survey of Canada (WSC). Gauges operated year round.
2) Data for stations 29CD001 and 29DD003 supplied by Dept. of Indian and Northern Affairs (DIAN). Gauges not operated during freeze period.
3) Data for Williams and Minto Creeks supplied by J. Gibson and Associates, Whitehorse.
4) Distance between sites refers to distances between centers of basin areas.
5) 1993 Williams Creek data does not include the freshet flows.

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Table 4.2
Minto Explorations Ltd.
Minto Project
Minto Creek Streamflow Data

Gauge Location	Area (km^2)	Flows (m^3/s)					Unit Area Flows (mm)				
		29-Sep-93	15-May-94	5-Jun-94	7-Jul-94	11-Aug-94	29-Sep-93	15-May-94	5-Jun-94	7-Jul-94	11-Aug-94
Minto Creek H1	4.75	0.035	0.119	0.029	0.042	0.005	0.637	2.165	0.527	0.764	0.091
Minto Creek H3	10.38	0.028	0.101	0.029	0.040	0.011	0.236	0.841	0.241	0.333	0.092
Minto Creek H2	42.18	0.060	0.312	0.061	0.095	n/a	0.123	0.639	0.125	0.195	n/a
Williams Creek	22.26	n/a	n/a	0.023	0.071	n/a	n/a	n/a	0.089	0.276	n/a
H1/H3	0.46	1.2	1.2	1.0	1.1	0.5	2.7	2.6	2.2	2.3	1.0
H1/H2	0.11	0.6	0.4	0.5	0.4	n/a	5.2	3.4	4.2	3.9	n/a
H3/H2	0.25	0.5	0.3	0.5	0.4	n/a	1.9	1.3	1.9	1.7	n/a

Notes: Streamflow data provided by John Gibson and Associates.

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Table 4.3
Minto Explorations Ltd.
Minto Project
Estimated Runoff Coefficient

Creek	Mean Basin Elevation	Basin Area	Time Period	Total Flow (mm)	Estimated Precipitation (mm)	Runoff Coeff.
Williams	850	22.26	June 4 to July 24, 1994	7.6	92	8.2%
Minto (H2)	775	42.18	June 4 to July 24, 1994	7.9	115	6.9%
Minto (H1)	885	4.75	June 4 to July 24, 1994	31.6	125	25.3%
Minto (H2)	775	42.18	June 4 to Sept. 26, 1994	11.9	154	7.7%
Big Creek	1150	1750	June 1975-93	26.0	61	42.5%
Big Creek	1150	1750	Jul, Aug, Sep 1975-93	64	193	33.1%
Big Creek	1150	1750	Apr, May, Jun 1975-93	69.4	116	59.8%

Notes:

1) Precipitation values based on Pelly Ranch historical data and an orographic factor of 8% increase per 100 m of elevation.

2) Jul, Aug, Sep 1975-93 runoff likely contains very little snowmelt.

3) Minto (H1) flow estimated by multiplying Minto (H2) values by a factor of 4 (approx. ratio of H1/H2 unit area flows in June/July).

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Table 4.4
Minto Explorations Ltd.
Minto Project
Streamflow Distributions

Streamflow Station	Years of Record	unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Big Creek	1975-83, 84-93	m^3/s	0.3	0.2	0.1	2.0	26.8	17.3	19.4	13.3	10.0	3.8	1.3	0.6	7.9
(09AH003)		mm	0.4	0.2	0.2	2.9	40.4	26.0	29.2	20.0	15.0	5.8	1.9	0.9	143.0
		%	0.3%	0.2%	0.2%	2.1%	28.2%	18.2%	20.4%	14.0%	10.5%	4.0%	1.3%	0.6%	100.0%
Minto Creek (actual)	1994	m^3/s						0.10	0.04	0.04	0.02				
(H2)		mm						6.5	2.6	2.3	1.4				
Minto Creek (estimated)	1994	m^3/s						0.09	0.06	0.01	0.03				
(H2)		mm						5.6	3.8	0.9	2.2				
Minto Creek (estimated)	long-term	m^3/s	0.00	0.00	0.00	0.20	0.09	0.06	0.09	0.06	0.04	0.00	0.00	0.00	0.05
(H2)		mm	0	0	0	12	5	4	5	4	3	0	0	0	34
		%	0%	0%	0%	37%	16%	11%	16%	10%	8%	1%	0%	0%	100%

Notes:

1) Big Creek data from Water Survey of Canada (WSC).

2) Minto Creek estimated 1994 values calculated by adjusting Minto Creek estimated long-term values by the ratios of 1994 to long-term Pelly Ranch precipitation.

3) H2 is the name given to a streamflow station located near the mouth of Minto Creek.

4) Minto Creek data from J. Gibson and Assoicates.

5) Long-term Minto Creek distribution is different than the distribution in Table 5.5 because of streambed infiltration effects.

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Table 4.5
Minto Explorations Ltd.
Minto Project
Estimated Runoff Distributions

Runoff due to Rainfall and Snowmelt

Location	Flow Component	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Entire Basin (H2)	Rainfall (mm)	0	0	0	0	9	15	22	14	11	1	0	0	73
(expected values)	Rainfall (m^3/s)	0.00	0.00	0.00	0.00	0.15	0.25	0.35	0.23	0.18	0.02	0.00	0.00	0.10
	% rainfall	0.0%	0.0%	0.0%	0.0%	13.0%	21.2%	29.6%	19.3%	15.2%	1.7%	0.0%	0.0%	100.0%
	% runoff	0.0%	0.0%	0.0%	0.0%	9.1%	14.9%	20.8%	13.6%	10.7%	1.2%	0.0%	0.0%	70.2%
	Snowmelt	0	0	0	25	6	0	0	0	0	0	0	0	31
	Snowmelt (m^3/s)	0.00	0.00	0.00	0.40	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
	% snowmelt	0.0%	0.0%	0.0%	80.0%	20.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	% runoff	0.0%	0.0%	0.0%	23.8%	6.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	29.8%
	Total Runoff (mm)	0	0	0	25	16	15	22	14	11	1	0	0	104
	Total Runoff (m^3/s)	0.00	0.00	0.00	0.40	0.25	0.25	0.35	0.23	0.18	0.02	0.00	0.00	0.14
	% runoff	0.0%	0.0%	0.0%	23.8%	15.1%	14.9%	20.8%	13.6%	10.7%	1.2%	0.0%	0.0%	100.0%
Big Creek (actual)	Total Runoff (mm)	0.4	0.2	0.2	2.9	40.4	26.0	29.2	20.0	15.0	5.8	1.9	0.9	143
Big Creek (estimated)	Total Runoff (mm)	0.4	0.2	0.2	2.7	37.0	23.9	26.7	18.3	13.8	5.3	1.7	0.8	131
(H2) estimated values	Total Runoff (mm)	0	0	0	12	5	4	5	4	3	0	0	0	34
	Total Runoff (m^3/s)	0.00	0.00	0.00	0.20	0.09	0.06	0.09	0.06	0.04	0.00	0.00	0.00	0.05
Tailings Pond	Total Runoff (mm)	0	0	0	28	18	18	25	16	13	1	0	0	119
	Total Runoff (m^3/s)	0.00	0.00	0.00	0.10	0.07	0.06	0.09	0.06	0.05	0.01	0.00	0.00	0.04
Water Decant Pond	Total Runoff (mm)	0	0	0	25	16	15	22	14	11	1	0	0	104
	Total Runoff (m^3/s)	0.000	0.000	0.000	0.011	0.007	0.007	0.009	0.006	0.005	0.001	0.000	0.000	0.004

Notes:

1) For water balance modeling, the total runoff values should be used to represent water inflow due to surface runoff at the indicated location.

2) Expected values are those expected for Minto Creek based on Big Creek values. Estimated values are expected values reduced to account for streambed infiltration. Rainfall runoff is reduced by 75% and snowmelt runoff is reduced by 50%.

3) Calculations assume 30.5 days per month.

4) Big Creek estimated values are those values estimated by the same techniques used to estimate the Minto Creek values.

5) H2 is the name given to a streamflow station located near the mouth of Minto Creek.

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Table 4.6
Minto Explorations Ltd.
Minto Project
Wet and Dry Year Runoff

1) At Tailings Pond

Annual Runoff

mean = 119 mm
standard deviation = 40 mm

Return Period	Precipitation (mm)
1:10 year dry (mean - 1.282 s.d.)	67
1:20 year dry (mean - 1.645 s.d.)	52
1:10 year wet (mean + 1.282 s.d.)	171
1:20 year wet (mean + 1.645 s.d.)	186
1:50 year wet (mean + 2.054 s.d.)	202
1:100 year wet (mean + 2.326 s.d.)	213
1:200 year wet (mean + 2.575 s.d.)	223

2) At Water Decant Pond

Annual Runoff

mean = 104 mm
standard deviation = 35 mm

Return Period	Precipitation (mm)
1:10 year dry (mean - 1.282 s.d.)	59
1:20 year dry (mean - 1.645 s.d.)	46
1:10 year wet (mean + 1.282 s.d.)	149
1:20 year wet (mean + 1.645 s.d.)	162
1:50 year wet (mean + 2.054 s.d.)	177
1:100 year wet (mean + 2.326 s.d.)	186
1:200 year wet (mean + 2.575 s.d.)	195

Notes:

1) Estimates assume a normal distribution of annual runoff.

2) Standard deviation estimated from a C.V. value of 0.34, calculated with 18 years of WSC Big Creek flow data (1975 - 1993).

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Table 4.7
Minto Explorations Ltd.
Minto Project
Dry, Wet and Average Year Streamflow Distributions

Streamflow Station	Years of Record	unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Big Creek (DRY)	1989	m^3/s	0.404	0.181	0.081	0.18	10.6	7.88	6.13	4.74	3.96	2.47	1.13	0.515	3.1893
		%	1.1%	0.5%	0.2%	0.5%	27.7%	20.6%	16.0%	12.4%	10.3%	6.5%	3.0%	1.3%	100.0%
	1981	m^3/s	0.175	0.169	0.173	0.225	12.8	4.72	18.4	14	5.89	4.8	1.61	0.432	5.2828
		%	0.3%	0.3%	0.3%	0.4%	20.2%	7.4%	29.0%	22.1%	9.3%	7.6%	2.5%	0.7%	100.0%
	1977	m^3/s	0.224	0.201	0.152	0.512	17.6	17.9	15.8	3.92	4.28	2.79	0.696	0.087	5.3468
		%	0.3%	0.3%	0.2%	0.8%	27.4%	27.9%	24.6%	6.1%	6.7%	4.3%	1.1%	0.1%	100.0%
	average	%	0.6%	0.4%	0.2%	0.5%	25.1%	18.6%	23.2%	13.5%	8.8%	6.1%	2.2%	0.7%	100.0%
	st. dev.		0.4%	0.1%	0.0%	0.2%	4.3%	10.4%	6.6%	8.0%	1.9%	1.6%	1.0%	0.6%	
Big Creek (WET)	1992	m^3/s	1.1	0.447	0.488	1.37	52.2	33.7	36.2	12.4	16.5	4.92	2.02	1.1	13.537
		%	0.7%	0.3%	0.3%	0.8%	32.1%	20.7%	22.3%	7.6%	10.2%	3.0%	1.2%	0.7%	100.0%
	1990	m^3/s	0.262	0.113	0.065	21.8	76.8	17	8.48	3.65	19	5.88	0.96	0.317	12.9
		%	0.2%	0.1%	0.0%	14.1%	49.8%	11.0%	5.5%	2.4%	12.3%	3.8%	0.6%	0.2%	100.0%
	1991	m^3/s	0.21	0.257	0.368	2.77	49.6	23.1	18.1	18	20.5	5.75	3.59	2.15	12.03
		%	0.1%	0.2%	0.3%	1.9%	34.4%	16.0%	12.5%	12.5%	14.2%	4.0%	2.5%	1.5%	100.0%
	average	%	0.3%	0.2%	0.2%	5.6%	38.7%	15.9%	13.4%	7.5%	12.2%	3.6%	1.5%	0.8%	100.0%
	st. dev.		0.3%	0.1%	0.1%	7.4%	9.6%	4.9%	8.4%	5.1%	2.0%	0.5%	0.9%	0.6%	
Big Creek (AVERAGE)	average	%	0.3%	0.2%	0.2%	2.1%	28.2%	18.2%	20.4%	14.0%	10.5%	4.0%	1.3%	0.6%	100.0%

Notes:

1) Big Creek data from Water Survey of Canada (WSC).

2) Given the large standard deviation values, wet and dry distributions are not significantly different than the average distribution.

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Table 4.8
Minto Explorations Ltd.
Minto Project
Peak Instantaneous Flows

Summary of Return Period Peak Flow Estimates (m^3/s)

Basin	Area (km^2)	Technique	Return Period (years)					
			2	10	25	50	100	200
Tailings Pond	9.56	Janowicz	0.8	2.1		3.6	4.3	
		Rational	7	11	13	15	17	21
		Regional - Big Creek	1.8	3.2	3.7	4.1	4.4	4.8
		Regional - Thistle Creek	1.5	2.5	3	3.4	3.8	4.3
		HEC-1	0.01	0.07	0.24	0.4	0.55	0.77
		Best Guess	2.3	4.0	4.6	5.1	5.5	6.0
Decant Pond	1.12	Janowicz	0.1	0.3		0.6	0.7	
		Rational	2.2	3.7	4.6	5.3	6	7.2
		Regional - Big Creek	0.3	0.5	0.6	0.7	0.7	0.8
		Regional - Thistle Creek	0.3	0.4	0.5	0.6	0.7	0.8
		HEC-1	0.05	0.24	0.44	0.62	0.77	0.98
		Best Guess	0.6	1.0	1.2	1.4	1.4	1.6

Notes:

1) Tailings pond "Best Guess" estimates were generated by increasing regional-Big Creek values by 25%.

2) Decant pond "Best Guess" estimates were generated by increasing regional-Big Creek values by 100%.

3) The HEC-1 peak flows for the decant pond basin are greater than those for the tailings pond basin. This is not an error but simply due to a much higher runoff curve number and shorter time of concentration.

Table 4.9
Minto Explorations Ltd.
Minto Project
Janowicz and Rational Peak Instantaneous Flow Estimates

Janowicz Technique

Basin	Area (km^2)	Region	Return Period (years)	Regression Constant "a"	Regression Constant "b"	Peak Discharge (m^3/s)
Tailings Pond	9.56	Mountain	2	0.085	1.007	0.8
			10	0.257	0.923	2.1
			25			
			50	0.5	0.873	3.6
			100	0.631	0.855	4.3
			200			
Decant Pond	1.12	Mountain	2	0.085	1.007	0.1
			10	0.257	0.923	0.3
			25			
			50	0.5	0.873	0.6
			100	0.631	0.855	0.7
			200			

Rational Formula

Basin	Area (km^2)	Time of Conc. (hrs)	Return Period (years)	Runoff Coeff.	Rainfall Intensity (mm/hr)	Peak Discharge (m^3/s)
Tailings Pond	9.56	2.5	2	0.75	3.3	7
			10	0.77	5.3	11
			25	0.77	6.4	13
			50	0.80	7.1	15
			100	0.80	8.1	17
			200	0.80	9.9	21
Decant Pond	1.12	1.0	2	0.95	7.3	2.2
			10	0.97	12	3.7
			25	0.97	15	4.6
			50	1.00	17	5.3
			100	1.00	19	6.0
			200	1.00	23	7.2

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Table 4.10
Minto Explorations Ltd.
Minto Project
Regional Frequency Estimates of Peak Instantaneous Flows

Regional Analysis - Big Creek

Basin	Area (km^2)	Return Period (years)	Peak Flows (based on various distributions)				
			Extreme Value	3-P Lognormal	Log Pearson III	Wakeby	Best Guess
Big Creek	1750	2	116	115	114	115	115
		10	195	201	207	203	204
		25	223	236	240	243	238
		50	245	265	265	277	265
		100	262	290	284	305	287
		200	277	315	300	332	308
Tailings Pond	9.56	2	1.8	1.8	1.8	1.8	1.8
		10	3.0	3.1	3.2	3.1	3.2
		25	3.5	3.7	3.7	3.8	3.7
		50	3.8	4.1	4.1	4.3	4.1
		100	4.1	4.5	4.4	4.7	4.4
		200	4.3	4.9	4.6	5.1	4.8
Decant Pond	1.12	2	0.3	0.3	0.3	0.3	0.3
		10	0.5	0.6	0.6	0.5	0.5
		25	0.6	0.7	0.7	0.6	0.6
		50	0.7	0.7	0.7	0.7	0.7
		100	0.7	0.8	0.8	0.7	0.7
		200	0.8	0.9	0.8	0.8	0.8

Regional Analysis - Thistle Creek

Basin	Area (km^2)	Return Period (years)	Peak Flows (based on various distributions)				
			Extreme Value	3-P Lognormal	Log Pearson III	Wakeby	Best Guess
Thistle Creek	210	2	17.5	17.4	17.5	17.4	17.5
		10	29	29.9	29.1	29.8	29.5
		25	34.6	36.1	34.6	36.7	35.4
		50	39.7	41.8	39.4	42.9	40.6
		100	44.4	47.1	43.8	48.7	45.5
		200	49.2	52.5	48.3	54.7	50.4
Tailings Pond	9.56	2	1.5	1.5	1.5	1.5	1.5
		10	2.4	2.5	2.5	2.5	2.5
		25	2.9	3.0	2.9	3.1	3.0
		50	3.4	3.5	3.3	3.6	3.4
		100	3.7	4.0	3.7	4.1	3.8
		200	4.2	4.4	4.1	4.6	4.3
Decant Pond	1.12	2	0.3	0.3	0.3	0.3	0.3
		10	0.4	0.5	0.4	0.5	0.4
		25	0.5	0.5	0.5	0.6	0.5
		50	0.6	0.6	0.6	0.7	0.6
		100	0.7	0.7	0.7	0.7	0.7
		200	0.7	0.8	0.7	0.8	0.8

Notes

1) All peak flow values generated with WSC's flood frequency software CFA88.

2) Values based on 15 years of Big Creek data and 14 years of Thistle Creek data.

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Table 4.11
Minto Explorations Ltd.
Minto Project
Summary of HEC-1 Input Parameters

Input Parameter	Tailings Pond	Decant Pond
Time of Concentration (Tc)	2.5 hrs	1 hrs
Basin Area	9.56 sq. km.	1.69 sq. km.
Storage Coefficient	2.5 hrs	1 hrs
Curve Number (CN)	62	81
Initial Abstraction (Ia)	31 mm	12 mm
Starting Flow	0.01 m^3/s	0.001 m^3/s
End Flow	0.01 m^3/s	0.001 m^3/s
24 hr - 1 in 2 Year Precipitation	24 mm	
24 hr - 1 in 10 Year Precipitation	36 mm	
24 hr - 1 in 25 Year Precipitation	43 mm	
24 hr - 1 in 50 Year Precipitation	48 mm	
24 hr - 1 in 100 Year Precipitation	52 mm	
24 hr - 1 in 200 Year Precipitation	57 mm	
Precipitation Distribution	SCS Type 1	
Unit Hydrograph Type	Clark	
Rate of Decay	1.001 (0.1% per hour)	

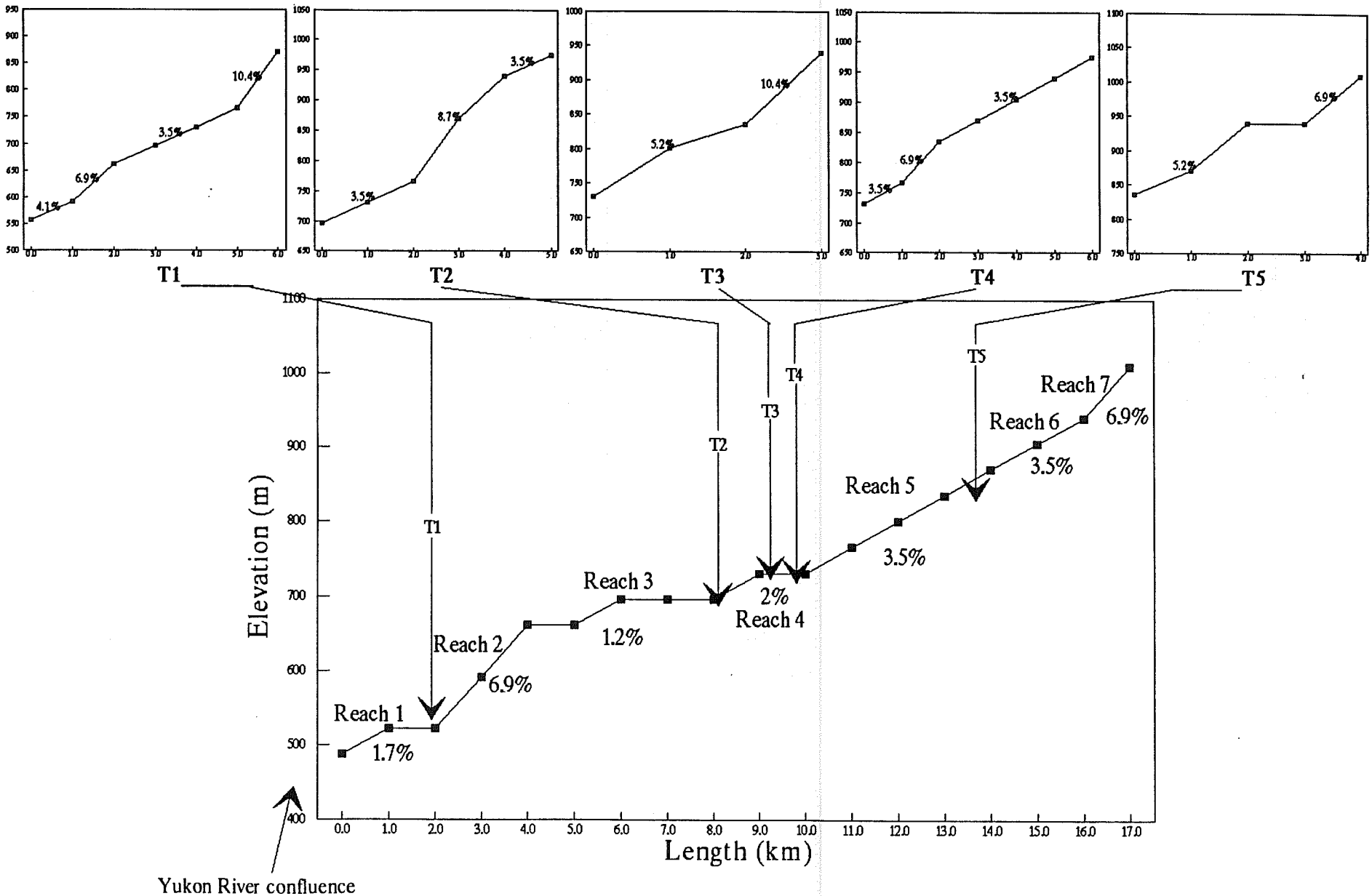
Notes:

1) Assume antecedent moisture condition (AMC) II for all return periods.

2) Initial abstraction = 0.2S.

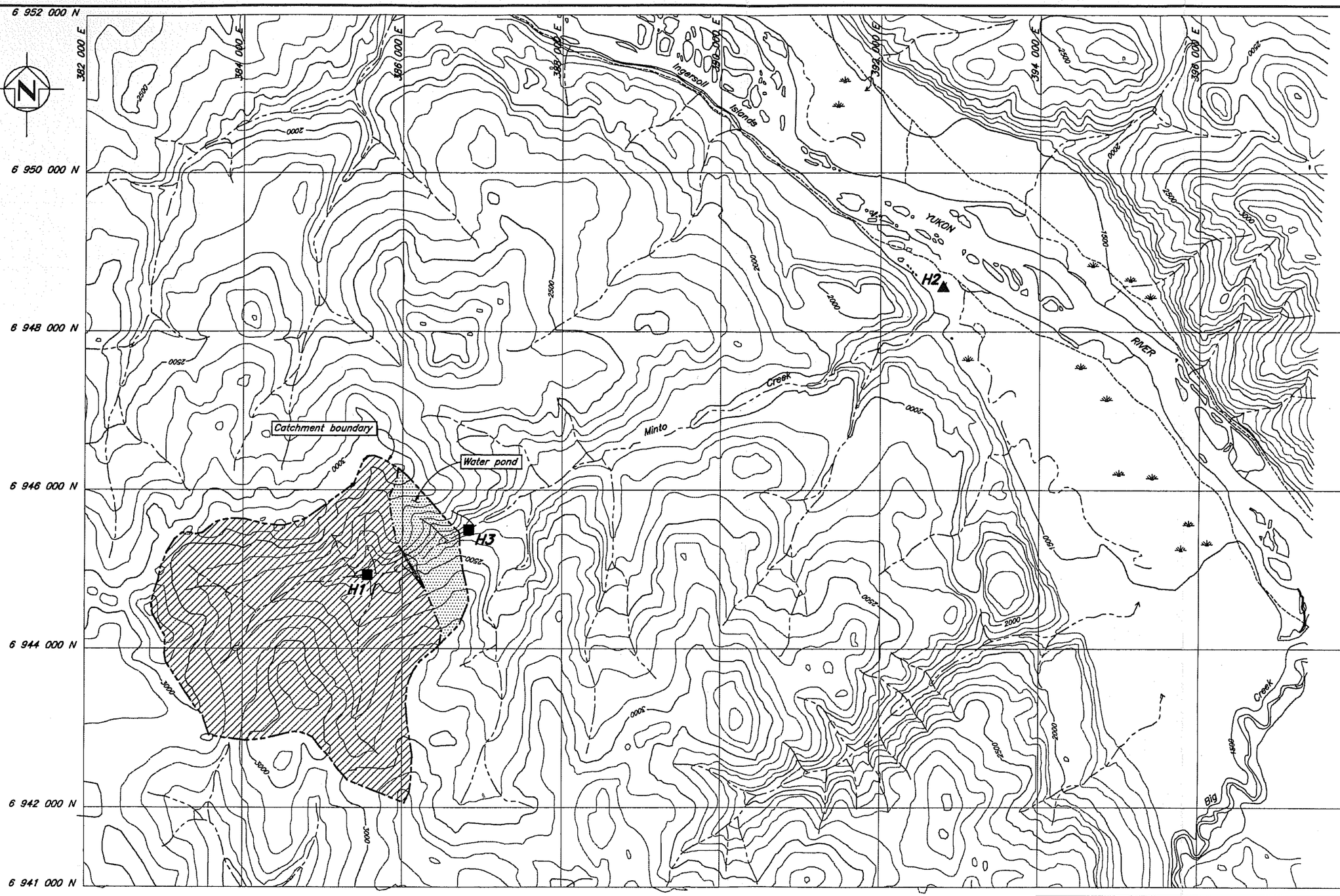
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T1 = tributary 1

FIGURE 4.1: MINTO CREEK PROFILE



LEGEND

H1 ■ Hydrology Monitoring Station (Staff gauge)

H2 ▲ Hydrology Monitoring Station (Staff gauge automatic water level recorder)

Water Pond

Tailings Catchment

Scale 1000 500 0 1000 2000 Metres

NOTE: Contour interval 100 feet

DRG. NO.	DESCRIPTION	REV.	DATE	DESCRIPTION	APPROVED	REV.	DATE	DESCRIPTION	APPROVED
REFERENCE DRAWINGS		REVISIONS				REVISIONS			

HALLAM KNIGHT PIESOLD LTD.
ENVIRONMENTAL CONSULTANTS – VANCOUVER, B.C.

MINTO EXPLORATIONS LTD.

MINTO PROJECT

TAILINGS/WATER AND DRAINAGE AREAS
LOCATIONS OF BASINS

DESIGNED	–
DRAWN	VY
CHECKED	–
APPROVED	

DATE DEC. 2, 1994 | SCALE AS SHOWN | DRG. NO. FIGURE 4.2 | REV. C

CAD FILE \PROJECT\1000\1300\1300\DRG08 1:25000 PLM 1-25 DEC. 11, 1994

Minto Explorations Ltd.
Minto Project
Minto Creek (H2) Hydrograph - June to September 1994

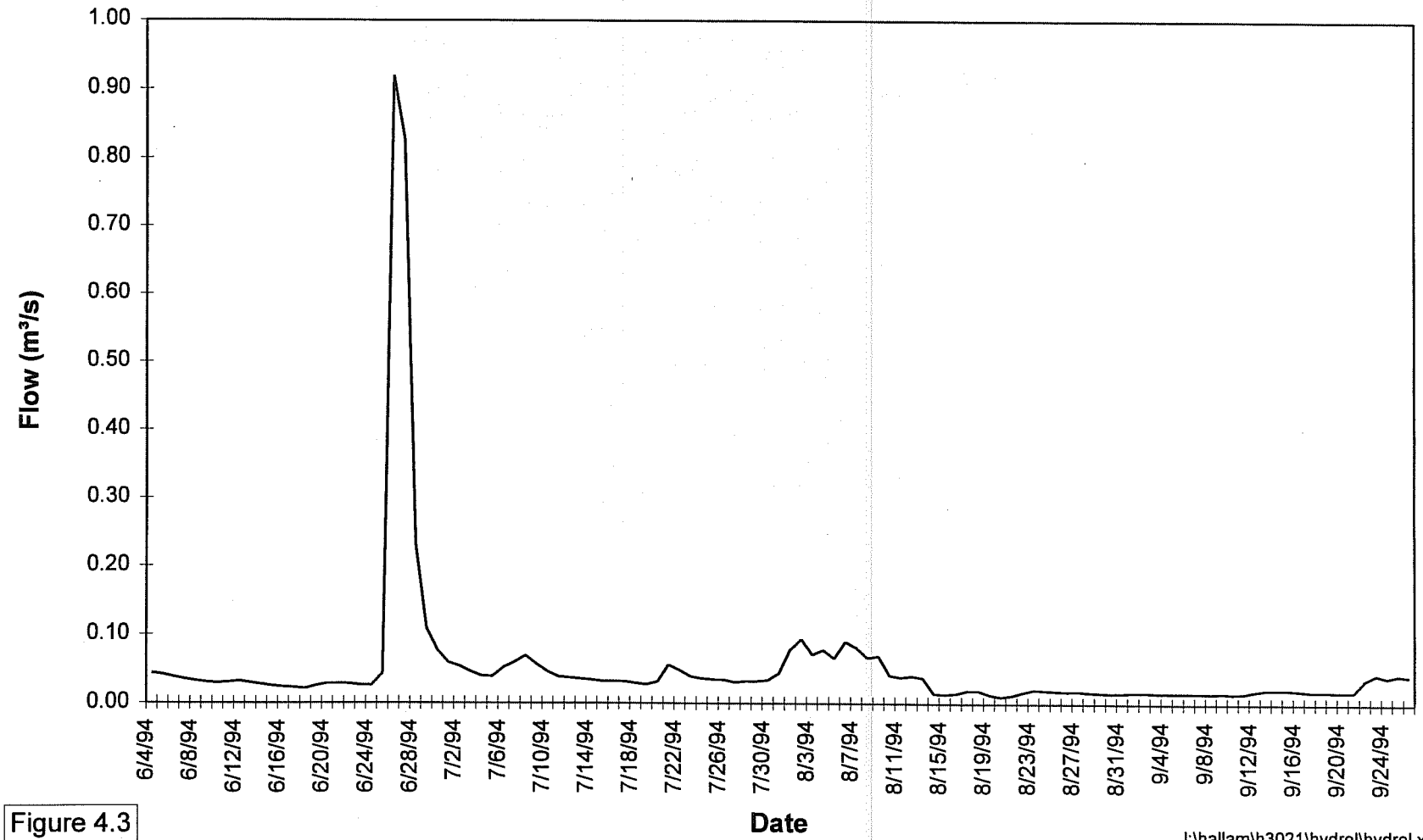


Figure 4.3

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SECTION 5.0 - WATER AND SEDIMENT QUALITY

5.1 SURFACE WATER QUALITY

Baseline monitoring of surface water quality in the project area has been conducted both in the 1970s and 1990s as part of the mine development process. Water quality data has been compiled from previous reports for the project site and is separated into initial (1970s) data and recent (1993-94) data for discussion in the following subsections.

All surface water quality data has been compared to both Federal, Canadian Council of Ministers of the Environment, 1991 (CCME), and British Columbia, Approved and Working Criteria for Water Quality, 1991 (AWCWQ) criteria for protection of freshwater aquatic life. The B.C. AWCWQ has only been used as reference criteria for further evaluation of the data where Federal CCME criteria do not currently exist. The criteria, as related to the project, are summarized in Table 5.1.

5.1.1 Historic Surface Water Quality Programs (1975-76)

Initial baseline surface water quality studies were conducted in 1975 and 1976 by Environment Canada (data presented in their report: "An Assessment of Pre-Development Water Quality and Biological Conditions in the Water Shed Around the Minto Ore Body", dated September 1977), and in 1976 by B.C. Research (data presented in their report: "Initial Environmental Study of the Minto Project", prepared for Wright Engineers Ltd.).

5.1.1.1 Sampling Locations and Analytical Parameters

Environment Canada collected water quality samples at seven sites (EC-1 to EC-7) on May 15 and June 30, 1975, and at all sample sites except EC-6 on September 21, 1976. The seven sites

designated in the area on Minto Creek (EC-3 and EC-7), Big Creek (EC-1 and EC-2), Wolverine Creek (EC-4 and EC-5) and an unnamed creek now designated "Creek B" (EC-6). Parameters such as temperature, pH, conductivity and dissolved oxygen were measured in the field, and samples were analyzed at the Environment Canada laboratory in West Vancouver for dissolved solids, hardness, alkalinity, turbidity, colour and selected total metals.

Water quality samples were collected at twelve sites within the Minto Creek watershed (BCR-1 to BCR-12) by B.C. Research, concurrent with the 1976 exploration of the Minto deposit. All samples, except BCR-1, BCR-2 and BCR-4, were located on Minto Creek or its tributaries. Sample sites BCR-1 and BCR-2 were located on the Yukon River above and below the confluence with Minto Creek, respectively. Sample site BCR-4 was located on an unnamed creek now designated "Creek A". Temperature readings were measured in the field and samples were analysed at the B.C. Research laboratory for conductivity, dissolved and suspended solids, hardness, pH, alkalinity, turbidity, colour, nitrates, nitrite, total phosphate, sulphate, and selected dissolved and total metals.

Within these two independent studies, the only sites that were located in the same vicinity were BCR-3 and EC-3 near the mouth of Minto Creek, and BCR-6 and EC-7 along Reach 3 of Minto Creek. Historic sample site locations are presented on Figure 5.1.

5.1.1.2 Minto Creek Water Quality Results

In general, surface waters in the Minto Creek watershed appeared to be of good quality with low to moderate hardness. The pH of upper Minto Creek surface waters (5.7 to 7.5) suggests that the drainage is confined to a shallow active layer and are presumed to be due to the presence of humic material since the weathered country rock is basic. The total organic carbon and color levels at these stations were comparatively high and consistent with the presence of humic materials.

All samples were low in nitrates, nitrites, ammonia and phosphates. Minto Creek water samples had low turbidity and low suspended solids, except for Tributary 4. The levels of dissolved and total metals in Minto Creek surface water samples were generally low except for copper and iron, both of which consistently exceeded CCME criteria.

No definite spacial trends were apparent with respect to water quality, although parameters such as pH, hardness and alkalinity increased slightly from the upper portion to the mouth of Minto Creek. Although the dates of data collection were limited, temporal trends appeared to be typical of creeks that experience high flows during spring freshet an lower flows during dry summer months. This was evident based on higher values of parameters such as suspended solids and colour, and lower values of parameters such as dissolved solids, conductivity and hardness during the spring compared to the summer.

Based on the data from BRC-1, BRC-2 and BRC-3, Minto Creek outflow did not have any apparent impact on Yukon River water quality.

All historic data for Minto Creek and the Yukon River is presented in Table 5.2.

5.1.1.3 Regional Water Quality Results

Historical data from creeks surrounding the Minto Creek basin indicated that regional surface water generally had moderate hardness (70 to 166 mg/L $CaCO_3$), neutral to slightly basic pH (6.90 to 8.00 pH units) and moderate alkalinity (70 to 160 mg/L $CaCO_3$). Although total metals concentrations appeared to be generally low, detection limits of analyses by the Environment Canada laboratory were generally higher than from B.C. Research and in some cases exceeded current CCME and AWCWQ criteria levels.

All historic regional water quality data is presented in Table 5.3.

5.1.2 Baseline Surface Water Quality Monitoring (1993-94)

The recent baseline surface water quality monitoring program was initiated by Minto Explorations Ltd. in 1993 as part of pre-development mine application requirements. The program was designed to to define the water quality of watercourses draining the working areas of the Minto property.

5.1.2.1 Sampling Locations

The recent baseline water quality program commenced with collection of a single set of samples from two sites (W1 and W2) in September 1993. In May 1994 sampling recommenced and was expanded to include seven additional sites (W3 to W9). Due to site access problems, surface water samples were not collected from Sites W6 and W7 in May or September 1994, and a sample was not collected from Site W8 in June 1994. Samples could not be obtained from any of the sites during winter months due to the absence of flow. During this period, an auger was drilled through the extensive ice that formed in the creek bottoms; however, no flowing water was observed at any of the sites.

The nine water quality monitoring sites were selected based on their relation to the deposit and current mine development plans, to monitor existing background conditions at the site and assess potential impacts from the planned mine development. Monitoring sites located directly on Minto Creek included W1 (lower Reach 6), W2 (Reach 1), W3 (Reach 5) and W9 (upper Reach 6). Sites W6, W7 and W8 were located on the main tributaries to Minto Creek (Tributaries 3, 4 and 5, respectively). Site W7 (Tributary 4) was selected as the control station because the deposit and exploration area are located at the top of the Minto Creek watershed.

All 1993-94 water quality monitoring station locations (W1 to W9) are shown on Figure 5.2.

5.1.2.2 Methods

During each water quality sampling event, a set of five bottles was filled at each site for analysis of general parameters, cyanide, mercury, and selected total and dissolved metals, respectively. The samples were field preserved, including filtering for dissolved metals samples, and were shipped to Analytical Services Laboratories Ltd. (ASL) in Vancouver within 48 hours of collection, for analysis. The methods of preservation were:

·	cyanide	preserved with NaOH to pH of 12 or higher;
·	general parameters	kept cold;
·	mercury	preserved with HNO_3 to pH 2 or lower;
·	dissolved metals	filtered (0.45 u cellulose nitrate) and preserved with HNO_3 to pH 2 or lower, and
·	total metal	preserved with HNO_3 to pH 2 or lower.

Analyses of water were performed by ASL in accordance with "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, 1985 and 1989. Analysis consisted of physical parameters such as conductivity, turbidity, pH, alkalinity, suspended and dissolved solids, nutrients (including nitrogen and phosphorous species), cyanide and selected total and dissolved metals.

5.1.2.3 Water Quality Results

General Trends

Water quality in the Minto Creek basin, excluding Site W8, may be generally characterized as neutral to slightly basic (mean pH range of 7.51 to 7.97), moderately hard (mean hardness range of 77.7 to 115.2 mg/L $CaCO_3$), moderately high in total suspended and dissolved solids (mean ranges of 32.3 to 86.8 and 85.2 to 156.3 mg/L, respectively), and moderately to highly conductive (mean range of 151.0 to 247.5 μmhos/cm). Dissolved anions are moderately high for alkalinity (73.4 to 105.3mg/L $CaCO_3$), chloride (0.90 to 1.22 mg/L) and fluoride (0.146 to 0.227 mg/L), with moderate levels of sulphates (5.10 to 20.32 mg/L). Nutrients are similarly moderately high, likely due to runoff from recent burn areas. Concentrations of cyanide or cyanogen-like compounds in background water quality were also found to be relatively high (0.0077 to 0.0226 mg/L).

Total and dissolved metals levels essentially reflect the general parameters. The majority of metal

concentrations are moderate to moderately high. In particular, aluminum (mean concentration range of 0.235 to 1.953 mg/L), copper (0.0017 to 0.0192 mg/L) and iron (0.553 to 5.61 mg/L) naturally exceeded Canadian Council of Ministers of Environment (CCME) guidelines for the protection of aquatic life. The mean concentration of total lead also exceeded the CCME guideline at Site W9 (0.033 mg/L). Mean water quality values for all 1993-94 monitoring stations (W1 to W9) are presented in Table 5.4. Complete 1993-94 water quality and statistical analysis data is reported in Tables 1 to 9 in Appendix I.

Spacial Trends

Variations in water quality were apparent both between stations and at different times of the year. Generally, background levels at the control site, Site W7, and at Site W6 were lower than in Minto Creek, as expected. The highest concentrations of metals occurred at sample sites adjacent to and directly downstream of the deposit, and although general parameters were also relatively high, the highest levels for general parameters were found at Site W8.

Temporal Trends

As shown in Figure 5.3, water quality during spring freshet was higher in total suspended solids, turbidity and total metals (such as aluminum, iron and copper), but lower in conductivity, total dissolved solids, hardness, pH and anions (such as alkalinity, fluoride and sulphate). Nutrient levels were also generally slightly lower during freshet than during the summer, with the exception of total phosphorous which was likely higher as a result of higher sediment loadings.

Yukon River Water Quality

In comparison to Minto Creek, water quality in the Yukon River (directly upstream of Minto Creek) was slightly lower for most parameters, though mean values also exceeded CCME guidelines for aluminum (0.332 mg/L) and iron (0.446 mg/L). During the monitoring period, other metals such as copper and lead occasionally exceeded CCME guidelines. This is common in large rivers in which high levels of suspended solids occur.

As shown in Figure 5.4, the Yukon River follows temporal trends similar to Minto Creek for parameters such as total suspended solids, turbidity and total metals; however, a parallel trend was not evident for the other parameters. The spacial comparison of parameters such as sulphate, hardness, conductivity, total dissolved solids and alkalinity in Figure 5.4, suggests that Minto Creek does not currently impact Yukon River water quality. The two water courses showed similar values throughout the monitoring period for parameters such as pH and fluoride.

5.1.3 Quality Assurance, Quality Control

A single set of Duplicate samples was taken during each of three sampling events and transportation blanks were included four times over the course of the sampling period as components of the water quality QA/QC program. Duplicate samples were collected at Site W1 on September 30, 1993, and at Site W2 on June 7 and August 10, 1994. Travel blanks were submitted on May 15, June 7, August 10 and September 26, 1994.

Ratios of values for original versus duplicate data were calculated to compare the two sets of data. All data generally matched very closely (i.e., ratios were close to 1.00), and the few instances where there was greater than a 20% difference were isolated to cases where one or both values were at or near the method detection limits.

Travel blank samples were generally clean, with most parameters below detection limits, though minor levels of lead and phosphorous contamination accompanied slightly elevated conductivity and turbidity in May 1994. Levels of total magnesium in the June 1994 travel blank sample, and silicon in August 1994, were above detection limits. These slightly increased levels were not reflected in water quality samples collected during the same sampling events.

Water quality QA/QC data, including: original data; duplicate data; ratios for comparison, and travel blank data, is presented in Table 5.5. A summary of analytical methods and laboratory internal QA/QC has been provided by the project laboratory is included in Appendix II.

5.2 METAL COMPLEXING

5.2.1 Methods and Background

Duplicate water samples were collected from water quality sites W1, W2 and W9 in August 1994, and were frozen for transport to CB Research in Sidney, British Columbia, for metal complexing analysis. Metal complexing tests for the proportion of metals which may be complexed with the natural humic and fulvic acids that occur in organic matter in the water column. Once these metals are complexed, they are not as likely to adversely impact the environment, as they are no longer available for uptake by stream biota. In essence, metal complexing results give a measure of the ability of the creek to accommodate metal influxes, for example from the proposed mine, and this can be useful in determining site-specific effluent discharge limits.

Laboratory analysis was completed for copper using a metal titration measured electrochemically with a metrohm 625 polarocard polarograph and electrode assembly. The electrode assembly was filled with a hanging mercury drop working electrode, a platinum wire counter electrode and a Ag/AgCl reference electrode. Identification of the endpoint was determined using the abscissa of the inflection point method.

The MINE 1.30 model was used to determine the metal complexing capacity of several selected metals. This model uses the copper complexing capacity and known coefficients to determine the capacity of the stream water to complex with other metals.

5.2.2 Results and Discussion

Values as originally presented in this section are incorrect; Table 5.6 is correct, but this text has been changed. Minto states this fact in

The results of the copper complexing capacity of Minto Creek water are presented in Table 5.6. Copper complexing results show that water from lower Minto Creek, at site W2 (MC3), has an average copper complexing capacity of ~~88.13~~ 74.05% with the remaining ~~11.87~~ 25.95% of the total copper in the water column available to stream biota. Further upstream, near site W3 (MC2), the water has a ~~slightly lower~~ higher complexing capacity for copper, with an average of 79.09% complexed and the

Complexing capacity decreases with distance downstream

remaining 20.91% free. Still further upstream, at site W9 (MC1), the complexing capacity is again slightly lower at 74.05%, with 25.95% of the copper remaining bioavailable. The locations of these three metal complexing sampling sites are shown on Figure 5.2.

Although the complexing capacity for copper is high in the Minto Creek watershed, its capacity for complexing other metals is negligible. This is due to high levels of alkali earth metals, such as calcium, which have an affinity with humic acid and readily bind with it, outcompeting metals other than copper in the water column. Consequently, close to 100% of the aluminum, iron and lead are unbound.

Monthly concentrations of copper, lead, iron, aluminum and organic carbon at three sites along Minto Creek (W2, W3 and W9) are illustrated in Figure 5.5. Comparison of these charts shows that the highest metal complexing capacity is required during high flow periods such as spring freshet, which corresponds with the highest organic carbon content. Although during the test period (August 1994) the complexing capacity was quite high, this corresponded with the lowest copper concentrations recorded during the monitoring period. The organic carbon concentration is only 25% to 60% higher during freshet than during low flow periods, and copper comlexing capability would not be sufficient during freshet to bring copper concentrations below CCME guidline levels, as shown in Table 5.7.

Based on this analysis of copper complexing at high concentrations during freshet conditions and the minimal complexing capability for other metals of potential concern, such as iron, aluminum and lead, complexing will not be a useful method for setting guidelines for discharges from the mine operation on the Minto property. Instead, a basic dilution method will likely be applied.

5.3 GROUNDWATER QUALITY

Groundwater samples were collected from two monitoring wells in the deposit area (Well 93E and Well 94-20) on September 26, 1994. The 5 cm (2") diameter PVC wells were developed and sampled using a Waterra system with a teflon foot-valve and heavy-gauge high-density polyethylene (HDPE) tubing. Well 93E was 83.4 m deep from the top of the casing, which was 0.8 m above

the ground surface, and the water level was 25.2 m from the top of the casing; therefore, the standing water column was 58.2 m, which equates to approximately 116.4 L of water. Well 94-20 was 36.4 m deep from the top of the casing, which was 0.55 m above the ground surface, and the water level was 16.1 m from the top of the casing; therefore, the standing water column was 20.3 m in length, or approximately 40.3 L of water. Prior to collecting samples, 349.2 L (3 well volumes) of groundwater was pumped out of Well 93E using the Waterra system, and 260 L (over 6 well volumes) was pumped out of Well 94-20. Both sets of samples were collected following the same protocols as for surface water quality samples, and were submitted to the project laboratory (ASL) for the same suite of analyses. The locations of the two groundwater wells are shown on Figure 5.2.

Water quality results for parameters such as conductivity, total dissolved and suspended solids and turbidity indicated that, although several well-volumes of groundwater were removed, there was still a high level of particulate matter in the samples. This was also reflected in the high concentrations of total compared to dissolved metals, which were similar to surface water quality results, having high levels of aluminum, copper, iron and lead. Most general parameters were also similar to surface water quality results from Minto Creek adjacent to the deposit; however, parameters such as alkalinity (upto 145 mg/L $CaCO_3$), fluoride (upto 1.29 mg/L) and sulphate (upto 125 mg/L) were much higher.

Groundwater quality data is presented in Table 5.8.

5.4 STREAM SEDIMENTS

5.4.1 Methods

Analysis of stream sediments for metals levels is one component of an integrated aquatics monitoring program for the Minto Project. The objectives of the sediment program are to provide:

- baseline benthic invertebrate habitat quality data, both physically and chemically, for

benthos studies;

- baseline characterization of sediment quality of potentially impacted streams for future monitoring purposes;

- baseline data to develop site-specific sediment quality guidelines.

Fine sediments were collected in triplicate from the Minto Creek mainstem (Figure 5.2). The samples were sent to Analytical Services Laboratories (ASL) Ltd. in Vancouver for analysis of moisture, total metals including antimony, arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, silver and zinc, and grain size. Metal determinations were conducted using hydride vapour atomic absorption spectrophotometry (HVAAS) for antimony and either atomic absorption spectrophotometry (AAS) or atomic emission spectrophotometry (ICP) for the remaining metals. Chromium and molybdenum are often associated with the silicate matrix of the sediment. Because of this, the recoveries of these elements may be low using the specified digestion. From an environmental standpoint, this is not usually of concern since available metals are typicaly the fraction of interest (ASL Laboratories Ltd. 1994).

5.4.2 Results and Discussion

Results from sediment analysis are presented in Table 5.9. Sediments in Minto Creek are composed mostly of sand, with some gravel and minimal fractions of silt and clay. Levels of antimony, cadmium, mercury, molybdenum and silver were low at all sites. Levels of arsenic were extremely high, with a maximum level detected at site S4, at the bottom of the Minto Creek watershed. Levels of chromium and zinc were highest at site S3, with average values of 23.3 and 48.53, respectively. Levels of copper were extremely elevated at site S1, in the vicinity of the deposit.

Table 5.1

MINTO EXPLORATIONS LTD.
MINTO PROJECT

Federal and British Columbia Water Quality Criteria
For Protection of Aquatic Life

	Federal (CCME)	B.C. (AWCWQ)
Total Dissolved Solids		+10 or 10%
pH	6.5 to 10	6.5 to 9
Total Suspended Solids	+10 or 10%	
Turbidity		+5 or 10%
Alkalinity (total)		20 (sensitivity rating)
Sulphate (dissolved)		100
Ammonia Nitrogen		0.680 to 1.37 fn([pH]&[Temp])
Nitrate Nitrogen		200
Nitrite Nitrogen	0.06	0.06 to 0.6
Cyanide	0.005 (as Free cyanide)	0.01 (as WAD cyanide)
Aluminum (total)	0.005 to 0.1 fn(pH)	
Antimony (total)		0.05
Arsenic (total)	0.05	0.05
Barium (total)		5
Beryllium (total)		0.0053
Cadmium (total)	0.0002 to 0.0018 fn(Hardness)	0.0002 to 0.0018 fn(Hardness)
Chromium (total)	0.002 or 0.02	0.002 or 0.02
Cobalt (total)		0.05
Copper (total)	0.002 to 0.004 fn(Hardness)	0.002 + fn(Hardness)
Iron (total)	0.3	0.3
Lead (total)	0.001 to 0.007 fn(Hardness)	0.001 + fn(Hardness)
Manganese (total)		0.1 to 1
Mercury (total)	0.0001	0.0001
Molybdenum (total)		2
Nickel (total)	0.025 to 0.150 fn(Hardness)	0.025 to 0.150 fn(Hardness)
Selenium (total)	0.001	0.001
Silver (total)	0.0001	0.0001
Uranium (total)		0.3
Vanadium (total)		10
Zinc (total)	0.03	0.03
Aluminum (dissolved)		0.05 + fn (pH)
Calcium (dissolved)		8 (sensitivity rating)

CCME - Canadian Council of Ministers of Environment, 1991 guidelines.

AWCWQ - Approved and Working Criteria for Water Quality in British Columbia, 1994.

Table 5.2

MINTO EXPLORATIONS LTD.
MINTO PROJECT

Historic Minto Creek and Adjacent Yukon River Water Quality Data
B.C. Research and Environment Canada (1975-76)

Location		Yukon River (Upstream)		Yukon River (Downstream)		Minto Creek Reach 1					Tributary 1	Minto Creek Reach 3				
Station #		BCR - 1	BCR - 1	BCR - 2	BCR - 2	BCR - 3	BCR - 3	EC - 3	EC - 3	EC - 3	BCR - 5	BCR - 6	BCR - 6	EC - 7	EC - 7	EC - 7
Date		8-May-76	28-Jul-76	8-May-76	28-Jul-76	8-May-76	28-Jul-76	15-May-75	30-Jun-75	21-Sep-76	8-May-76	8-May-76	28-Jul-76	15-May-75	30-Jun-75	21-Sep-76
Physical Tests	Units															
Temperature	°C	0	14	0	14	0	9	3.0	10.5	5.0	1	0	9	1.0	9.0	3.5
Colour	Alpha units	100	28	132	26	328	153		144	64	312	334	152		91	61
Dissolved Oxygen	mg/L							11.2	6.2	10.1				10.8	9.1	10.1
Conductivity	umhos/cm	33	135	41	111	57	109	30	160	115	47	64	120	30	200	120
Total Dissolved Solids	mg/L	50	211	180	214	190	254		<3	11	125	131	255		3	<5
Hardness	mg/L CaCO3	49	62	57	59	39	65		89	100	17	27	63		110	120
pH	pH Units	7.8	7.7	7.6	7.7	7.1	7.5	6.65	7.25	7.80	7.0	7.2	7.5	6.65	7.80	7.70
Total Suspended Solids	mg/L	143	17	184	<1	155	7				8	13	12			
Turbidity	NTU	6.0	5.6	5.5	6.2	1.0	2.0			1.3	0.6	0.9	2.7			1.3
Anions																
Alkalinity (Total) *	mg/L CaCO3	52	56	53	56	22	55			89	35	45	54			70
Sulphate (dissolved)	mg/L	<1	5	<1	5	<1	<1					<1	<1			
Nutrients																
Ammonia Nitrogen	mg/L		0.031		0.027		0.051						0.031			
Nitrate Nitrogen	mg/L		0.012		0.008		0.019						0.007			
Nitrite Nitrogen	mg/L		0.001		0.001		0.002						0.002			
Total Dissolved Phosphate	mg/L	0.486	0.060	0.600	0.038	0.584	0.020					0.076	0.014			
Total Metals																
Antimony (total)	mg/L								<0.3	<0.3					<0.3	<0.3
Arsenic (total)	mg/L	0.003	<0.002	0.003	<0.002	0.004	0.003			<0.02		0.003	0.003			<0.02
Barium (total)	mg/L	<2	<2	<2	<2	<2	<2					<2	<2			
Cadmium (total)	mg/L	<0.0002	<0.0002	0.0002	<0.0002	<0.0002	<0.0002		<0.01	<0.01	<0.0002	<0.0002	<0.0002		<0.01	<0.01
Calcium (total)	mg/L								22	27					28	30
Copper (total)	mg/L	0.0092	0.0028	0.0114	0.0025	0.0161	0.0105		<0.01	<0.01	0.0049	0.0129	0.0094		<0.01	0.01
Iron (total)	mg/L	2.00	0.23	2.12	0.26	2.04	0.36			0.22	0.16	0.47	0.50			0.17
Lead (total)	mg/L	0.0015	0.0004	0.0015	0.0004	0.0012	0.0002		<0.02	<0.02		0.0005	0.0004		<0.02	<0.02
Magnesium (total)	mg/L								8.2	8.3					10.5	9.7
Manganese (total)	mg/L	0.12	0.01	0.12	0.02	0.05	0.01					0.03	0.03			
Mercury (total)	mg/L	0.00011	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005		<0.4	<0.2		0.00017	<0.00005		<0.4	<0.2
Molybdenum (total)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.3	<0.1			<0.001		<0.3	<0.1
Nickel (total)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.1	<0.05		<0.005	<0.005		<0.1	<0.05
Silver (total)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.03	<0.03	<0.0005	<0.0005	<0.0005		<0.03	<0.03
Zinc (total)	mg/L	0.028	0.0085	0.020	0.014	0.032	0.0040		<0.01	<0.01	0.020	0.028	0.0046		0.02	<0.01
Dissolved Metals																
Cadmium (dissolved)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002					<0.0002	<0.0002			
Copper (dissolved)	mg/L	0.0026	0.0026	0.0042	0.0022	0.0062	0.0105					0.0126	0.0094			
Iron (dissolved)	mg/L	0.16	0.088	0.19	0.074	0.26	0.28					0.26	0.33			
Zinc (dissolved)	mg/L	0.027	0.016	0.025	0.019	0.039	0.012					0.024	0.0074			
Organic Parameters																
Total Organic Carbon	mg/L	15	6	18	5	59	30				62	60	30			

* - BOLD VALUES for Alkalinity indicate moderate to low acid buffering capacity.
- Exceeds Federal (CCME, 1991) Freshwater Guidelines for protection of aquatic life.
- Exceeds B.C. (AWCWQ, 1994) Freshwater Criteria for protection of aquatic life.

Table 5.2

MINTO EXPLORATIONS LTD.
MINTO PROJECT

Historic Minto Creek and Adjacent Yukon River Water Quality Data
B.C. Research and Environment Canada (1975-76)

Location		Tributary 2		Minto Creek Reach 4		Tributary 4		Minto Creek Reach 6		Tributary 5		Tributary 3
Station #		BCR - 7	BCR - 7	BCR - 8	BCR - 8	BCR - 9	BCR - 9	BCR - 10	BCR - 10	BCR - 11	BCR - 11	BCR - 12
Date		8-May-76	28-Jul-76	8-May-76	28-Jul-76	8-May-76	28-Jul-76	8-May-76	28-Jul-76	8-May-76	28-Jul-76	8-May-76
Physical Tests	Units											
Temperature	°C	0	9	0	8	0	7	0	7	0.5	11	0
Colour	Alpha units	312	151	310	149	308	155	324	181	242	167	22
Dissolved Oxygen	mg/L											
Conductivity	umhos/cm	38	59	51	111	36	61	39	32	38	92	85
Total Dissolved Solids	mg/L	142	237	174	253	173	233	157	214	165	243	102
Hardness	mg/L CaCO3	13	36	17	66	12	37	9.5	21	14	59	55
pH	pH Units	6.6	6.9	6.6	7.6	6.5	7.0	5.7	6.2	6.7	7.5	7.4
Total Suspended Solids	mg/L	8	2	11	5	29	9	31	2	170	351	6
Turbidity	NTU	0.5	0.5	0.9	1.8	0.9	1.5	0.7	0.5	1.7	5.0	0.5
Anions												
Alkalinity (Total) *	mg/L CaCO3	29		37	57	30		26	9	30		63
Sulphate (dissolved)	mg/L			<1	<1			<1	<1			
Nutrients												
Ammonia Nitrogen	mg/L				0.038				0.036			
Nitrate Nitrogen	mg/L				0.016				0.034			
Nitrite Nitrogen	mg/L				0.002				0.001			
Total Dissolved Phosphate	mg/L			0.104	0.006			0.180	<0.005			
Total Metals												
Antimony (total)	mg/L											
Arsenic (total)	mg/L			0.002	0.003			0.002	0.002			
Barium (total)	mg/L			<2	<2			<2	<2			
Cadmium (total)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	**0.0003**	<0.0002	<0.0002	<0.0002	<0.0002
Calcium (total)	mg/L											
Copper (total)	mg/L	0.0044	0.0048	0.0143	0.0139	0.0050	0.0040	0.0082	0.0062	0.0365	0.30	0.0016
Iron (total)	mg/L	0.13	0.16	0.54	0.36	0.36	0.87	1.20	0.30	0.33	2.04	0.005
Lead (total)	mg/L			0.0006	0.0003			0.0006	0.0002			
Magnesium (total)	mg/L											
Manganese (total)	mg/L			0.04	0.02			0.05	0.01			
Mercury (total)	mg/L			<0.00005	<0.00005			0.00005	<0.00005			
Molybdenum (total)	mg/L				<0.001				<0.001			
Nickel (total)	mg/L			<0.005	<0.005			<0.005	<0.005			
Silver (total)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Zinc (total)	mg/L	0.020	0.0082	0.019	0.0038	0.020	0.0091	0.028	0.0096	0.030	0.025	0.014
Dissolved Metals												
Cadmium (dissolved)	mg/L			0.016	<0.0002			<0.0002	<0.0002			
Copper (dissolved)	mg/L			0.0123	0.0148			0.0066	0.0073			
Iron (dissolved)	mg/L			0.33	0.35			0.36	0.30			
Zinc (dissolved)	mg/L			0.024	0.010			0.028	0.022			
Organic Parameters												
Total Organic Carbon	mg/L	63	33	56	28	54	27	61	35	54	27	21

* - BOLD VALUES for Alkalinity indicate moderate to low acid buffering capacity.
- Exceeds Federal (CCME, 1991) Freshwater Guidelines for protection of aquatic life.
- Exceeds B.C. (AWCWQ, 1994) Freshwater Criteria for protection of aquatic life.

Table 5.3

MINTO EXPLORATIONS LTD.
MINTO PROJECT

Historic Regional Water Quality Data

B.C. Research and Environment Canada (1975-76)

Location		Creek A Reach 1		Big Creek (Above Dark Creek)			Big Creek Reach 1			Wolverine Creek Reach 1			Wolverine Creek (Upstream)			Creek B Reach 2	
Station #		BCR - 4	BCR - 4	EC - 1	EC - 1	EC - 1	EC - 2	EC - 2	EC - 2	EC - 4	EC - 4	EC - 4	EC - 5	EC - 5	EC - 5	EC - 6	EC - 6
Date		8-May-76	28-Jul-76	15-May-75	30-Jun-75	21-Sep-76	15-May-75	30-Jun-75	21-Sep-76	15-May-75	30-Jun-75	21-Sep-76	15-May-75	30-Jun-75	21-Sep-76	15-May-75	30-Jun-75
Physical Tests	Units																
Temperature	°C	1	3	1.8	14.0	7.0	1.8	15.2	9.0	2.5	12.0	4.0	2.0	11.5	5.0	0.5	7.0
Colour	Alpha units	2	<1		43	25		43			65			69	56		87
Dissolved Oxygen	mg/L			11.2	9.0	10.3	10.6	8.5	10.2	11.4	8.0	11.7	11.3	8.5	10.5	11.0	8.3
Conductivity	umhos/cm	280	273	150	130	95	120	115	100	28	150	90	20	160	95	28	152
Total Dissolved Solids	mg/L	192	329		<3	<5		<3	<5		<3	<5		<3	10		<3
Hardness	mg/L CaCO3	157	166		70	74		71	78		84	80		88	79		91
pH	pH Units	7.7	7.8	6.90	7.80	7.40	6.80	7.80	7.80	6.80	7.50	8.00	7.15	7.50	7.70	6.75	7.50
Total Suspended Solids	mg/L	20	1														
Turbidity	NTU	0.5	0.3			0.8									0.7		
Anions																	
Alkalinity (Total)	mg/L CaCO3	160				70			74			72			99		
Total Metals																	
Antimony (total)	mg/L				<0.3	<0.3		<0.3	<0.3		<0.3	<0.3		<0.3	<0.3		<0.3
Arsenic (total)	mg/L					<0.02			<0.02			0.04			<0.02		
Cadmium (total)	mg/L	<0.0002	<0.0002		<0.01	<0.01		<0.01	<0.01		<0.01	<0.01		<0.01	<0.01		<0.01
Calcium (total)	mg/L				16	19		16	20		17	18		18	18		24
Copper (total)	mg/L	0.0061	0.0084		<0.01	<0.01		<0.01	<0.01		<0.01	<0.01		<0.01	<0.01		<0.01
Iron (total)	mg/L	0.003	0.021			0.05			<0.03			0.10			0.07		
Lead (total)	mg/L				<0.02	<0.02		<0.02	<0.02		<0.02	<0.02		<0.02	<0.02		<0.02
Magnesium (total)	mg/L				7.2	6.5		7.6	6.8		10.0	8.6		10.5	8.3		7.6
Mercury (total)	mg/L				<0.4	<0.2		<0.4	<0.2		<0.4	<0.2		<0.4	<0.2		<0.4
Molybdenum (total)	mg/L				<0.3	<0.1		<0.3	<0.1		<0.3	<0.1		<0.3	<0.1		<0.3
Nickel (total)	mg/L				<0.1	<0.05		<0.1	<0.05		<0.1	<0.05		<0.1	<0.05		<0.1
Silver (total)	mg/L	<0.0005	<0.0005		<0.03	<0.03		<0.03	<0.03		<0.03	<0.03		<0.03	<0.03		<0.03
Zinc (total)	mg/L	0.0068	0.0052		0.01	<0.01		0.01	<0.01		0.01	<0.01		0.01	<0.01		0.01
Organic Parameters																	
Total Organic Carbon	mg/L	2	3														

▒ - Exceeds Federal (CCME, 1991) Freshwater Guidelines for protection of aquatic life.
□ - Exceeds B.C. (AWCWQ, 1994) Freshwater Criteria for protection of aquatic life.

Table 5.4

MINTO EXPLORATIONS LTD.
MINTO PROJECT

Mean Values* for 1993-94 Water Quality Data
Stations W1 to W9

Sample Station:		W1	W2	W3	W4	W5	W6	W7	W8	W9
Physical Tests	Units									
Conductivity	umhos/cm	247.5	185.7	239.4	125.5	142.6	165.0	151.0	505.3	157.2
Total Dissolved Solids	mg/L	156.3	125.8	154.0	85.2	88.2	110.3	106.0	347.5	105.0
Hardness	mg/L CaCO3	115.2	93.4	113.1	67.96	70.54	83.7	77.7	254.3	80.2
pH	pH Units	7.767	7.773	7.862	7.972	7.856	7.590	7.577	8.238	7.508
Total Suspended Solids	mg/L	86.8	42.0	85.4	34.2	26.2	20.0	32.3	252.0	93.8
Turbidity	NTU	32.63	18.41	32.99	14.51	12.72	3.290	6.78	51.4	37.9
Anions										
Alkalinity (Total) *	mg/L CaCO3	89.7	86.5	105.3	61.6	64.98	86.7	73.37	265.3	76.7
Chloride (dissolved)	mg/L	1.22	1.07	1.20	0.59	0.48	0.90	1.10	1.23	1.22
Fluoride (dissolved)	mg/L	0.160	0.203	0.162	0.118	0.112	0.217	0.227	0.25	0.146
Sulphate (dissolved)	mg/L	18.72	13.70	20.32	8.96	8.72	5.90	10.57	37.85	5.10
Nutrients										
Ammonia Nitrogen	mg/L	0.0690	0.0052	0.0157	0.00250	0.00250	0.0168	0.0062	0.0163	0.0458
Nitrate Nitrogen	mg/L	0.0523	0.0339	0.0602	0.0123	0.0119	0.0267	0.0570	0.0274	0.0190
Nitrite Nitrogen	mg/L	0.0051	0.0029	0.0050	0.0026	0.0024	0.0023	0.0037	0.0050	0.0054
ortho-Phosphate	mg/L	0.0232	0.0083	0.0166	0.0096	0.0061	0.0057	0.0083	0.0215	0.0488
Total Dissolved Phosphate	mg/L	0.0293	0.0155	0.0256	0.0134	0.0082	0.0110	0.0127	0.0340	0.0574
Total Phosphorus	mg/L	0.1410	0.0573	0.068	0.0364	0.0416	0.0217	0.0400	0.1320	0.0960
Cyanide										
Total Cyanide	mg/L	0.0190	0.0127	0.0196	0.0035	0.0021	0.0077	0.0100	0.0225	0.0226
Total Metals										
Aluminum (total)	mg/L	1.873	0.948	1.952	0.3472	0.3316	0.2830	0.2350	1.50	1.953
Antimony (total)	mg/L	0.00007	0.00007	0.000050	0.000050	0.000050	0.00010	0.000050	0.000050	0.000050
Arsenic (total)	mg/L	0.00147	0.00087	0.00140	0.00051	0.00074	0.00073	0.00057	0.00190	0.00204
Barium (total)	mg/L	0.1110	0.0678	0.1048	0.0390	0.0410	0.0567	0.0563	0.1360	0.1248
Beryllium (total)	mg/L	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250
Bismuth (total)	mg/L	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Boron (total)	mg/L	0.102	0.107	0.112	0.050	0.050	0.050	0.050	0.050	0.120
Cadmium (total)	mg/L	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00014
Calcium (total)	mg/L	29.22	24.77	29.28	19.80	20.62	23.60	20.30	45.15	23.06
Chromium (total)	mg/L	0.0046	0.0026	0.0042	0.0011	0.0011	0.0012	0.0012	0.0064	0.0042
Cobalt (total)	mg/L	0.0018	0.0009	0.0016	0.0005	0.0005	0.0005	0.0007	0.0036	0.0021
Copper (total)	mg/L	0.0192	0.0080	0.0130	0.0017	0.0021	0.0017	0.0020	0.0138	0.0152
Iron (total)	mg/L	4.28	1.834	4.064	0.416	0.446	0.6480	0.5530	2.50	5.61
Lead (total)	mg/L	0.0015	0.0022	0.0048	0.0045	0.0015	0.0105	0.0005	0.0355	0.0033
Magnesium (total)	mg/L	11.9	8.31	11.24	4.930	5.112	6.22	6.693	36.08	6.9
Manganese (total)	mg/L	0.2623	0.0660	0.2376	0.0210	0.0207	0.0363	0.0473	0.1903	0.3532
Mercury (total)	mg/L	0.000009	0.000009	0.000011	0.000006	0.000007	0.000005	0.000007	0.000006	0.000008
Molybdenum (total)	mg/L	0.0008	0.0006	0.0014	0.0006	0.0007	0.00050	0.00050	0.00050	0.0008
Nickel (total)	mg/L	0.008	0.004	0.007	0.001	0.001	0.0027	0.0030	0.0100	0.006
Selenium (total)	mg/L	0.000250	0.000250	0.000250	0.000250	0.000250	0.000250	0.000250	0.000250	0.000250
Silicon (total)	mg/L	7.61	6.293	7.74	3.094	3.134	7.897	5.17	6.315	7.76
Silver (total)	mg/L	0.00006	0.00005	0.00006	0.000050	0.000050	0.000050	0.000050	0.000050	0.000060
Strontium (total)	mg/L	0.1985	0.1942	0.206	0.092	0.0954	0.1057	0.2110	0.4943	0.1286
Uranium (total)	mg/L	0.00036	0.00042	0.00045	0.000652	0.000652	0.000067	0.000280	0.00141	0.00017
Vanadium (total)	mg/L	0.0177	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150
Zinc (total)	mg/L	0.0103	0.0061	0.0108	0.0046	0.0046	0.0040	0.0025	0.0120	0.0103
Dissolved Metals										
Aluminum (dissolved)	mg/L	0.0423	0.0335	0.0422	0.0196	0.0159	0.0200	0.0443	0.0224	0.084
Antimony (dissolved)	mg/L	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050
Arsenic (dissolved)	mg/L	0.00053	0.00037	0.00038	0.00031	0.00034	0.00023	0.00023	0.00045	0.00098
Barium (dissolved)	mg/L	0.0618	0.0457	0.0576	0.0328	0.0338	0.0430	0.0487	0.0763	0.072
Beryllium (dissolved)	mg/L	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250
Bismuth (dissolved)	mg/L	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Boron (dissolved)	mg/L	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Cadmium (dissolved)	mg/L	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010
Calcium (dissolved)	mg/L	27.85	24.17	27.98	19.30	20.16	23.40	20.17	43.90	21.82
Chromium (dissolved)	mg/L	0.00050	0.00050	0.00050	0.00050	0.00060	0.00050	0.00050	0.00050	0.0007
Cobalt (dissolved)	mg/L	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.0009
Copper (dissolved)	mg/L	0.0058	0.0038	0.0056	0.0010	0.0009	0.0013	0.0020	0.0040	0.0038
Iron (dissolved)	mg/L	0.978	0.3393	0.7596	0.0270	0.0402	0.0870	0.2147	0.1295	2.304
Lead (dissolved)	mg/L	0.00050	0.00050	0.00050	0.00080	0.00050	0.00050	0.00050	0.00050	0.0031
Magnesium (dissolved)	mg/L	11.1	7.97	10.48	4.812	4.926	6.16	6.623	35.1	6.3
Manganese (dissolved)	mg/L	0.1700	0.0148	0.1370	0.0039	0.0041	0.0040	0.0380	0.0933	0.2532
Molybdenum (dissolved)	mg/L	0.0008	0.0005	0.0010	0.00050	0.00050	0.00050	0.00050	0.00050	0.0006
Nickel (dissolved)	mg/L	0.0014	0.0010	0.0011	0.0006	0.0006	0.0008	0.0020	0.0015	0.0019
Potassium (dissolved)	mg/L	0.778	0.823	0.888	0.758	0.770	0.520	0.673	1.525	0.542
Selenium (dissolved)	mg/L	0.000250	0.000250	0.000250	0.000250	0.000250	0.000250	0.000250	0.000250	0.000250
Silicon (dissolved)	mg/L	5.297	5.045	5.194	2.782	2.782	7.783	4.99	4.69	5.488
Silver (dissolved)	mg/L	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050
Sodium (dissolved)	mg/L	6.71	4.762	6.65	1.786	1.764	4.103	3.760	20.55	4.070
Strontium (dissolved)	mg/L	0.1870	0.1895	0.1946	0.0904	0.0934	0.1047	0.2093	0.4818	0.1208
Uranium (dissolved)	mg/L	0.000280	0.000332	0.000316	0.000580	0.000612	0.000053	0.000233	0.00128	0.000078
Vanadium (dissolved)	mg/L	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150
Zinc (dissolved)	mg/L	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250	0.0034	0.00250
Organic Parameters										
Dissolved Organic Carbon	mg/L	21.50	27.20	20.85	6.84	4.105	♦	♦	♦	23.50
Total Organic Carbon	mg/L	18.50	18.90	16.10	2.23	2.28	11.17	21.17	14.93	21.53

* - Mean values calculated using 1/2 the method detection limit where original data reported as "<" (less than).
♦ - Insufficient data to calculate mean value.
- Exceeds Federal (CCME, 1991) Freshwater Guidelines for protection of aquatic life.
- Exceeds B.C. (AWCWQ, 1994) Freshwater Criteria for protection of aquatic life.

Table 5.5

MINTO EXPLORATIONS LTD.

MINTO PROJECT

1993-94 Water Quality QA/QC Data

		Duplicate Set 1			Duplicate Set 2			Duplicate Set 3			Travel Blanks			
Station #		W1	W1 (Dup)	Orig:Dup	W2	W2 (Dup)	Orig:Dup	W2	W2 (Dup)	Orig:Dup				
Date		30-Sep-93	30-Sep-93	Ratio	7-Jun-94	7-Jun-94	Ratio	10-Aug-94	10-Aug-94	Ratio	15-May-94	7-Jun-94	10-Aug-94	26-Sep-94
Physical Tests	Units													
Conductivity	umhos/cm	236	240	0.98	175	174	1.01	270	268	1.01	7.0		1.5	1.5
Total Dissolved Solids	mg/L	167	166	1.01	123	124	0.99	183	183	1.00	<1		<1	<1
Hardness	mg/L CaCO3	126	124	1.02	88.5	88.9	1.00	130	131	0.99	<0.05		<0.05	<0.05
pH	pH Units	7.85	7.73	0.99	7.83	7.62	1.00	7.97	7.97	1.00	5.74		5.97	5.55
Total Suspended Solids	mg/L	39	43	0.91	19	20	0.95	3	3	1.00	<1		<1	<1
Turbidity	NTU	21.5	22.6	0.95	8.24	8.23	1.00	0.88	0.82	1.07	0.38		<0.10	<0.10
Anions														
Alkalinity (Total)	mg/L CaCO3	112	110	1.02	79.8	79.1	1.01	132	129	1.02	<1.0		<1.0	<1.0
Chloride (dissolved)	mg/L	1.4	1.3	1.08	0.9	0.9	1.00	1.2	1.0	1.20	<0.5		<0.5	<0.5
Fluoride (dissolved)	mg/L	0.13	0.13	1.00	0.20	0.19	1.05	0.36	0.36	1.00	<0.02		<0.02	0.02
Sulphate (dissolved)	mg/L	18.0	18.3	0.98	14.2	14.7	0.97	20.1	20.2	1.00	<1.0		<1.0	<1.0
Nutrients														
Ammonia Nitrogen	mg/L	0.033	0.033	1.00	0.015	0.014	1.07	<0.005	<0.005	1.00	<0.005		<0.005	<0.005
Nitrate Nitrogen	mg/L	0.064	0.063	1.02	0.080	0.080	1.00	0.026	0.025	1.04	<0.005		<0.005	<0.005
Nitrite Nitrogen	mg/L	<0.001	0.001	0.50	0.004	0.005	0.80	0.002	0.002	1.00	<0.001		<0.001	<0.001
ortho-Phosphate	mg/L	0.037	0.037	1.00	0.009	0.010	0.90	0.003	0.003	1.00	<0.001		<0.001	<0.001
Total Dissolved Phosphate	mg/L	0.041	0.036	1.08	0.016	0.016	1.00	0.008	0.007	1.14	0.002		<0.001	<0.001
Total Phosphorus	mg/L	0.105	0.100	1.05	0.036	0.037	0.97	0.008	0.010	0.80	0.002		0.001	<0.001
Cyanide														
Total Cyanide	mg/L	0.023	0.020	1.15	0.020	0.008	2.50	0.011	0.014	0.79	<0.001		<0.001	0.004
Total Metals														
Aluminum (total)	mg/L	0.740	0.600	1.23	0.315	0.306	1.03	0.037	0.033	1.12	<0.005	0.005	<0.005	<0.005
Antimony (total)	mg/L	0.0001	0.0001	1.00	0.0001	0.0002	0.50	<0.0001	<0.0001	1.00	<0.0001	<0.0001	<0.0001	<0.0001
Arsenic (total)	mg/L	0.0007	0.0007	1.00	0.0005	0.0005	1.00	0.0003	0.0003	1.00	<0.0001	<0.0001	<0.0001	<0.0001
Barium (total)	mg/L	0.083	0.079	1.05	0.054	0.056	0.96	0.064	0.063	1.02	<0.010	<0.010	<0.010	<0.010
Beryllium (total)	mg/L	<0.005	<0.005	1.00	<0.005	<0.005	1.00	<0.005	<0.005	1.00	<0.005	<0.005	<0.005	<0.005
Bismuth (total)	mg/L	<0.10	<0.10	1.00	<0.10	<0.10	1.00	<0.10	<0.10	1.00	<0.10	<0.10	<0.10	<0.10
Boron (total)	mg/L	<0.10	<0.10	1.00	<0.10	<0.10	1.00	<0.10	<0.10	1.00	<0.10	<0.10	<0.10	<0.10
Cadmium (total)	mg/L	<0.0002	<0.0002	1.00	<0.0002	<0.0002	1.00	<0.0002	<0.0002	1.00	<0.0002	<0.0002	<0.0002	<0.0002
Calcium (total)	mg/L	31.9	31.6	1.01	22.4	22.9	0.98	33.7	33.8	1.00	<0.050	<0.050	<0.050	<0.050
Chromium (total)	mg/L	0.001	0.001	1.00	<0.001	0.001	0.50	<0.001	<0.001	1.00	<0.001	<0.001	<0.001	<0.001
Cobalt (total)	mg/L	<0.001	<0.001	1.00	<0.001	<0.001	1.00	<0.001	<0.001	1.00	<0.001	<0.001	<0.001	<0.001
Copper (total)	mg/L	0.009	0.008	1.13	0.004	0.004	1.00	0.002	0.004	0.50	<0.001	<0.001	<0.001	<0.001
Iron (total)	mg/L	2.14	2.11	1.01	0.743	0.760	0.98	0.082	0.085	0.96	<0.030	<0.030	<0.030	<0.030
Lead (total)	mg/L	<0.001	<0.001	1.00	<0.001	<0.001	1.00	<0.001	<0.001	1.00	0.005	0.005	<0.001	<0.001
Magnesium (total)	mg/L	12.0	11.9	1.01	7.90	8.06	0.98	11.2	11.4	0.98	<0.010	<0.010	0.016	<0.010
Manganese (total)	mg/L	0.279	0.280	1.00	0.029	0.030	0.97	0.019	0.019	1.00	<0.005	<0.005	<0.005	<0.005
Mercury (total)	mg/L	0.00001	0.00002	0.50	0.00001	0.00001	1.00	<0.00001	<0.00001	1.00	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum (total)	mg/L	<0.001	<0.001	1.00	<0.001	<0.001	1.00	0.001	0.001	1.00	<0.001	<0.001	<0.001	<0.001
Nickel (total)	mg/L	0.003	0.003	1.00	0.003	0.002	1.50	0.001	0.001	1.00	<0.001	<0.001	<0.001	<0.001
Selenium (total)	mg/L	<0.0005	<0.0005	1.00	<0.0005	<0.0005	1.00	<0.0005	<0.0005	1.00	<0.0005	<0.0005	<0.0005	<0.0005
Silicon (total)	mg/L	6.51	6.47	1.01	5.06	5.16	0.98	5.49	5.56	0.99	<0.050	1.38	0.081	<0.050
Silver (total)	mg/L	<0.0001	<0.0001	1.00	<0.0001	<0.0001	1.00	<0.0001	<0.0001	1.00	<0.0001	<0.0001	<0.0001	<0.0001
Strontium (total)	mg/L	0.202	0.203	1.00	0.180	0.185	0.97	0.300	0.303	0.99	<0.001	<0.001	<0.001	<0.001
Uranium (total)	mg/L	0.00028	0.00030	0.93	0.00034	0.00035	0.97	0.00071	0.00066	1.08	<0.00001	<0.00001	<0.00001	<0.00001
Vanadium (total)	mg/L	<0.030	<0.030	1.00	<0.030	<0.030	1.00	<0.030	<0.030	1.00	<0.030	<0.030	<0.030	<0.030
Zinc (total)	mg/L	<0.005	<0.005	1.00	<0.005	<0.005	1.00	<0.005	<0.005	1.00	<0.005	<0.005	<0.005	<0.005
Dissolved Metals														
Aluminum (dissolved)	mg/L	0.034	0.039	0.87	0.033	0.031	1.06	0.019	0.017	1.12	<0.005		<0.005	<0.005
Antimony (dissolved)	mg/L	<0.0001	<0.0001	1.00	<0.0001	<0.0001	1.00	<0.0001	<0.0001	1.00	<0.0001		<0.0001	<0.0001
Arsenic (dissolved)	mg/L	0.0007	0.0005	1.40	0.0004	0.0004	1.00	0.0003	0.0003	1.00	<0.0001		<0.0001	<0.0001
Barium (dissolved)	mg/L	0.065	0.061	1.07	0.046	0.046	1.00	0.063	0.063	1.00	<0.010		<0.010	<0.010
Beryllium (dissolved)	mg/L	<0.005	<0.005	1.00	<0.005	<0.005	1.00	<0.005	<0.005	1.00	<0.005		<0.005	<0.005
Bismuth (dissolved)	mg/L	<0.10	<0.10	1.00	<0.10	<0.10	1.00	<0.10	<0.10	1.00	<0.10		<0.10	<0.10
Boron (dissolved)	mg/L	<0.10	<0.10	1.00	<0.10	<0.10	1.00	<0.10	<0.10	1.00	<0.10		<0.10	<0.10
Cadmium (dissolved)	mg/L	<0.0002	<0.0002	1.00	<0.0002	<0.0002	1.00	<0.0002	<0.0002	1.00	<0.0002		<0.0002	<0.0002
Calcium (dissolved)	mg/L	31.2	30.6	1.02	22.4	22.6	0.99	33.7	33.8	1.00	<0.050		<0.050	<0.050
Chromium (dissolved)	mg/L	<0.001	<0.001	1.00	<0.001	<0.001	1.00	<0.001	<0.001	1.00	<0.001		<0.001	<0.001
Cobalt (dissolved)	mg/L	<0.001	<0.001	1.00	<0.001	<0.001	1.00	<0.001	<0.001	1.00	<0.001		<0.001	<0.001
Copper (dissolved)	mg/L	0.004	0.004	1.00	0.004	0.004	1.00	0.002	0.004	0.50	<0.001		<0.001	<0.001
Iron (dissolved)	mg/L	1.03	1.00	1.03	0.366	0.366	1.00	0.063	0.059	1.07	<0.030		<0.030	<0.030
Lead (dissolved)	mg/L	<0.001	<0.001	1.00	<0.001	<0.001	1.00	<0.001	<0.001	1.00	<0.001		<0.001	<0.001
Magnesium (dissolved)	mg/L	11.7	11.6	1.01	7.90	7.91	1.00	11.2	11.4	0.98	<0.010		<0.010	<0.010
Manganese (dissolved)	mg/L	0.246	0.242	1.02	<0.005	0.006	0.42	0.019	0.019	1.00	<0.005		<0.005	<0.005
Molybdenum (dissolved)	mg/L	<0.001	<0.001	1.00	<0.001	<0.001	1.00	<0.001	<0.001	1.00	<0.001		<0.001	<0.001
Nickel (dissolved)	mg/L	<0.001	<0.001	1.00	0.002	0.001	2.00	<0.001	<0.001	1.00	<0.001		<0.001	<0.001
Potassium (dissolved)	mg/L	0.69	0.70	0.99	0.81	0.81	1.00	1.16	1.17	0.99	<0.01		<0.01	<0.01
Selenium (dissolved)	mg/L	<0.0005	<0.0005	1.00	<0.0005	<0.0005	1.00	<0.0005	<0.0005	1.00	<0.0005		<0.0005	<0.0005
Silicon (dissolved)	mg/L	5.92	5.84	1.01	4.90	4.86	1.01	5.49	5.56	0.99	<0.050		0.075	<0.050
Silver (dissolved)	mg/L	<0.0001	<0.0001	1.00	<0.0001	<0.0001	1.00	<0.0001	<0.0001	1.00	<0.0001		<0.0001	<0.0001
Sodium (dissolved)	mg/L	7.26	7.28	1.00	4.47	4.70	0.95	6.83	7.99	0.85	0.01		<0.01	<0.01
Strontium (dissolved)	mg/L	0.197	0.195	1.01	0.180	0.180	1.00	0.300	0.303	0.99	<0.001		<0.001	<0.001
Uranium (dissolved)	mg/L	0.00028	0.00027	1.04	0.00032	0.00033	0.97	0.00062	0.00062	1.00	<0.00001		<0.00001	<0.00001
Vanadium (dissolved)	mg/L	<0.030	<0.030	1.00	<0.030	<0.030	1.00	<0.030	<0.030	1.00	<0.030		<0.030	<0.030
Zinc (dissolved)	mg/L	<0.005	<0.005	1.00	<0.005	<0.005	1.00	<0.005	<0.005	1.00	<0.005		<0.005	<0.005
Organic Parameters														
Dissolved Organic Carbon	mg/L			0.00	24.1	20.8	1.17			0.00	<0.50	<0.50		
Total Organic Carbon	mg/L			0.00	24.1	24.2	1.00	12.3	12.6	0.98		<0.5	<0.5	<0.5

Table 5.6

MINTO EXPLORATIONS LTD.
MINTO PROJECT

Copper Complexing Capacity of Minto Creek

Sample Site	Replicate #	Complexing Capacity		% Copper		Average % Cu *	
		umol/L	ug/L	Free	Bound	Free	Bound
MC1	1	2.252	143.08	15.00	85.00		
	2	2.332	148.19	9.60	90.40	11.87	88.13
	3	1.585	100.71	11.01	88.99		
	2 (Dup)	2.404	152.77	7.27	92.73		
MC2	1	1.283	81.50	17.96	82.04		
	2	0.931	59.18	23.12	76.88	20.91	79.09
	3	1.282	81.47	21.66	78.34		
MC3	1	1.078	68.49	18.23	81.77		
	2	1.651	104.89	39.89	60.11	25.95	74.05
	3	1.294	82.23	19.73	80.27		

* - Duplicate values not included in calculations.

(See Lutes p. 4, Sept 1/94 response)

Table 5.7

MINTO EXPLORATIONS LTD.
MINTO PROJECT

Copper Complexing During Freshet Conditions

Sample Site	Freshet Copper Concentration (mg/L) *	Average % Free Copper	Organic Carbon Ratio **	Resultant Copper Conc. (mg/L)	CCME Guideline ***
MC1 (W9)	0.060	11.87	0.883	**0.0063**	0.002
MC2 (W3)	0.073	20.91	0.510	**0.0078**	0.002
MC3 (W2)	0.030	25.95	0.406	**0.0032**	0.002

* - May 1994 Data.
** - Ratio calculated using August 1994 vs. May 1994 values.
*** - CCME Guideline based on May 1994 Hardness values.

Table 5.8

MINTO EXPLORATIONS LTD.
MINTO PROJECT

HKP Groundwater Quality Data

Well #		Well - 93E	Well - 94-20
Date		26-Sep-94	26-Sep-94
Physical Tests	Units		
Conductivity	umhos/cm	521	238
Total Dissolved Solids	mg/L	354	135
Hardness	mg/L CaCO3	202	111
pH	pH Units	7.55	7.77
Total Suspended Solids	mg/L	93	50
Turbidity	NTU	41.8	29.5
Anions			
Alkalinity (Total)	mg/L CaCO3	145	106
Chloride (dissolved)	mg/L	0.8	0.5
Fluoride (dissolved)	mg/L	1.29	0.37
Sulphate (dissolved)	mg/L	125	9.2
Nutrients			
Ammonia Nitrogen	mg/L	0.014	0.013
Nitrate Nitrogen	mg/L	0.010	0.059
Nitrite Nitrogen	mg/L	0.007	0.009
ortho-Phosphate	mg/L	0.024	0.026
Total Dissolved Phosphate	mg/L	0.040	0.026
Total Phosphorus	mg/L	0.306	0.111
Cyanide			
Total Cyanide	mg/L	0.006	<0.001
Total Metals			
Aluminum (total)	mg/L	0.822	0.644
Antimony (total)	mg/L	<0.0001	<0.0001
Arsenic (total)	mg/L	0.0010	0.0003
Barium (total)	mg/L	0.074	0.070
Beryllium (total)	mg/L	<0.005	<0.005
Bismuth (total)	mg/L	<0.10	<0.10
Boron (total)	mg/L	<0.10	<0.10
Cadmium (total)	mg/L	<0.0002	<0.0002
Calcium (total)	mg/L	59.7	35.2
Chromium (total)	mg/L	0.005	0.001
Cobalt (total)	mg/L	0.003	<0.001
Copper (total)	mg/L	0.045	0.005
Iron (total)	mg/L	1.94	0.366
Lead (total)	mg/L	0.011	0.005
Magnesium (total)	mg/L	12.9	5.66
Manganese (total)	mg/L	0.275	0.071
Mercury (total)	mg/L	<0.00001	<0.00001
Molybdenum (total)	mg/L	0.018	<0.001
Nickel (total)	mg/L	0.004	0.005
Selenium (total)	mg/L	<0.0005	<0.0005
Silicon (total)	mg/L	6.65	5.81
Silver (total)	mg/L	<0.0001	<0.0001
Strontium (total)	mg/L	1.43	0.160
Uranium (total)	mg/L	0.00171	0.00094
Vanadium (total)	mg/L	<0.030	<0.030
Zinc (total)	mg/L	0.026	<0.005
Dissolved Metals			
Aluminum (dissolved)	mg/L	0.006	0.100
Antimony (dissolved)	mg/L	<0.0001	<0.0001
Arsenic (dissolved)	mg/L	0.0005	0.0002
Barium (dissolved)	mg/L	0.074	0.070
Beryllium (dissolved)	mg/L	<0.005	<0.005
Bismuth (dissolved)	mg/L	<0.10	<0.10
Boron (dissolved)	mg/L	<0.10	<0.10
Cadmium (dissolved)	mg/L	<0.0002	<0.0002
Calcium (dissolved)	mg/L	59.7	35.2
Chromium (dissolved)	mg/L	<0.001	<0.001
Cobalt (dissolved)	mg/L	<0.001	<0.001
Copper (dissolved)	mg/L	0.001	0.001
Iron (dissolved)	mg/L	0.033	0.095
Lead (dissolved)	mg/L	<0.001	<0.001
Magnesium (dissolved)	mg/L	12.9	5.66
Manganese (dissolved)	mg/L	0.247	0.035
Molybdenum (dissolved)	mg/L	0.018	<0.001
Nickel (dissolved)	mg/L	0.001	0.001
Potassium (dissolved)	mg/L	2.93	1.35
Selenium (dissolved)	mg/L	<0.0005	<0.0005
Silicon (dissolved)	mg/L	5.95	5.78
Silver (dissolved)	mg/L	<0.0001	<0.0001
Sodium (dissolved)	mg/L	30.0	3.72
Strontium (dissolved)	mg/L	1.43	0.160
Uranium (dissolved)	mg/L	0.00137	0.00090
Vanadium (dissolved)	mg/L	<0.030	<0.030
Zinc (dissolved)	mg/L	<0.005	<0.005
Organic Parameters			
Total Organic Carbon	mg/L	1.8	2.4

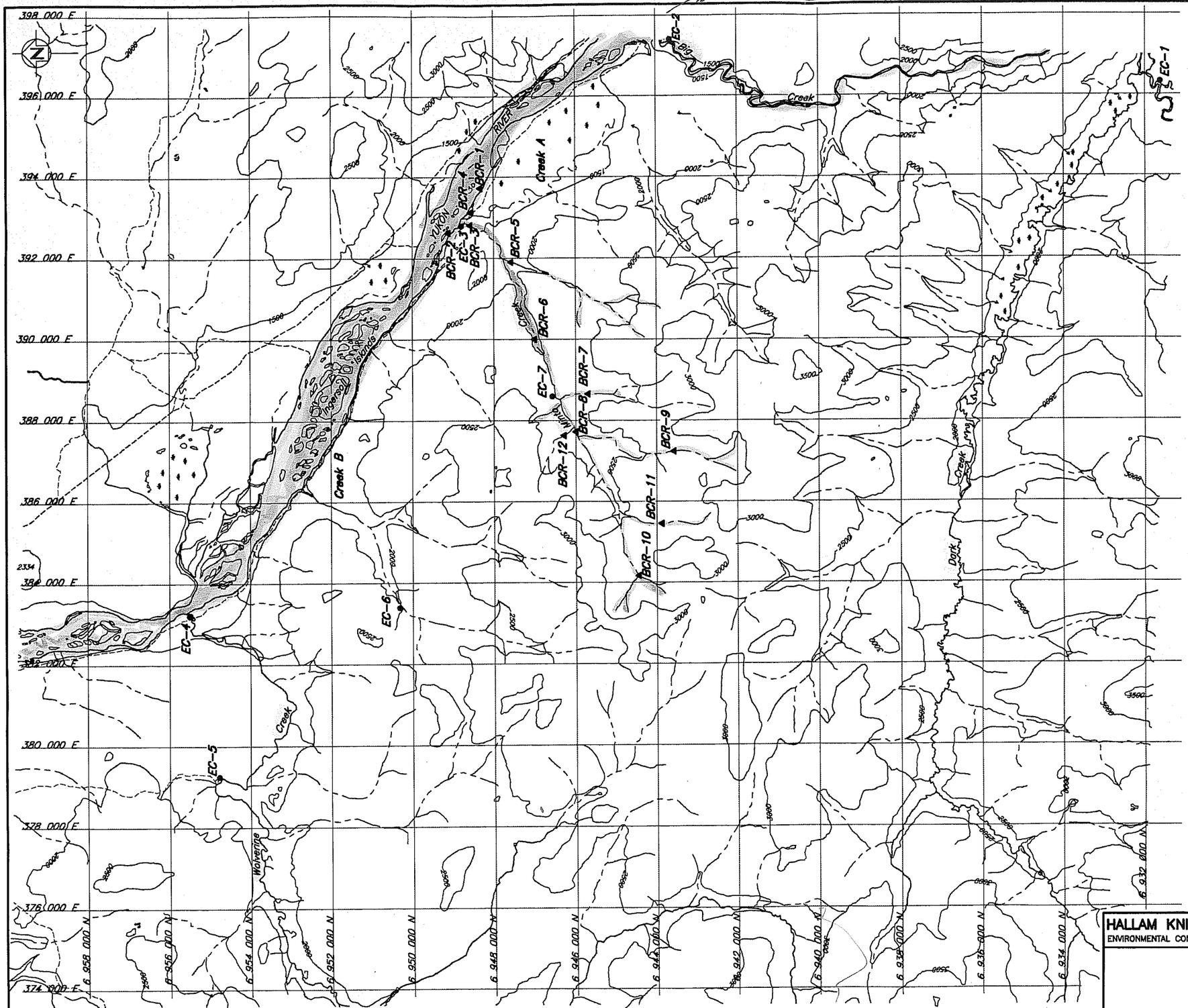
- Exceeds Federal (CCME, 1991) Freshwater Guidelines for protection of aquatic life.
- Exceeds B.C. (AWCWQ, 1994) Freshwater Criteria for protection of aquatic life.

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Table 5.9
Stream Sediment Analysis+

ANALYSIS	SAMPLING STATION															
	S1				S2				S3				S4			
	Replicate				Replicate				Replicate				Replicate			
	a	b	c	AVG	a	b	c	AVG	a	b	c	AVG	a	b	c	AVG
Physical Tests:																
Moisture %	24.50	27.50	23.70	**25.23**	25.30	20.40	19.40	**21.70**	23.00	24.30	25.00	**24.10**	21.00	18.10	16.30	**18.47**
Total Metals:*																
Antimony	0.45	0.31	0.33	**0.36**	0.46	0.36	0.44	**0.42**	0.38	0.49	0.45	**0.44**	0.32	0.29	0.25	**0.29**
Arsenic	4.59	4.62	3.01	**4.07**	4.16	4.59	4.37	**4.37**	4.25	3.85	4.56	**4.22**	4.57	4.66	4.09	**4.44**
Cadmium	0.11	0.11	<0.1	**0.07**	0.12	0.15	0.12	**0.13**	<0.1	<0.1	<0.1	**0.00**	<0.1	<0.1	<0.1	**0.00**
Chromium	17.40	19.30	14.90	**17.20**	25.30	19.70	21.40	**22.13**	24.00	21.50	24.40	**23.30**	13.40	15.00	13.70	**14.03**
Copper	113.00	104.00	91.40	**102.80**	46.70	49.00	49.10	**48.27**	41.50	39.00	40.90	**40.47**	14.20	14.20	13.00	**13.80**
Lead	3.10	4.00	3.00	**3.37**	3.90	4.10	3.80	**3.93**	3.90	3.70	3.90	**3.83**	2.60	2.20	<2	**1.60**
Mercury	0.02	0.02	0.01	**0.02**	0.01	0.01	0.01	**0.01**	0.01	0.01	0.02	**0.01**	0.01	0.01	0.02	**0.01**
Molybdenum	<4.0	<4.0	<4.0	**0.00**	<4.0	<4.0	<4.0	**0.00**	<4.0	<4.0	<4.0	**0.00**	<4.0	<4.0	<4.0	**0.00**
Silver	<2.0	<2.0	<2.0	**0.00**	<2.0	<6.0	<2.0	**0.00**	<2.0	<2.0	<2.0	**0.00**	<2.0	<2.0	<2.0	**0.00**
Zinc	34.30	38.00	34.90	**35.73**	47.20	49.10	47.10	**47.80**	47.20	46.50	51.90	**48.53**	30.40	28.90	29.00	**29.43**
Particle Size:																
Gravel – % (>2.00 mm)	8.39	10.50	8.84	**9.24**	5.36	4.39	4.95	**4.90**	2.58	1.24	1.43	**1.75**	25.00	27.50	34.00	**28.83**
Sand – % (2.00–0.063 mm)	74.00	72.60	69.90	**72.17**	75.30	75.20	75.10	**75.20**	78.80	77.70	77.10	**77.87**	65.40	64.00	58.50	**62.63**
Silt – % (0.063 mm–4 um)	13.10	12.80	16.30	**14.07**	13.60	14.20	14.00	**13.93**	12.30	14.80	15.20	**14.10**	7.59	6.56	5.74	**6.63**
Clay – % (<4 um)	4.47	4.16	5.02	**4.55**	5.79	6.24	5.91	**5.98**	6.39	6.24	6.31	**6.31**	1.99	1.93	1.75	**1.89**

+ Values expressed are means
* Results are expressed as milligram per dry kilogram



LEGEND:

EC-1 ● Environment Canada Station (1975–76)

BCR-1 ▲ B.C. Research Station (1976)

NOTE: Contour interval in feet

Scale 1000 0 1000 2000 3000 4000 5000 Metres

D:\EQ FILES\PROJECTS\1000\A3001\DA1.DGN 1:50000 Plot 1=50 STD.1 Dec. 11, 1994

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

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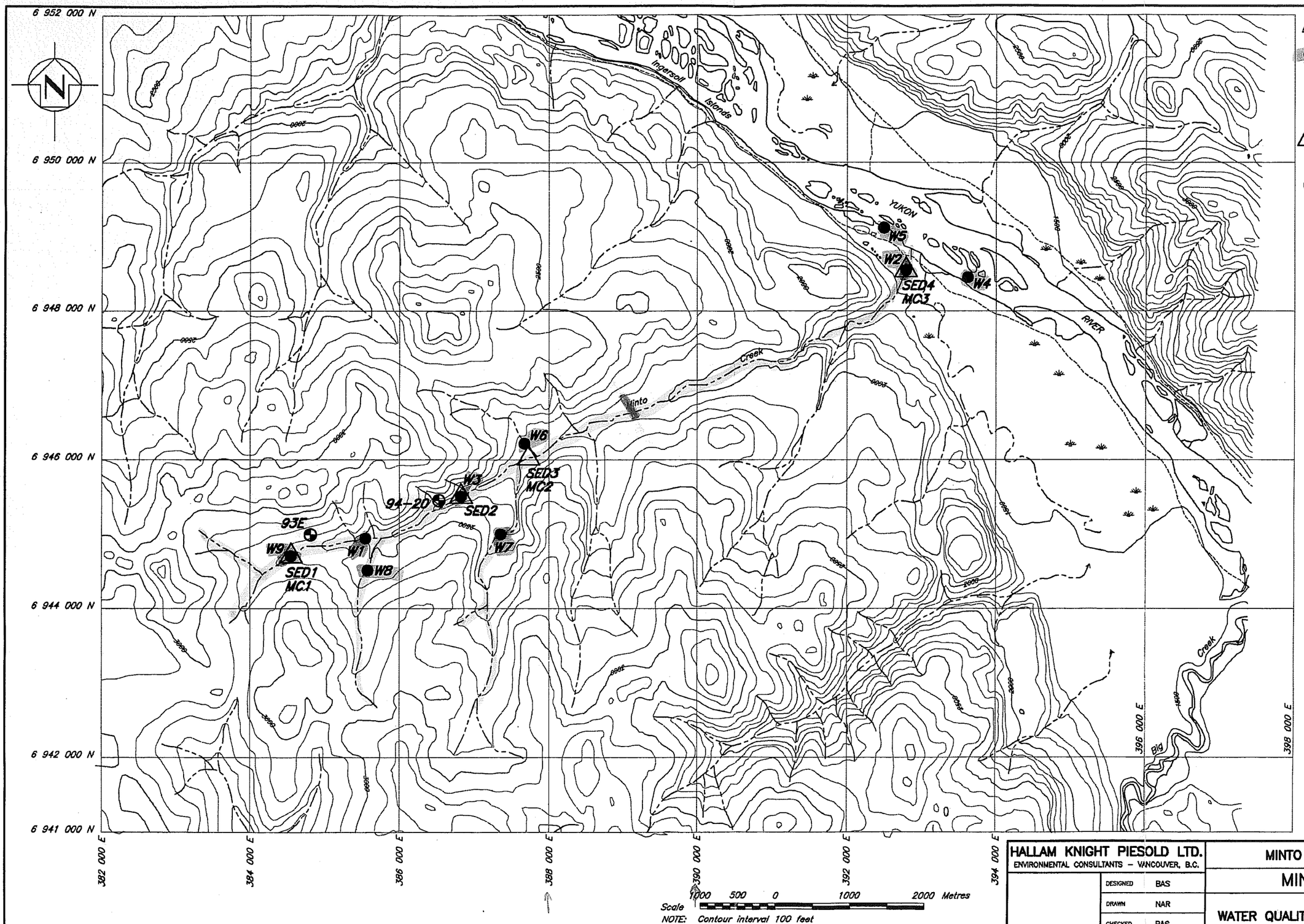
MINTO EXPLORATIONS LTD.

MINTO PROJECT

HISTORIC WATER QUALITY SAMPLING LOCATIONS (1975–1976)

DESIGNED			
DRAWN	NSD		
CHECKED			
APPROVED			

DATE NOV. 25, 1994 | SCALE AS SHOWN | FIG. NO. FIGURE 5.1 | REV. –



LEGEND

- W5 Water Quality Station
  (Note: Stations W1, W2 and W3 are also Hydrology Monitoring Stations. An automatic water level recorder is installed at Station W2)
- SED3 Stream Sediment Sample Location
- MC2 Metal Complexing Sample Location
- 93E Groundwater Monitoring Well

CAD FILE \PROJECT\1000\H3021\APPHOM\B2 1:25000 Plot 1=25 DEC 7, 1994

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

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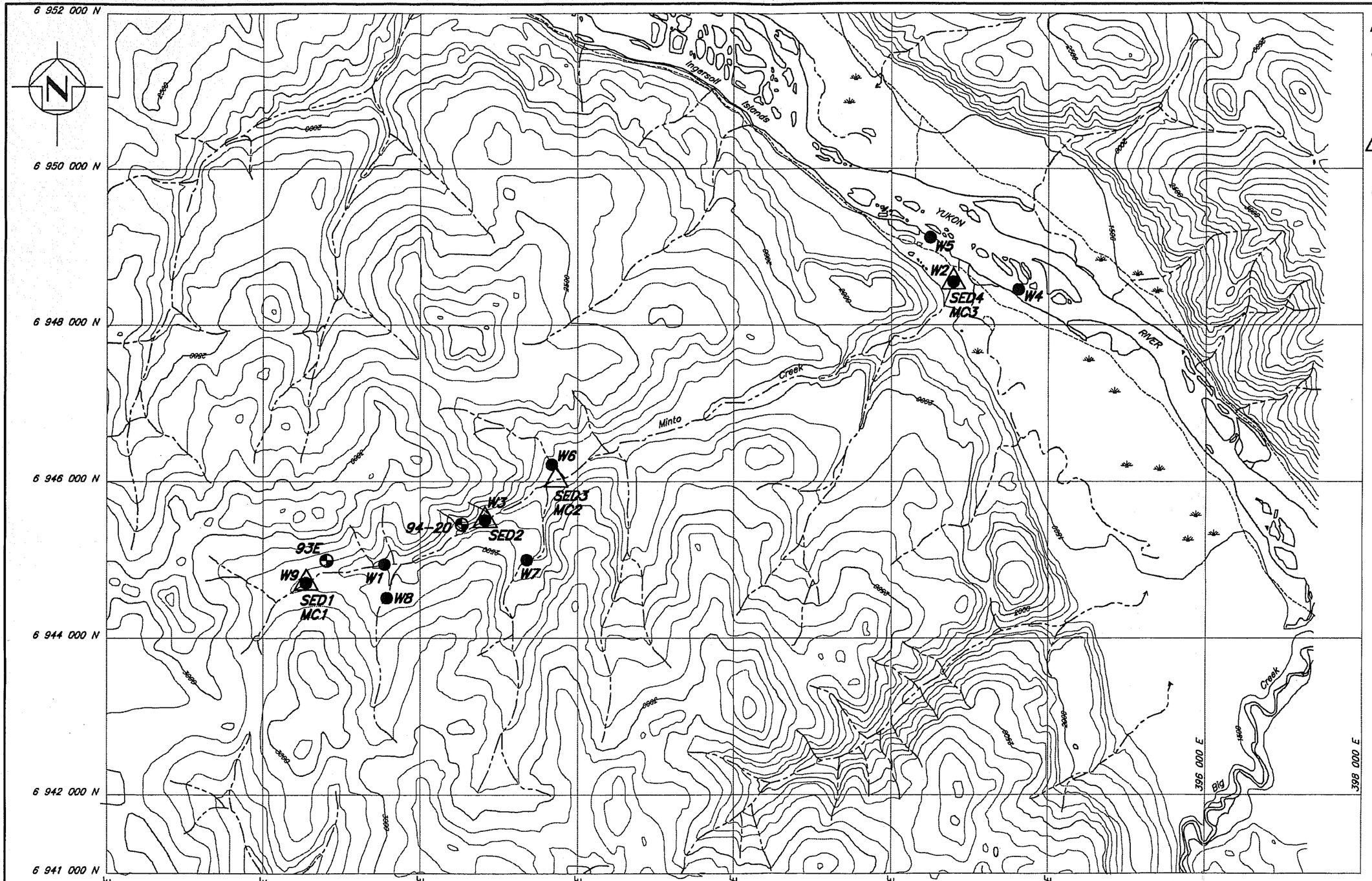
MINTO EXPLORATIONS LTD.

MINTO PROJECT

WATER QUALITY, METAL COMPLEXING AND STREAM SEDIMENT SAMPLING LOCATIONS

DESIGNED	BAS
DRAWN	NAR
CHECKED	BAS
APPROVED	

DATE DEC. 7, 1994 | SCALE AS SHOWN | PROJ. NO. H3021 | FIGURE 5.2



LEGEND

- **W5** *Water Quality Station*
  (Note: Stations W1, W2 and W3 are also Hydrology Monitoring Stations. An automatic water level recorder is installed at Station W2)
- **SED3** *Stream Sediment Sample Location*
- **MC2** *Metal Complexing Sample Location*
- **93E** *Groundwater Monitoring Well*

Scale 1000 500 0 1000 2000 *Metres*

NOTE: Contour interval 100 feet

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

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MINTO PROJECT

DESIGNED	BAS
DRAWN	NAR
CHECKED	BAS
APPROVED	

WATER QUALITY, METAL COMPLEXING AND STREAM SEDIMENT SAMPLING LOCATIONS

DATE **DEC. 7, 1994** | SCALE AS SHOWN | PROJ. NO. **H3021** | **FIGURE 5.2**

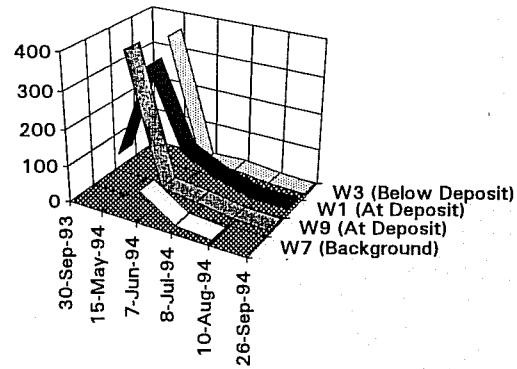
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Figure 5.3

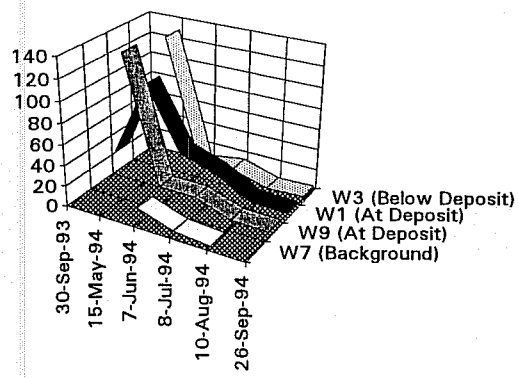
MINTO EXPLORATIONS LTD.
MINTO PROJECT

Trends in Water Quality
Exploration Site Area

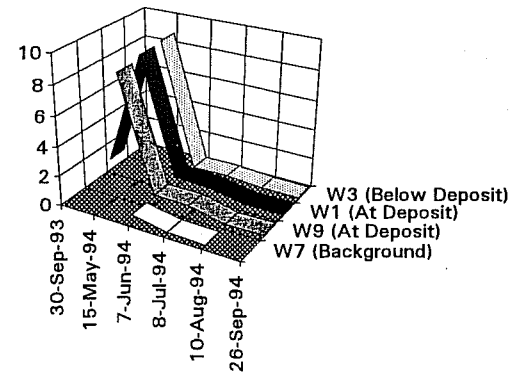
Total Suspended Solids



Turbidity



Total Aluminum



Total Iron

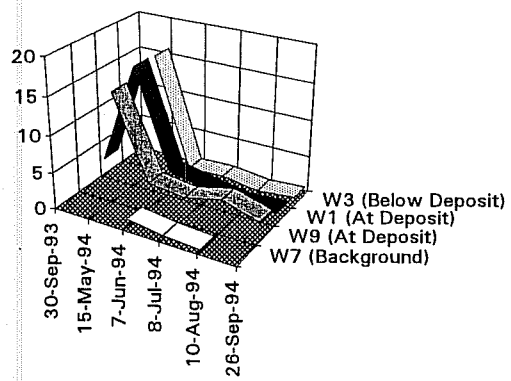
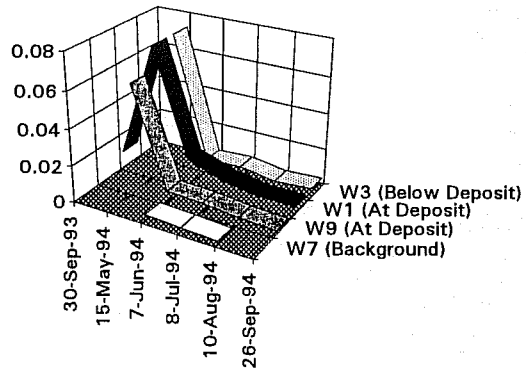


Figure 5.3

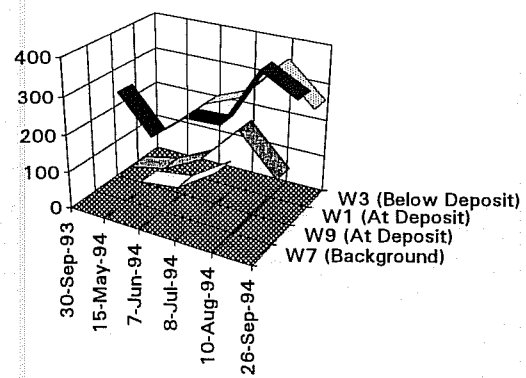
MINTO EXPLORATIONS LTD.
MINTO PROJECT

Trends in Water Quality
Exploration Site Area

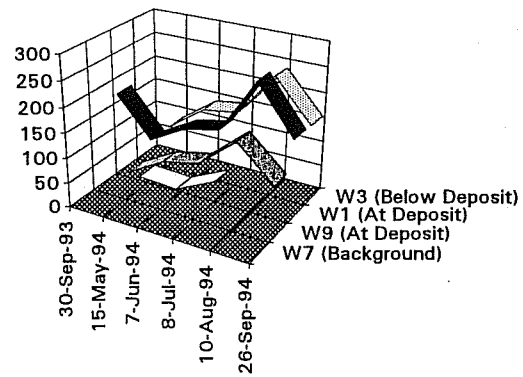
Total Copper



Conductivity



Total Dissolved Solids



Hardness

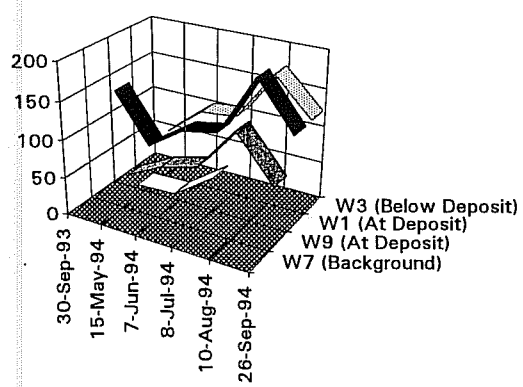


Figure 5.3

MINTO EXPLORATIONS LTD.
MINTO PROJECT

Trends in Water Quality
Exploration Site Area

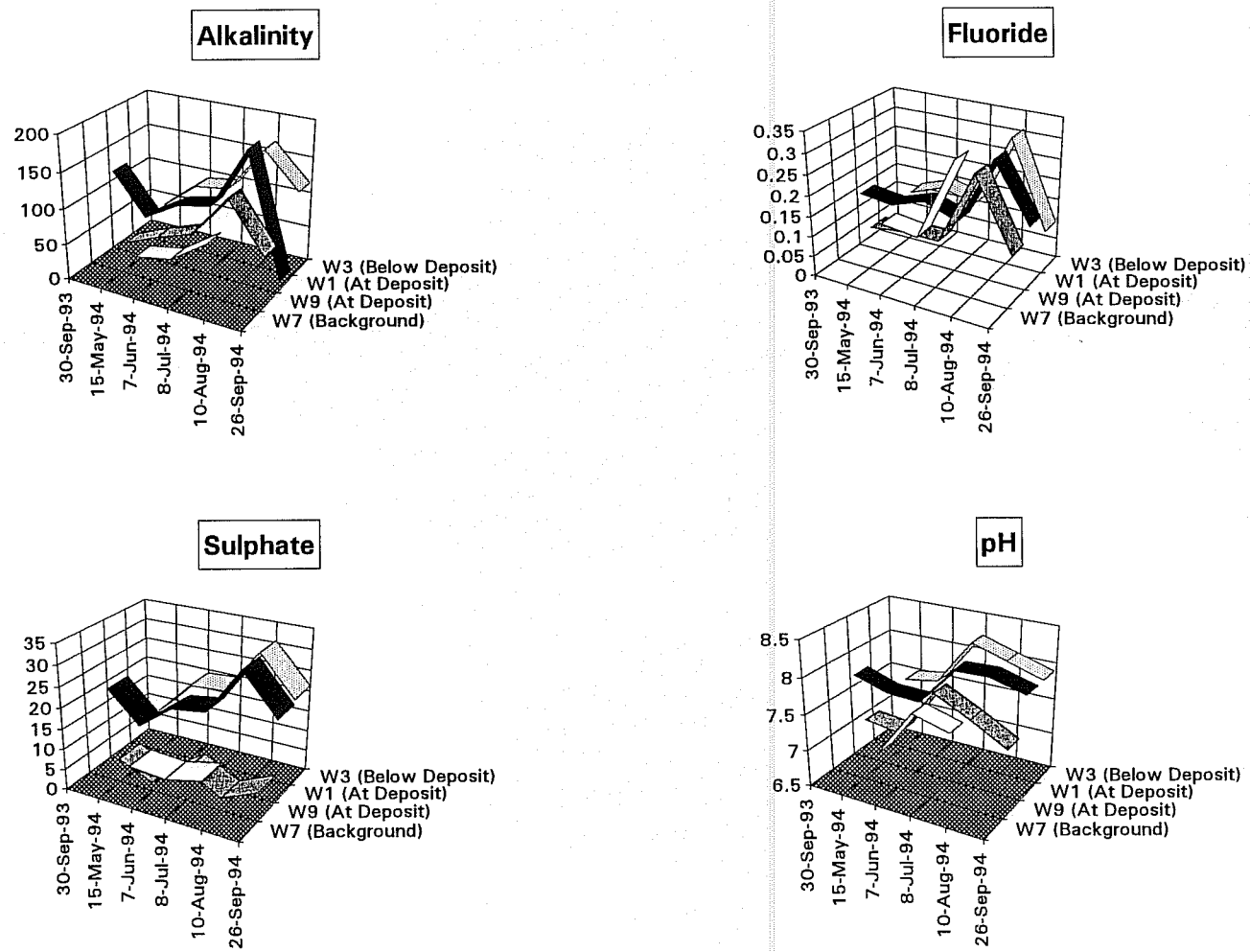
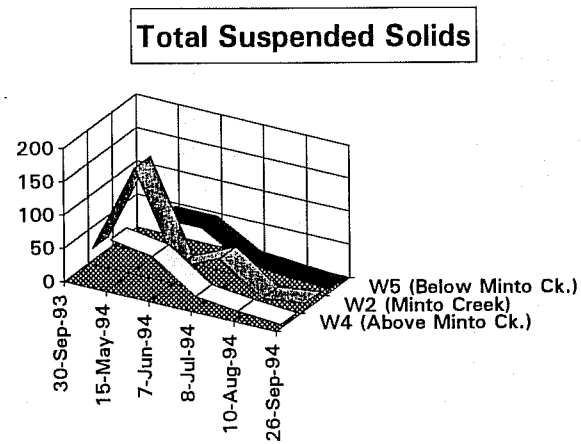
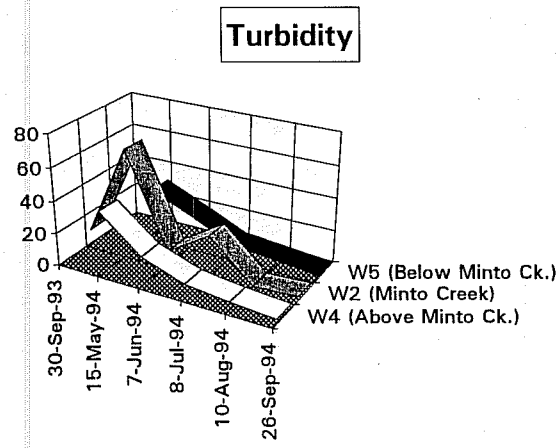


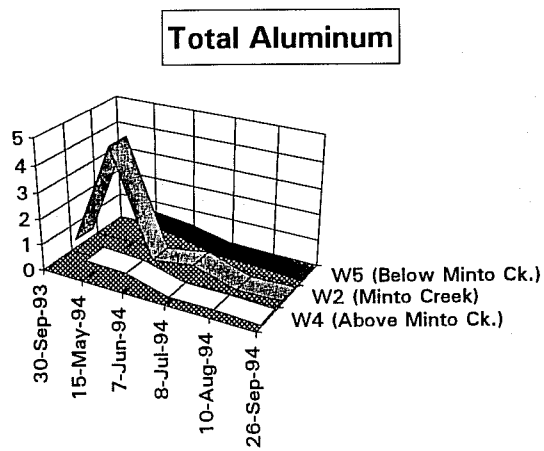
Figure 5.4

MINTO EXPLORATIONS LTD.
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Trends in Water Quality
Yukon River at Minto Creek Confluence







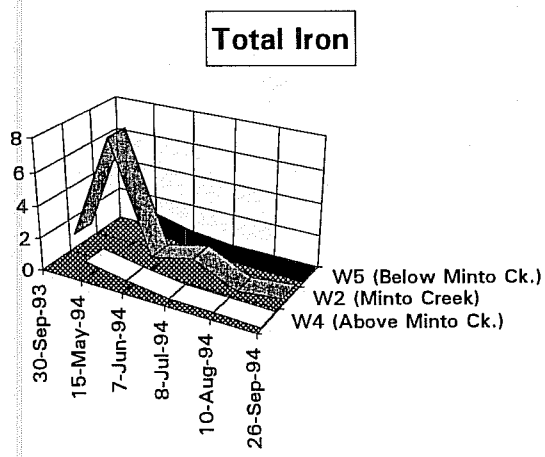
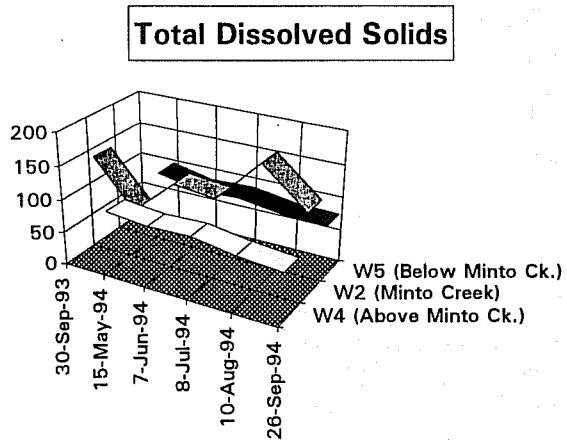
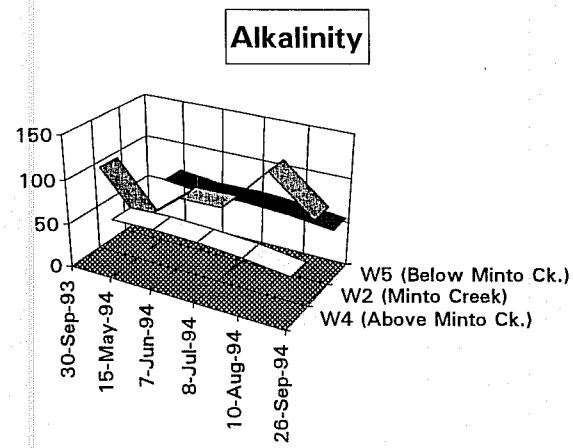


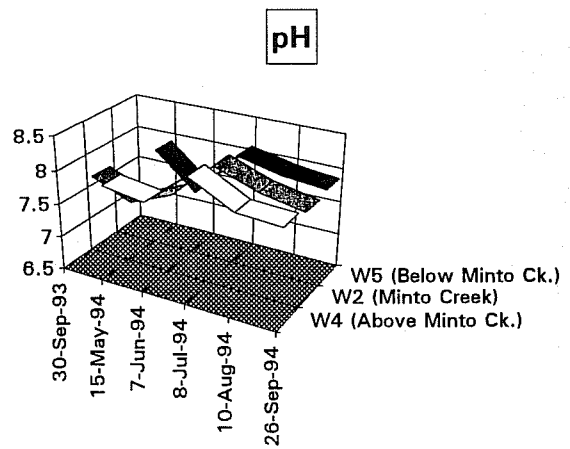
Figure 5.4

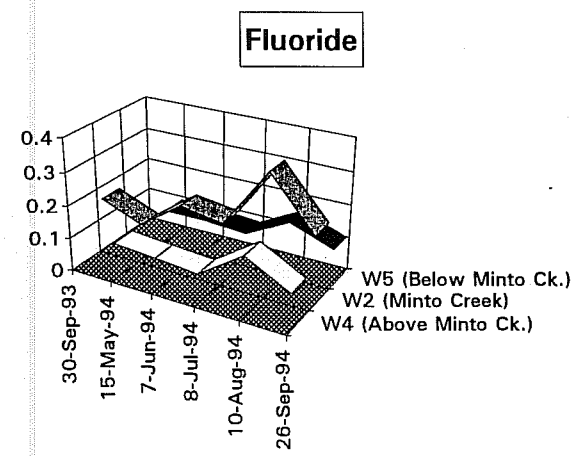
MINTO EXPLORATIONS LTD.
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Trends in Water Quality
Yukon River at Minto Creek Confluence

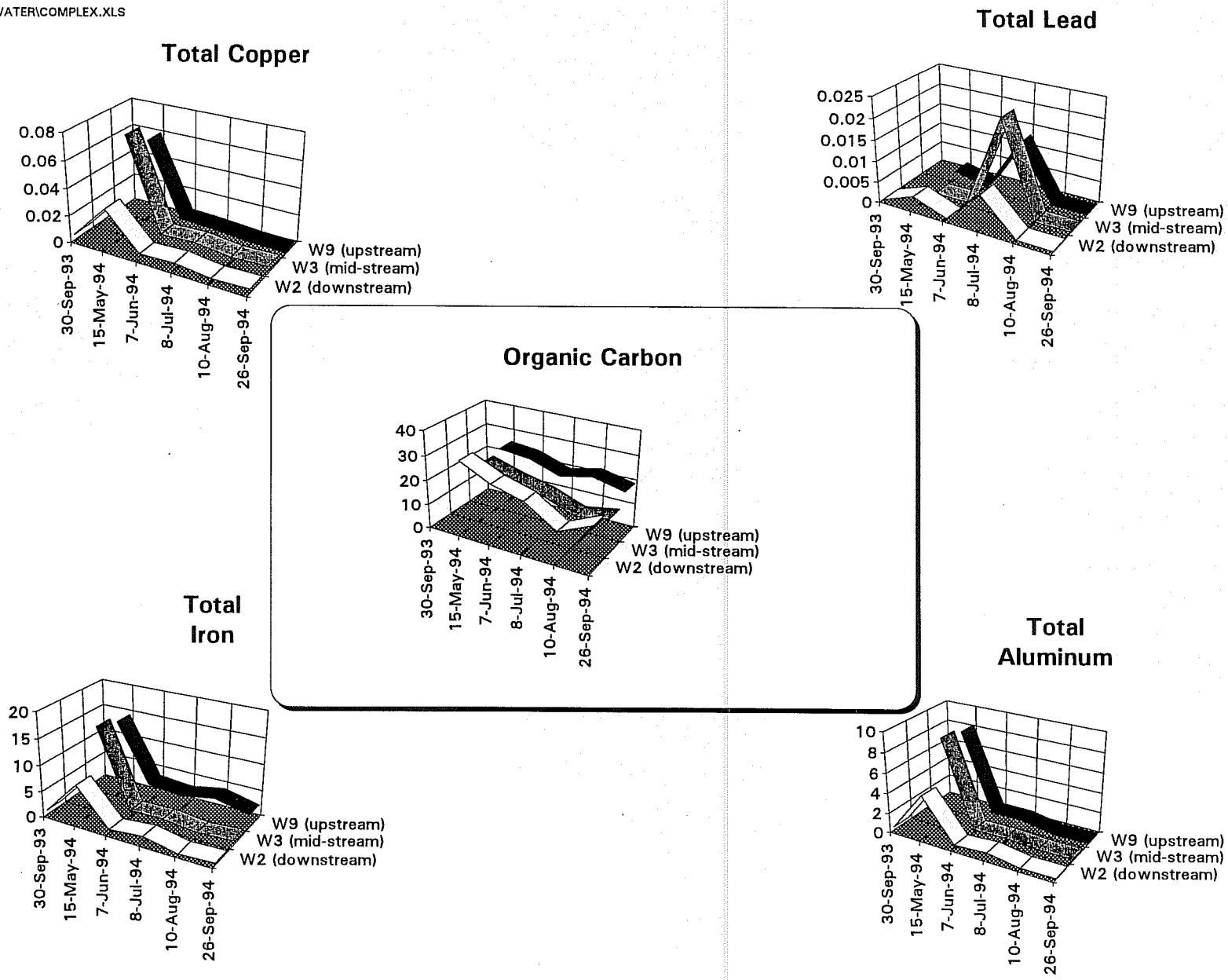








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Minto Explorations Ltd.
Minto Project

Minto Creek
Metal Complexing Reference Charts

FIGURE 5.5

SECTION 6.0 - FISHERIES

6.1 REGIONAL OVERVIEW

6.1.1 Yukon River

Fish species found in the Yukon River include chinook, coho and chum salmon, rainbow trout, lake trout, least cisco, Bering cisco, round whitefish, lake whitefish, inconnu, Arctic grayling, northern pike, burbot, longnose sucker and slimy sculpin (Table 6.1). Life histories for each of these species are presented in Appendix III.

Total catch data of chinook and chum salmon for the Yukon River drainage has been compiled for 1961 to 1993. Figure 6.1 presents the number of fish caught in each year including both the Yukon First Nation food fishery and the total catch recorded by the Whitehorse Department of Fisheries and Oceans (DFO). Chinook salmon catch was low from the early 1960's to the late 1970's ranging from 2,500 to 10,000, and increased in the early 1980's to present levels ranging from 16,000 to 22,000 (DFO, 1993). This increase is expected to be mainly a result of increased effort, and it appears that numbers are stable.

Chum catch is more variable but has the same pattern with increased effort in the early 1980's resulting in a larger recorded catch. Catch numbers are more variable ranging from 12,500 to 45,000 chum caught from 1980 to present. Within the vicinity of the Minto Project the important salmon spawning areas in the Yukon River are the shoals of the Ingersoll Islands and the islands upstream near Big Creek. These areas offer an extensive network of side channels and sloughs which are composed of good spawning gravel.

6.1.2 Big Creek

Several fisheries surveys of the Big Creek watershed have been conducted by DFO and the Yukon

Territorial Government, Fisheries and Wildlife. Chum salmon, chinook salmon, arctic grayling and whitefish have been observed in the Big Creek mainstem and several of its tributaries. Chum salmon have been observed spawning at 13.7 km upstream of the Yukon River confluence. Chinook salmon adults have been observed 47.4 km upstream and have also been observed spawning in the lower reaches of Big Creek. Fry were captured as far as 55.8 km upstream of the Yukon River confluence. Arctic grayling have been observed in the mainstem and in tributaries to Magman Creek. Whitefish species have been observed 59 km upstream of the Yukon River confluence. Big Creek appears to provide good spawning and rearing habitat and has been classified as a Type I, salmonid spawning stream, by the Yukon Fisheries Protection Authorization.

6.1.3 Wolverine Creek

Wolverine Creek flows east northeast into the Yukon River and has a mainstem length of 49.3 km. The lower section of this creek has been classified by DFO under the Yukon Fisheries Protection Authorization as Type II habitat, a salmonid rearing stream. A fisheries study conducted by Environment Canada (1977) in Wolverine Creek indicated that the most abundant species found in Wolverine Creek were slimy sculpins and Arctic grayling. Four chinook salmon were also collected from the creek.

6.1.4 Minto Creek and Project Area Watersheds

The following watersheds in the vicinity of the Minto Project were assessed for the presence of fish: Minto Creek (local name, ungazetted), Creek A (unnamed), Creek B (unnamed) and Dark Creek (Figure 6.2). These watersheds were traversed via helicopter to observe obstructions such as beaver dams, log jams or waterfalls and to determine the biophysical homogeneity of the system so that reaches could be defined.

6.1.4.1 Minto Creek

Minto Creek flows northeast, approximately 17 km before it confluences with the Yukon River. The creek has five major tributaries, which for the purpose of this report, have been designated T1 through T5. The Minto Creek mainstem has been subdivided into seven (7) reaches. A profile of Minto Creek and each of the tributaries is shown in Figure 4.1.

Reach 1 is approximately 2 km in length and has an average gradient of 1.7% and a wetted width of 3.3 m. Three sample sites were located in Reach 1; site 1 located 30 m upstream from the Yukon River confluence (Plate 1), site 2 located approximately 300 m upstream from the Yukon River confluence at H2/W2 (Plate 2) and site 3 located at the upper reach break. A description of each fisheries survey site is detailed in Table 6.2.

The second reach is also 2 km in length and has an average wetted width of 3 m. Within this reach is a steep canyon with a gradient 21%.

Reach 3 is 4 km long, has an average gradient of 1.2% and an average wetted width of 3 m. This reach drains an area which has been severely burnt and an abundance of debris has accumulated in the creek mainstem.

Reach 4 is 2 km long and an average gradient of 2%. The average wetted width is 3.0 m. Reach 5 is 4 km in length, has a gradient of 3.5% and a wetted width of 3.0 m. Two sample sites were established in Reach 5: site 1, located 1.8 km upstream of the reach break, site 2 located 800 m downstream of site 1 at H3/W3.

Reach 6 is 2 km long and has a gradient of 3.5% and has an average wetted width of 1.5 m. Reach 7 is the uppermost reach and comprises the headwaters. It has a length of approximately 1 km, and average gradient of 6.9% and a wetted width of 1 m.

The surface water in Minto Creek has high sediment and organic input due to the fact that a large proportion of the watershed was burned during forest fires in the last fifteen years. The entire

creek is ephemeral with no flows during the coldest winter period and therefore, no overwintering habitat.

Based on an assessment of Minto Creek completed by the Yukon Fisheries Protection Authorization (1988) the creek has been classified as Type II habitat, salmonid rearing stream. From an assessment of topographic maps and site habitat assessment, this Type II habitat is restricted to the lower 1.5 km of creek immediately upstream of the Yukon River. Steep gradients above this point prevent fish from further upstream migration. The possibility of overwintering habitat is questionable, as the creek freezes completely during the winter and no flows are present within the watershed. A survey of Minto Creek conducted by Environment Canada (1977) concluded that the absence of fish in the watershed was likely due to the intermittent nature of the creek.

6.1.4.2 Unnamed Creek A

The headwaters of an unnamed creek (Creek A) originate approximately 4 km southeast of Minto Creek and flow for 7 km along a riparian floodplain into the Yukon River. Two reaches were defined for Creek A (Figure 6.2). Reach 1 begins at the Yukon River confluence and continues for approximately 3 km upstream where it confluences with a tributary flowing northeast. Reach 2 continues along the riparian floodplain for another 4 km. Two fisheries sites were established in Reach 1; site 1 located approximately 2 km upstream of the Yukon River confluence and site 2 located approximately 1.5 km downstream of site 1, at the road crossing.

6.1.4.3 Unnamed Creek B

Creek B headwaters originate north of the Minto Project and flow north northeast 9.5 km to the Yukon River confluence. Three reaches were defined for Creek B (Figure 6.2). Reach 1 begins at the river confluence and stretches 2 km before the creek forks. The western fork of the creek is considered reach 2 and the eastern fork is considered reach 3. Fisheries sites were established in reaches 1 and 2. The sample site in reach 1, was located at the confluence with the Yukon River and the sample site in reach 2 was located a further 4 km upstream.

6.1.4.4 Dark Creek

The headwaters of Dark Creek originate southwest of the Minto Project. The creek has a mainstem length of 56.5 km and flows southeast into Big Creek. Fisheries sample sites were established on Dark Creek and on a tributary immediately south of the proposed development (Figure 6.2).

6.2 FISHERIES STUDIES

6.2.1 Fisheries Investigation Periods

Based on collected regional fisheries data the fish species expected to occur in the vicinity of the Minto Project include chinook salmon, chum salmon, round whitefish, Arctic grayling and slimy sculpin. Fish sampling and fish habitat assessments were conducted on the drainage systems surrounding the mine site to identify areas of spawning, overwintering and rearing and to identify barriers to fish migration. Fish sampling attempted to establish species presence, species composition and population characteristics. Three sampling periods were selected so that the watershed can be properly qualified as fish habitat. Sample sites were chosen on the basis of the location of the proposed mine development and reach breaks in the system.

Fieldwork to groundtruth mapped stream reaches and to assess instream habitat and species presence took place from June 4 to 7 1994 to provide data regarding any activity or sign of spring spawners. A second fisheries study was conducted from August 10 to 14, 1994. The third fisheries sampling study was conducted from September 13 to 15, 1994, to document any late spawning activity in the study area and to continue monitoring habitat use by resident species.

6.2.2 Sampling Methods

Sampling protocol consisted of electro-fishing replicate stream sections using stop-nets at the upstream and downstream limits of each survey section. During the electro-fishing surveys, minnow traps were also set. In one case, when electroshocking was not possible, angling was attempted. Electrofishing sites were enclosed using upstream and downstream stop-nets. The multiple capture (two pass/upstream and downstream) was used, depending on the size of the representative habitat being sampled, streamflow characteristics and capture success. The electrofishing lapse-time was recorded for each pass, and the cumulative total was calculated (catch per unit effort). Fish collection was conducted using a Smith Root Model 12 Battery Powered Electrofisher. All fish captured were identified to species and the total number of species captured were recorded. All fish captured were anaesthetized with "Alka Seltzer", measured (fork length) to the nearest millimetre and weighed to the nearest 0.1 grams using an A&D EK-1200A Electronic Balance. Scales were taken for the purpose of aging and submitted to North-South Consultants Ltd. (Winnipeg) for analyses. Subsamples of arctic grayling, round whitefish and slimy sculpin were retained, frozen and transported to ASL labs in Vancouver for metal analyses of tissue.

6.2.3 Fisheries Sampling Program Results

The results of fish collected is presented in Table 6.3.

6.2.3.1 Minto Creek

During the initial aerial survey of the Minto Creek watershed conducted in June, 1994, a canyon was observed approximately 2 km upstream of the Yukon River on Minto Creek (Plate 8). This portion of Minto Creek has a gradient of 21% and is a barrier to the upstream migration of fish. The first Minto Creek tributary also has a steep gradient (18.5%). Observations made during winter site visits indicate that no surface flow exists from October to May. Extensive glaciation exists in the headwaters, but flow was not observed throughout the system. Therefore, it was not expected that any resident populations of fish existed above these two barriers due to the severity

of winter conditions. In addition, extensive debris and log jams existed throughout the system. Two sites were established above the barrier to confirm this assumption. Fish were not captured or observed at these sites throughout the period of study. Upper portions of the creek provide extremely poor habitat due to the effects of forest fire. Extensive amounts of burnt trees and debris are in the creek. In addition, a thick layer of fine sediments overlays the creek substrate. The water is extremely turbid and the creek banks are unstable.

Immediately below the barrier the quality of the fish habitat improves substantially. Both adult and juvenile arctic grayling were captured at this site. This area has not been burnt and therefore, water quality, creek substrate and creek cover flows provide optimal grayling habitat. During the August survey an adult arctic grayling (3 years) and a juvenile (0+ years) were captured. During the September survey two juveniles (0+ years) were caught. This area likely provides rearing habitat and may also be used for spawning.

One km downstream, within the vicinity of the W2/H2 site, creek flows were dramatically decreased. Four slimy sculpins were collected during the August survey.

During summer low flows the lower 1.5 km of Minto Creek was traversed. Approximately 150 m downstream of H2\W2 Minto Creek dries up completely and remains dry until 100 m upstream of the river confluence. Approximately 100 m of backwater from the Yukon River was present in Minto Creek. The water at the Yukon River confluence was static and turbid and the creek bottom was heavily sedimented. During the June survey a round whitefish (3 years) of 237 mm in length was caught. Two slimy sculpins were also caught in minnow traps. During the August survey two slimy sculpins were caught and a juvenile northern pike was observed. This site likely provides rearing habitat for several juvenile fish species and may be used for overwintering.

6.2.3.2 Creek A

Extensive portions of unnamed Creek A were dry throughout the survey. This system has two confluences (Y-fork) with the Yukon River, but neither had any flow; one was dry and the other

was glaciated. A length of approximately 1 km between the sample site and the confluence with the Yukon River consisted of intermittent surface and subsurface flows. Fish were not observed or captured during the survey. Several wood frogs were noted.

6.2.3.3 Creek B

A waterfall was noted approximately 500 m upstream of the Yukon River confluence on unnamed Creek B, and several log jams were also observed, the lowest one positioned approximately 100 m upstream of the river confluence. Fish were not observed in Reach 2 throughout the survey. Below this barrier, the creek provides good rearing habitat for arctic grayling. During the August survey 16 juvenile arctic grayling (age 0+ to 1 year) were caught using electroshocking and minnow traps. The average length of the fish was 65 mm. Three slimy sculpin were also caught. The lower reaches of Creek B appear to provide good rearing habitat for arctic grayling.

6.2.3.4 Dark Creek

The Dark Creek tributary surveyed did not appear to provide good fish habitat. This tributary which was assessed only once, in September 1994, did not contain any fish. Due to recent forest fires, the water quality of the creek was poor. In addition, extensive LOD was present in the creek and created an abundance of small fish barriers.

Dark Creek was surveyed at the confluence of the above mentioned tributary in September 1994. The creek appeared to provide good fish habitat. Three juvenile arctic grayling (ages 0+ to 1 year) with an average length of 88 mm were caught using electroshocking. A slimy sculpin of 99 mm in length was also caught. Extensive cover was available due to deep water and undercut banks. Dark Creek appears to provide good rearing and overwintering habitat for arctic grayling and may also be used for spawning.

6.3 FISH MUSCLE METAL ANALYSIS

Fish muscle and liver tissue were analyzed in order to determine baseline levels of bioaccumulated metals in the organs and flesh. The levels of metals, combination of metals, and conditions to which a fish may be exposed, which result in acute toxicity or sublethal effects, varies with species, health of the fish and geographic location. Exposure to heavy metals can result in the stimulation of hepatic metallothionine, a low molecular protein in fish liver cytosols which detoxifies the metals absorbed by the fish. Exposure to an excess of metals in the environment may result in acute toxicity or sublethal effects (ie. chronic stress and potential secondary infections) to the fish.

During the June and August surveys fish were retained for muscle and liver tissue metal analysis. Fish were frozen and sent to Analytical Services Laboratories Ltd. (ASL) for analyses. Individual muscle tissue analyses was conducted, but due to the small size of the fish livers, composites were necessary. Analysis was carried out according to standard protocol which included digestions of the tissue with nitric acid and hydrogen peroxide. Extract was bulked to volume with deionized/distilled water and analyzed for:

- Cu, Zn - determined by direct flame atomic absorption spectrophotometry,
- Pb, Ag - determined by graphite furnace atomic absorption spectrophotometry,
- As, Sb - determined by hybrid generation atomic absorption spectrophotometry, and
- Hg - determined by cold vapour atomic absorption spectrophotometry.

Results of fish tissue metal analyses are presented in Table 6.4. Metal concentrations for muscle tissue were below present Health and Welfare Canada, Food and Drug Regulations, Division 15: maximum consumption concentrations for fish protein of 3.5 ppm arsenic, 0.5 ppm lead and 0.5 ppm mercury of wet weight (Health and Welfare Canada, 1991).

It is difficult to compare metal values between sites because of species variations and the fact that often entire body analysis was necessary. Levels of antimony in liver, muscle and entire fish analyses were below detection limits in all but one sample (whitefish liver), and silver levels were

generally below detection, except in whitefish liver and arctic grayling muscle from sites at the Yukon River confluence. The highest levels of copper (17.1 mg/wet kg), mercury (0.303 mg/wet kg) and zinc (162 mg/wet kg) were detected in arctic grayling muscle tissue from the mouth of unnamed Creek B. The highest level of arsenic (0.48 mg/wet kg) was detected from a total fish analyses of slimy sculpins from Reach 1, the mouth of Minto Creek.

It appears that juvenile graylings tend to accumulate arsenic and zinc at higher concentrations in muscle tissue than the adults. In fish captured at Reach 1, site 3, the levels of arsenic and zinc in the adult fish were five times higher and two times higher, respectively. Levels of arsenic and zinc ranged from 0.06 to 0.29 and 18.7 to 42.8 mg/wet kg, respectively. It is questionable as to whether one can consider these values as baseline metals levels in Minto Creek fish because these fish are likely a transient population that only rear in the creek during the summer months. Contribution of metals may have come from the Yukon River. Therefore, fish tissue metal analyses is likely not an efficient biomonitoring tool.

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Table 6.1
Fish Species in the Yukon River System

Common Name	Scientific Name
Coho salmon	*Oncorhychus kisutch*
Chum salmon	*Oncorhynchus keta*
Chinook salmon	*Oncorhynchus tshawytscha*
Rainbow trout	*Oncorhynchus mykiss*
Burbot	*Lota lota*
Bering cisco	*Coregonus laurettae*
Least cisco	*Coregonus sardinella*
Arctic grayling	*Thymallus arcticus*
Inconnu	*Stenodus leucichthys*
Lake trout	*Salvelinus namaycush*
Lake whitefish	*Coregonus clupeaformis*
Northern pike	*Esox lucius*
Longnose sucker	*Catostomus catostomus*
Round whitefish	*Prosopium cylindraceum*
Slimy sculpin	*Cottus cognatus*

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Table 6.2
Description of Fisheries Sample Sites

Minto Creek

Reach 1, site 1 (Plate 1):	The stream gradient is 1.5%. Bed material consists of clays, silts and small gravel. This section of the creek is in an area of backwater from the Yukon River, and therefore, the water is relatively static. The stream cover was approximated at 45% and was comprised of large organic debris (LOD), undercut banks and deep pools. In addition, the water was extremely turbid. The average depth of the creek was 1.3 m. The average wetted width was 4.5 m. The creek banks are very unstable.
Reach 1, site 2 (Plate 2):	The stream gradient is 2.5%. Bed material consists of mostly fines (40%), gravel (35%) and small cobble (30%). The stream is composed mostly of run (45%), with areas of riffle (35%) and several pools (20%). Cover was provided by cutbanks, deep pools and LOD. The average wetted width was 2.5 m. Flows were estimated at 0.612 m^3/s. The water was clearer than site #1, but was dark brown in colour.
Reach 1, site 3 (Plate 3):	Due to limited access a new site was established approximately 1.5 km downstream of site 1. Unlike site 1, site 2 did not appear to be in the burn zone which covers the majority of the Minto Creek watershed. The stream gradient at site 2 is 6% and the average wetted width is 3 m. Bed material consists of mostly large cobble with some boulders. The creek is primarily composed of pools and chutes. Stream cover was approximated at 20% and was comprised of overvegetation and large boulders.
Reach 3, site 1 (Plate 4):	The stream gradient is 3.0% and the average wetted width is 3.0 m. Bed material consists of mostly fines (85%) with some small gravel (15%). The creek is primarily composed of run with some pools. Stream cover was approximated at 65% and was comprised of LOD, deep pools, overstream vegetation and cutbanks.
Reach 5, site 1 (Plate 5):	The stream gradient is 4% and the average wetted width is 3.0 m. Bed material consists mostly of fines (60%) with some gravel and small cobble. The stream is composed of mostly riffle (45%), with some areas of pool and run. Substantial cover (50%) is provided yb LOD, overstream vegetation, cutbanks and deep pools.

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Table 6.2 (continued)
Description of Fisheries Sample Sites

Minto Creek

Reach 5, site 2 (Plate 6):	An alternate site was also designated for reach 5 so that it could be accessed by vehicle. The stream gradient is 4% and the average wetted width is 3.0 m. Bed material consists mostly of fines (60%) with some gravel and small cobble. The stream is composed of mostly riffle (45%), with some areas of pool and run. Substantial cover (50%) is provided by LOD, overstream vegetation, cutbanks and deep pools.

Creek A

Reach 1, Site 1 (Plate 7):	The creek has an approximate gradient of 0.5% and an average wetted width of 0.5 m. The stream is composed mainly of run (88%) and the stream bed consists exclusively of fines. The stream cover is provided mostly by cutbanks, with some areas of deep pools, and occasional in-stream and over-stream vegetation.
Reach 1, Site 2 (Plate 8):	An alternate site adjacent to the road was chosen so the site could be accessed by truck. The creek has an average wetted width of 0.50 m. The stream is composed mainly of run (88%) and the stream bed consists exclusively of fines. The stream cover is provided mostly by cutbanks, with some areas of deep pools, and occasional in-stream and over-stream vegetation. The creek meanders throughout an area which consists of mostly of sedge. Many small ponds exist in the area.

Creek B

Reach 1, Site 1 (Plate 9):	The average wetted width was 2.5 m and the gradient was 3%. The bed material consisted of mostly fines, gravels and small cobble with some large cobble and boulders. The stream was composed mostly of run with equal amounts of riffle and pool. Stream cover (30%) was comprised of cutbank, deep pool and LOD.

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Table 6.2 (continued)
Description of Fisheries Sample Sites

Creek B

Reach 2, Site 1 (Plate 10):	The average wetted width of the creek was 2.0 m and the stream gradient was 4.5%. The stream was composed mostly of run (60%) with areas of riffle and few pools. The creek bed was comprised mostly of fines, gravels and small cobbles. Stream cover was extensive (80%) and was comprised of over-stream vegetation, cutbanks, LOD and deep pools.

Dark Creek

Site 1 (Plate 11):	The average wetted width of the creek was 4.0 m and the gradient was 2%. The stream was composed mostly of run (50%). The creek substrate was composed of large cobble and boulders with areas of fine silt. Stream cover was estimated at 30% and was comprised of deep pools, boulders and undercut banks.
Tributary, Site 1 (Plate 12):	The average wetted width of the stream was 1.5 m and the gradient was 4%. The stream was composed of mostly run (55%) with some pools (30%). Stream substrate was composed of mostly fines and gravels. Cover was estimated at 45% and was comprised of LOD and deep pools.

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Table 6.3
Fisheries Survey Results (1994)

Minto Creek, Reach 1, Site 1

June
Pass #1 – 110 seconds, Pass #2 – 100 seconds, total effort – 210 seconds.

Fish	Sample #	Pass	Length (mm)	Weight (g)	Age (years)
Round whitefish	1	1	237	101.5	3
Slimy sculpin	MT1*	–	45	ND	ND
Slimy sculpin	MT2*	–	48	ND	ND

*MT = minnow trap

August
No electroshocking conducted at this site.
Angling effort = 60 minutes, no angling success.

Fish	Sample #	Pass	Length (mm)	Weight (g)
Slimy sculpin	MT1*	–	72	5.0
Slimy sculpin	MT2*	–	57	2.0

*MT = minnow trap

Minto Creek, Reach 1, Site 2

June
Pass #1 – 270 seconds

No fish caught

August
Pass #1 – 203 seconds, Pass #2 – 187 seconds, total effort = 390 seconds

Fish	Sample #	Pass	Length (mm)	Weight (g)
Slimy sculpin	1	1	92	–
Slimy sculpin	2	2	88	average (4) 7.5
Slimy sculpin	MT1	–	77	–
Slimy sculpin	MT2	–	65	–

*MT = minnow trap

September
Pass #1 – 211 seconds, Pass #2 – 59 seconds, total effort = 270 seconds

No fish caught

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Table 6.3
Fisheries Survey Results (1994)

Minto Creek, Reach 1, Site 3

August
Spot–shocking – 150 seconds

Fish	Sample #	Pass	Length (mm)	Weight (g)	Age (years)
Arctic grayling	1	–	232	153.5	3
Arctic grayling	2	–	75	5.3	0

September

Pass #1 – 315 seconds, Pass #2 – 249 seconds, total effort = 564 seconds

Fish	Sample #	Pass	Length (mm)	Weight (g)	Age (years)
Arctic grayling	1	1	85	7.9	0+
Arctic grayling	2	2	88	8.9	0+

Minto Creek, Reach 5, Site 1

June
Pass #1 – 124 seconds

No fish caught

September
Pass #1 – 151 seconds, Pass #2 – 157 seconds, total effort = 312 seconds

No fish caught

Minto Creek, Reach 5, Site 2

August
Pass #1 – 109 seconds, Pass #2 – 183 seconds, total effort = 292 seconds

No fish caught

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Table 6.3
Fisheries Survey Results (1994)

Unnamed Creek A, Reach 1, Site 1 **June** Spot–shocking – 71 seconds **No fish caught**
Unnamed Creek A, Reach 1, Site 2 **August** Spot–shocking – 80 seconds **No fish caught**
September Spot–shocking – 342 seconds **No fish caught**

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Table 6.3
Fisheries Survey Results (1994)

Unnamed Creek B, Reach 1, Site 1

June
Spot–shocking – 264 seconds

Fish	Sample #	Pass	Length (mm)	Weight (g)
Arctic grayling	1	1	35	ND
Slimy sculpin	MT1*	1	40	ND

MT = minnow trap

August
Pass #1 – 152 seconds, Pass #2 – 108 seconds, total effort = 260 seconds

Fish	Sample #	Pass	Length (mm)	Weight (g)	Age (years)
Arctic grayling	1	1	75	5.1	1
Arctic grayling	2	1	62	2.6	1
Arctic grayling	3	1	65	3.1	0+
Arctic grayling	4	1	75	ND	
Arctic grayling	5	1	66	ND	
Arctic grayling	6	2	60	ND	
Arctic grayling	7	2	62	ND	
Arctic grayling	8	2	60	ND	
Arctic grayling	MT1	–	64	3.2	0+
Arctic grayling	MT2	–	66	3.7	0+
Arctic grayling	MT3	–	68	3.9	0+
Arctic grayling	MT4	–		ND	
Arctic grayling	MT5	–		ND	
Arctic grayling	MT6	–		ND	
Arctic grayling	MT7	–		ND	
Arctic grayling	MT8	–		ND	
Arctic grayling	MT9	–		ND	
Arctic grayling	MT10	–	average (13) = 65	ND	
Arctic grayling	MT11	–		ND	
Arctic grayling	MT12	–		ND	
Arctic grayling	MT13	–		ND	
Arctic grayling	MT14	–		ND	
Arctic grayling	MT15	–		ND	
Arctic grayling	MT16	–		ND	
Slimy sculpin	1	1	71	ND	
Slimy sculpin	2	1	73	ND	
Slimy sculpin	3	1	55	ND	

MT = minnow trap

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Table 6.3
Fisheries Survey Results (1994)

Unnamed Creek B, Reach 2, Site 2

June
Pass #1 – 123 seconds.

No fish caught

September
Pass #1 – 169 seconds

No fish caught

Dark Creek tributary, site 1

September
Pass #1 – 227 seconds

No fish caught

Dark Creek, site 1

September
Pass #1 – 650 seconds, Pass #2 – 501, total effort = 1151 seconds

Fish	Sample #	Pass	Length (mm)	Weight (g)	Age (years)
Arctic grayling	1	1	94	10.4	1
Arctic grayling	2	1	90	9.7	1
Arctic grayling	3	2	80	6.9	0+
Slimy sculpin	1	2	99	14.8	

(\H3021\IEE\FISH.WK3)

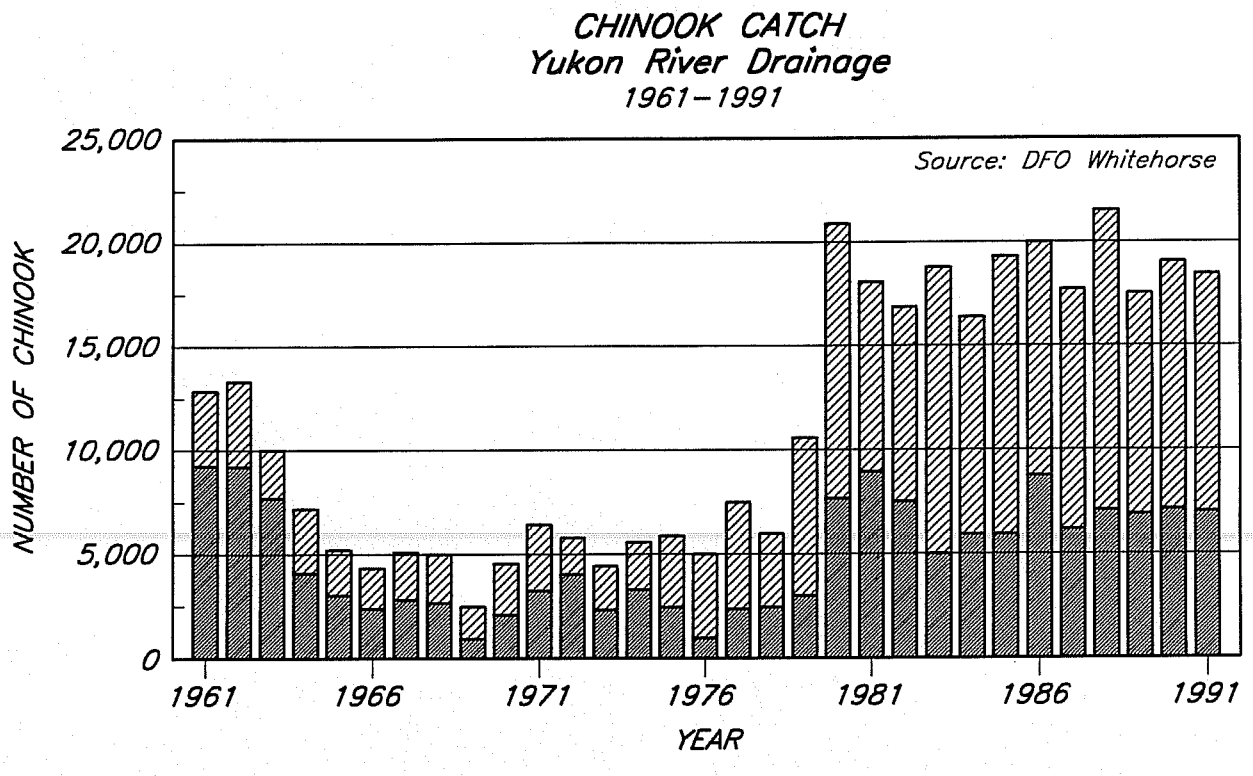
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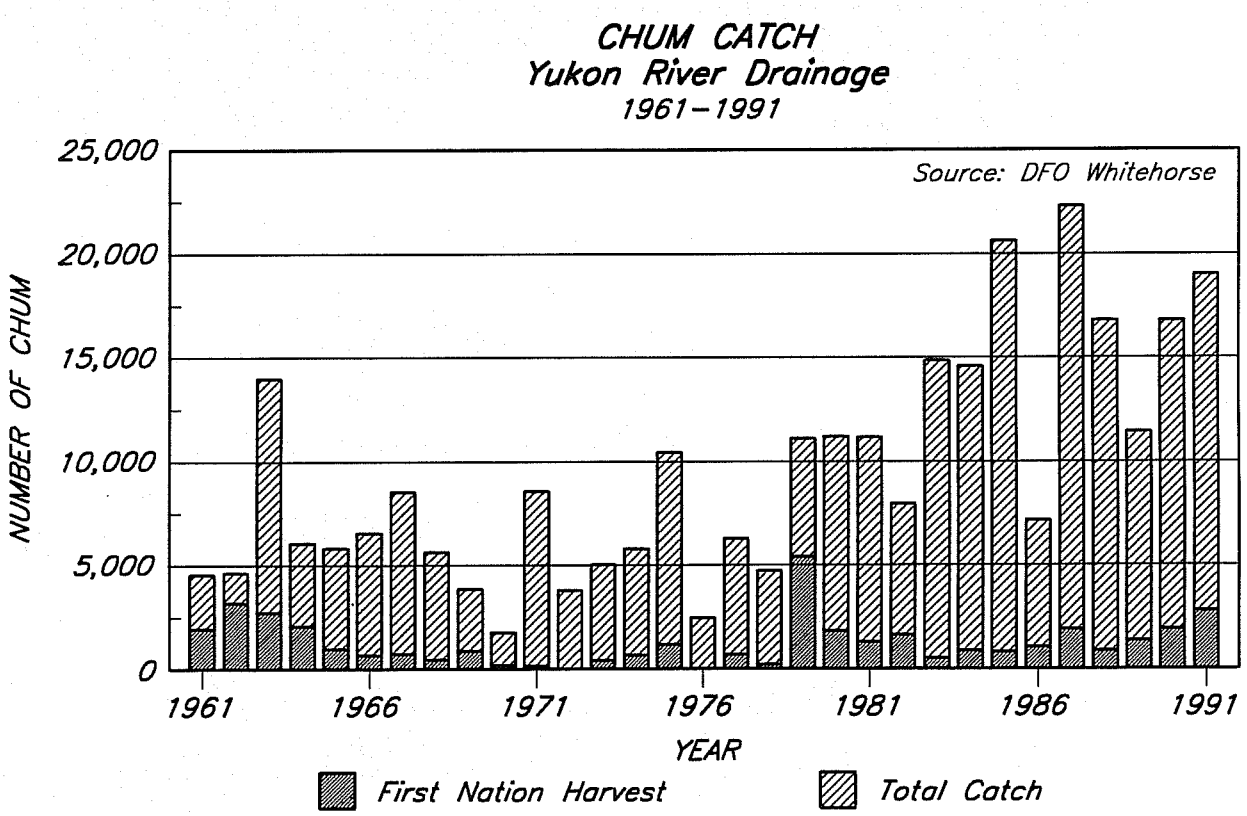
Table 6.4
Fish Tissue Analysis
(June[1] and August[2] 1994)

Parameter/Fish Total Metals (mg/wet kg)	Minto Creek						
	Reach 1, Site 1–Fish 1[1] Round whitefish		Reach 1, Site 1–Composite[2] Slimy sculpin	Reach 1, Site 2–Composite[2] Slimy sculpin	Reach 1, Site 3–Fish 1[2] Arctic grayling	Reach 1, Site 3–Fish 2[2] Arctic grayling	
	muscle	liver	total fish	total fish	muscle	muscle	liver
Antimony	<0.05	0.2	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	0.09	0.2	0.48	0.15	0.29	0.06	<0.05
Copper	0.47	6.3	4.47	5.11	2.85	2.14	0.53
Lead	0.05	0.2	0.18	0.08	<0.05	<0.05	<0.05
Mercury	0.07	0.106	0.112	0.100	0.128	0.125	0.021
Silver	<0.05	0.2	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	7.91	20.1	126	111	42.8	18.7	6.16

Parameter/Fish Total Metals (mg/wet kg)	Unnamed Creek "B"	
	Reach 1, Site 1–Composite[2] Arctic grayling muscle	Reach 1, Site 1–Composite[2] Arctic grayling total fish
Antimony	<0.05	<0.05
Arsenic	0.36	0.26
Copper	17.1	3.7
Lead	<0.05	0.06
Mercury	0.303	0.071
Silver	0.07	<0.05
Zinc	162	95.8

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CHINOOK AND CHUM CATCHES ON THE YUKON RIVER



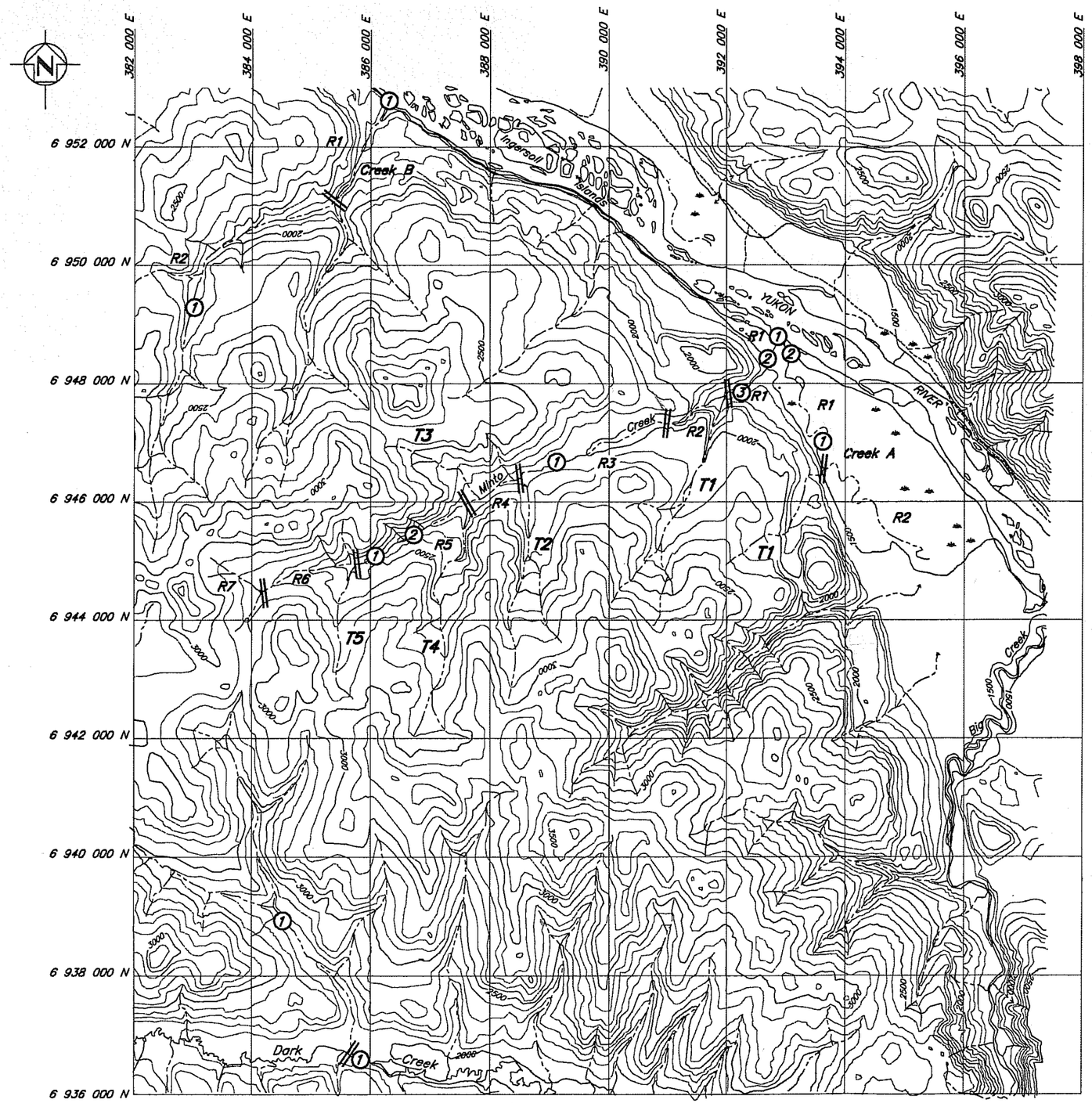


Dec. 7, 1994

HALLAM KNIGHT PIESOLD LTD.
ENVIRONMENTAL CONSULTANTS

FIGURE 6.1

CAD FILE: \PROJECT\1000\H3021\APPLICNT\A2 Plot scale 1=1



LEGEND

Fisheries Survey

- Reach Break
- R1 Reach 1
- ① Sample Site
- T1 Tributary

NOTE: Contour interval 100 feet

Scale 1000 0 2000 4000 Metres

CAD FILE: \PROJECT\1000\A1031\PIC\01 1:40000 Plot 1=40 DEC. 11, 1994

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

HALLAM KNIGHT PIESOLD LTD.
ENVIRONMENTAL CONSULTANTS – VANCOUVER, B.C.

MINTO EXPLORATIONS LTD.

MINTO PROJECT

FISHERIES SURVEY SITES (1994)

DESIGNED	–
DRAWN	VY
CHECKED	
APPROVED	

DATE DEC. 1, 1994 | SCALE AS SHOWN | DRG. NO. FIGURE 6.2 | REV. –



Plate 1: Minto Creek, Reach 1, Site 1 (at Yukon River)



Plate 2: Minto Creek, Reach 1, Site 2.



Plate 3: Minto Creek, Reach 1, Site 3.



Plate 4: Minto Creek, Reach 3, Site 1.



Plate 5: Minto Creek, Reach 5, Site 1.



Plate 6: Minto Creek, Reach 5, Site 2 (at H3/W3).



Plate 7: Creek A, Reach 1, Site 1.



Plate 8: Creek A, Reach 1, Site 2.



Plate 9: Creek B, Reach 1, Site 1.



Plate 10: Creek B, Reach 2, Site 1.



Plate 11: Dark Creek Tributary, Site 1

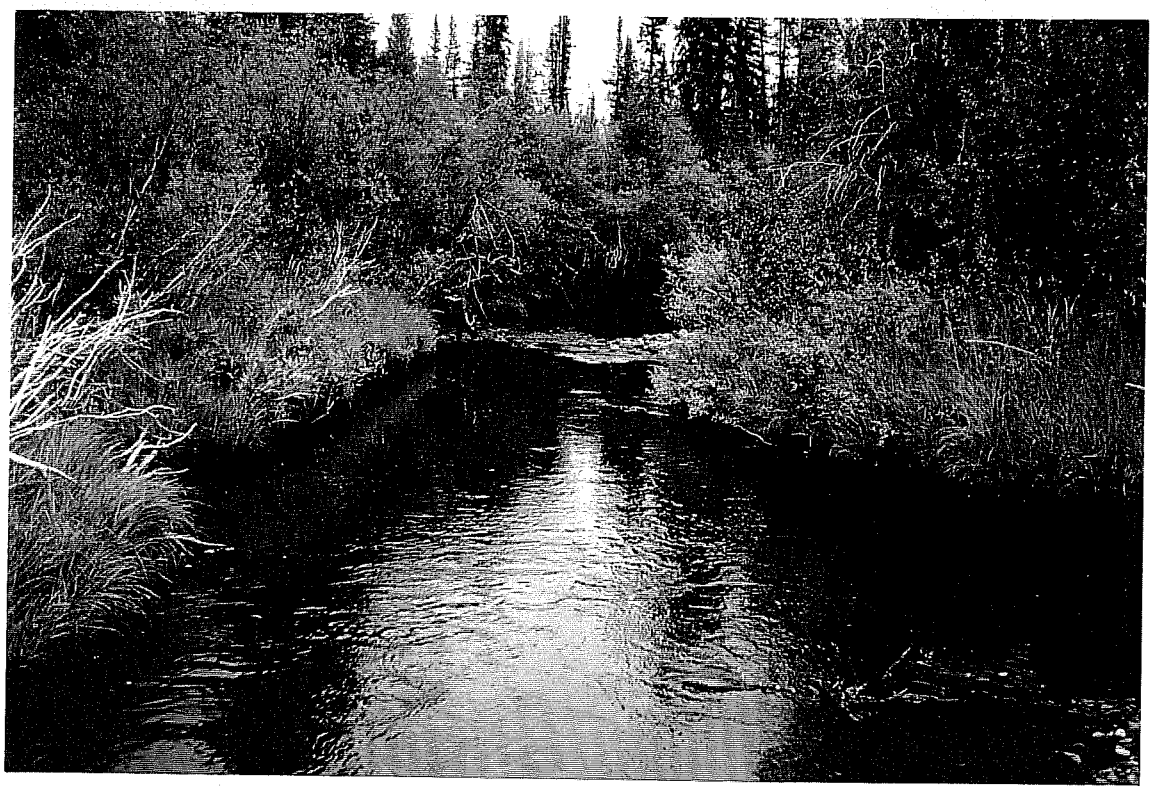


Plate 12: Dark Creek, Site 1.



Plate 13: Fish Barrier in Minto Creek, Reach 2

SECTION 7.0 - BENTHIC MACROINVERTEBRATES

7.1 BACKGROUND

Benthic invertebrates are non-backboned animals inhabiting bottom sediments in aquatic systems. As the most important primary consumers in stream ecosystems, benthic macroinvertebrates also form an extremely important food source for fish. Hydrology, water quality, substrate type, creek morphology and climatic conditions constitute habitat variables in any given section of creek. The communities that develop reflect the relative success of the various species that have adapted to suit these environments. As habitat conditions change during yearly cycles or from disturbance, the community structure also changes.

Once baseline community compositions are known, year to year sampling can detect gross changes in community structure, indicative of changes in physical structure of the habitat or changes to water chemistry. Benthic macroinvertebrates exhibit varying degrees of sensitivity to environmental pollutants/conditions and can be used as reliable indicators of water quality (Hynes 1958, Cairns and Dickson 1971, Kovalak 1981).

The primary objective of the benthic macroinvertebrate sampling program is to determine background community structure and to make a relative assessment of secondary productivity of the proposed mine site watershed.

7.2 METHODS

Benthic macroinvertebrate samples were collected in triplicate from August 10 to 14, 1994 at six sites on the Minto Creek watershed. Sampling was standardized by sampling to a depth of 10 cm in riffle areas of similar depth, velocity and substrate type. Samples were taken using a modified Hess sampler measuring 42 cm high and 35 cm in diameter with a 250 micron mesh. Late August

was regarded as the optimum time for sampling, as adult emergence is complete and young are in place in the stream.

The benthic sampling stations B1 to B6 correspond to water quality stations 1, 2, 3, 7, 8 and 9, respectively (Figure 7.1). Samples were preserved with 10% formalin and Rose Bengal stain and shipped to Dr. Charles Low in Victoria, B.C. for taxonomic analysis and enumeration. Laboratory analysis consisted of washing samples through a 180 micron mesh and separating macroinvertebrates from debris. Organisms were then identified to the lowest taxonomic level practicable (to species where possible) and enumerated using the following taxonomic references: Allen and Edmunds (1965), Brinkhurst (1976), Edmonson (1959), Brinkhurst and Jamieson (1971), Oliver and Roussel (1983), Usinger (1963), Pennak (1978) and McAlpine et al (1981). Species were sorted into functional groups to provide percent composition of sensitive, facultative and tolerant organisms. A sample organism archive has been maintained.

7.3 ANALYTICAL APPROACH

Meaningful analyses of benthic communities requires manipulation of community data in a flexible fashion. Biological communities are dynamic entities of biomass that do not necessarily behave in well-defined patterns; in effect, a reflection of the complicated nature of integrated abiotic/biotic systems. Consequently, the applications of different analytical tools in a given assessment of, for example, community responses to industrial discharges, runoff, etc., is beneficial from the point of view of facilitating an "integrated" approach to impact reviews.

The integrated approach scenario becomes more critical when studies are directed at communities in areas that are not necessarily impacted to catastrophic levels. Subtle impacts on communities may not be detected unless a series of tests are applied to the database. No single approach should be applied in isolation from other techniques.

Subsequent to taxonomic identification of the benthic macroinvertebrate samples, sample abundance and number of taxa were determined for each sample. In addition, relative abundance of indicator families, categorization by tolerance categories and a series of community indices were determined

for each sample to assist in describing the structure of biological communities relative to overall habitat conditions.

Laboratory analysis included sorting species into **Tolerance Categories** (Beak 1965) to determine relative abundances of benthic organisms at each station classified as sensitive, facultative or tolerant fauna. Various groups of benthic invertebrates display varying degrees of sensitivity to degradation in habitat quality. It should be noted that species may vary with tolerance categories. In most cases, sensitive species include Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) which are found primarily in "clean" water conditions containing little contamination or little organic matter. These species have a low tolerance range due to their physiology, which makes them susceptible to disturbance and, therefore, are a good indicator of environmental change.

Facultative benthic fauna have a moderate tolerance range for temperature, water quality and substrate types. These may include Diptera (true flies), Homoptera (aphids), Coleoptera (beetles), Collembola (springtails) and non-insect benthic families such as nematodes, gastropods and crustaceans.

Tolerant organisms are those that tend to dominate communities which are affected by severe habitat degradation. Tolerant species consist mainly of the Oligochaetae (freshwater segmented worms and earthworms).

Various indices were applied to the data to produce quantitative values for community structure measures. The **Equitability Index** (Pielou 1966a) measures the degree of evenness with which sampled individuals are distributed in the taxa represented in the community. If ones species is dominant in the sample, a low index value will represent this population skew.

The **Richness Index** (Margalef 1958) is the measure of the "taxonomic wealth" in a benthic community. Species richness indicates the number of taxa represented relative to the population size. The higher the richness in a community, the more organisms (taxonomically) exist, which in turn reflects habitat complexity (i.e., the greater the number of habitat niches that are available

for biological use, the greater variety of invertebrate fauna able to colonize, survive and reproduce in a given area).

The **Shannon-Weiner Diversity Index** (Shannon and Weiner 1949) combines the indices of equitability and richness to provide a single measure of community diversity and complexity based strictly on numerical values. As sample size decreases, the diversity index becomes less reliable. In addition, other qualifiers exist; for example, diversity indices do not consider the taxonomic category of fauna used in the calculation and, in addition, studies have shown that a reduction in actual diversity value may be recorded only in the most severe cases of habitat degradation.

The **Keefe-Bergersen TU Diversity Index** (Keefe and Bergersen 1977), which is a variation of the Shannon-Weiner Diversity Index, is calculated from determining the proportion of taxa represented in the sample in relation to the number of individuals in the sample.

The **Dominance Index** (Simpson 1949) determines the proportion of population found in any one taxa in relation to the whole population. A high index number represents high density of one species and a low index shows a more even distribution of individuals among taxa.

7.4 POPULATION DENSITIES

In addition to samples collected in 1994, a set of samples was taken in June 1975 and September 1976 by Fisheries and Environment Canada, Environmental Protection Service (1977). Table 7.1 presents the macroinvertebrate data collected by Surber sampler in September 1976 for a comparison to 1994 sampling. Densities of organisms observed in 1976 were substantially lower (928 individuals/m^2) than those in 1994 (range 2637 to 20,140 individuals/m^2). Ten of the 17 taxa observed on Minto Creek in 1976, were also observed in 1994. The dominant taxa found in 1976 was the stonefly *Nemoura sp.*, *Kincaidiana hexatheca* and *Stylodrilus sp.* also comprise a major proportion of the population.

Taxonomic identification and enumeration results for all sample sites are presented in Table 7.2. The densities of benthic fauna collected are summarized in Table 7.3 and Figure 7.1. Densities

ranged from a low of 2,637 organisms/m^2 at Site B3 to a high of 20,140 organisms/m^2 at Site B4. The number of taxa collected at each Site ranged from 31 at Site B6 to 44 at Site B1. These values are comparable to other creeks in the area.

7.5 TOLERANCE CATEGORIES AND TAXONOMIC OVERVIEW

Categorizing benthic invertebrate species into sensitive, facultative and tolerant groups provides a characterization of the communities in each region of the stream. Table 7.3 and Figure 7.2 summarize the tolerance categories at all sample sites. With the exception of Site B4, benthic communities in Minto Creek contain a large proportion of facultative species in comparison to sensitive and tolerant species. Facultative species may predominate the other stations due to the influence of burns in the upper watershed and the higher organic component in the substrate.

Tolerant organisms consistently made up less than 10%. This is still a relatively large component of the community in a natural watershed. Once again this is likely due to chemical and debris inputs from the burn areas in the upper watershed.

Each site was dominated by a slightly different group of invertebrates. Site B1 was dominated by mostly facultative species (66%) and in particular nematodes.

Site B2 was similar to Site B1, with 62.2% facultative taxa. There was a slightly larger component of sensitive species at Site B2 than Site B1. Facultative taxa were dominated by nematodes in addition to large numbers of *Isotoma* sp. (a springtail) and *Eukiefferiella* sp. (Chironomid midges). Sensitive taxa were dominated by an unidentified juvenile plecopteran species and *Podmosta* sp. Both *Eukiefferiella* and *Podmosta* inhabit lotic, erosional habitats, are sprawlers, and collectors and gatherers.

Site B3 contained both a large proportion of sensitive taxa (49.4%), and almost as many facultative taxa (44.5%). Sensitive taxa were dominated by the detritivore *Capnia* sp. (a stonefly), which inhabits lotic, depositional and erosional habitats consisting of coarse sediments, wood and leaf packs.

Site B4 consisted mostly of sensitive species (71.8%). Predominated once again by *Capnia* sp., which comprises 17% of the total population. Also found in large numbers was the mayfly *Baetis* sp. *Baetis* is lotic, erosional and depositional and contains species of swimmers, climbers, clingers, collectors and gatherers. In addition, the population contained a high proportion of harpacticoid copepod species and tubificid worms resulting from habitat characteristics of pools and sandy substrate.

Site B5 was dominated by facultative species (74.2%) with few sensitive species (16.7%). Dominant species included an unidentified juvenile chironomid species and *Candona* sp. (an ostracod).

Site B6 was composed mostly of facultative organisms (91.3%) and was dominated by an unidentified juvenile chironomid species (13%) and nematodes.

In general, all sites contained a well rounded representation of sensitive, facultative and tolerant species. In comparison to a number of other creeks, Minto Creek carried a relatively low quantity of caddisflies. Dipteran taxa were well represented in the facultative group, but overall, facultative species contained a large proportion of other insects and invertebrates. These included aphids, springtails, spider mites, copepods, ostracods, round worms, segmented worms and the odd terrestrial anomaly of beetle, butterfly and snail. Copepod populations as found in Minto Creek indicate that the creek contains a fairly large quantity of pool habitat, where standing water and nutrients allow for copepod reproduction and growth.

7.6 COMMUNITY INDICES

Community indices are used to provide a quantitative description of the benthic community. A number of indices including diversity, dominance, equitability and richness may be used to more fully describe a community than observing raw enumeration data. Table 7.3 presents this suite of indices for each station.

Diversity indices provide a single quantitative measure of system complexity. In Minto Creek, benthic communities have a relatively high Shannon-Weiner and TU diversity ranging from 2.59 to 3.88 and 0.623 to 0.894, respectively.

Dominance was low for most stations and ranged from 0.11 for Sites B1 and B2 to 0.38 for Site B4. Dominance indices are generally higher in areas more directly affected by the forest fires in the upper watershed.

Equitability indices for the benthic monitoring stations were relatively high and ranged from 0.51 at Site B4 to 0.72 at Site B3. Overall, equitability in the study area was high, resulting from a wide distribution of fauna in available taxa. Equitability is relatively low at sites B4 and B5 due to the large populations of *Capnia* sp. and a Chironomid species, respectively.

Richness values were highest on the mainstem of Minto Creek and ranged from 5.34 to 5.89. Tributaries to the mainstem and the headwater site contained slightly lower richness values ranging from 3.60 to 3.87.

These results indicate that benthic macroinvertebrate communities in Minto Creek were relatively stable (in terms of maintaining complexity of trophic structure) and capable of compensating for limited water quality changes without resulting in large community changes. If one species is susceptible to metal or sediment inputs, that species may disappear. In diverse, species rich communities, the other species would be able to fill this empty habitat without resulting in large affects on the community. As may be expected, greater inputs will affect more than one species which would result in a greater overall community effect.

Once the mine begins operations, benthic communities may be used as a monitoring tool to determine whether the mine is having an effect on the stream biota. Monitoring would comprise reproduction of the sampling methods presented here at the same sample stations in August of a given year. The results could then be compared directly to determine the aquatic effects.

Table 7.1
Macroinvertebrate Data Collected with a Surber Sampler
(Environment Canada, September 1976)

	1 Big Creek above Dark Creek			2 Big Creek above Yukon River			3 Minto Creek above Yukon River			4 Wolverine Creek above Yukon River			5 Wolverine Creek 10 km upstream		
Sample Station	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Sensitive															
Baetis sp	2	1	3			2						1			
Ephemerella sp	12	6	8		1	4									
Centroptilum sp						1									
Heptagenia sp				2	1							1			2
Cinygmula sp										4	1				
Rithrogena sp						1									
Nemoura sp				1	1		54	71	52	6	1	3			
Isogenus sp	9	4	9		1	1									
Arcynopteryx sp					1										
Diura sp										1					
Hastaperla sp		3	2	14	5	5						7	1		
Paraperla sp										4	3				
Brachycentrus sp						1					1				
Lepidostoma sp												3			
Drusinus sp		1													
Phryganeidae					1										
Facultative															
Teutonia sp												1			
Celina sp									1						
Limnophora sp										1					
Hemerodromia sp						1									
Empididae					1										
Deuterophlebia sp	1														
Atherix sp									4						
Simulidae	2					1									
Diamesa sp			2		6					1	2				
Monodiamesa sp	5	2													
Pseudodiamesa sp	1		1		4	3									
Diamesinae	5	4				4						1			
Crictopus sp	1	1	9	3	1					21	9	16			
Cardiocladius sp								1							
Brillia sp	2		4							2					
Psectrocladius sp				1		1		2	1		11	17			
Orthocladius sp		2		2								1			
Orthocladinae				3		8		2			1	8	1	2	
Orthocladinae pupae		3		12	5	3									
Eukiefferiella sp	1					1		1							
Chironomini sp			1												
Tanytarsini sp				7											
Constempellina sp				9											
Micropsectra sp					1										
Rheotanytarsus sp						1									
Polypedilum ophioicles														3	
Smittia sp										1					
Chironominae pupae	1								1			16			
Chironomini sp adult	1														
Brachycera pupae		2													
Diptera larva			1												
Sciaridae adult								1							
Pedicia sp	1														
Tipula sp								1	1	3	1	4			
Antiocha sp								2							
Tipulidae sp				1			1		4			1			
Tolerant															
Lumbriculus sp					2		2					4			
Lumbriculidae								1							
Kincaidiana hexatheca				4	11	2	8	18			4				
Kincaidiana sp								1		27	2				
Stylodrilus sp	18	3	7	3		1	9		19			21			2
Tubifex sp														10	

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Table 7.2
Benthic Macroinvertebrates (September 1994)

Station	B1			B2			B3			B4			B5			B6		
	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
Sensitive organisms																		
Ephemeroptera																		
Ameletus sp	1	2	12			1				1	1	2						
Baetis sp	7	5	4	3	1	1	38	16	7	71	40	159	51	16	8	8	1	5
Cinygmula sp	2						3	1	1	15		9	1	4				
Ephemerella doddsi																		
Ephemerella grandis																		
Ephemerella infrequens																		
Ephemerella sp																		
Heptagenia sp																		
Rhithrogena sp																		
Plecoptera, unid Juv	10	30	143	266	66	196	26	27	21	1	12	144	144	88	142	24	8	37
Arcynopteryx sp																		
Capnia sp	33	30	87	52	83	36	103	82	29	1429	404	1555	46	63	50	5	8	
Isoperla sp																		
Podmosta sp	2	1	2	147	60	49	5	1	1	41	7	127	10	16	12			
Setvena (bradleyi)																		
Sweltsa sp group		1																
Taenionema sp																		
Utaperla sp																		
Zapada sp																		
Trichoptera, unid Juv/dam						1												
Adult trichoptera																		
Dicosmoecus sp	11		1	1	2	5		1										
Ecclisomyia sp																		
Glossosoma sp																		
Grensia sp																		
Facultative organisms																		
Diptera unid Adult																		
Chironomidae, unid Juv/dam	3	86	72	56	41	49	58	11	15	66	1	34	121	409	231	881	670	417
Chironomidae pupae		2	4	3	2					33	56		4	5	35	8	10	2
Chironomidae adult									1									
S.F. Chironominae																		
Chironomus sp																		1
Micropsectra sp		1															8	
Phaenopsectra sp	2					2										8	31	36
Rheotanytarsus sp		1		2		2											1	
S.F. Diamesinae																		
Diamesa sp										8		8	4			4		1
Odontomesa sp																	1	1
Prodiamesa sp																		
S.F. Orthocladiinae																		
Cardiocladius sp			2		2	7									2			
Corynoneura sp																		
Cricotopus sp	1	4	18	68	17	89	3	3	1	17	33	59	2		1	32	73	6
Diplocladius sp		2	4	4		5	2			4	1	4	24	15	12	8	16	5
Eukiefferiella sp		44	64	95	23	138	9	11	10	44	50	68	158	155	76	67	117	36
Eurylhapsis sp	14	32		4	5	27	9	3	2	29	51	63	60	27	17	17	29	3
Heleniella sp		10		2	2	1				4	8	16		4	10			
Metriocnemus cf. fuscipes															1			
Orthocladius sp																		
Rheocricotopus sp																		
Symposiocladius sp				6	1				1						4			
Synorthocladius sp		2		2	2	17	6	3	4		1							
Thienemanniella sp				3	2													
Ceratopogonidae																		
Palpomyia sp																1		
Culicidae A																		
Empididae																		
Chelifera sp																		
Clinocera sp				1														
Weidemannia sp																		
Muscidae, unid J/D				1	1	1		1				2			1			8
Lispe sp						1				1					2			
Psychodidae																		
Pericoma sp								1										

Table 7.2 cont'd

Station	B1			B2			B3			B4			B5			B6		
	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
Simulidae unid J/D										1								
Gymnopais sp																		
Prosimulium sp	1	7	12					1				2						
Prosimulium sp P			1															
Simulium sp		8	18				5	8	12	3	1	8						
Simulium sp P			7						1									
Syrphidae																		
Syrphus sp																		
Tipulidae unid J/D																	1	
Antocha sp												1						
Dicranota sp	8	8	3	22	24	12	10	10	3	12	13	18	6	19	26	60	6	2
Hesperoconopa sp																		
Hexatoma sp																		
Tipula sp				1	2							1	1					
Homoptera Unid A	1		1															
Aphididae	1	1	2	2	2	1	3	1	1	4				4	10	14	14	55
Hymenoptera unid A			2				1											
Coleoptera unid L/A					1													
Thysanoptera																		
Colembola																		
Bourletiella spinata					1													
Hypogastrura sp				4	9	82		1	1									
Isotoma sp		24	10	28	68	176	13	4	5		4	8		4				
Podura aquatica							5	2	8					4	30			
Lepidoptera unid L Terr.		1																
Aranea																		
Hydracarina unid J		2	2	2	3	6	4	1		4	8		18		4	4		
Lebertia sp																		
Sperchon sp		2		1		3									1		1	
Torrenticola sp			2		1	2	1	1			4							
Wandesia sp																		
Oribatei		6	2		1	4	1	1						20	6		8	
Copepoda																		
Cyclopoida	20	26	28	26	18	8		2	2	4	12	8	16	48	30	124	112	8
Harpacticoida		8	2	8	9	14	10	1		32	72	120	4	24	16	12	24	
Ostracoda																		
Candona sp	1	11	6		1	16		1	1	16	24	16	476	323	141	64	21	20
Cypria sp	1	1			1				1									
Tardigrada			1															
Gastropoda unid Terr.					1													
Oligochaeta, Naididae																		
Nais (communis)																12		
Pristina so	4	2	10	2						4	8		8		8	13		
Nematoda	7	254	90	193	94	80	39	5	5	33	44	153	20	81	162	139	333	249
Turbellaria									1						1			
Tolerant organisms																		
Oligochaeta																		
Enchytraeidae	8	15	23	2	1			4	4	37	4	29	5	24	25	9	17	4
Lumbriculidae	1		2				1	1									1	
Kincaidiana hexatheca								1										
Tubificidae	2	9	57	3	2	2	9	11	6	105	21	16	42	145	60	157	24	22

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Table 7.3
Minto Creek Benthic Community Characteristics

	B1	B2	B3	B4	B5	B6
Density (#/m^2)						
Sensitive	1381	3489	1302	14453	2342	345
Facultative	3496	5802	1173	4673	10395	13608
Tolerant	421	36	162	1014	1277	950
Total	5298	9327	2637	20140	14014	14903
%						
Sensitive	26.07	37.41	49.39	71.76	16.71	2.32
Facultative	65.99	62.21	44.47	23.20	74.18	91.31
Tolerant	7.94	0.39	6.14	5.04	9.11	6.37
# of Species	44	43	38	34	33	31
Shannon Weiner Diversity	3.88	3.69	3.76	2.59	3.56	2.82
Dominance	0.11	0.11	0.13	0.38	0.13	0.27
Equitability	0.71	0.68	0.72	0.51	0.71	0.57
Richness	5.89	5.34	5.61	3.82	3.87	3.60
TU Diversity	0.892	0.894	0.873	0.623	0.871	0.732
Variance	0.027	0.015	0.049	0.319	0.030	0.165

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6 952 000 N
6 950 000 N
6 948 000 N
6 946 000 N
6 944 000 N
6 942 000 N
6 941 000 N

382 000 E
384 000 E
386 000 E
388 000 E
390 000 E
392 000 E
394 000 E
396 000 E
398 000 E

Ingersoll Islands
YUKON RIVER
Minto Creek
Big Creek

B1 — 44 / 5298
B2 — 43 / 9327
B3 — 38 / 2637
B4 — 34 / 20140
B5 — 33 / 14014
B6 — 31 / 14903

LEGEND
Density and No. of Taxa
B2 — Sampling Station
43 / 9327 — Number of taxa / Density (No./m²)

Scale 1000 500 0 1000 2000 Metres

NOTE: Contour interval 100 feet

CAD FILE \PROJECT\1000\H3021\FIG\B2 1:25000 Plot 1=25 DEC. 11, 1994

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

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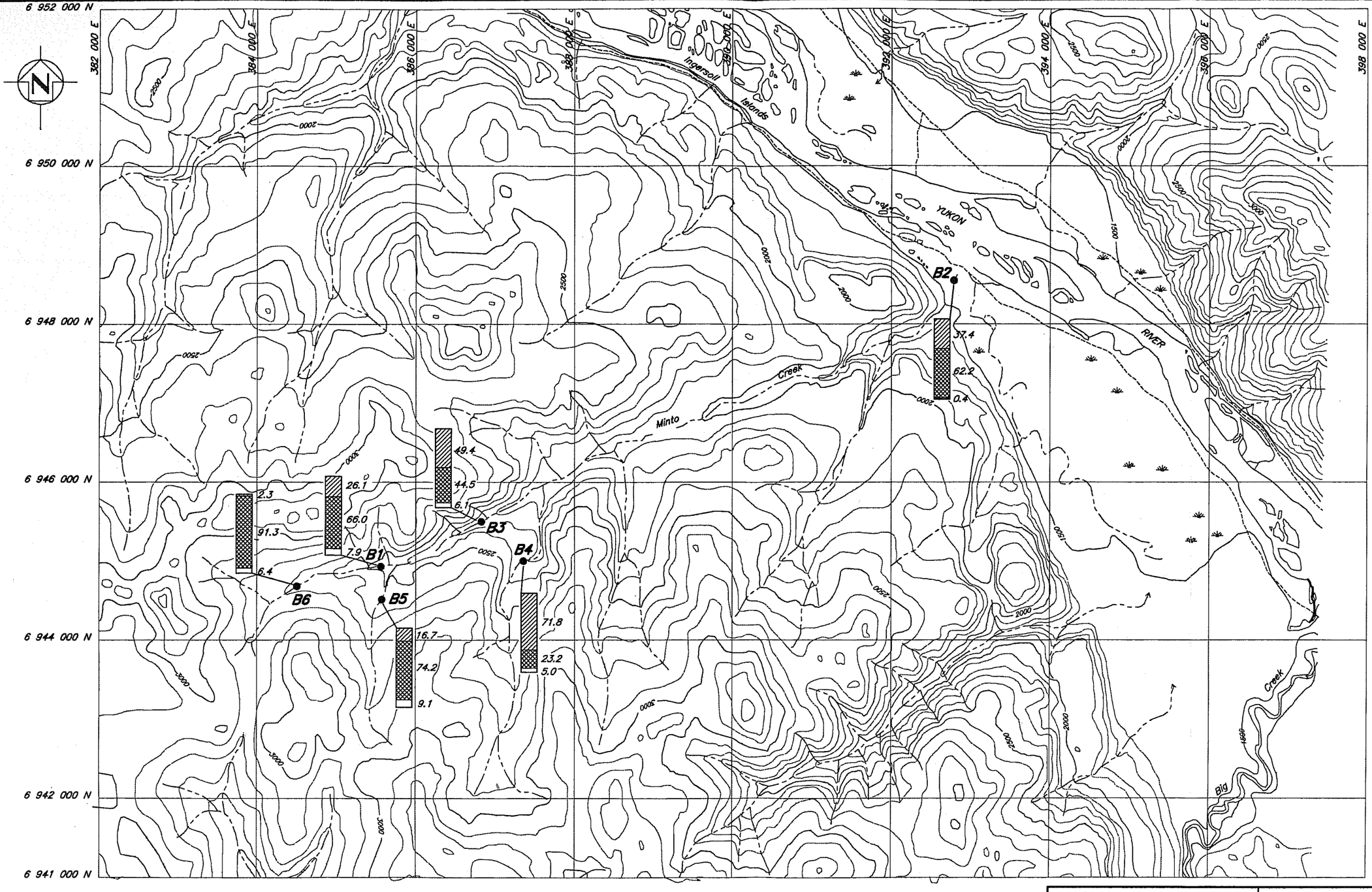
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MINTO PROJECT

BENTHIC INVERTEBRATE SAMPLING STATIONS: DENSITY AND NO. OF TAXA

DESIGNED	–
DRAWN	VY
CHECKED	–
APPROVED	

DATE DEC. 1, 1994 | SCALE AS SHOWN | DRG. NO. FIGURE 7.1 | REV. C



LEGEND

Tolerance Categories

B2 Sampling station

100 (%) 0

Sensitive

Facultative

Tolerant

CAD FILE \PROJECT\1000\H3921\FIG\F63 1:25000 Plot 1-25 DEC. 11, 1994

DRG. NO.	DESCRIPTION	REV.	DATE	DESCRIPTION	APPROVED	REV.	DATE	DESCRIPTION	APPROVED
REFERENCE DRAWINGS		REVISIONS				REVISIONS			

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MINTO PROJECT

BENTHIC INVERTEBRATE SAMPLING STATIONS: TOLERANCE CATEGORIES

DESIGNED	–
DRAWN	VY
CHECKED	–
APPROVED	

DATE DEC. 1, 1994 | SCALE AS SHOWN | DRG. NO. FIGURE 7.2 | REV. –

SECTION 8.0 - PERIPHYTON

8.1 BACKGROUND

Periphytic algae are simple aquatic plants which inhabit the substrate of water bodies. As photosynthesizers, algae form the base of the aquatic food web. Algal concentrations and population composition vary seasonally with changing photoperiod, temperature, nutrient levels and flow regimes. Periphyton can provide a valuable biological monitoring tool to assess potential impacts of nutrient enrichment and metal toxicity.

The introduction of nitrogen-based compounds to aquatic systems from use of explosives during mining and increased phosphorous loadings in runoff originating from disturbance of igneous and metamorphic rocks in the mine site area can have a detrimental effect on water quality. Excessive increases in nitrogen have the potential to impair water quality for drinking, aquatic life and recreation due to toxicity of nitrates, nitrites and ammonia, and their role as a limiting nutrient in promoting algal growth. Biologically available phosphorous or ortho-phosphate is more readily accumulated by living organisms and can contribute to accelerated algae growth. Excessive algal growth can in turn result in lake eutrophication and the choking of streams.

Chlorophyll "a" is the primary photosynthetic pigment and is common to all algae. Determining chlorophyll "a" concentrations provides a measure of algae biomass and thus, the primary productivity of a given aquatic location. Measuring this environmental parameter provides baseline data for monitoring possible future impacts to downstream water quality.

Taxonomic identification and relative abundance ranking of the algae samples provides information on community complexity and composition. Species presence information allows comparison to known community associations from the literature and regional studies, and permits increased prediction capabilities. This qualitative sampling should be able to detect gross changes in the dominant species.

8.2 RATIONALE AND METHODS

Periphyton sampling was conducted in August 1994, concurrent with benthic invertebrate collection to provide a temporal and spatial baseline database of relative productivity and typical algal community composition. Five sites were selected to cover drainages upstream and downstream of expected potential impact areas (Figure 8.1).

The sampling stations correspond to water quality stations W1, W2, W3, W5, and W9 on Minto Creek. Station W8 was located on a tributary of Minto Creek. Six replicate samples each were taken for taxonomic analysis and chlorophyll "a" analysis at each site.

The specific sample locations were normalized to areas of similar depth and velocity. Representative samples of algae were taken from 5.3 cm^2 areas of cobble-sized substrate at each site using a 50 ml Stockner sampler and transferred to plastic 50 ml sample containers.

Samples for chlorophyll "a" concentration determination were individually filtered through 0.45 μm cellulose acetate filters, buffered with $MgCO_3$, stored on silicate crystals and submitted to ASL Laboratories Ltd. for analysis.

Samples for community composition studies were preserved with Lugol's iodine solution and sent to Munroe Environmental Consulting for taxonomic analysis. Subsamples were settled in 2.5 ml settling chambers, then examined to identify species and estimate percent abundance of green, blue-green and other common species. Diatoms were identified and assigned the relative abundance rankings of predominant, common and present.

8.3 CHLOROPHYLL "a" RESULTS

Mean chlorophyll "a" values ranged from 0.079 at station P3 to 0.392 ug/cm^2 at station P5 (Table 8.1). The highest mean concentration of chlorophyll "a" was detected at P5 in the upper reaches of the Minto Creek watershed in an area of disturbance. Very little over vegetation exists in this

region due to mining exploration activities and forest fire. Therefore, an abundance of sunlight is allowed into the water column. A thick algal mat was observed on the creek substrate. The lowest value was detected in an area with thick overgrowth consisting of willows and alder. Extreme variability was observed between replicates at sites P3 and P5.

8.4 SPECIES COMPOSITION

A comparison of species presence between sampling periods is included as Table 8.2. A summary of dominant and common species is presented by site below:

Site P1(W1) Three samples from site B1 contained very little visible sediment and three contained a moderate amount, which consisted mostly of detritus, silt and small amounts of algae. Diatoms comprised 50 to 95% of the periphyton. *Navicula* spp. were predominant. The red alga *Audouinella violacea* was predominant in some samples, comprising 5 to 50% of the alga.

Site P2(W2) Four samples contained very little visible sediment and two contained a moderate amount (silt, detritus and algae). Diatoms comprised 59 to 99% of the periphyton; *Nitzschiaspp.* were predominant. The bluegreen algae *Chamaesiphon incrustans*, *Lyngbya diguetii*, and *Plectonema notatum* were common in two samples and comprised up to 25% of the sample.

Site P3(W3) All samples contained very little visible sediment or algae. Only two samples contained enough algae to estimate percent abundance. Diatoms comprised 30 and 90% of the periphyton in these two samples. Common diatoms in all six samples included *Nitzschia* spp., *Navicula* spp., *Synedra* cf. *incisa* and *Synedra rumpens*. *Audouinella violacea* and *Phormidium* sp. were common (5 to 35%) in the two samples where abundance was estimated.

Site P4(W7)

Samples from P4 were not collected quantitatively due to limited substrate, but were analyzed in the usual manner for periphyton composition. Three samples contained coarse sand and were comprised almost completely of iatoms. *Nitzschia* spp. were predominant and *Navicula* spp. were common. Two samples contained large amounts of moss (*Fontinalis* sp.) and were covered by the epiphytic bluegreen algae *Lygnbya nordgaardii*. One sample was composed of filamentous algae and contained the chrysophyte *Hydrurus foetidus* (50%), *Nitzschia* spp. and *Navicula spp.*

Site P5(W8)

Samples from P5 contained very small amounts of fine sediment and very little algae. Two samples contained too little periphyton to estimate percent abundance. Diatoms comprised 90 to 99% of the periphyton in the other four samples. The most common diatom species were *Navicula* spp., *Synedra rumpens*, and *Nitzschia* spp. The bluegreen alga *Nostoc* sp. was common in one sample. *Audouinella violacea* was common in another.

Site P6(W9)

Samples from P6 contained very small amounts of sediment. Diatoms comprised 45 to 93% of the periphyton. *Gomphonema* spp. were predominant. *Meridion circulaire*, *Navicula* spp. and *Synedra rumpens* were common. The chrysophyte *Hydrurus foetidus* was predominant in two samples (25 to 40%) and common (5%) in three others. The crustose bluegreen algae *Chamaesiphon incrustans* was predominant in two samples and common in two others. Other common species included *Lyngbya diguetii* and an unidentified filamentous bluegreen algae.

In general, samples from most sites contained very little periphyton material, which likely indicates a relatively unproductive stream or a stream subject to scouring from high flows during freshet. Species composition was similar to other creeks observed in the southwest Yukon. High proportions of the diatoms *Nitzschia* spp. were found at site P2 and P3. *Nitzschia* species, in abundance, often are associated with organic or nutrient enrichment. Although periphyton

abundance was low, *Nitzschia* predominance at site P2 and P3 may indicate locations with a potential sensitivity to enrichment.

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Table 8.1
Chlorophyll "a" Content of Periphyton
(ug/cm^2)

Replicate	Site P1	Site P2	Site P3	Site P4	Site P5
1	0.187	0.059	0.094	0.352	0.375
2	0.208	0.112	0.141	<0.01	0.181
3	0.132	0.637	0.098	0.153	1.104
4	0.059	0.077	0.073	0.092	0.189
5	0.941	0.473	0.022	0.081	0.167
6	0.061	0.312	0.047	0.077	0.334
Mean	**0.265**	**0.278**	**0.079**	**0.126**	**0.392**
S.D.	**0.045**	**0.053**	**0.206**	**0.109**	**0.142**

(\H3021\IEE\CHLORA-2.WK3)

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Table 8.2
Periphyton Study

Species	Site 1 Replicate						Site 2 Replicate						Site 3 Replicate					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2*	3*	4*	5*	6
Cyanophyceae																		
Chamaesiphon incrustans										10%	10%							
Lyngbya digueti										25%	5%	1%						
Lyngbya nordgaardii																		
Nostoc sp.										+							+	+
Phormidium sp.										+		+	35%	+	+			5%
Plectonema notatum			10%			+				5%	5%							
(unidentified filament)																		
Chlorophyceae																		
Closterium sp.	+						+		+		+							
Microspora amoena																		
Stigeoclonium sp.																		
(unidentified – 15 um)																		
Chrysophyceae																		
Hydrurus foetidus						+							+					
Rhodophyceae																		
Audouinella violacea	25%	50%	10%	59%	5%	25%		+	1%	1%	2%		35%	+		+	+	5%
Bacillariophyceae																		
Achnanthes spp.	++	++	+	+	+	+		+		+		+	+	+			+	+
Amphora sp.					+							+						
Caloneis ventricosa								+										
Cymbella spp.	+		+				+	+	+	+	+	+				+		
Eunotia sp.			+															
Fragilaria cf. *capucina*																		
Gomphonema spp.				+			+	+	+	+	+	+	+		+	+	+	+
Hannaea arcus																	+	
Meridion circulare	+	+	+	+	+		+	+	+	+	+	+						+
Navicula spp.	+++	+++	+++	+	+++	+++	+	++	+	+	+	+++	+	+	+		+	+++
Nitzschia spp. (30–50 um)	+	+	+	+	+	+	++	+++	+++	++	++	++				+	+	++
Nitzschia sp. (100 x 6 um)			+			+	+++	+++	++	++	+++	+++						
Nitzschia sp. (100 x 10 um)								++	++	++	++	+++			++	+	+	+++
Nitzschia acicularis									+	+		++						
Pinnularia sp.	+				+	+		+										
Stauroneis sp.			+							+		+						+
Surirella angustata					+		+	+	+	+	+	+						+
Synedra cf. *incisa*	+	+++	++	+++	+	++				+		+	++		++	+	+	++
Synedra rumpens	+				+		+		+		+	+	+	+	+	+	++	++
Synedra ulna					+							+						+
% Bacillariophyceae	75	50	80	50	95	75	>99	>99	99	59	78	99	30					90

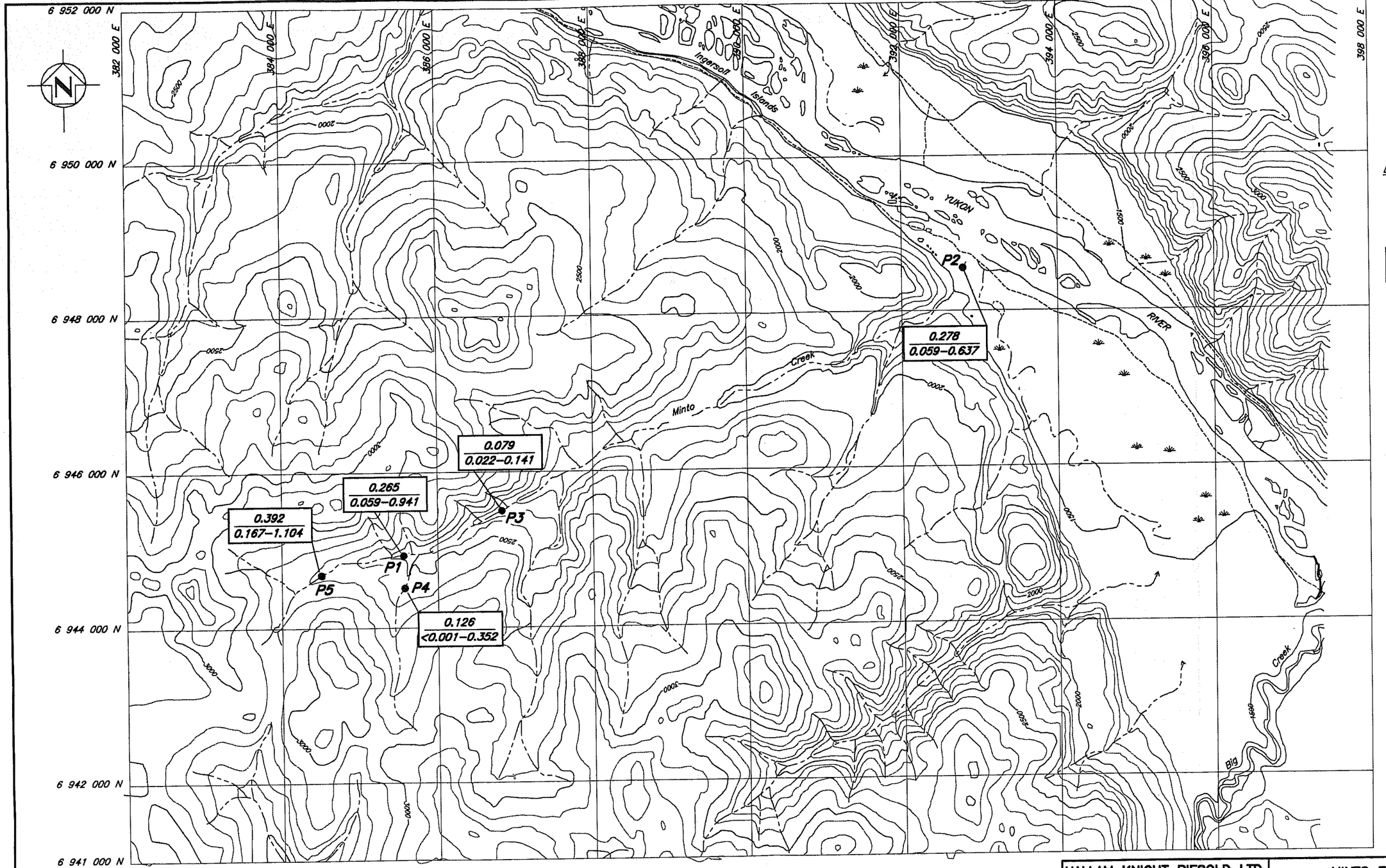
Key to abundance: +++ Dominant, ++ Common, + Present
* too little in sample to estimate % abundance
i sample not collected quantitatively

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Table 8.2
Periphyton Study

Species	Site 4[i] Replicate						Site 5 Replicate						Site 6 Replicate					
	1	2	3	4	5	6	1*	2*	3	4	5	6	1	2	3	4	5	6
Cyanophyceae																		
Chamaesiphon incrustans															30%	10%	10%	25%
Lyngbya digueti	20%				5%								5%	5%	5%	5%	5%	5%
Lyngbya nordgaardii																		
Nostoc sp.										+	10%	+						
Phormidium sp.							+			1%								
Plectonema notatum																		
(unidentified filament)														1%	1%	1%	10%	+
Chlorophyceae																		
Closterium sp.	5%	1%	+	+	1%	+		+					+	+	+	5%	5%	+
Microspora amoena	+												+					
Stigeoclonium sp.														1%				
(unidentified – 15 um)																	+	
Chrysophyceae																		
Hydrurus foetidus				50%							+		40%		5%	5%	25%	5%
Rhodophyceae																		
Audouinella violacea										+	+	5%						
Bacillariophyceae																		
Achnanthes spp.	+	+	+	+	+	+	+	+	++	+	+	+	+	+	++	+	+	+
Amphora sp.																		
Caloneis ventricosa			+															
Cymbella spp.	+	+	+	+	+	+			+			+	+		+	+	+	+
Eunotia sp.	+				+	+												
Fragilaria cf. *capucina*		+																
Gomphonema spp.	++	+		+	+	+				++	+		+++	+++	+++	+++	++	++
Hannaea arcus																		
Meridion circulare	+++	+	+	+	+	++		+	+	+		+	++	+	++	+	+	++
Navicula spp.	++	++	++	++	++	++	+	++	+	+++	++	++	++	++	++	++	+	+
Nitzschia spp. (30–50 um)	+	++	+++	+++	+++	+++	+	+		+	+	+	+		+	+	+	+
Nitzschia sp. (100 x 6 um)	++	+	++	++	++	++					+				+	+	+	+
Nitzschia sp. (100 x 10 um)	++	+++	+++	++	+++	++		+				+						+
Nitzschia acicularis							+	+	+	++	+	+						
Pinnularia sp.																		
Stauroneis sp.	+	+							+									
Surirella angustata	+	+	+	+		+	+				+	+			+			
Synedra cf. *incisa*	+	+				+	+	+			+	+	+					+
Synedra rumpens							++	++	++	+	+	+	+				++	++
Synedra ulna	+	+		+	+	+											+	
% Bacillariophyceae	75	99	>99	50	94	>99			100	99	90	95						

Key to abundance: +++ Dominant, ++ Common, + Present
* too little in sample to estimate % abundance
i sample not collected quantitatively



CAD FILE \PROJECTS\1000\K0021\PCP.DWG 1:25000 Plot 1=25 DEC. 11, 1994

HALLAM KNIGHT PIESOLD LTD. ENVIRONMENTAL CONSULTANTS – VANCOUVER, B.C.		MINTO EXPLORATIONS LTD.
		MINTO PROJECT
	DESIGNED –	
	DRAWN VY	PERIPHYTON SAMPLE STATIONS
	CHECKED –	
	APPROVED	
DATE DEC. 1, 1994	SCALE AS SHOWN	DRG. NO. FIGURE 8.1 REV. –

DRG. NO.	DESCRIPTION	APPROVED
REFERENCE DRAWINGS		

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

SECTION 9.0 - VEGETATION

9.1 REGIONAL OVERVIEW

The Minto Project area lies within the Pelly River Ecoregion (Oswald and Senyck, 1976). Black and white spruce form the most common forest types. Paper birch occurs on cooler sites and aspen and balsam poplar occupy disturbed areas. Lodgepole pine frequently invades burnt-over areas, but is often in competition with deciduous trees on moist to wet sites. The tree line occurs at elevations of 1350 to 1500 m. Feathermoss dominates the understory vegetation of nearly closed coniferous stands, but as trees become less dense, willows and ericaceous shrubs become prevalent. Sedge or sphagnum tussocks are common in wetlands and under black spruce. Sagewort grassland, with several forbs, and sometimes aspen, occurs on steep south-facing slopes. Shrub birch and willow occur in the subalpine and extend well above the treeline. Ericaceous shrubs and prostrate willows dominate the alpine vegetation, except on rocky terrain, where lichens are more prevalent.

9.2 STUDY METHODS

Major vegetation communities were plotted on 1:50,000 NTS topographical maps from stereo-examinations and interpretations were made for wildlife habitat suitability, forestry capability and reclamation species. A ground proofing vegetation survey and assessment were conducted in July 1994. Vegetation mapping was completed in conjunction with wildlife habitat mapping by assessing the abundance and distribution of important browse species and lichen cover.

Sampling consisted of establishing transects (20 m^2) within the Minto Project area, including the open pit, waste rock storage area, mill site, tailings storage facility and access road. The percent cover values for species was determined for dominant trees (trees that comprise the upper portion of the height distribution population of the main canopy), tall shrubs (all woody plants between 2 and 10 m tall, including shrubs and advanced tree regeneration), low shrubs (all woody plants less

than 2 m high including shrubs and established tree regeneration), herbs (herbaceous species, regardless of their height, and some low woody plants), mosses, lichens, liverworts, tree seedlings and fungi. A list of the plant species observed in the Minto Project area is presented in Table 9.1.

9.3 SITE ZONATION

Vegetation mapping of the Minto Project area is presented in Figure 9.2. The results of the 12 vegetation transects is presented in Table 9.2.

The Minto Project area has been burned by four separate forest fires over the last 40 years. Consequently, much of the vegetation in this region is in varying stages of regenerative growth. The most recent fire occurred in 1980 and burnt 4550 ha, including the top of the Minto Creek watershed (J. Gibson, 1994).

Stages of early vegetative regrowth were observed in the upper Minto Creek watershed. These areas of regeneration consisted mostly of willows and an herb layer composed of grasses and berry producing plants such as lingonberry, dwarf blueberry and red bearberry.

Vegetative communities of aspen, alder and willow were observed in areas of later regenerative growth. The tree canopy was comprised of aspen, low tree willows and frequently, alder species. Pine and spruce, which typically invade these sites were frequently present in the shrub layer. Willow, wild rose, Labrador tea and soapberry were usually present. The groundcover was comprised of variable amounts of lingonberry, kinnikinnick and moss.

Dense stands of juvenile lodgepole pine were observed in areas of later successional growth on south aspect slopes in the upper watershed. Willow were scattered throughout the tall shrub layer. Due to the extremely dense growth of the trees, very little ground cover growth was present except for sparse fireweed and lingonberry.

Mixed deciduous coniferous forests existed in areas where fire had not occurred for many years. The tree canopy was usually dominated by lodgepole pine and trembling aspen, with willow species common throughout the understory. White spruce appeared in the low shrub layer in areas of later successional growth. This species frequently dominates stands and will reach maturity on these sites. Associated species include balsam poplar, highbush-cranberry, wild rose, soapberry, kinnikinnick, lingonberry, twinflower, altai fescue, reedgrass and wheatgrass.

Willow/sedge communities occurred in the Minto Creek valley, adjacent to the creek. This region was usually poorly drained and prone to flooding. A moderate to dense overstory of willow occurred. Groundcover was dominated by sedge species and moss; grasses and horsetail were common and sphagnum moss was often present. Riparian vegetation occurred along the creek drainage. Associated species included scrub birch, shrubby cinquefoil, nagoonberry, sedge, grass (Graminaceae), horsetail, coltsfoot, tall lungwort and sphagnum moss.

Black spruce communities occurred on north aspect slopes in the Minto Creek valley. These communities have a sparse tree layer dominanted by black spruce and a shrub understory of scrub birch, willow, Labrador tea and shrubby cinquefoil. The herb layer for these communities consisted of bog blueberry, crowberry, red bearberry, cloudberry and lousewort. The moss groundcover layer in these areas was extensive and was usually dominated by sphagnum moss and feathermoss.

Within the floodplain of lower Minto Creek existed a white spruce/balsam poplar community. The open tree canopy was dominated by white spruce and mature balsam poplar. The shrub layer was diverse included willow, alder, highbush cranberry and red-osier dogwood. The herb layer consisted mostly of horsetail.

White spruce/black spruce communities occurred on low gradient south aspect slopes in the Minto Project area. Willow species dominated the tall shrub layer, while wild rose and Labrador tea occurred in the lower shrub layer. The herb layer consisted of bog blueberry, red bearberry, crowberry and lingonberry. A continuous moss layer, which was comprised mostly of feathermoss with some sphagnum moss, occurred throughout the community.

Vegetation on steep south aspect slopes in the Minto Project area consisted of low scattered aspen with a ground cover layer dominated by pasture sage and grasses such as altai fescue and wheatgrass. A sparse shrub layer consisted of common juniper, kinnikinnick and soapberry.

Based on regional studies and data collected during the vegetation survey a schematic vegetation zone of the Minto Creek valley was compiled and is presented in Figure 9.2

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Table 9.1
Tree and plant species observed at the Minto Project site.

Trees

Black spruce (*Picea mariana*)
White spruce (*Picea glauca*)
Lodgepole pine (*Pinus contorta* var. *latifolia*)
Trembling aspen (*Populus tremuloides*)
Balsam poplar (*Populus balsamifera* ssp. *balsamifera*)

Shrubs

Green alder (*Alnus viridis* ssp. *fruticosa*)
Mountain alder (*Alnus viridis* ssp. *sinuata*)
Willow spp. (*Salix* spp.)
Wild rose (*Rosa acicularis*)
Scrub birch (*Betula glandulosa* var. *glandulosa*)
Highbush-cranberry (*Viburnum edule*)
Shrubby cinquefoil (*Potentilla fruticosa*)
Labrador tea (*Ledum groenlandicum*)
Soapberry (*Shepherdia canadensis*)
Common juniper (*Juniperus communis*)

Herbs

Mountain death-camas (*Zygadenus elegans*)
Arctic lupine (*Lupinus arcticus*)
Northern water-carpet (*Chrysosplenium tetrandrum*)
Tall lungwort (*Mertensia paniculata*)
Cutleaf anemone (*Anemone multifida*)
Thoroughwort (*Bupleurum triradiatum*)
Twinflower (*Linnaea borealis*)
Alpine milk-vetch (*Astragalus alpinus*)
Bog blueberry (*Vaccinium uliginosum*)
Dwarf blueberry (*Vaccinium caespitosum*)
Lingonberry (*Vaccinium vitis-idaea*)
Cloudberry (*Rubus chamaemorus*)

Table 9.1 (continued)

Tree and plant species observed at the Minto Project site.

Herbs (cont'd.)

Sweet coltsfoot (*Petasites frigidus*)
Bog cranberry (*Vaccinium oxycoccus*)
Red bearberry (*Arctostaphylos rubra*)
Fireweed (*Epilobium angustifolium*)
Stoloniferous mitrewort (*Mitella nuda*)
Crowberry (*Empetrum nigrum*)
Pink wintergreen (*Pyrola asarifolia*)
Northern Jacob's ladder (*Polemonium boreale*)
Northern goldenrod (*Solidago multiradiata*)
Kinnikinnick (*Arctostaphylos uva-ursi*)
Yarrow (*Achillea millefolium*)
Northern bedstraw (*Galium boreale*)
Showy pussytoes (*Antennaria pulcherrima*)
Pasture sage (*Artemesia frigida*)

Grasses

Water sedge (*Carex aquatilis*)
Altai fescue (*Festuca altaica*)
Reedgrass (*Calamagrostis* spp.)
Wheatgrass (*Agropyron* spp.)
Cottongrass (*Eriophorum* spp.)
Polargrass (*Arctagrostis latifolia*)

Lichens

Green reindeer lichen (*Cladina mitis*)
Grey reindeer lichen (*Cladina rangiferina*)
Freckled lichen (*Peltigera aphthosa*)
Dog lichen (*Peltigera canina*)
Green kidney lichen (*Nephroma arcticum*)

Mosses

Red stem feather moss (*Pleurozium schreberi*)
Common red sphagnum moss (*Sphagnum capillaceum*)
Common green sphagnum moss (*Sphagnum girgensohnii*)
Common brown sphagnum moss (*Sphagnum fuscum*)
Stiff-leaved polytrichum (*Polytrichum alpinum*)
Golden fuzzy fen moss (*Tomenthypnum nitens*)

Table 9.2
Vegetation Study - Species Composition

Site #1: South aspect gentle slope in lower Minto Creek area

Gradient: 6% Altitude: 557 m (1600 ft) Aspect: east

Observations: Area shows evidence of a burn
Extensive leaf litter covers forest floor

Species present: Trembling aspen
White spruce
Balsam poplar
Wild rose
Fireweed
Northern bedstraw
Tall Lungwort
Cut-leaf Anemone
Soapberry
Thorough-wort
Mountain death-camass
Wheatgrass
Freckled lichen

Most Common:

Tree layer-
Trembling aspen-86%
White spruce-12%

Tall shrub layer-
Trembling aspen
Wild rose-10%

Low shrub layer-
Soapberry-25%
Wild rose-10%

Herb layer-
fireweed-65%
grasses-15%

Moss and lichen layer-
Freckled lichen

Table 9.2 (continued)
Vegetation Study - Species Composition

Site #2:

Gradient: 3% Altitude: 579 m (1900 ft) Aspect: southeast

Observations: Thick layer of moss covers forest floor, with large patches of reindeer lichen.

Species Present:
- Black spruce
- Trembling aspen
- Willow spp.
- Pink Wintergreen
- Lingonberry
- Red-stem feathermoss
- Golden fuzzy fen moss
- Wild rose
- Tall Lungwort
- Bog blueberry
- High-bush cranberry
- Arctic lupine
- Twinflower
- Crowberry
- Freckled Lichen
- Reindeer Lichen
- Foxtail

Most Common:

Tree layer-
- Black spruce-95%

Tall shrub layer-
- Willow sp.

Low shrub layer-
- Wild rose-50%
- Bog blueberry-20%

Herb layer-
- Crowberry-40%
- Lingonberry-20%

Moss and lichen layer-
- Red-stem feathermoss-90%
- Reindeer lichen-10%

Site #3: Minto Creek Valley, adjacent to the creek

Gradient: 32% (19°) Altitude: 762 m (2500 ft) Aspect: North

Observations: Valley slope is steep, area shows signs of an extensive burn.
Signs of regeneration; spruce and pine saplings.

Species Present: Black spruce (fire killed and juvenile)
Lodgepole pine (juvenile)
Alder
Fireweed
Willows (4)
Palmated coltsfoot
Tall lungwort
Lingonberry
Labrador tea
Pink wintergreen
Dwarf blueberry
Reedgrass
Red stem feather moss
Golden fuzzy fen moss
Scouring grass
Horsetail
Streamside moss
Foamflower
Freckled lichen
Water sedge

Most Common:

Tree layer-
Black spruce (fire killed)-100%

Tall shrub layer-
Willow spp.-49%
Black spruce (juvenile)-46%

Low shrub layer-
Labrador tea-80%

Herb layer-
Dwarf blueberry-40%
Pink wintergreen-40%

Moss and lichen layer-
Red-stem feathermoss
Golden fuzzy fen moss

Site #4: North facing slope in upper Minto Creek valley

Gradient: 8% (4.8°) Altitude: 940 m (2700 ft) Aspect: north northeast

Observations: Area shows evidence of burn. Early signs of regeneration; spruce and aspen.

Species Present:Black spruce
Trembling aspen
Green alder
Willow spp.
Lingonberry
Wild rose
Fireweed
Bog blueberry
Labrador tea
Tall lungwort
Tall Jacob's ladder
Coltsfoot
Purple reedgrass
Horsetail
Green sphagnum moss
Star moss
Freckled lichen
Northern watercarpet

Most common:

Tree layer-
Black spruce-100% (fire kill)

Tall shrub layer-
Trembling aspen-40%
Alder-40%

Low shrub layer-
Willow sp.-40%
Labrador tea-20%
Wild rose-10%

Herb layer-
Tall lungwort-20%
Fireweed-30%
Horsetail-15%
Purple reedgrass-35%

Moss and lichen layer-
Green sphagnum moss-50%
Clubmoss-25%

Site #5: Steep south aspect slope

Gradient: 37% (22°) Altitude: m (2000 ft) Aspect: South

Observations: Area is extremely xeric, active signs of erosion.
Very few trees.

Species Present: White spruce
Trembling aspen
Kinnikinnick
Soapberry
Common juniper
Thoroughwort
Yarrow
Goldenrod
Cut-leaf anemone
Northern bedstraw
Jacob's ladder
Pussy toes
Pasture sage
Altai fescue

Most common:

Tree layer-
Trembling aspen-70%
White spruce-30%

Tall shrub layer-
Trembling aspen

Low shrub layer-
Kinnikinnick-75%
Soapberry-25%

Herb layer-
Altai fescue-40%
Yarrow-20%
Thoroughwort-20%
Goldenrod-10%

Moss and lichen layer-
none

Site #6: Upper Minto Creek

Gradient: 3% (2°) Altitude: 793 m (2600 ft) Aspect: south southeast

Observations: Area has been burnt. Extremely dense regrowth of lodgepole pine has occurred.
Full cover of pine needles.

Species Present: Lodgepole pine
Trembling aspen
Willow spp.
Alder
Lingonberry
Fireweed
Star moss

Most common:

Tree layer-
none, dead Black spruce

Tall shrub layer-
Lodgepole pine

Low shrub layer-
Lodgepole pine-80%
Alder-10%
Willow sp.-10%

Herb layer-
Fireweed-45%
Lingonberry-35%

Moss and lichen layer-
Clubmoss

Site #7: Adjacent to road in vicinity of open pit

Gradient: 3% (1.8°) Altitude: 823 m (2700 ft) Aspect: northeast

Observations: Extremely xeric soils. Evidence of fire. Very little regrowth and limited ground cover; patches of bare earth common.

Species present: Trembling aspen
Lodgepole pine
White spruce
Lingonberry
Labrador tea
Clubmoss
Fireweed
Altai fescue

Most common:

Tree layer-
none

Tall shrub layer-
Lodgepole pine-45%
Trembling aspen-45%

Low shrub layer-
White spruce-45%
Labrador tea-45%

Herb layer-
Altai fescue-65%
Lingonberry-30%

Moss and lichen layer-
Clubmoss

Site #8: Top of Minto Creek watershed

Gradient: 1 % (0.6°) Altitude: 914 m (3000 ft) Aspect: east

Observations: Poor drainage; ground water saturated. Area has been recently burnt. Early stages of regenerative growth observed.

Species present:Black spruce (regenerative)
Scrub birch
Willow sp.
Shrubby cinquefoil
Labrador tea
Bog blueberry
Coltsfoot
Red bearberry
Net-veined willow
Cottongrass
Cloudberry
Horsetail
Freckled lichen
Green sphagnum moss
Bog cranberry
Golden fuzzy fen moss

Most common:

Tree layer-
none (dead Black spruce)

Tall shrub layer-
none

Low shrub layer-
Scrub birch-40%
Willow sp.-30%

Herb layer-
Cloudberry-30%
Red bearberry-30%

Moss and lichen layer-
Green sphagnum moss-75%
Golden fuzzy fen moss-10%
Freckled lichen-10%

Site #9: Near the Yukon River

Gradient: 1% (0.6°) Altitude: 427 m (1400 ft) Aspect: east northeast

Observations: Area may flood during freshet and high flows from Yukon River.

Species present:White spruce
Trembling aspen
Willow sp.
Wild rose
Lingonberry
Bog blueberry
Soapberry
Twinflower
Mountain death-camass
Arctic lupine
Thoroughwort
Jacob's ladder
Cut-leaf anemone
Altai fescue
Tall lungwort
Reindeer lichen
Dog lichen
Freckled lichen
Red-stem feathermoss

Most common:

Tree layer-
White spruce-55%
Trembling aspen-40%

Tall shrub layer-
Willow sp.

Low shrub layer-
Soapberry-25%
Wild rose-25%
Bog blueberry-40%

Herb layer-
Lingonberry--25%
Arctic lupine-20%
Altai fescue-40%

Moss and lichen layer-
Red-stem feathermoss-35%
Freckled lichen-25%

Table 9.2 (continued)
Vegetation Study - Species Composition

Site #10: Below canyon, adjacent to Minto Creek

Gradient: 8% (4.8°) Altitude: 518 m (1700 ft) Aspect: northwest

Species present:Black spruce
White spruce
Willow sp.
Lingonberry
Twinflower
Freckled lichen
Reindeer lichen
Red-stem feathermoss

Site #11: At H2W2, adjacent to Minto Creek

Gradient: 8% (4.8°) Altitude: 518 m (1700 ft) Aspect: northwest

Species present: White spruce
Balsam poplar
Trembling aspen
Willow sp.
Mountain alder
High-bush cranberry
Wild rose
Horsetail
Toadflax

Table 9.2 (continued)
Vegetation Study - Species Composition

Site #12:

Gradient: 2% (1.2°) Altitude: 914 m (3000 ft) Aspect: south southeast

Observations: Mixed deciduous/coniferous forest

Species present: Trembling aspen
Paper birch
Green alder
White spruce (juvenile)
Labrador tea
Dwarf blueberry
Lingonberry
Kinnikinnick
Altai fescue
Red-stem feathermoss
Clubmoss

Most common:

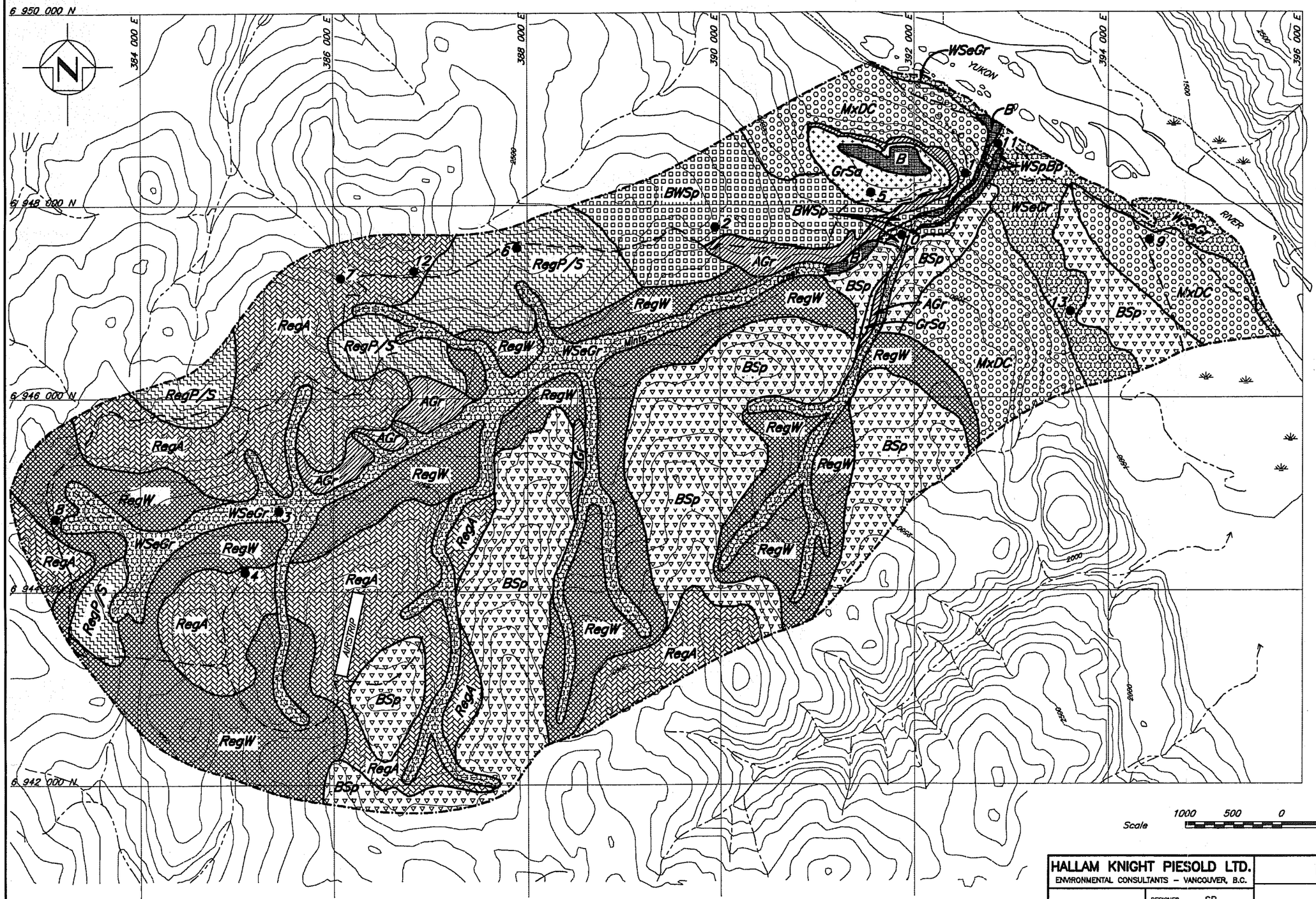
Tree layer-
Trembling aspen-80%
Paper birch-20%

Tall shrub layer-
Green alder-70%
White spruce-20%

Low shrub layer-
Labrador tea-40%
Dwarf blueberry-40%

Herb layer-
Kinnikinnick-35%
Lingonberry-35%
Altai fescue-30%

Moss and lichen layer-
Red-stem feathermoss



VEGETATION COMMUNITIES:

- BSp – Black spruce
- BWSp – Black and White spruce
- WSpBp – White spruce/Balsam poplar
- MxDC – Mixed deciduous coniferous
- RegW – Fire regeneration, Willows
- RegA – Fire regeneration, Aspen
- RegP/S – Fire regeneration, Pine and Spruce
- WSeGr – Willow, Sedge, Grasses
- AGr – Aspen, Grasses
- GrSa – Grasses, Sage
- B – Bedrock
- ● 1 Vegetation Transect

NOTE: Contour interval 100 feet

Scale 1000 500 0 1000 2000 Metres

CAD FILES\PROJECT\1000\A3021\DSYS5 1=20000 Plot 1=20 Dec. 11, 1994

REFERENCE DRAWINGS		REVISIONS				REVISIONS			
DRG. NO.	DESCRIPTION	REV.	DATE	DESCRIPTION	APPROVED	REV.	DATE	DESCRIPTION	APPROVED

HALLAM KNIGHT PIESOLD LTD.
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MINTO EXPLORATIONS LTD.

MINTO PROJECT

VEGETATION SURVEY

DESIGNED	SB
DRAWN	RDT
CHECKED	
APPROVED	

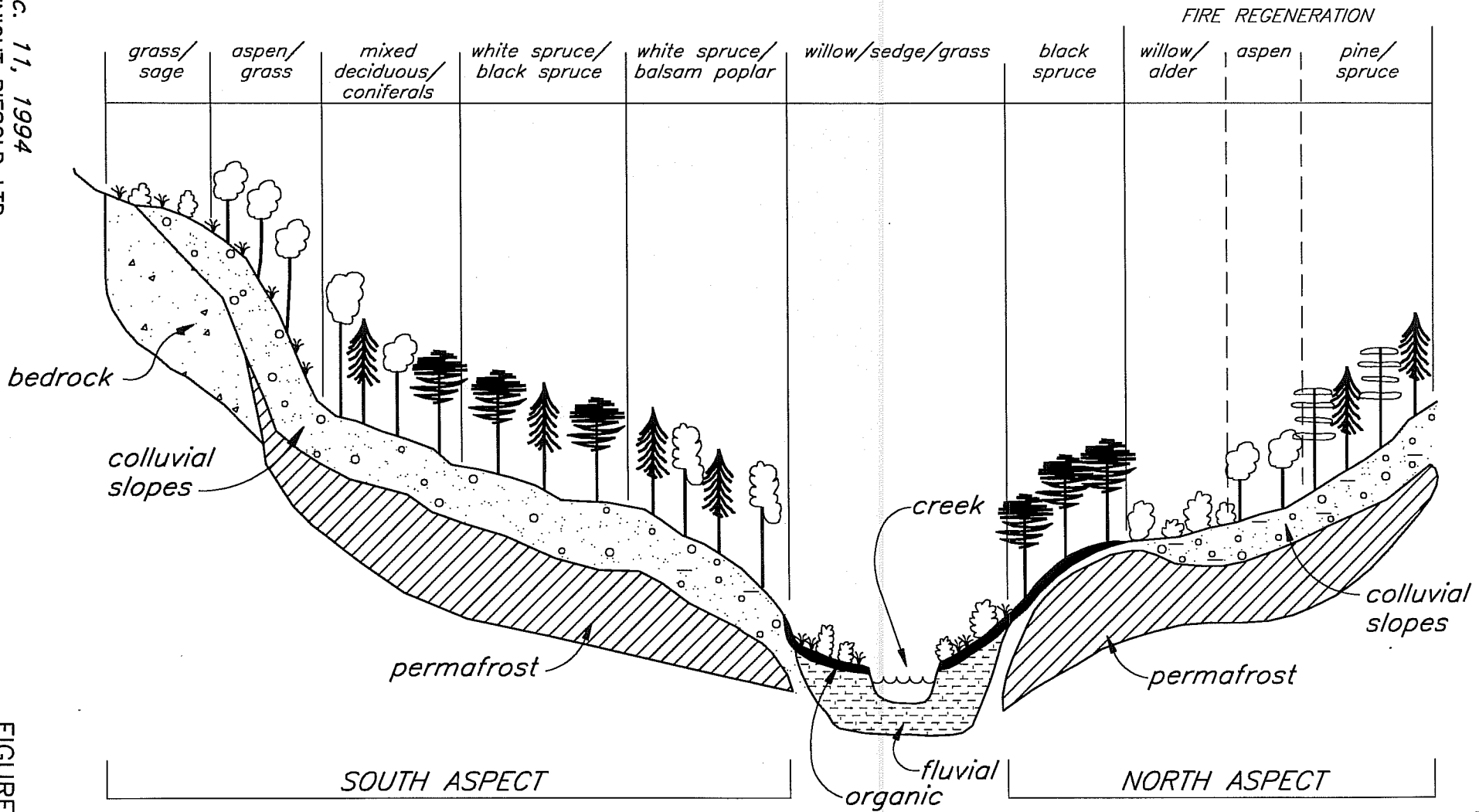
DATE NOV. 30, 1994 | SCALE AS SHOWN | DRG. NO. FIGURE 9.1 | REV. –

CAD FILE: \PROJECT\1000\H3021\FIG\A3 Plot 1=1

MINTO EXPLORATIONS LTD.

MINTO PROJECT

SCHEMATIC VEGETATION AND LANDFORM RELATIONSHIPS



Adapted from: C. Kennedy, 1993

FIGURE 9.2

Dec. 11, 1994

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H3021.A3

SECTION 10.0 - WILDLIFE RESOURCES

10.1 METHODS AND SOURCES OF INFORMATION

Wildlife information was compiled from existing sources including Wildlife Key Habitat Areas maps provided by the Yukon Territory government and the "Initial Environmental Study of the Minto Project" completed by B.C. Research. Key habitats are areas of wildlife use critical to seasonal life functions which may include mineral licks, nesting/breeding grounds or critical winter forage sites and may or may not be used each year (YTG 1994). Local information was also provided by the Selkirk First Nation Land Claims.

Field surveys completed in 1994 included an aerial wildlife survey of the Minto Property, an aerial sheep survey, an aerial raptor survey and a ground survey pellet count. The aerial wildlife survey was undertaken by Hallam Knight Piesold Ltd. on June 4. Concurrently, the sheep survey was conducted in the vicinity of cliffs on the north side of the Yukon River, from Minto Landing to the Yukon River/Pelly River confluence.

A raptor aerial survey was conducted on July 5 in association with Yukon Territorial Government, Fish and Wildlife. The survey began at Carmacks and continued downstream along the Yukon River to Pelly Crossing. The Yukon River valley was checked for the presence of peregrine falcons and golden eagles. If breeding pairs were observed the brood size was determined.

A pellet count survey was conducted in July concurrent with the vegetation transect documentation. Transects (5 m^2) were established in the study area at vegetation transects 1-9 (Figure 9.2) and were assessed for the presence of pellets/scat, trails and the evidence of browsing. Results of the survey are presented in Table 10.2. Other observations pertaining to wildlife sightings or sign are presented in Table 10.3.

10.2 HABITAT CLASSIFICATION

10.2.1 Mixed Coniferous/Deciduous Forest Zone

Wildlife distributions follow vegetation zone classifications. In the Minto Creek valley, wildlife associated with a mixed coniferous/deciduous boreal forest dominated by white and black spruce and trembling aspen may include mammals such as moose, caribou, mule deer, black bear, grey wolf, lynx, marten, ermine, red squirrel, porcupine, varying hare and deer mouse. Bird species which are expected to occur in these zones include northern goshawk, northern hawk-owl, great horned owl, sharp-tailed grouse, ruffed grouse, common raven, grey jay, downy woodpecker, yellow-bellied sapsucker, hermit thrush, least flycatcher, yellow warbler, dark-eyed junco, black-capped chickadee, purple finch, and white-throated sparrow (DeLong et al 1991).

10.2.2 Black spruce/Willow/Sedge Zone

Wildlife often associated with vegetative zones dominated by black spruce, willow and sedge, which occur in the Minto Creek valley, includes moose, caribou, black bear, grey wolf, lynx, wolverine, porcupine, varying hare, red squirrel, deer mouse, and least weasel. Potential birds to be found in these areas include the northern goshawk, northern hawk-owl, spruce grouse, three-toed woodpecker, common raven, grey jay, yellow-bellied sapsucker, hermit thrush, grey-cheeked thrush, Swainson's thrush, dark-eyed junco, Wilson's warbler, Bohemian waxwing, ruby-crowned kinglet, boreal chickadee and red-breasted nuthatch (Pojar and Stewart 1991).

10.2.3 Regenerative Forests

Bird species associated with regenerative forests include sharp-tailed grouse, which do best in early stages of forest succession, and ruffed grouse, in forests where birch, poplar and willow dominate (Canadian Wildlife Service, 1973). Many varieties of smaller birds are similarly specialized in their requirements. The more generally distributed birds include: the hermit thrush, mourning warbler, common yellowthroat, American goldfinch, Northern junco, white-throated sparrow,

eastern kingbird, Say's phoebe, alder flycatcher, tree swallow, house wren, American robin, Townsend's solitaire, Bohemian and cedar waxwings, rusty blackbird and song sparrow (Erskine, 1977).

Moose and deer will often concentrate in areas of recent burn as they require an ample deciduous forest for winter browse. Moose populations will reach a maximum in deciduous successional forest between 10 and 30 years following fire. Black bear and grizzly bear may also move into successional forests in response to an increase in berry-producing shrubs (Kelsall et al. 1977).

A list of the wildlife species that are expected to inhabit the Minto Project area are presented in Table 10.1.

10.3 HABITAT CAPABILITY

10.3.1 Moose

For most of the Yukon, moose key habitat are areas of late winter range. These are habitats where moose aggregate from January to April where browse is available and snow is shallow. Typical of late winter range habitat are areas of dense coniferous forests that prevent the accumulation of snow on the ground. Vegetation in the Minto Project area consists mostly of sparsely growing black spruce, with extensive areas of burn. Therefore, it is very unlikely that moose key habitat is present in the project area.

The Ingersoll Islands, downstream from the mouth of Minto Creek, are used as a spring calving grounds and as rearing during summer months (B.C. Research, 1976, Magrum, 1994). Moose utilize the Yukon River banks and swamp lands below Minto Creek as well as the Minto Creek valley's abundant burn areas. The area of proposed development also provides good summer range for moose. Good summer moose habitat is evident around the project area. New growth on burns provides food. They have been observed congregating on small islands on the Yukon River potentially as a safe place for calving.

Despite this there is some use of the area by moose during winter months. In years of low snow depth, areas that have been disturbed by forest fire or logging can provide winter forage because of the presence of stands of tall shrubs. A number of moose bedding signs were noted during winter water quality sampling within the burned areas on site. It appears that snow depth is not limiting in this site and winter browse is available. The upper portion of the Minto Creek watershed also appears to provide some good summer range for moose as signs of browse and pellets were common.

Based on a Lambert conformal conic projection study conducted by the Yukon Territorial Government, Fish and Wildlife (January, 1994) it has been estimated that there are approximately 40 moose/1000 km^2 in the Minto area. Studies completed for moose populations from 1980 to 1989 for the Casino Trail area indicate 40 moose/1000 km^2, however, due to small numbers, the proportion of bulls and calves to cows could not be determined (YTG 1990).

10.3.2 Caribou

Winter range, migration corridors and rutting areas have been qualified as key habitat for woodland caribou (YTG, 1994). In response to severe winter conditions caribou concentrate in forest and subalpine shrub areas where snow has not accumulated and where lichens, their primary food, are more readily available. Caribou have not been recorded to occur in the immediate project area, but key winter range habitat has been identified for the Klaza herd west of the project, in the headwaters of Big Creek, approximately 15 km from the project.

Work on the caribou in this region is currently in progress (YTG 1994). Beginning in 1987, the Yukon Government has been studying the Klaza Caribou Herd in the area of the proposed Casino Trail south to the Nisling River, north to the Yukon River from Carmacks to the Casino mine site. This area also included the Minto Creek area. Through radio collaring, relocation and stratified random sampling, the Klaza herd has been estimated at 955 animals. Through mapping, the herd's range does not enter into the Minto project area and remains in a winter range where snow depths and pack is favourable for winter forage. The diet and health of the herd was assessed. It was

10.3.4 Mule deer

All mule deer range is classified as key habitat in the Yukon because of their low numbers and their designation as "specially protected wildlife" (YTG, 1994). Mule deer are commonly found in burn areas and on exposed south facing slopes. Burn areas can be considered key habitat if sightings within these areas are common. Mule deer were not sighted on the Minto Property but pellets were observed at two sites in the vicinity of Minto Creek.

10.3.5 Carnivores, furbearers and small mammals

Based on fur harvest and big game harvest statistics for the Minto Project area the following carnivores and furbearers are expected to inhabit the area: coyote, grey wolf, red fox, black bear, grizzly bear, lynx, wolverine, marten, least weasel, mink, river otter and beaver.

Seasonally concentrated feeding areas constitute black bear key habitat (YTG, 1994). Concentrations of black bears in the spring usually occur on open, south aspect slopes in sagewort/bearberry/grassland habitat. Summer and fall feeding areas are those that are productive for berries. Black bears were observed in the lower portion of the watershed during the summer months.

Key habitat for grizzly bears includes areas where they concentrate seasonally, such as feeding areas, floodplains and movement corridors. Feeding areas include areas of high berry production and major salmon spawning rivers (YTG, 1994). Key habitat has not been identified for the Minto Project area, but grizzly were observed on the property. A female grizzly with two cubs was seen adjacent to Minto Creek and a juvenile was observed at the exploration camp located at the top of the Minto Creek watershed.

Although wolves were not observed, tracks were noted at the mouth of Minto Creek. Sign of varying hare and red squirrel were observed throughout the project area. Vole were also observed in the creek valley in areas dominated by black spruce and sphagnum moss.

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10.3.6 Birds

Key habitat for waterfowl includes wetlands used for spring and fall staging, and summer nesting and moulting. Waterfowl are not known to utilize the Minto Project area for any length of time, mainly due to the lack of suitable wetlands in the area. A key habitat area lies approximately 30 km east of the project in the area of the Wilczek lakes which is used for nesting and moulting in the summer (YTG Fish and Wildlife Branch 1974). Waterfowl which may intermittently inhabit the Minto Creek watershed include Canada goose, mallard duck, pintail duck, green-winged teal and American widgeon.

Other game birds that may inhabit the Minto Project area include spruce grouse, ruffed grouse, willow ptarmigan, sharp-tailed grouse, white-tailed ptarmigan and rock ptarmigan. Of the several species of grouse that inhabit the Yukon the sharp-tailed grouse is currently the only species of management concern. Sharp-tailed grouse have a limited distribution in the Yukon because only small pockets of suitable habitat exist. Gravel outwashes with fairly stable aspen parkland habitat and wet sedge-hummock meadows after fire are considered suitable habitats for sharp-tailed grouse. Sharp-tailed grouse and spruce have been observed in the project area.

In the Yukon, gyrfalcon, peregrine falcon, golden eagle, bald eagle and osprey have been given management priority due to their high vulnerability to disturbance. Gyrfalcons and golden eagles are alpine dwellers and peregrine falcons, bald eagles and osprey inhabit riparian areas. Key habitats mapped for alpine and riparian raptors include a 2 km buffer zone to prevent disturbances which might affect breeding success (YTG, 1994). The Minto Project area does not contain any alpine areas and few rock outcrops, therefore, it is unlikely that gyrfalcon or golden eagle inhabit the area. The Yukon River main valley is known as exceptional riparian cliff habitat for birds of prey, notably peregrine falcons and golden eagles. A population of the *Anatum* peregrines, listed as endangered in Canada, is of great importance both to the species as well as the Yukon. The location of breeding peregrines at the historic site at the Pelly River mouth is of particular importance. One pair of peregrine falcons is known to utilize the Yukon River near the Minto Project area (Mossop, pers.comm.).

10.3.7 Reptiles and Amphibians

Many of the areas surrounding the project are too cold and dry for many reptiles and amphibians, however, potential species inhabiting this area include western garter snake, common garter snake, wood frog, spotted frog and western toad. Wood frogs were observed in the vicinity of the Minto Project.

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Table 10.1
Wildlife Species in the Vicinity of the Minto Project Area

Ungulates	
Moose	*Alces alces*
Woodland caribou	*Rangifer tarandus*
Dall sheep	*Ovis dalli dalli*
Mule deer	*Odocoileus hemionus*
Carnivores and Furbearers	
Grizzly bear	*Ursus horribilis*
Black bear	*Ursus americanus*
Coyote	*Canis latrans*
Wolf	*Canis lupens*
Lynx	*Lynx canadensis*
Red fox	*Vulpes vulpes*
Wolverine	
Marten	
Least weasel	
Mink	
Muskrat	
River otter	*Lutra canade*
Beaver	*Castor canadensis*
Squirrel	*Tamiasciurus hudsonicus*
Varying hare	*Lepus americanus*
Game Birds	
Spruce grouse	*Dendragapus canadensis*
Ruffed grouse	*Bonasa umbellus*
Sharp-tailed grouse	*Tympanuchus phasianellus*
Willow ptarmigan	*Lagopus lagopus*
White-tailed ptarmigan	*Lagopus leucurus*
Rock ptarmigan	*Lagopus mutus*
Canada goose	*Branta canadensis*
Mallard duck	*Anas platyrhynchos*
Northern pintail	*Anas acuta*
Green-winged teal	*Anas crecca*
American widgeon	*Anas americana*

Travis - Done

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Table 10.2
Wildlife Survey (July 1994)

Site	Habitat Unit	Species	Sign
1	Mixed Deciduous/Coniferous	Varying hare	pellets winter browse on young aspen
		Grouse sp.	tracks
		Red squirrel	pellets
2	Black and White Spruce	Varying hare	pellets
		Red squirrel	sighting pellets middens
3	Willow, Sedge, Grasses	Varying hare	pellets
		Moose	pellets
4	Fire Regeneration, Aspen	Vole sp.	pellets nests
		Moose	pellets
5	Grasses, Sage	Varying hare	pellets
6	Fire Regeneration, Pine and Spruce	Varying hare	pellets winter browse on willows
7	Fire Regeneration, Aspen	Varying hare	pellets
8	Fire Regeneration, Willows	Moose	pellets browse on scrub birch
		Red-tailed hawk	call sighting
9	Mixed Deciduous/Coniferous	Varying hare	pellets browse on kinnikinnick and willow
		Red squirrel	pellets middens (2)
		Grouse sp.	pellets
		Bohemian waxwing	sighting
		Semipalmated plover	sighting

(L:\Hallam\H3021\EE\wildlf.WK3)

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Table 10.3

Wildlife Observations in the vicinity of the Minto Project

Date	Species	Location	Comments
June 4/94	Dall sheep	North side of Yukon River, northeast of the Minto Project, on cliffs.	4 rams, 13 ewes and 5 lambs observed during sheep survey
June 4/94	Grizzly bear	Lower road	sow and 2 cubs
June 4/94	Grizzly bear	North side of Yukon River, northeast of the Minto Project below cliffs near river.	a sow and 2 yearling cubs
June 5/94	River otter	at H2/W2	tracks on creek bed
June 5/94	Red–tailed hawk	62 37.36 137 13.05	sighting
June 6/94	Bohemian waxwing	near Yukon River, at access road	6 juveniles observed
June 7/94	Moose	Ingersoll Islands	sighting
June 7/94	Moose	Upstream site at Creek B	pellets and signs of browse
June 7/94	Mule deer	at H2/W2	pellets observed
June 7/94	Varying hare	at H2/W2	pellets observed
June 7/94	Moose	At W9	very fresh moose pellets
June 8/94	Vole sp.	At fisheries site 3	holes and pellets in melting snow
June 8/94	Moose	At fisheries site 3	fresh signs of browse
June 8/94	Cliff swallows	At Creek B confluence	sighting
June 8/94	Merganser	At Creek B confluence	sighting
June 8/94	River otter	Upstream of Minto Creek	sighting
July 7/94	Grizzly bear	at camp	yearling
July 7/94	Nighthawk	at camp	sighting
Aug. 10/94	Moose	Lower Minto Creek	tracks
Aug. 10/94	Black bear	Site H2\W2	sighting
Sept. 13/94	Moose	At top of Minto Creek watershed	bull moose, sighting

SECTION 11.0 - LAND CAPABILITY AND HISTORICAL USE

11.1 LAND TENURE

Minto Explorations Ltd. holds the DEF Claims (59) previously held by Falconbridge Limited, the DEF Leases (29), Minto Leases (36) and the Minto Claims (40) (held previously by ASARCO Inc. and Teck Corporation). Collectively, 99 claims and 65 leases which lie at the headwaters of Minto Creek cover an area of approximately 2,731 hectares and are presented in Figure 11.1.

11.2 MINING

The Minto Project was acquired by Minto Explorations Ltd. from ASARCO Inc. and Teck Corporation, and from Falconbridge for the purpose of developing the copper-gold deposit.

Other mining in the area includes placer mining in the Big Creek watershed immediately south of the Project and in Williams Creek, where an open pit copper mine is presently proposed.

11.3 FORESTRY

Very little forestry potential exists in the vicinity of the Minto Project. The lower portions of Minto Creek valley contain small amounts of commercially viable white spruce and some trembling aspen and balsam poplar. Due to the inaccessibility and relatively steep slopes of most of the valley, it is not expected to be feasible for logging.

The upper portion of the Minto Project is dominated by black spruce which are poorly developed and do not have densities adequate for feasible logging. In addition, most of the upper watershed has been burnt by forest fires, the most recent covering 4550 hectares. The burnt timber is not

suitable for pulp and paper manufacturing, but can be salvaged for use as firewood. Minto Explorations Ltd. are examining the viability of harvesting these areas for that purpose (Appendix IV).

11.4 AGRICULTURE

The Minto Project is located within a vegetative zone dominated by black spruce and willow which is typified by a long cold winter and a short cool growing season. Dry conditions prevail and discontinuous permafrost is abundant. Some soils in the lower Minto Creek watershed on alluvial brunisols have moderately low potential for agriculture, however, the site is limited by very xeric conditions and accessibility.

In addition, a majority of the property has been burnt by forest fire and the quality of the existing soil is nutritionally poor (Section 2). Due to the steep slopes, there is little range potential at the proposed mine. Consequently, the agricultural potential of the Minto Project area is rated as very low.

11.5 TRAPPING

Traplines at the Minto Project include RTC 145 held by Glen Bullied, RTC 146 held by Tommy McGinty and RTC 136 registered to Heinz Sauer. Also potentially affected by the proposed mining project are RTC 147 and RTC 142 registered to Kathleen Sam and David Silverfox, respectively (Figure 11.2). Trapping harvest data for the 10 surrounding traplines from 1984 to 1993 is presented in Table 11.1. Species harvest varies in percent composition from year to year but in general, squirrel harvest was largest (12,218 over 10 years) followed by marten (854), lynx (347) and weasel (326).

11.6 HUNTING AND GUIDING

Hunting and guiding in the area is within outfitter concession #13 (Figure 11.3) held by Mr. Rod Hardie of Yukon Hunting and Guiding Ltd., Whitehorse, YT. Guiding returns are presented in Table 11.2. Big game harvests for the area consist mostly of sheep (54%) and moose (22%), with some grizzly bear, grizzly bear, caribou and black bear also hunted. Harvest numbers were at a maximum in 1990, but have decreased in recent years. Numbers of caribou and moose that have been harvested have dropped, but sheep harvest numbers have remained constant.

11.7 RECREATION

Summer canoeing between Whitehorse or Carmacks and Dawson City is very popular, with 693 users registered during 1992. In addition, the annual Yukon Quest Dog Sled race parallels the Yukon River and crosses lower Minto Creek. Besides these activities, hunting and fishing are the main recreational uses of the area surrounding the project.

11.8 ARCHAEOLOGY AND HERITAGE RESOURCES

Four historic sites were identified during an archaeological impact assessment of the Minto Project area. However, three of these sites occur on the east side of the Yukon River opposite the Minto Project. The one site which occurs on the west side of the Yukon River is located near the mouth of Minto Creek and will not be impacted by the proposed development. No sites were detected or are believed to likely exist in the vicinity of open pit or mill site or on the west shore of the Yukon River in the vicinity of the proposed barge landing. Most of the proposed route for the access road is set well back from the Yukon River, and away form such topographic features such as terrace edge or benches, and well away from the mouth of Big Creek. Therefore, it is unlikely that any sites exist in this area. Further details are presented in Volume III.

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Minto Project

Table 11.1
Annual Fur Harvest for Seasons 1983 – 84 to 1992 – 93
(For Surrounding 10 Traplines)

SPECIES	SEASON										
Frequency	1983 – 84	1984 – 85	1985 – 86	1986 – 87	1987 – 88	1988 – 89	1989 – 90	1990 – 91	1991 – 92	1992 – 93	Total
Beaver	4	17	13	23	2	25	0	6	0	2	92
Coyote	0	4	0	0	0	0	1	0	2	3	10
Red fox	13	36	9	5	7	3	2	4	8	4	91
Arctic fox	0	0	1	0	0	0	0	0	0	0	1
Lynx	13	28	17	22	36	67	65	49	22	28	347
Marten	28	136	152	96	133	95	72	32	87	23	854
Mink	3	16	9	11	9	16	2	2	3	0	71
Muskrat	1	4	8	10	6	3	0	0	0	0	32
Otter	0	1	0	0	1	0	0	0	0	1	3
Squirrel	3149	1129	796	920	1854	1625	860	906	79	900	12218
Weasel	1	99	77	22	51	27	29	2	4	14	326
Wolf	3	2	1	2	0	0	1	1	3	0	13
Wolverine	2	13	3	11	1	6	2	4	6	4	52
Total	3217	1485	1086	1122	2100	1867	1034	1006	214	979	14110

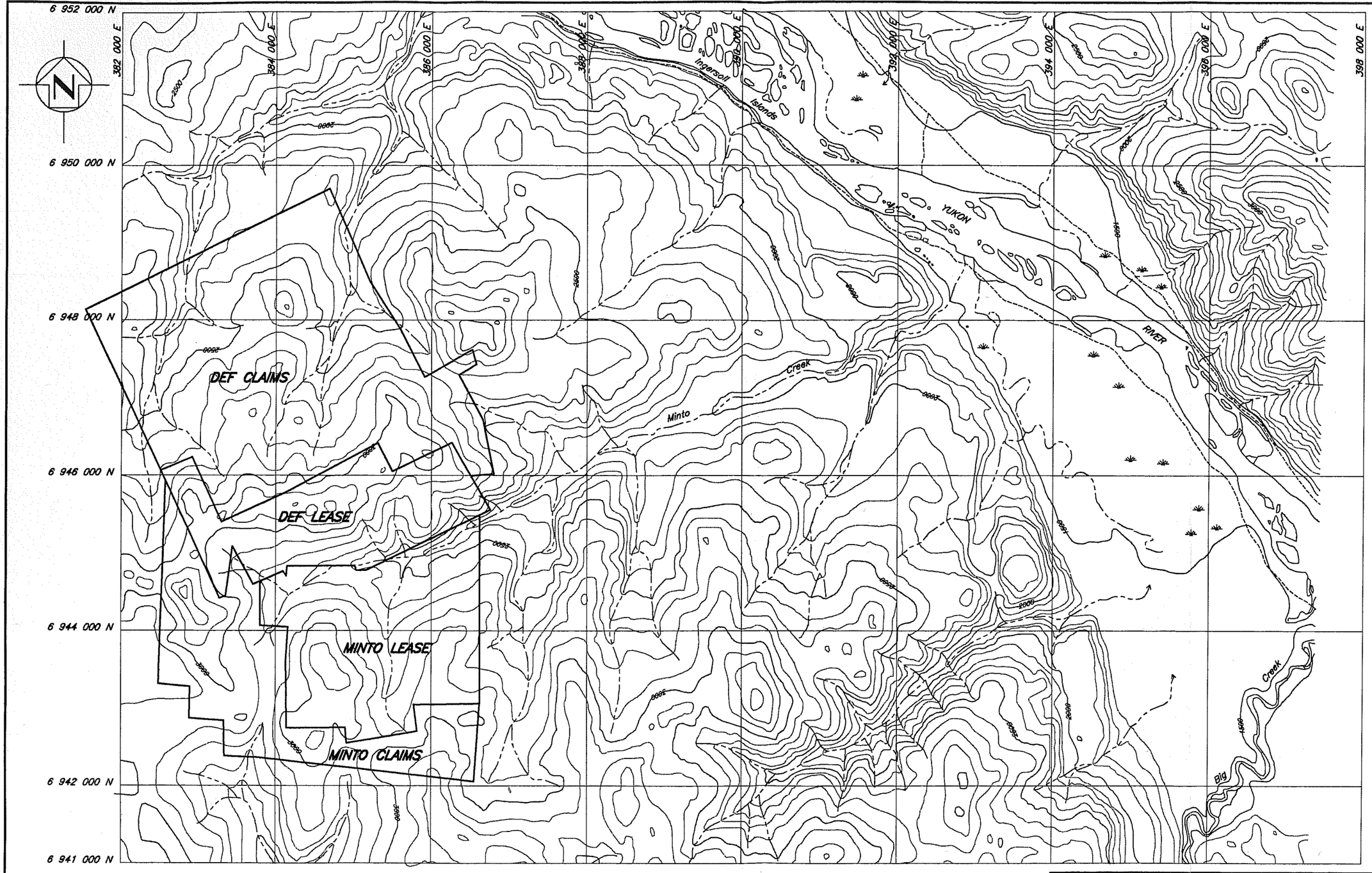
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Table 11.2
Area 13 – Big Game Harvest Statistics
1989 to 1993

Year	Moose	Caribou	Sheep	Black Bear	Grizzly	Total
1989	34	17	40	3	7	101
1990	18	21	57	5	14	115
1991	17	–	38	–	5	60
1992	17	2	43	1	8	71
1993	5	–	42	2	9	58
Total	91	40	220	11	43	405

Note: Aboriginal harvest is NOT included.

(\H3021\IEE\GAMEHARV.WK3)



Scale 1000 500 0 1000 2000 Metres

NOTE: Contour interval 100 feet

CAD FILE \PROJECTS\0001\H3021\02\02 1:25000 Plot 1=25 Dec. 12, 1994

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

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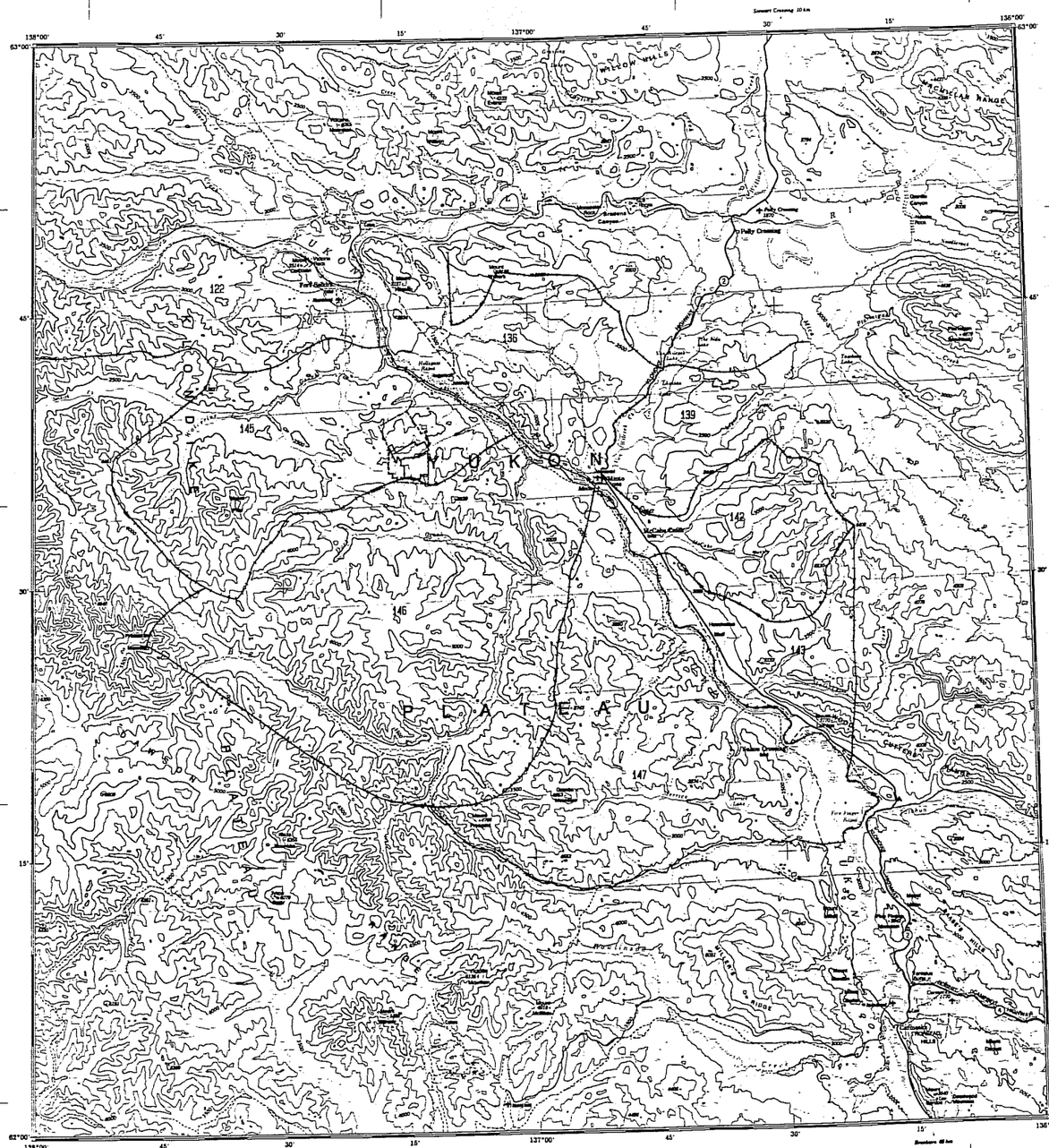
MINTO PROJECT

MINTO LEASES AND CLAIMS AREA

DESIGNED	RH
DRAWN	NAR
CHECKED	RH
APPROVED	

DATE AUG. 10, 1993 | SCALE AS SHOWN | DRG. NO. H3021.101 | REV. A

FIGURE 11.1



145 GLENN BULLIED
BOX 108
CARMACKS, YUKON Y0B 1C0

146 TOMMY McGINTY
GENERAL DELIVERY
PELLY CROSSING, YUKON Y0B 1P0

147 KATHLEEN SAM
BOX 62
CARMACKS, YUKON Y0B 1C0

142 DAVID SILVERFOX
GENERAL DELIVERY
PELLY CROSSING, YUKON Y0B 1P0

136 HEINZ SAUER
BOX 127
CARMACKS, YUKON Y0B 1C0

FIGURE 11.2

CARMACKS
YUKON TERRITORY TERRITOIRE DU YUKON

Scale 1:250 000 Échelle

CONVERSION SCALE FOR ELEVATIONS ÉCHELLE DE CONVERSION DES ALTITUDES

REVISION	BY	DATE
1:		
2:		
3:		
4:		
5:		

MINTO EXPLORATIONS LTD.

TRAP LINES IN THE MINTO PROJECT AREA

Carmacks, N.T.S. 115 I

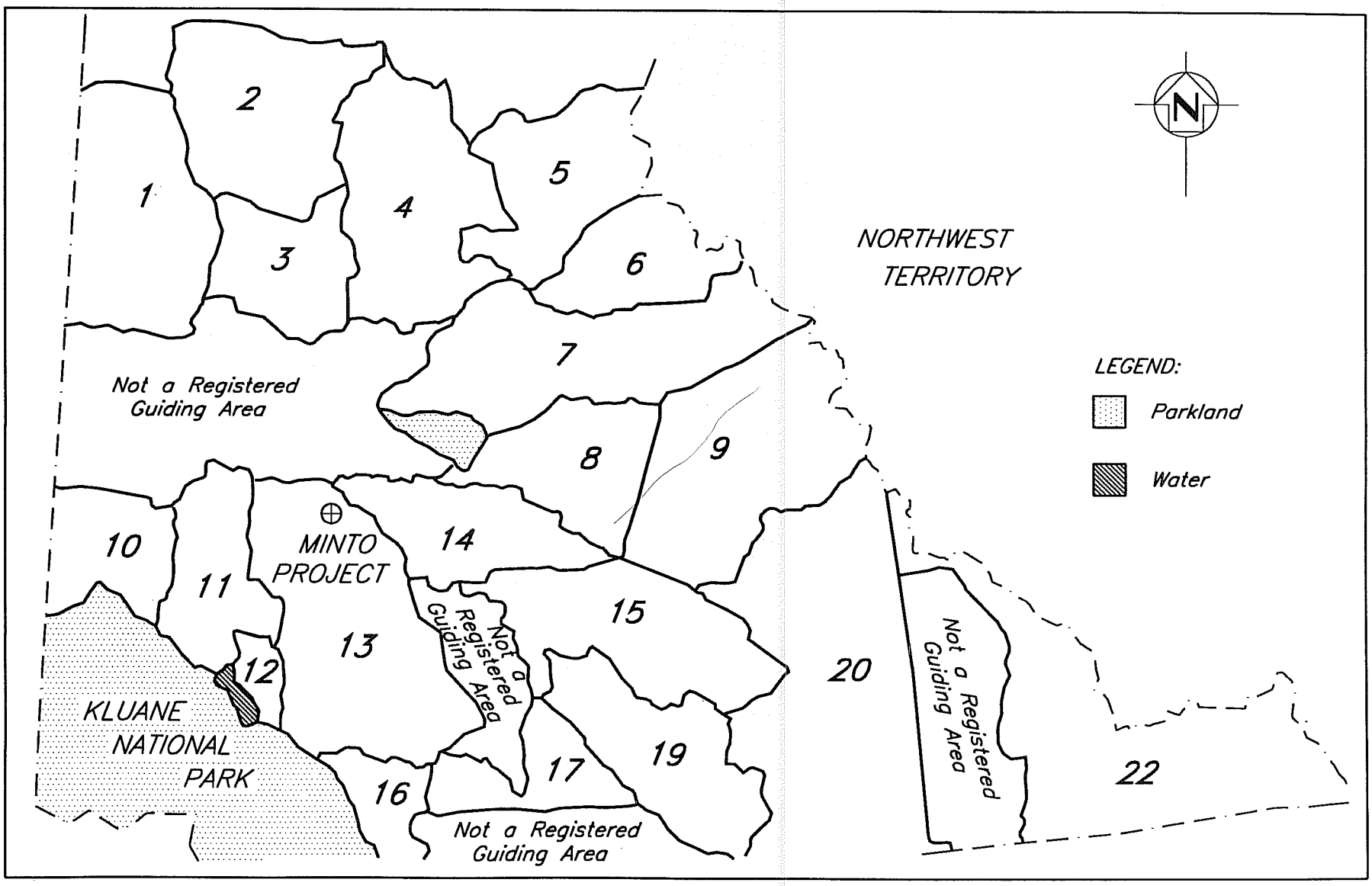
DRAWN BY:	jsp	DRAWING NO:	
DATE:	94/04/11	SCALE:	1 : 250,000
		PROJECT:	MINTO PROJECT, Yukon Territory

CAD FILE: \PROJECT\1000\H3021\FIG\A4 Plot 1=1

MINTO EXPLORATIONS LTD.

MINTO PROJECT

YUKON TERRITORY – BIG GAME GUIDING AREAS



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ENVIRONMENTAL CONSULTANTS

Dec. 11, 1994

FIGURE 11.3

H3021.A4

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APPENDIX I

1993-94 Water Quality and Statistical Analysis Data (Sites W1 to W9)

Table 1

MINTO EXPLORATIONS LTD.
MINTO PROJECT

HKP Station W1 - Minto Creek, Reach 6 (Lower Portion)
Water Quality Data

Date		30-Sep-93	15-May-94	7-Jun-94	8-Jul-94	10-Aug-94	26-Sep-94	Statistics ** Maximum	Minimum	Mean	σ
Physical Tests	Units										
Conductivity	umhos/cm	236	130	208	212	376	323	376	130	247.5	88.3
Total Dissolved Solids	mg/L	167	86	127	143	254	161	254	86	156.3	56.0
Hardness	mg/L CaCO3	126	60.8	93.2	103	185	123	186	60.8	115.2	41.6
pH	pH Units	7.65	7.50	7.48	8.02	8.04	7.91	8.04	7.48	7.767	0.255
Total Suspended Solids	mg/L	39	312	93	46	16	15	312	15	86.8	113.9
Turbidity	NTU	21.5	96.5	37.4	26.3	7.6	6.50	96.5	6.5	32.63	33.39
Anions											
Alkalinity (Total) *	mg/L CaCO3	112	55.0	83.4	94.5	182	11.3	182	11.3	89.7	57.3
Chloride (dissolved)	mg/L	1.4	1.6	0.9	1.2	1.4	0.8	1.6	0.8	1.22	0.31
Fluoride (dissolved)	mg/L	0.13	0.12	0.15	0.12	0.29	0.15	0.29	0.12	0.160	0.065
Sulphate (dissolved)	mg/L	18.0	10.2	16.6	17.8	29.6	20.1	29.6	10.2	18.72	6.30
Nutrients											
Ammonia Nitrogen	mg/L	0.033	0.014	0.291	0.053	0.008	0.015	0.291	0.008	0.0690	0.1100
Nitrate Nitrogen	mg/L	0.064	0.011	0.095	0.042	0.071	0.031	0.095	0.011	0.0523	0.0303
Nitrite Nitrogen	mg/L	<0.001	0.004	0.014	0.005	0.004	0.003	0.014	0.0005	0.0051	0.0046
ortho-Phosphate	mg/L	0.037	0.008	0.027	0.025	0.021	0.021	0.037	0.008	0.0232	0.0095
Total Dissolved Phosphate	mg/L	0.041	0.024	0.033	0.027	0.027	0.024	0.041	0.024	0.0293	0.0066
Total Phosphorus	mg/L	0.105	0.437	0.127	0.098	0.043	0.036	0.437	0.036	0.1410	0.1494
Cyanide											
Total Cyanide	mg/L	0.023	0.042	0.021	0.004	0.014	0.010	0.042	0.004	0.0190	0.0133
Total Metals											
Aluminum (total)	mg/L	0.740	8.60	0.776	0.641	0.249	0.231	8.60	0.231	1.873	3.304
Antimony (total)	mg/L	0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.00005	0.00007	0.00003
Arsenic (total)	mg/L	0.0007	0.0044	0.0012	0.0013	0.0007	0.0005	0.0044	0.0005	0.00147	0.00147
Barium (total)	mg/L	0.083	0.266	0.103	0.074	0.081	0.059	0.266	0.059	0.1110	0.0773
Beryllium (total)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (total)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (total)	mg/L	<0.10	0.36	<0.10	<0.10	<0.10	<0.10	0.36	0.05	0.102	0.127
Cadmium (total)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (total)	mg/L	31.9	21.1	23.8	25.5	42.5	30.5	42.5	21.1	29.22	7.67
Chromium (total)	mg/L	0.001	0.021	0.002	0.002	0.001	<0.001	0.021	0.0005	0.0046	0.0081
Cobalt (total)	mg/L	<0.001	0.006	0.002	0.001	<0.001	<0.001	0.006	0.0005	0.0018	0.0022
Copper (total)	mg/L	0.009	0.073	0.015	0.008	0.005	0.005	0.073	0.005	0.0192	0.0266
Iron (total)	mg/L	2.14	16.2	2.89	1.92	1.1	1.43	16.2	1.1	4.28	5.87
Lead (total)	mg/L	<0.001	0.006	<0.001	0.001	<0.001	<0.001	0.006	0.0005	0.0015	0.002214
Magnesium (total)	mg/L	12.0	9.40	9.74	9.68	19	11.4	19	9.40	11.9	3.6
Manganese (total)	mg/L	0.279	0.612	0.184	0.162	0.159	0.178	0.612	0.159	0.2623	0.1769
Mercury (total)	mg/L	0.00001	0.00002	0.00001	<0.00001	<0.00001	<0.00001	0.00002	0.000005	0.000009	0.000006
Molybdenum (total)	mg/L	<0.001	<0.001	<0.001	0.001	0.002	<0.001	0.002	0.0005	0.0008	0.0006
Nickel (total)	mg/L	0.003	0.030	0.004	0.004	0.002	0.002	0.030	0.002	0.008	0.011
Selenium (total)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (total)	mg/L	6.51	15.4	5.68	5.93	6.38	5.78	15.4	5.68	7.61	3.83
Silver (total)	mg/L	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.00005	0.00006	0.00002
Strontium (total)	mg/L	0.202	0.149	0.164	0.165	0.325	0.186	0.325	0.149	0.1985	0.0647
Uranium (total)	mg/L	0.00028	0.00041	0.00035	0.00022	0.0006	0.00028	0.0006	0.00022	0.00036	0.00014
Vanadium (total)	mg/L	<0.030	0.031	<0.030	<0.030	<0.030	<0.030	0.031	0.015	0.0177	0.0065
Zinc (total)	mg/L	<0.005	0.040	0.007	0.007	<0.005	<0.005	0.040	0.0025	0.0103	0.0147
Dissolved Metals											
Aluminum (dissolved)	mg/L	0.034	0.054	0.048	0.053	0.025	0.040	0.054	0.025	0.0423	0.0115
Antimony (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (dissolved)	mg/L	0.0007	0.0005	0.0005	0.0006	0.0005	0.0004	0.0007	0.0004	0.00053	0.00010
Barium (dissolved)	mg/L	0.065	0.051	0.061	0.06	0.079	0.055	0.079	0.051	0.0618	0.0097
Beryllium (dissolved)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (dissolved)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (dissolved)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Cadmium (dissolved)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (dissolved)	mg/L	31.2	15.1	22.3	25.5	42.5	30.5	42.5	15.1	27.85	9.29
Chromium (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Cobalt (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Copper (dissolved)	mg/L	0.004	0.007	0.006	0.008	0.005	0.005	0.008	0.004	0.0058	0.0015
Iron (dissolved)	mg/L	1.03	0.996	1.03	1.03	0.742	1.04	1.04	0.742	0.978	0.117
Lead (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Magnesium (dissolved)	mg/L	11.7	5.63	9.14	9.68	19	11.4	19	5.63	11.1	4.4
Manganese (dissolved)	mg/L	0.246	0.195	0.113	0.136	0.156	0.174	0.246	0.113	0.1700	0.0469
Molybdenum (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	0.002	0.0005	0.0008	0.0006
Nickel (dissolved)	mg/L	<0.001	0.001	0.002	0.002	0.002	0.001	0.002	0.0005	0.0014	0.0007
Potassium (dissolved)	mg/L	0.69	0.91	0.76	0.56	1.07	0.68	1.07	0.56	0.778	0.183
Selenium (dissolved)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (dissolved)	mg/L	5.92	3.23	4.81	5.66	6.38	5.78	6.38	3.23	5.297	1.135
Silver (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Sodium (dissolved)	mg/L	7.26	3.50	5.96	5.64	11.3	6.59	11.3	3.50	6.71	2.58
Strontium (dissolved)	mg/L	0.197	0.099	0.150	0.165	0.325	0.186	0.325	0.099	0.1870	0.0758
Uranium (dissolved)	mg/L	0.00028	0.00016	0.00024	0.00018	0.00059	0.00023	0.00059	0.00016	0.000280	0.000158
Vanadium (dissolved)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (dissolved)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Organic Parameters											
Dissolved Organic Carbon	mg/L		23.7	19.3				23.7	19.3	21.50	3.11
Total Organic Carbon	mg/L			19.3	18.7	14.8	21.2	21.2	14.8	18.50	2.69

* - BOLD VALUES for Alkalinity indicate moderate to low acid buffering capacity.
** - Statistics calculated using 1/2 the method detection limit where reported as "<" (less than).
- Exceeds Federal (CCME, 1991) Freshwater Guidelines for protection of aquatic life.
- Exceeds B.C. (AWCWQ, 1994) Freshwater Criteria for protection of aquatic life.

Table 2

MINTO EXPLORATIONS LTD.
MINTO PROJECT

HKP Station W2 - Minto Creek, Reach 1
Water Quality Data

Date		30-Sep-93	15-May-94	7-Jun-94	8-Jul-94	10-Aug-94	26-Sep-94	Statistics ** Maximum	Minimum	Mean	σ
Physical Tests	Units										
Conductivity	umhos/cm	197	94.0	175	173	270	205	270	94.0	185.7	57.1
Total Dissolved Solids	mg/L	137	67	123	117	183	128	183	67	125.8	37.3
Hardness	mg/L CaCO3	106	51.2	88.5	86.1	130	98.5	130	51.2	93.4	26.0
pH	pH Units	7.63	7.37	7.63	8.20	7.97	7.84	8.20	7.37	7.773	0.293
Total Suspended Solids	mg/L	17	154	19	48	3	11	154	3	42.0	56.9
Turbidity	NTU	8.50	65.5	8.24	24.9	0.88	2.45	65.5	0.88	18.41	24.59
Anions											
Alkalinity (Total)	mg/L CaCO3	93.7	41.0	79.8	80.8	132	91.9	132	41.0	86.5	29.3
Chloride (dissolved)	mg/L	1.0	1.7	0.9	1.1	1.2	0.5	1.7	0.5	1.07	0.39
Fluoride (dissolved)	mg/L	0.16	0.11	0.20	0.18	0.36	0.21	0.36	0.11	0.203	0.085
Sulphate (dissolved)	mg/L	13.4	7.9	14.2	12.8	20.1	13.8	20.1	7.9	13.70	3.89
Nutrients											
Ammonia Nitrogen	mg/L	<0.005	<0.005	0.015	0.006	<0.005	<0.005	0.015	0.0025	0.0052	0.0050
Nitrate Nitrogen	mg/L	0.048	0.008	0.080	0.039	0.026	<0.005	0.080	0.0025	0.0339	0.0285
Nitrite Nitrogen	mg/L	<0.001	0.005	0.004	0.004	0.002	0.002	0.005	0.0005	0.0029	0.0017
ortho-Phosphate	mg/L	0.014	0.007	0.009	0.010	0.003	0.007	0.014	0.003	0.0083	0.0037
Total Dissolved Phosphate	mg/L	0.018	0.021	0.016	0.014	0.008	0.016	0.021	0.008	0.0155	0.0044
Total Phosphorus	mg/L	0.041	0.173	0.036	0.067	0.008	0.019	0.173	0.008	0.0573	0.0602
Cyanide											
Total Cyanide	mg/L	0.018	0.010	0.020	0.006	0.011	0.011	0.020	0.006	0.0127	0.0053
Total Metals											
Aluminum (total)	mg/L	0.310	4.37	0.316	0.555	0.037	0.098	4.37	0.037	0.948	1.687
Antimony (total)	mg/L	0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.00005	0.00007	0.00003
Arsenic (total)	mg/L	0.0004	0.0024	0.0005	0.0013	0.0003	0.0003	0.0024	0.0003	0.00087	0.00084
Barium (total)	mg/L	0.052	0.134	0.054	0.061	0.064	0.042	0.134	0.042	0.0678	0.0333
Beryllium (total)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (total)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (total)	mg/L	<0.10	0.39	<0.10	<0.10	<0.10	<0.10	0.39	0.05	0.107	0.139
Cadmium (total)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (total)	mg/L	27.8	16.4	22.4	22.5	33.7	25.8	33.7	16.4	24.77	5.84
Chromium (total)	mg/L	0.001	0.011	<0.001	0.002	<0.001	<0.001	0.011	0.0005	0.0026	0.0042
Cobalt (total)	mg/L	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	0.003	0.0005	0.0009	0.0010
Copper (total)	mg/L	0.004	0.030	0.004	0.005	0.002	0.003	0.030	0.002	0.0080	0.0108
Iron (total)	mg/L	0.881	7.53	0.743	1.37	0.082	0.399	7.53	0.082	1.834	2.824
Lead (total)	mg/L	<0.001	0.003	<0.001	0.008	<0.001	<0.001	0.008	0.0005	0.0022	0.0030
Magnesium (total)	mg/L	9.20	6.04	7.90	7.26	11.2	8.25	11.2	6.04	8.31	1.76
Manganese (total)	mg/L	0.035	0.254	0.029	0.042	0.019	0.017	0.254	0.017	0.0660	0.0926
Mercury (total)	mg/L	0.00001	0.00002	0.00001	<0.00001	<0.00001	<0.00001	0.00002	0.000005	0.000009	0.000006
Molybdenum (total)	mg/L	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	0.0005	0.0006	0.0002
Nickel (total)	mg/L	0.002	0.017	0.003	<0.001	0.001	0.001	0.017	0.0005	0.004	0.006
Selenium (total)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (total)	mg/L	6.07	9.81	5.08	5.67	5.49	5.64	9.81	5.08	6.293	1.752
Silver (total)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.00005	0.00000
Strontium (total)	mg/L	0.205	0.121	0.180	0.166	0.300	0.193	0.300	0.121	0.1942	0.0594
Uranium (total)	mg/L	0.00036	0.00039	0.00034	0.00026	0.00071	0.00046	0.00071	0.00026	0.00042	0.00016
Vanadium (total)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (total)	mg/L	<0.005	0.024	<0.005	<0.005	<0.005	<0.005	0.024	0.0025	0.0061	0.0088
Dissolved Metals											
Aluminum (dissolved)	mg/L	0.034	0.053	0.033	0.042	0.019	0.020	0.053	0.019	0.0335	0.0130
Antimony (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (dissolved)	mg/L	0.0004	0.0004	0.0004	0.0004	0.0003	0.0003	0.0004	0.0003	0.00037	0.00005
Barium (dissolved)	mg/L	0.043	0.035	0.046	0.045	0.063	0.042	0.063	0.035	0.0457	0.0093
Beryllium (dissolved)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (dissolved)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (dissolved)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Cadmium (dissolved)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (dissolved)	mg/L	27.5	13.1	22.4	22.5	33.7	25.8	33.7	13.1	24.17	6.83
Chromium (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Cobalt (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Copper (dissolved)	mg/L	0.003	0.006	0.004	0.005	0.002	0.003	0.006	0.002	0.0038	0.0015
Iron (dissolved)	mg/L	0.397	0.531	0.366	0.393	0.063	0.286	0.531	0.063	0.3393	0.1568
Lead (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Magnesium (dissolved)	mg/L	9.06	4.15	7.90	7.26	11.2	8.25	11.2	4.15	7.97	2.32
Manganese (dissolved)	mg/L	0.009	0.041	<0.005	0.007	0.019	0.010	0.041	0.0025	0.0148	0.0139
Molybdenum (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.0005	0.0000
Nickel (dissolved)	mg/L	<0.001	0.002	0.002	<0.001	<0.001	<0.001	0.002	0.0005	0.0010	0.0008
Potassium (dissolved)	mg/L	0.72	0.79	0.81	0.67	1.16	0.79	1.16	0.67	0.823	0.173
Selenium (dissolved)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (dissolved)	mg/L	5.85	3.07	4.90	5.32	5.49	5.64	5.85	3.07	5.045	1.020
Silver (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Sodium (dissolved)	mg/L	5.53	2.46	4.47	4.23	6.83	5.05	6.83	2.46	4.762	1.457
Strontium (dissolved)	mg/L	0.202	0.096	0.180	0.166	0.300	0.193	0.300	0.096	0.1895	0.0660
Uranium (dissolved)	mg/L	0.00033	0.00013	0.00032	0.00024	0.00062	0.00035	0.00062	0.00013	0.000332	0.000163
Vanadium (dissolved)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (dissolved)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Organic Parameters											
Dissolved Organic Carbon	mg/L		30.3	24.1				30.3	24.1	27.20	4.38
Total Organic Carbon	mg/L			24.1	20.7	12.3	18.5	24.1	12.3	18.90	4.97

** - Statistics calculated using 1/2 the method detection limit where reported as "<" (less than).
- Exceeds Federal (CCME, 1991) Freshwater Guidelines for protection of aquatic life.
- Exceeds B.C. (AWCWQ, 1994) Freshwater Criteria for protection of aquatic life.

Table 3

MINTO EXPLORATIONS LTD.
MINTO PROJECT

HKP Station W3 - Minto Creek, Reach 5
Water Quality Data

Date	Units	15-May-94	7-Jun-94	8-Jul-94	10-Aug-94	26-Sep-94	Statistics ** Maximum	Minimum	Mean	σ
Physical Tests										
Conductivity	umhos/cm	125	209	249	352	262	352	125	239.4	82.6
Total Dissolved Solids	mg/L	86	138	150	238	158	238	86	154.0	54.7
Hardness	mg/L CaCO3	62.4	101	106	172	124	172	62.4	113.1	39.9
pH	pH Units	7.51	7.59	8.22	8.07	7.92	8.22	7.51	7.862	0.305
Total Suspended Solids	mg/L	360	20	25	13	9	360	9	85.4	153.6
Turbidity	NTU	130	9.48	14.9	4.6	5.97	130	4.6	32.99	54.38
Anions										
Alkalinity (Total)	mg/L CaCO3	53.0	92.0	99.7	165	117	165	53.0	105.3	40.8
Chloride (dissolved)	mg/L	1.6	1.0	1.2	1.3	0.9	1.6	0.9	1.20	0.27
Fluoride (dissolved)	mg/L	0.12	0.15	0.13	0.31	0.10	0.31	0.10	0.162	0.085
Sulphate (dissolved)	mg/L	10.8	19.2	19.7	30.6	21.3	30.6	10.8	20.32	7.05
Nutrients										
Ammonia Nitrogen	mg/L	0.016	0.027	0.027	<0.005	0.006	0.027	0.0025	0.0157	0.0114
Nitrate Nitrogen	mg/L	0.016	0.082	0.055	0.108	0.040	0.108	0.016	0.0602	0.0359
Nitrite Nitrogen	mg/L	0.004	0.009	0.004	0.004	0.004	0.009	0.004	0.0050	0.0022
ortho-Phosphate	mg/L	0.009	0.020	0.021	0.013	0.020	0.021	0.009	0.0166	0.0053
Total Dissolved Phosphate	mg/L	0.023	0.027	0.032	0.019	0.027	0.032	0.019	0.0256	0.0049
Total Phosphorus	mg/L	0.173	0.052	0.052	0.03	0.033	0.173	0.03	0.068	0.060
Cyanide										
Total Cyanide	mg/L	0.044	0.022	0.006	0.014	0.012	0.044	0.006	0.0196	0.0148
Total Metals										
Aluminum (total)	mg/L	8.76	0.320	0.343	0.176	0.162	8.76	0.162	1.952	3.807
Antimony (total)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (total)	mg/L	0.0044	0.0006	0.0011	0.0005	0.0004	0.0044	0.0004	0.00140	0.00170
Barium (total)	mg/L	0.269	0.064	0.066	0.071	0.054	0.269	0.054	0.1048	0.0920
Beryllium (total)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (total)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (total)	mg/L	0.36	<0.10	<0.10	<0.10	<0.10	0.36	0.05	0.112	0.139
Cadmium (total)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (total)	mg/L	22.1	24.8	26.5	41.6	31.4	41.6	22.1	29.28	7.68
Chromium (total)	mg/L	0.018	0.001	0.001	<0.001	<0.001	0.018	0.0005	0.0042	0.0077
Cobalt (total)	mg/L	0.006	<0.001	<0.001	<0.001	<0.001	0.006	0.0005	0.0016	0.0025
Copper (total)	mg/L	0.073	0.006	0.007	0.004	0.005	0.073	0.004	0.0190	0.0302
Iron (total)	mg/L	16.0	1.21	1.38	0.66	1.07	16	0.66	4.064	6.678
Lead (total)	mg/L	<0.001	<0.001	0.022	<0.001	<0.001	0.022	0.0005	0.0048	0.0096
Magnesium (total)	mg/L	9.38	9.57	9.64	16.6	11.0	16.6	9.38	11.24	3.07
Manganese (total)	mg/L	0.649	0.097	0.131	0.143	0.168	0.649	0.097	0.2376	0.2314
Mercury (total)	mg/L	0.00003	0.00001	<0.00001	<0.00001	<0.00001	0.00003	0.000005	0.000011	0.000011
Molybdenum (total)	mg/L	<0.001	0.001	<0.001	0.002	0.003	0.003	0.0005	0.0014	0.0011
Nickel (total)	mg/L	0.025	0.002	0.003	0.002	0.001	0.025	0.001	0.007	0.010
Selenium (total)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (total)	mg/L	16.0	5.11	5.62	6.19	5.79	16.0	5.11	7.74	4.63
Silver (total)	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.00005	0.00006	0.00002
Strontium (total)	mg/L	0.156	0.174	0.176	0.33	0.195	0.33	0.156	0.206	0.071
Uranium (total)	mg/L	0.00062	0.00033	0.00024	0.00072	0.00035	0.00072	0.00024	0.00045	0.00021
Vanadium (total)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (total)	mg/L	0.037	<0.005	0.007	0.005	<0.005	0.037	0.0025	0.0108	0.0148
Dissolved Metals										
Aluminum (dissolved)	mg/L	0.078	0.039	0.045	0.023	0.026	0.078	0.023	0.0422	0.0220
Antimony (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (dissolved)	mg/L	0.0004	0.0004	0.0004	0.0004	0.0003	0.0004	0.0003	0.00038	0.00004
Barium (dissolved)	mg/L	0.048	0.061	0.058	0.067	0.054	0.067	0.048	0.0576	0.0072
Beryllium (dissolved)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (dissolved)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (dissolved)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Cadmium (dissolved)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (dissolved)	mg/L	15.7	24.7	26.5	41.6	31.4	41.6	15.7	27.98	9.50
Chromium (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Cobalt (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Copper (dissolved)	mg/L	0.008	0.005	0.007	0.004	0.004	0.008	0.004	0.0056	0.0018
Iron (dissolved)	mg/L	0.966	0.797	0.816	0.399	0.820	0.966	0.399	0.7596	0.2126
Lead (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Magnesium (dissolved)	mg/L	5.65	9.50	9.64	16.6	11.0	16.6	5.65	10.48	3.96
Manganese (dissolved)	mg/L	0.188	0.086	0.112	0.131	0.168	0.188	0.086	0.1370	0.0413
Molybdenum (dissolved)	mg/L	<0.001	0.001	<0.001	0.002	0.001	0.002	0.0005	0.0010	0.0006
Nickel (dissolved)	mg/L	0.001	0.001	0.002	0.001	<0.001	0.002	0.0005	0.0011	0.0005
Potassium (dissolved)	mg/L	0.85	0.88	0.64	1.26	0.81	1.26	0.64	0.888	0.228
Selenium (dissolved)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (dissolved)	mg/L	3.29	5.08	5.62	6.19	5.79	6.19	3.29	5.194	1.137
Silver (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Sodium (dissolved)	mg/L	3.43	6.08	5.70	11.4	6.66	11.4	3.43	6.65	2.92
Strontium (dissolved)	mg/L	0.102	0.170	0.176	0.33	0.195	0.330	0.102	0.1946	0.0835
Uranium (dissolved)	mg/L	0.00014	0.00026	0.00020	0.00068	0.00030	0.00068	0.00014	0.000316	0.000212
Vanadium (dissolved)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (dissolved)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Organic Parameters										
Dissolved Organic Carbon	mg/L	24.1	17.6				24.1	17.6	20.85	4.60
Total Organic Carbon	mg/L		20.2	17.2	12.3	14.7	20.2	12.3	16.10	3.39

** - Statistics calculated using 1/2 the method detection limit where reported as "<" (less than).
- Exceeds Federal (CCME, 1991) Freshwater Guidelines for protection of aquatic life.
- Exceeds B.C. (AWCWQ, 1994) Freshwater Criteria for protection of aquatic life.

Table 4

MINTO EXPLORATIONS LTD.
MINTO PROJECT

HKP Station W4 - Yukon River (Upstream)
Water Quality Data

Date	Units	15-May-94	7-Jun-94	8-Jul-94	10-Aug-94	26-Sep-94	*Statistics* ** Maximum	Minimum	Mean	σ
Physical Tests										
Conductivity	umhos/cm	142	145	142	132	66.3	145	66.3	125.5	33.4
Total Dissolved Solids	mg/L	94	88	90	80	74	94	74	85.2	8.1
Hardness	mg/L CaCO3	70.4	71.9	69.7	65.8	62.0	71.9	62.0	67.96	4.02
pH	pH Units	7.89	7.79	8.30	7.96	7.92	8.30	7.79	7.972	0.194
Total Suspended Solids	mg/L	73	63	18	11	6	73	6	34.2	31.3
Turbidity	NTU	38.4	17.5	8.26	5.32	3.06	38.4	3.06	14.51	14.44
Anions										
Alkalinity (Total)	mg/L CaCO3	63.7	65.3	64.0	60.6	54.5	65.3	54.5	61.6	4.3
Chloride (dissolved)	mg/L	1.0	0.5	0.6	0.6	<0.5	1.0	0.25	0.59	0.27
Fluoride (dissolved)	mg/L	0.11	0.10	0.09	0.18	0.11	0.18	0.09	0.118	0.036
Sulphate (dissolved)	mg/L	11.1	8.6	8.4	8.3	8.4	11.1	8.3	8.96	1.20
Nutrients										
Ammonia Nitrogen	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Nitrate Nitrogen	mg/L	0.023	0.024	0.007	<0.005	0.005	0.024	0.0025	0.0123	0.0104
Nitrite Nitrogen	mg/L	0.002	0.004	0.003	0.002	0.002	0.004	0.002	0.0026	0.0009
ortho-Phosphate	mg/L	0.001	0.024	0.015	0.004	0.004	0.024	0.001	0.0096	0.0097
Total Dissolved Phosphate	mg/L	0.008	0.032	0.016	0.005	0.006	0.032	0.005	0.0134	0.0113
Total Phosphorus	mg/L	0.06	0.062	0.026	0.017	0.017	0.062	0.017	0.0364	0.0228
Cyanide										
Total Cyanide	mg/L	0.014	0.002	<0.001	<0.001	<0.001	0.014	0.0005	0.0035	0.0059
Total Metals										
Aluminum (total)	mg/L	0.684	0.624	0.154	0.166	0.108	0.684	0.108	0.3472	0.2817
Antimony (total)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (total)	mg/L	0.0010	0.0007	<0.0001	0.0005	0.0003	0.0010	0.00005	0.00051	0.00036
Barium (total)	mg/L	0.055	0.045	0.037	0.032	0.026	0.055	0.026	0.0390	0.0113
Beryllium (total)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (total)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (total)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Cadmium (total)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (total)	mg/L	20.4	20.2	20.9	19.2	18.3	20.9	18.3	19.80	1.04
Chromium (total)	mg/L	0.003	0.001	<0.001	<0.001	<0.001	0.003	0.0005	0.0011	0.0011
Cobalt (total)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.0005	0.0000
Copper (total)	mg/L	0.004	0.002	0.001	<0.001	0.001	0.004	0.0005	0.0017	0.0014
Iron (total)	mg/L	1.03	0.561	0.210	0.179	0.102	1.03	0.102	0.416	0.386
Lead (total)	mg/L	0.005	<0.001	0.016	<0.001	<0.001	0.016	0.0005	0.0045	0.0067
Magnesium (total)	mg/L	5.91	5.52	4.90	4.37	3.95	5.91	3.95	4.930	0.804
Manganese (total)	mg/L	0.045	0.030	0.014	0.01	0.006	0.045	0.006	0.0210	0.0162
Mercury (total)	mg/L	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	0.00001	0.000005	0.000006	0.000002
Molybdenum (total)	mg/L	<0.001	<0.001	<0.001	0.001	<0.001	0.001	0.0005	0.0006	0.0002
Nickel (total)	mg/L	0.003	0.001	0.001	<0.001	<0.001	0.003	0.0005	0.001	0.001
Selenium (total)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (total)	mg/L	3.79	3.56	3.24	2.54	2.34	3.79	2.34	3.094	0.632
Silver (total)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Strontium (total)	mg/L	0.117	0.094	0.087	0.087	0.077	0.12	0.077	0.092	0.015
Uranium (total)	mg/L	0.00078	0.00060	0.00054	0.00058	0.00076	0.00078	0.00054	0.000652	0.000110
Vanadium (total)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (total)	mg/L	0.013	<0.005	<0.005	<0.005	<0.005	0.013	0.0025	0.0046	0.0047
Dissolved Metals										
Aluminum (dissolved)	mg/L	0.035	0.020	0.023	0.013	0.007	0.035	0.007	0.0196	0.0106
Antimony (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (dissolved)	mg/L	0.0004	0.0003	<0.0001	0.0005	0.0003	0.0005	0.00005	0.00031	0.00017
Barium (dissolved)	mg/L	0.039	0.037	0.033	0.029	0.026	0.039	0.026	0.0328	0.0054
Beryllium (dissolved)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (dissolved)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (dissolved)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Cadmium (dissolved)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (dissolved)	mg/L	19.2	19.7	20.1	19.2	18.3	20.1	18.3	19.30	0.67
Chromium (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Cobalt (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Copper (dissolved)	mg/L	0.002	0.001	<0.001	<0.001	0.001	0.002	0.0005	0.0010	0.0006
Iron (dissolved)	mg/L	0.075	<0.030	<0.030	<0.030	<0.030	0.075	0.015	0.0270	0.0268
Lead (dissolved)	mg/L	<0.001	<0.001	0.002	<0.001	<0.001	0.002	0.0005	0.00080	0.00067
Magnesium (dissolved)	mg/L	5.47	5.52	4.75	4.37	3.95	5.52	3.95	4.812	0.685
Manganese (dissolved)	mg/L	0.007	0.005	<0.005	<0.005	<0.005	0.007	0.0025	0.0039	0.0020
Molybdenum (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Nickel (dissolved)	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.0005	0.0006	0.0002
Potassium (dissolved)	mg/L	0.89	0.72	0.76	0.68	0.74	0.89	0.68	0.758	0.079
Selenium (dissolved)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (dissolved)	mg/L	2.83	3.40	2.96	2.47	2.25	3.40	2.25	2.782	0.446
Silver (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Sodium (dissolved)	mg/L	2.35	2.20	1.53	1.37	1.48	2.35	1.37	1.786	0.453
Strontium (dissolved)	mg/L	0.113	0.090	0.085	0.087	0.077	0.113	0.077	0.0904	0.0135
Uranium (dissolved)	mg/L	0.00064	0.00060	0.00045	0.00058	0.00063	0.00064	0.00045	0.000580	0.000076
Vanadium (dissolved)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (dissolved)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Organic Parameters										
Dissolved Organic Carbon	mg/L	10.4	3.27				10.4	3.27	6.84	5.04
Total Organic Carbon	mg/L		3.4	2.1	1.7	1.7	3.4	1.7	2.23	0.81

** - Statistics calculated using 1/2 the method detection limit where reported as "<" (less than).
- Exceeds Federal (CCME, 1991) Freshwater Guidelines for protection of aquatic life.
- Exceeds B.C. (AWCWQ, 1994) Freshwater Criteria for protection of aquatic life.

Table 5

MINTO EXPLORATIONS LTD.
MINTO PROJECT

HKP Station W5 - Yukon River (Downstream)
Water Quality Data

Date	Units	15-May-94	7-Jun-94	8-Jul-94	10-Aug-94	26-Sep-94	Statistics ** Maximum	Minimum	Mean	σ
Physical Tests										
Conductivity	umhos/cm	158	144	141	134	136	158	134	142.6	9.5
Total Dissolved Solids	mg/L	101	88	91	82	79	101	79	88.2	8.6
Hardness	mg/L CaCO3	75.4	72.4	69.9	66.2	68.8	75.4	66.2	70.54	3.51
pH	pH Units	7.93	7.40	8.10	7.96	7.89	8.10	7.40	7.856	0.267
Total Suspended Solids	mg/L	51	52	14	9	5	52	5	26.2	23.3
Turbidity	NTU	30.1	19.4	7.03	4.74	2.34	30.1	2.34	12.72	11.73
Anions										
Alkalinity (Total)	mg/L CaCO3	70.9	65.2	66.4	63.9	58.5	70.9	58.5	64.98	4.48
Chloride (dissolved)	mg/L	0.9	0.5	0.5	<0.5	<0.5	0.9	0.25	0.48	0.27
Fluoride (dissolved)	mg/L	0.10	0.10	0.09	0.16	0.11	0.16	0.09	0.112	0.028
Sulphate (dissolved)	mg/L	10.6	8.9	8.0	8.2	7.9	10.6	7.9	8.72	1.12
Nutrients										
Ammonia Nitrogen	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Nitrate Nitrogen	mg/L	0.022	0.023	0.006	<0.005	0.006	0.023	0.0025	0.0119	0.0098
Nitrite Nitrogen	mg/L	0.001	0.004	0.003	0.002	0.002	0.004	0.001	0.0024	0.0011
ortho-Phosphate	mg/L	<0.001	0.008	0.015	0.004	0.003	0.015	0.0005	0.0061	0.0057
Total Dissolved Phosphate	mg/L	0.003	0.011	0.017	0.005	0.005	0.017	0.003	0.0082	0.0058
Total Phosphorus	mg/L	0.094	0.056	0.033	0.011	0.014	0.094	0.011	0.0416	0.0344
Cyanide										
Total Cyanide	mg/L	0.004	0.003	0.002	0.001	<0.001	0.004	0.0005	0.0021	0.0014
Total Metals										
Aluminum (total)	mg/L	0.740	0.557	0.180	0.153	0.028	0.740	0.028	0.3316	0.3019
Antimony (total)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (total)	mg/L	0.0010	0.0008	0.0011	0.0005	0.0003	0.0011	0.0003	0.00074	0.00034
Barium (total)	mg/L	0.058	0.045	0.038	0.033	0.031	0.058	0.031	0.0410	0.0109
Beryllium (total)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (total)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (total)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Cadmium (total)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (total)	mg/L	22.6	20.3	20.5	19.2	20.5	22.6	19.2	20.62	1.23
Chromium (total)	mg/L	0.003	0.001	<0.001	<0.001	<0.001	0.003	0.0005	0.0011	0.0011
Cobalt (total)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.0005	0.0000
Copper (total)	mg/L	0.004	0.002	0.001	0.003	<0.001	0.004	0.0005	0.0021	0.0014
Iron (total)	mg/L	1.18	0.560	0.240	0.15	0.098	1.18	0.098	0.446	0.448
Lead (total)	mg/L	0.004	<0.001	0.002	<0.001	<0.001	0.004	0.0005	0.0015	0.0015
Magnesium (total)	mg/L	6.28	5.54	4.99	4.42	4.33	6.28	4.33	5.112	0.814
Manganese (total)	mg/L	0.047	0.029	0.015	0.01	<0.005	0.047	0.0025	0.0207	0.0176
Mercury (total)	mg/L	0.00001	0.00001	<0.00001	<0.00001	<0.00001	0.00001	0.000005	0.000007	0.000003
Molybdenum (total)	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	0.0005	0.0007	0.0003
Nickel (total)	mg/L	0.003	0.001	0.001	<0.001	<0.001	0.003	0.0005	0.001	0.001
Selenium (total)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (total)	mg/L	3.73	3.56	3.30	2.57	2.51	3.73	2.51	3.134	0.564
Silver (total)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Strontium (total)	mg/L	0.116	0.095	0.091	0.088	0.087	0.116	0.087	0.0954	0.0119
Uranium (total)	mg/L	0.00071	0.00065	0.00057	0.0006	0.00073	0.00073	0.00057	0.000652	0.000069
Vanadium (total)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (total)	mg/L	0.013	<0.005	<0.005	<0.005	<0.005	0.013	0.0025	0.0046	0.0047
Dissolved Metals										
Aluminum (dissolved)	mg/L	0.019	0.021	0.019	0.018	<0.005	0.021	0.0025	0.0159	0.0076
Antimony (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (dissolved)	mg/L	0.0004	0.0003	0.0002	0.0005	0.0003	0.0005	0.0002	0.00034	0.00011
Barium (dissolved)	mg/L	0.040	0.035	0.033	0.032	0.029	0.040	0.029	0.0338	0.0041
Beryllium (dissolved)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (dissolved)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (dissolved)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Cadmium (dissolved)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (dissolved)	mg/L	20.9	20.1	20.1	19.2	20.5	20.9	19.2	20.16	0.63
Chromium (dissolved)	mg/L	<0.001	0.001	<0.001	<0.001	<0.001	0.001	0.0005	0.00060	0.00022
Cobalt (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Copper (dissolved)	mg/L	0.002	0.001	<0.001	<0.001	<0.001	0.002	0.0005	0.0009	0.0007
Iron (dissolved)	mg/L	0.044	0.096	0.031	<0.030	<0.030	0.096	0.015	0.0402	0.0335
Lead (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Magnesium (dissolved)	mg/L	5.66	5.43	4.81	4.42	4.31	5.66	4.31	4.926	0.600
Manganese (dissolved)	mg/L	0.007	0.006	<0.005	<0.005	<0.005	0.007	0.0025	0.0041	0.0022
Molybdenum (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Nickel (dissolved)	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.0005	0.0006	0.0002
Potassium (dissolved)	mg/L	0.91	0.72	0.74	0.69	0.79	0.91	0.69	0.770	0.086
Selenium (dissolved)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (dissolved)	mg/L	2.70	3.26	3.04	2.53	2.38	3.26	2.38	2.782	0.363
Silver (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Sodium (dissolved)	mg/L	2.16	2.00	1.63	1.44	1.59	2.16	1.44	1.764	0.302
Strontium (dissolved)	mg/L	0.110	0.095	0.088	0.088	0.086	0.110	0.086	0.0934	0.0099
Uranium (dissolved)	mg/L	0.00070	0.00065	0.00047	0.00057	0.00067	0.0007	0.00047	0.000612	0.000093
Vanadium (dissolved)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (dissolved)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Organic Parameters										
Dissolved Organic Carbon	mg/L	5.49	2.72				5.49	2.72	4.105	1.959
Total Organic Carbon	mg/L		3.2	2.5	1.8	1.6	3.2	1.6	2.28	0.73

** - Statistics calculated using 1/2 the method detection limit where reported as "<" (less than).
- Exceeds Federal (CCME, 1991) Freshwater Guidelines for protection of aquatic life.
- Exceeds B.C. (AWCWQ, 1994) Freshwater Criteria for protection of aquatic life.

Table 6

MINTO EXPLORATIONS LTD.
MINTO PROJECT

HKP Station W6 - Minto Creek Tributary #3
Water Quality Data

Date		7-Jun-94	8-Jul-94	10-Aug-94	Statistics ** Maximum	Minimum	Mean	σ
Physical Tests	Units							
Conductivity	umhos/cm	139	148	208	208	139	165.0	37.5
Total Dissolved Solids	mg/L	86	102	143	143	86	110.3	29.4
Hardness	mg/L CaCO3	69.5	75.7	106	106	69.5	83.7	19.5
pH	pH Units	7.25	7.81	7.71	7.81	7.25	7.590	0.299
Total Suspended Solids	mg/L	19	22	19	22	19	20.0	1.7
Turbidity	NTU	3.63	4.38	1.86	4.38	1.86	3.290	1.294
Anions								
Alkalinity (Total)	mg/L CaCO3	68.2	78	114	114	68.2	86.7	24.1
Chloride (dissolved)	mg/L	0.6	1.0	1.1	1.1	0.6	0.90	0.26
Fluoride (dissolved)	mg/L	0.18	0.16	0.31	0.31	0.16	0.217	0.081
Sulphate (dissolved)	mg/L	5.3	6.0	6.4	6.4	5.3	5.90	0.56
Nutrients								
Ammonia Nitrogen	mg/L	<0.005	0.041	0.007	0.041	0.0025	0.0168	0.0210
Nitrate Nitrogen	mg/L	0.051	0.008	0.021	0.051	0.008	0.0267	0.0221
Nitrite Nitrogen	mg/L	0.003	0.002	0.002	0.003	0.002	0.0023	0.0006
ortho-Phosphate	mg/L	0.007	0.007	0.003	0.007	0.003	0.0057	0.0023
Total Dissolved Phosphate	mg/L	0.013	0.011	0.009	0.013	0.009	0.0110	0.0020
Total Phosphorus	mg/L	0.022	0.026	0.017	0.026	0.017	0.0217	0.0045
Cyanide								
Total Cyanide	mg/L	0.010	0.008	0.005	0.010	0.005	0.0077	0.0025
Total Metals								
Aluminum (total)	mg/L	0.646	0.081	0.122	0.646	0.081	0.2830	0.3150
Antimony (total)	mg/L	0.0002	<0.0001	<0.0001	0.0002	0.00005	0.00010	0.00009
Arsenic (total)	mg/L	0.0006	0.0012	0.0004	0.0012	0.0004	0.00073	0.00042
Barium (total)	mg/L	0.057	0.055	0.058	0.058	0.055	0.0567	0.0015
Beryllium (total)	mg/L	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (total)	mg/L	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (total)	mg/L	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Cadmium (total)	mg/L	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (total)	mg/L	19.8	21.0	30.0	30.0	19.8	23.60	5.57
Chromium (total)	mg/L	0.001	0.002	<0.001	0.002	0.0005	0.0012	0.0008
Cobalt (total)	mg/L	<0.001	<0.001	<0.001	0.0005	0.0005	0.0005	0.0000
Copper (total)	mg/L	0.002	0.002	0.001	0.002	0.001	0.0017	0.0006
Iron (total)	mg/L	0.800	0.979	0.165	0.979	0.165	0.6480	0.4278
Lead (total)	mg/L	0.001	0.030	<0.001	0.030	0.0005	0.0105	0.0169
Magnesium (total)	mg/L	5.38	5.69	7.6	7.6	5.38	6.22	1.20
Manganese (total)	mg/L	0.056	0.039	0.014	0.056	0.014	0.0363	0.0211
Mercury (total)	mg/L	<0.00001	<0.00001	<0.00001	0.000005	0.000005	0.000005	0.000000
Molybdenum (total)	mg/L	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.0000
Nickel (total)	mg/L	0.003	0.004	0.001	0.004	0.001	0.0027	0.002
Selenium (total)	mg/L	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (total)	mg/L	7.51	7.52	8.66	8.66	7.51	7.897	0.661
Silver (total)	mg/L	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Strontium (total)	mg/L	0.087	0.094	0.136	0.136	0.087	0.1057	0.0265
Uranium (total)	mg/L	0.00006	0.00005	0.00009	0.00009	0.00005	0.000067	0.000021
Vanadium (total)	mg/L	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (total)	mg/L	<0.005	0.007	<0.005	0.007	0.0025	0.0040	0.0026
Dissolved Metals								
Aluminum (dissolved)	mg/L	0.016	0.029	0.015	0.029	0.015	0.0200	0.0078
Antimony (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (dissolved)	mg/L	0.0002	0.0002	0.0003	0.0003	0.0002	0.00023	0.00006
Barium (dissolved)	mg/L	0.037	0.038	0.054	0.054	0.037	0.0430	0.0095
Beryllium (dissolved)	mg/L	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (dissolved)	mg/L	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (dissolved)	mg/L	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Cadmium (dissolved)	mg/L	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (dissolved)	mg/L	19.2	21.0	30.0	30.0	19.2	23.40	5.79
Chromium (dissolved)	mg/L	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Cobalt (dissolved)	mg/L	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Copper (dissolved)	mg/L	0.001	0.002	0.001	0.002	0.001	0.0013	0.0006
Iron (dissolved)	mg/L	0.113	0.109	0.039	0.113	0.039	0.0870	0.0416
Lead (dissolved)	mg/L	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Magnesium (dissolved)	mg/L	5.24	5.65	7.6	7.6	5.24	6.16	1.26
Manganese (dissolved)	mg/L	<0.005	0.007	<0.005	0.007	0.0025	0.0040	0.0026
Molybdenum (dissolved)	mg/L	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Nickel (dissolved)	mg/L	0.001	0.001	<0.001	0.001	0.0005	0.0008	0.0003
Potassium (dissolved)	mg/L	0.68	0.34	0.54	0.68	0.34	0.520	0.171
Selenium (dissolved)	mg/L	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (dissolved)	mg/L	7.27	7.42	8.66	8.66	7.27	7.783	0.763
Silver (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Sodium (dissolved)	mg/L	3.35	3.58	5.38	5.38	3.35	4.103	1.112
Strontium (dissolved)	mg/L	0.085	0.093	0.136	0.136	0.085	0.1047	0.0274
Uranium (dissolved)	mg/L	0.00004	0.00003	0.00009	0.00009	0.00003	0.000053	0.000032
Vanadium (dissolved)	mg/L	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (dissolved)	mg/L	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Organic Parameters								
Dissolved Organic Carbon	mg/L	10.1			♦	♦	♦	♦
Total Organic Carbon	mg/L	10.1	13.6	9.8	13.6	9.8	11.17	2.11

** - Statistics calculated using 1/2 the method detection limit where reported as "<" (less than).
- Exceeds Federal (CCME, 1991) Freshwater Guidelines for protection of aquatic life.
- Exceeds B.C. (AWCWQ, 1994) Freshwater Criteria for protection of aquatic life.

Table 7

MINTO EXPLORATIONS LTD.
MINTO PROJECT

HKP Station W7 - Minto Creek Tributary #4
Water Quality Data

Date		7-Jun-94	8-Jul-94	10-Aug-94	Statistics ** Maximum	Minimum	Mean	σ
Physical Tests	Units							
Conductivity	umhos/cm	121	133	199	199	121	151.0	42.0
Total Dissolved Solids	mg/L	97	93	128	128	93	106.0	19.2
Hardness	mg/L CaCO3	64.9	67.1	101	101	64.9	77.7	20.2
pH	pH Units	7.18	7.84	7.71	7.84	7.18	7.577	0.350
Total Suspended Solids	mg/L	79	13	5	79	5	32.3	40.6
Turbidity	NTU	16.0	3.76	0.57	16.0	0.57	6.78	8.15
Anions								
Alkalinity (Total)	mg/L CaCO3	55.4	64.9	99.8	99.8	55.4	73.37	23.38
Chloride (dissolved)	mg/L	1.0	1.2	1.1	1.2	1.0	1.10	0.10
Fluoride (dissolved)	mg/L	0.17	0.16	0.35	0.35	0.16	0.227	0.107
Sulphate (dissolved)	mg/L	10.4	9.7	11.6	11.6	9.7	10.57	0.96
Nutrients								
Ammonia Nitrogen	mg/L	0.007	0.009	<0.005	0.009	0.0025	0.0062	0.0033
Nitrate Nitrogen	mg/L	0.063	0.048	0.06	0.063	0.048	0.0570	0.0079
Nitrite Nitrogen	mg/L	0.005	0.004	0.002	0.005	0.002	0.0037	0.0015
ortho-Phosphate	mg/L	0.008	0.010	0.007	0.010	0.007	0.0083	0.0015
Total Dissolved Phosphate	mg/L	0.014	0.013	0.011	0.014	0.011	0.0127	0.0015
Total Phosphorus	mg/L	0.083	0.026	0.011	0.083	0.011	0.0400	0.0380
Cyanide								
Total Cyanide	mg/L	0.009	0.013	0.008	0.013	0.008	0.0100	0.0026
Total Metals								
Aluminum (total)	mg/L	0.556	0.120	0.029	0.556	0.029	0.2350	0.2817
Antimony (total)	mg/L	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (total)	mg/L	0.0006	0.0008	0.0003	0.0008	0.0003	0.00057	0.00025
Barium (total)	mg/L	0.066	0.045	0.058	0.066	0.045	0.0563	0.0106
Beryllium (total)	mg/L	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (total)	mg/L	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (total)	mg/L	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Cadmium (total)	mg/L	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (total)	mg/L	17.0	17.5	26.4	26.4	17.0	20.30	5.29
Chromium (total)	mg/L	0.002	0.001	<0.001	0.002	0.0005	0.0012	0.0008
Cobalt (total)	mg/L	0.001	<0.001	<0.001	0.001	0.0005	0.0007	0.0003
Copper (total)	mg/L	0.003	0.002	0.001	0.003	0.001	0.0020	0.0010
Iron (total)	mg/L	1.11	0.411	0.138	1.11	0.138	0.5530	0.5013
Lead (total)	mg/L	<0.001	<0.001	<0.001	0.0005	0.0005	0.0005	0.0000
Magnesium (total)	mg/L	5.92	5.70	8.46	8.46	5.70	6.693	1.534
Manganese (total)	mg/L	0.082	0.016	0.044	0.082	0.016	0.0473	0.0331
Mercury (total)	mg/L	0.00001	<0.00001	<0.00001	0.00001	0.000005	0.000007	0.000003
Molybdenum (total)	mg/L	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Nickel (total)	mg/L	0.004	0.003	0.002	0.004	0.002	0.0030	0.0010
Selenium (total)	mg/L	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (total)	mg/L	4.84	5.16	5.5	5.5	4.84	5.17	0.33
Silver (total)	mg/L	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Strontium (total)	mg/L	0.171	0.179	0.283	0.283	0.171	0.2110	0.0625
Uranium (total)	mg/L	0.00035	0.00015	0.00034	0.00035	0.00015	0.000280	0.000113
Vanadium (total)	mg/L	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (total)	mg/L	<0.005	<0.005	<0.005	0.0025	0.0025	0.0025	0.0000
Dissolved Metals								
Aluminum (dissolved)	mg/L	0.055	0.057	0.021	0.057	0.021	0.0443	0.0202
Antimony (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (dissolved)	mg/L	0.0002	0.0002	0.0003	0.0003	0.0002	0.00023	0.00006
Barium (dissolved)	mg/L	0.044	0.044	0.058	0.058	0.044	0.0487	0.0081
Beryllium (dissolved)	mg/L	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (dissolved)	mg/L	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (dissolved)	mg/L	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Cadmium (dissolved)	mg/L	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (dissolved)	mg/L	16.6	17.5	26.4	26.4	16.6	20.17	5.42
Chromium (dissolved)	mg/L	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Cobalt (dissolved)	mg/L	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Copper (dissolved)	mg/L	0.003	0.002	0.001	0.003	0.001	0.0020	0.0010
Iron (dissolved)	mg/L	0.281	0.237	0.126	0.281	0.126	0.2147	0.0799
Lead (dissolved)	mg/L	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Magnesium (dissolved)	mg/L	5.71	5.70	8.46	8.46	5.70	6.623	1.591
Manganese (dissolved)	mg/L	0.058	0.012	0.044	0.058	0.012	0.0380	0.0236
Molybdenum (dissolved)	mg/L	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Nickel (dissolved)	mg/L	0.002	0.003	0.001	0.003	0.001	0.0020	0.0010
Potassium (dissolved)	mg/L	0.60	0.59	0.83	0.83	0.59	0.673	0.136
Selenium (dissolved)	mg/L	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (dissolved)	mg/L	4.32	5.16	5.5	5.5	4.32	4.99	0.61
Silver (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Sodium (dissolved)	mg/L	3.01	3.04	5.23	5.23	3.01	3.760	1.273
Strontium (dissolved)	mg/L	0.166	0.179	0.283	0.283	0.166	0.2093	0.0641
Uranium (dissolved)	mg/L	0.00025	0.00014	0.00031	0.00031	0.00014	0.000233	0.000086
Vanadium (dissolved)	mg/L	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (dissolved)	mg/L	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Organic Parameters								
Dissolved Organic Carbon	mg/L	22.6						
Total Organic Carbon	mg/L	25.2	24.7	13.6	25.2	13.6	21.17	6.56

** - Statistics calculated using 1/2 the method detection limit where reported as "<" (less than).
- Exceeds Federal (CCME, 1991) Freshwater Guidelines for protection of aquatic life.
- Exceeds B.C. (AWCWQ, 1994) Freshwater Criteria for protection of aquatic life.

Table 8

MINTO EXPLORATIONS LTD.
MINTO PROJECT

HKP Station W8 - Minto Creek Tributary #5
Water Quality Data

Date		15-May-94	8-Jul-94	10-Aug-94	26-Sep-94	Statistics ** Maximum	Minimum	Mean	σ
Physical Tests	Units								
Conductivity	umhos/cm	232	455	737	597	737	232	505.3	215.5
Total Dissolved Solids	mg/L	161	312	509	408	509	161	347.5	148.1
Hardness	mg/L CaCO3	117	231	372	297	372	117.0	254.3	108.1
pH	pH Units	8.20	8.32	8.3	8.13	8.32	8.13	8.238	0.089
Total Suspended Solids	mg/L	1	236	318	453	453	1	252.0	189.7
Turbidity	NTU	1.20	118	39.2	47.1	118	1.2	51.4	48.7
Anions									
Alkalinity (Total)	mg/L CaCO3	115	227	404	315	404	115.0	265.3	123.5
Chloride (dissolved)	mg/L	1.3	1.4	1.3	0.9	1.4	0.9	1.23	0.22
Fluoride (dissolved)	mg/L	0.12	0.19	0.4	0.27	0.4	0.12	0.25	0.12
Sulphate (dissolved)	mg/L	17.4	32.9	52.7	48.4	52.7	17.4	37.85	16.07
Nutrients									
Ammonia Nitrogen	mg/L	0.011	0.013	0.02	0.021	0.021	0.011	0.0163	0.0050
Nitrate Nitrogen	mg/L	<0.005	0.036	0.044	0.027	0.044	0.0025	0.0274	0.0180
Nitrite Nitrogen	mg/L	0.003	0.004	0.006	0.007	0.007	0.003	0.0050	0.0018
ortho-Phosphate	mg/L	0.006	0.025	0.028	0.027	0.028	0.006	0.0215	0.0104
Total Dissolved Phosphate	mg/L	0.018	0.042	0.043	0.033	0.043	0.018	0.0340	0.0116
Total Phosphorus	mg/L	0.026	0.063	0.325	0.114	0.325	0.026	0.1320	0.1336
Cyanide									
Total Cyanide	mg/L	0.025	0.018	0.024	0.023	0.025	0.018	0.0225	0.0031
Total Metals									
Aluminum (total)	mg/L	0.067	1.90	2.1	1.92	2.1	0.067	1.50	0.96
Antimony (total)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (total)	mg/L	0.0004	0.0022	0.0022	0.0028	0.0028	0.0004	0.00190	0.00104
Barium (total)	mg/L	0.041	0.137	0.189	0.177	0.189	0.041	0.1360	0.0671
Beryllium (total)	mg/L	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (total)	mg/L	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (total)	mg/L	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Cadmium (total)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (total)	mg/L	21.1	40.9	64.4	54.2	64.4	21.1	45.15	18.70
Chromium (total)	mg/L	<0.001	0.007	0.008	0.010	0.010	0.0005	0.0064	0.0041
Cobalt (total)	mg/L	<0.001	0.003	0.002	0.009	0.009	0.0005	0.0036	0.0037
Copper (total)	mg/L	0.003	0.011	0.016	0.025	0.025	0.003	0.0138	0.0092
Iron (total)	mg/L	0.138	3.14	3.9	2.84	3.9	0.138	2.50	1.64
Lead (total)	mg/L	0.002	0.135	0.001	0.004	0.135	0.001	0.0355	0.0663
Magnesium (total)	mg/L	15.8	31.7	53.4	43.4	53.4	15.8	36.08	16.17
Manganese (total)	mg/L	0.026	0.210	0.245	0.280	0.280	0.026	0.1903	0.1132
Mercury (total)	mg/L	<0.00001	<0.00001	0.00001	<0.00001	0.00001	0.000005	0.000006	0.000003
Molybdenum (total)	mg/L	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Nickel (total)	mg/L	0.002	0.010	0.008	0.020	0.020	0.002	0.0100	0.0075
Selenium (total)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (total)	mg/L	3.22	7.58	7.56	6.90	7.58	3.22	6.315	2.087
Silver (total)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Strontium (total)	mg/L	0.236	0.410	0.752	0.579	0.752	0.236	0.4943	0.2217
Uranium (total)	mg/L	0.00049	0.00087	0.0023	0.00197	0.0023	0.00049	0.00141	0.00086
Vanadium (total)	mg/L	<0.030	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (total)	mg/L	0.006	0.017	0.012	0.013	0.017	0.006	0.0120	0.0045
Dissolved Metals									
Aluminum (dissolved)	mg/L	0.036	<0.005	0.033	0.018	0.036	0.0025	0.0224	0.0154
Antimony (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (dissolved)	mg/L	0.0004	0.0004	0.0006	0.0004	0.0006	0.0004	0.00045	0.00010
Barium (dissolved)	mg/L	0.041	0.070	0.112	0.082	0.112	0.041	0.0763	0.0294
Beryllium (dissolved)	mg/L	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (dissolved)	mg/L	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (dissolved)	mg/L	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Cadmium (dissolved)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (dissolved)	mg/L	21.0	40.9	63.1	50.6	63.1	21.0	43.90	17.77
Chromium (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Cobalt (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Copper (dissolved)	mg/L	0.003	0.005	0.004	0.004	0.005	0.003	0.0040	0.0008
Iron (dissolved)	mg/L	0.101	0.140	0.143	0.134	0.143	0.101	0.1295	0.0194
Lead (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Magnesium (dissolved)	mg/L	15.7	31.2	52	41.5	52	15.70	35.1	15.5
Manganese (dissolved)	mg/L	0.025	0.092	0.146	0.110	0.146	0.025	0.0933	0.0507
Molybdenum (dissolved)	mg/L	<0.001	<0.001	<0.001	<0.001	0.0005	0.0005	0.00050	0.00000
Nickel (dissolved)	mg/L	0.001	0.003	0.001	0.001	0.003	0.001	0.0015	0.0010
Potassium (dissolved)	mg/L	1.50	1.16	1.77	1.67	1.77	1.16	1.525	0.268
Selenium (dissolved)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (dissolved)	mg/L	3.12	4.95	5.46	5.21	5.46	3.12	4.69	1.06
Silver (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Sodium (dissolved)	mg/L	8.10	15.8	35.1	23.2	35.1	8.10	20.55	11.49
Strontium (dissolved)	mg/L	0.233	0.405	0.736	0.553	0.736	0.233	0.4818	0.2141
Uranium (dissolved)	mg/L	0.00049	0.00086	0.0021	0.00167	0.0021	0.00049	0.00128	0.00074
Vanadium (dissolved)	mg/L	<0.030	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (dissolved)	mg/L	0.006	<0.005	<0.005	<0.005	0.006	0.0025	0.0034	0.0018
Organic Parameters									
Dissolved Organic Carbon	mg/L	21.8				↓	↓	↓	↓
Total Organic Carbon	mg/L		18.7	11.1	15.0	18.7	11.1	14.93	3.80

** - Statistics calculated using 1/2 the method detection limit where reported as "<" (less than).
- Exceeds Federal (CCME, 1991) Freshwater Guidelines for protection of aquatic life.
- Exceeds B.C. (AWCWQ, 1994) Freshwater Criteria for protection of aquatic life.

Table 9

MINTO EXPLORATIONS LTD.
MINTO PROJECT

HKP Station W9 - Minto Creek, Reach 6 (Upper Portion)
Water Quality Data

Date		15-May-94	7-Jun-94	8-Jul-94	10-Aug-94	26-Sep-94	Statistics ** Maximum	Minimum	Mean	σ
Physical Tests	Units									
Conductivity	umhos/cm	90.0	111	160	263	162	263	90	157.2	66.8
Total Dissolved Solids	mg/L	51	92	107	170	105	170	51	105.0	42.8
Hardness	mg/L CaCO3	41.0	65.6	78.2	137	79.2	137	41.0	80.2	35.3
pH	pH Units	7.31	7.25	7.91	7.67	7.40	7.91	7.25	7.508	0.276
Total Suspended Solids	mg/L	386	39	27	10	7	386	7	93.8	163.9
Turbidity	NTU	137	19.6	19.3	6.99	6.40	137	6.4	37.9	55.8
Anions										
Alkalinity (Total)	mg/L CaCO3	39.0	59.3	76.8	137	71.6	137	39.0	76.7	36.7
Chloride (dissolved)	mg/L	1.6	1.0	1.4	1.3	0.8	1.6	0.8	1.22	0.32
Fluoride (dissolved)	mg/L	0.10	0.11	0.11	0.29	0.12	0.29	0.10	0.146	0.081
Sulphate (dissolved)	mg/L	5.8	2.1	7.6	3.1	6.9	7.6	2.1	5.10	2.40
Nutrients										
Ammonia Nitrogen	mg/L	0.046	0.025	0.051	0.053	0.054	0.054	0.025	0.0458	0.0120
Nitrate Nitrogen	mg/L	0.014	0.008	0.021	0.034	0.018	0.034	0.008	0.0190	0.0097
Nitrite Nitrogen	mg/L	0.005	0.008	0.005	0.005	0.004	0.008	0.004	0.0054	0.0015
ortho-Phosphate	mg/L	0.016	0.049	0.045	0.083	0.051	0.083	0.016	0.0488	0.0238
Total Dissolved Phosphate	mg/L	0.030	0.053	0.052	0.093	0.059	0.093	0.030	0.0574	0.0227
Total Phosphorus	mg/L	0.121	0.097	0.071	0.117	0.074	0.121	0.071	0.0960	0.0233
Cyanide										
Total Cyanide	mg/L	0.043	0.019	0.012	0.023	0.016	0.043	0.012	0.0226	0.0121
Total Metals										
Aluminum (total)	mg/L	8.31	0.641	0.643	0.05	0.122	8.31	0.05	1.953	3.565
Antimony (total)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (total)	mg/L	0.0042	0.0016	0.0018	0.0016	0.0010	0.0042	0.001	0.00204	0.00124
Barium (total)	mg/L	0.297	0.093	0.082	0.092	0.060	0.297	0.06	0.1248	0.0972
Beryllium (total)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (total)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (total)	mg/L	0.40	<0.10	<0.10	<0.10	<0.10	0.40	0.05	0.120	0.157
Cadmium (total)	mg/L	<0.0002	0.0003	<0.0002	<0.0002	<0.0002	0.0003	0.0001	0.00014	0.00009
Calcium (total)	mg/L	17.1	17.4	21.1	38.5	21.2	38.5	17.1	23.06	8.85
Chromium (total)	mg/L	0.017	0.001	0.002	<0.001	<0.001	0.017	0.0005	0.0042	0.0072
Cobalt (total)	mg/L	0.005	0.002	<0.001	0.001	0.002	0.005	0.0005	0.0021	0.0017
Copper (total)	mg/L	0.060	0.006	0.005	0.003	0.002	0.060	0.002	0.0152	0.0251
Iron (total)	mg/L	14.6	3.61	3.00	4.17	2.68	14.6	2.68	5.61	5.06
Lead (total)	mg/L	0.002	<0.001	0.013	<0.001	<0.001	0.013	0.0005	0.0033	0.0055
Magnesium (total)	mg/L	6.37	5.43	6.20	10	6.35	10	5.43	6.9	1.8
Manganese (total)	mg/L	0.467	0.362	0.291	0.388	0.258	0.467	0.258	0.3532	0.0824
Mercury (total)	mg/L	0.00002	<0.00001	<0.00001	<0.00001	<0.00001	0.00002	0.000005	0.000008	0.000007
Molybdenum (total)	mg/L	0.001	<0.001	0.001	0.001	<0.001	0.001	0.0005	0.0008	0.0003
Nickel (total)	mg/L	0.021	0.003	0.003	0.002	<0.001	0.021	0.0005	0.006	0.009
Selenium (total)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (total)	mg/L	14.4	5.39	5.83	6.97	6.23	14.4	5.39	7.76	3.75
Silver (total)	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.00005	0.000060	0.000022
Strontium (total)	mg/L	0.102	0.097	0.115	0.221	0.108	0.221	0.097	0.1286	0.0521
Uranium (total)	mg/L	0.00050	0.00012	0.00005	0.00012	0.00008	0.0005	0.00005	0.00017	0.00018
Vanadium (total)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (total)	mg/L	0.037	<0.005	0.007	<0.005	<0.005	0.037	0.0025	0.0103	0.0151
Dissolved Metals										
Aluminum (dissolved)	mg/L	0.124	0.108	0.087	0.04	0.060	0.124	0.04	0.084	0.034
Antimony (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Arsenic (dissolved)	mg/L	0.0006	0.0013	0.0008	0.0013	0.0009	0.0013	0.0006	0.00098	0.00031
Barium (dissolved)	mg/L	0.064	0.072	0.074	0.092	0.060	0.092	0.06	0.072	0.012
Beryllium (dissolved)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Bismuth (dissolved)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Boron (dissolved)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.05	0.05	0.050	0.000
Cadmium (dissolved)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001	0.00010	0.00000
Calcium (dissolved)	mg/L	11.0	17.3	21.1	38.5	21.2	38.5	11	21.82	10.21
Chromium (dissolved)	mg/L	0.001	0.001	<0.001	<0.001	<0.001	0.001	0.0005	0.0007	0.0003
Cobalt (dissolved)	mg/L	<0.001	0.002	<0.001	<0.001	0.001	0.002	0.0005	0.0009	0.0007
Copper (dissolved)	mg/L	0.007	0.003	0.004	0.003	0.002	0.007	0.002	0.0038	0.0019
Iron (dissolved)	mg/L	1.62	2.39	1.78	3.57	2.16	3.57	1.62	2.304	0.770
Lead (dissolved)	mg/L	0.001	<0.001	0.013	<0.001	<0.001	0.013	0.0005	0.0031	0.0055
Magnesium (dissolved)	mg/L	3.28	5.43	6.20	10	6.35	10	3.28	6.3	2.4
Manganese (dissolved)	mg/L	0.228	0.349	0.043	0.388	0.258	0.388	0.043	0.2532	0.1343
Molybdenum (dissolved)	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.0005	0.0006	0.0002
Nickel (dissolved)	mg/L	0.002	0.003	0.002	0.002	<0.001	0.003	0.0005	0.0019	0.0009
Potassium (dissolved)	mg/L	0.75	0.51	0.36	0.74	0.35	0.75	0.35	0.542	0.196
Selenium (dissolved)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00025	0.00025	0.000250	0.000000
Silicon (dissolved)	mg/L	3.49	5.14	5.61	6.97	6.23	6.97	3.49	5.488	1.311
Silver (dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00005	0.00005	0.000050	0.000000
Sodium (dissolved)	mg/L	2.24	3.20	3.95	7.14	3.82	7.14	2.24	4.070	1.844
Strontium (dissolved)	mg/L	0.065	0.095	0.115	0.221	0.108	0.221	0.065	0.1208	0.0592
Uranium (dissolved)	mg/L	0.00007	0.00007	0.00005	0.00012	0.00008	0.00012	0.00005	0.000078	0.000026
Vanadium (dissolved)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	0.015	0.015	0.0150	0.0000
Zinc (dissolved)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	0.00250	0.00000
Organic Parameters										
Dissolved Organic Carbon	mg/L	25.6	21.4				25.6	21.4	23.50	2.97
Total Organic Carbon	mg/L		24.2	19.7	22.6	19.6	24.2	19.6	21.53	2.26

** - Staistics calculated using 1/2 the method detection limit where reported as "<" (less than).
- Exceeds Federal (CCME, 1991) Freshwater Guidelines for protection of aquatic life.
- Exceeds B.C. (AWCWQ, 1994) Freshwater Criteria for protection of aquatic life.

APPENDIX II

ASL Analytical Methods and Internal QA/QC Information

20 Samples
4 Duplicates
3 Standard Reference Material (or Spike if not available)
3 Method Blanks

The quality control proposed above is very extensive. The information generated allows the determination of precision, accuracy and contamination control for all measurements. The data can be presented along with sample results in the final reports.

Additional quality assurance measures include the supply and use of sample submission forms so pertinent field information is transferred to the laboratory. In addition a representative from ASL will often visit a test site to initially set up and ensure appropriate handling and storage of samples prior to pick up. If deemed appropriate, transportation blanks are supplied for handling in the field to ensure that field contamination is not an issue.

Also important is the participation by ASL in numerous inter-laboratory programs organized by agencies such as Environment Canada, U.S. Environmental Protection Agency, B.C. Ministry of Environment and the National Research Council of Canada. ASL is officially registered with the B.C. Ministry of Environment and is a member of CAEAL (Canadian Association of Environmental Analytical Laboratories). ASL is also certified by both these agencies for a series of specific tests (additional information on request).

APPENDIX III

Life Histories of Yukon River Fish

Coho salmon *Oncorhynchus kisutch*

Coho salmon spawn as far inland as Dawson starting in October. Spawning occurs in swift flowing tributaries with gravel substrates. Coho salmon are brood hiders and, although they do not guard the deposited eggs, females often guard the redd throughout the spawning period. Exogenous feeding starts at the alevin phase and prey includes insects and other invertebrates. As the smolt phase is reached, fish become an important food source. Most juvenile coho salmon remain in the Yukon River system for two years in parr and smolt phases before entering the Bering sea. While in the Yukon river system, juveniles inhabit shallow gravel areas and in late summer or fall move to deeper pools. Coho salmon smolt reach the Bering sea in the spring or early summer of their second year. Presence of coho salmon in the Minto region has not yet been documented.

Chum salmon *Oncorhynchus keta*

Two chum salmon spawning runs occur in the Yukon river, one in late summer and one in late fall. The range extends into the Minto region. Chum salmon are brood hiders and the female partially covers the redd after spawning. Hatching occurs in winter and free embryos remain in the gravel until they are able to migrate to the sea. The fresh water rearing period for chum salmon alevins and juveniles has been reduced and migration to the sea may take only a few days to a few weeks. Alevins and juveniles may or may not feed during their migration. Chum salmon return to spawn in their third or fourth year.

Chinook salmon *Oncorhynchus tshawytscha*

Chinook salmon migrate up the Yukon river at a rate greater than 30 km per day and reach the spawning areas by July or August. Chum salmon are brood hiders and redds are covered with gravel after spawning. Females may dig more than one redd and spawn with more than one male. Females guard the nest for as long as they can before dying. Hatching occurs in the following spring and free embryos remain in the gravel until the yolk is absorbed. Alevins and juveniles prey on various invertebrate organisms during their two years in fresh water, while juveniles become predominantly piscivorous at sea. While in fresh water alevins will school but juveniles become defensive of territories. Adults return to the Yukon river to spawn usually after four to eight years at sea.

Burbot *Lota lota*

Burbot spawn in mid-winter, usually between January and March. They are open substrate spawners and produce pelagic larvae. At night during spawning activity several individuals roll together in a ball which constantly moves over sand or gravel substrates. Larger females may produce over a million small eggs (approximately 1 mm in diameter) which are not guarded. Eggs are semi-pelagic and are easily transported by water movement. Free embryos lack embryonic respiratory organs, similar to those belonging to the pelagic spawning guild. Small burbot prey on invertebrates, whereas larger individuals prey mainly on fish. Burbot feed actively at night. The adult period is reached at three or four years of age.

Arctic grayling *Thymallus arcticus*

Arctic grayling spawn in small streams as soon as ice break up has commenced. Males defend territories while on the spawning grounds. Arctic grayling spawn over unprepared cobble or gravel and produce benthic embryos and larvae. Hatching occurs fairly quickly and exogenous feeding starts while the yolk is still present. At this phase prey consists largely of zooplankton while various invertebrates, including a high percentage of terrestrial insects, make up the diet of older juveniles and adults. Spawning populations consist of individuals four years of age and older.

Inconnu *Stenodus leucichthys*

The anadromous inconnu are rock and gravel spawners and brood hiders. No protection is given to the embryos once spawning is completed. Spawning probably takes place in late summer or early fall. Free embryos remain in the spawning substrate until they emerge as fully formed alevins. Young inconnu prey on various invertebrates such as insect larvae and planktonic crustaceans. Fish, including young chinook salmon, comprise much of the diet of larger inconnu.

Bering cisco *Coregonus laurettae*

Bering cisco are open substrate spawners (brood not hidden) on rock and gravel. Free embryos are photophobic and retreat into the substrate. Bering cisco are likely anadromous and spawning probably occurs in early fall. It has been reported that crustaceans comprises some of their diet.

Least cisco *Coregonus sardinella*

Least cisco are rock and gravel, open substrate spawners. Spawning usually occurs in September and adults abandon the eggs after spawning has been completed. Hatching occurs the following spring and free embryos move into the substrate. Least cisco diet consists of various invertebrates. It may be that migratory and non-migratory populations exist.

Lake whitefish *Coregonus clupeaformis*

Lake whitefish are fall spawners on rock and gravel usually at depths less than 7.6 metres. Embryos are benthic and not guarded by the spawning adults. Adult diet consists of a wide variety of benthic and planktonic invertebrates, as well as small fish.

Round whitefish *Prosopium cylindraceum*

Round whitefish, like many other coregonids, are autumn, rock and gravel, open substrate spawners. Round whitefish are non-guarders and embryos are benthic. Diet consists of benthic invertebrates including mayfly larvae and pupae, chironomid and caddisfly larvae, amphipods, as well as small bivalves and gastropods.

Northern pike *Esox lucius*

Northern pike are spring, obligatory plant spawners and non-guarders. Spawning occurs in shallow water over a two to five day period. During this time, females release a small number of eggs in each of many spawning acts. After each episode, the highly adhesive eggs are scattered by a tail thrust and attach to macrophytes. Eggs hatch in approximately two weeks and non-photophobic free embryos are shaped so that they swim upwards. Cement glands are present on the heads of free embryos. These strategies have evolved so that embryos are not subject to the often hypoxic conditions of the spawning ground bottom. Small juveniles feed on zooplankton and sub-adult aquatic insects while larger juveniles and adults prey on various larger organisms such as fish and amphibians as well as small mammals and aquatic birds. In northern areas, males and females usually mature at five and six years of age, respectively.

Slimy sculpin *Cottus cognatus*

Slimy sculpin are spring, nest spawners and guarders of their young. Eggs are deposited in natural rock cavities or clean, constructed burrows where the male guards the embryos. These areas are generally well oxygenated and therefore, respiratory organs of the embryos are only partially developed. Adult diets consist mainly of benthic invertebrates. Slimy sculpin generally inhabit rock and gravel stream or lake bottoms.

Longnose sucker *Catostomus catostomus*

Longnose sucker are rock and gravel spawners and produce benthic larvae. Their spring spawning runs commence when stream water temperatures reach 5°C. Spawning usually occurs in streams at an approximate mean depth of 20 cm with a 30 to 45 cms^{-1} flow rate and a gravel and cobble substrate size range from 5 to 10 cm. Longnose sucker will spawn in shoal areas of lakes if streams are not present. Hatching occurs in approximately two weeks and photophobic free embryos remain in the substrate for one to two weeks. Prey of the longnose sucker is almost exclusively benthic invertebrates including amphipods, caddisfly, midge, mayfly, ostracods, gastropods, beetles, pelecypods, as well as copepods and cladocerans. Longnose sucker reach sexual maturity at varying ages, the youngest possibly at five years.

APPENDIX IV

Survey of Firekilled Fuelwood Potential

SURVEY

of

FIREKILLED FUELWOOD HARVEST POTENTIAL

MINTO CREEK, YUKON

for

Minto Explorations LTD.

Vancouver, B.C.

July, 1994

Prepared by
J.Gibson & Associates
Whitehorse, Yukon

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Introduction

J. Gibson & Associates were contracted by Minto Exploration Ltd. to prepare a preliminary assessment of the firekilled wood harvest potential of the upper Minto Creek watershed in the area presently under quartz claims held by the company.

Minto Explorations Ltd. purposes to utilize the firekilled timber in a chipper/boiler operation to heat their mill and associated facilities.

Area History

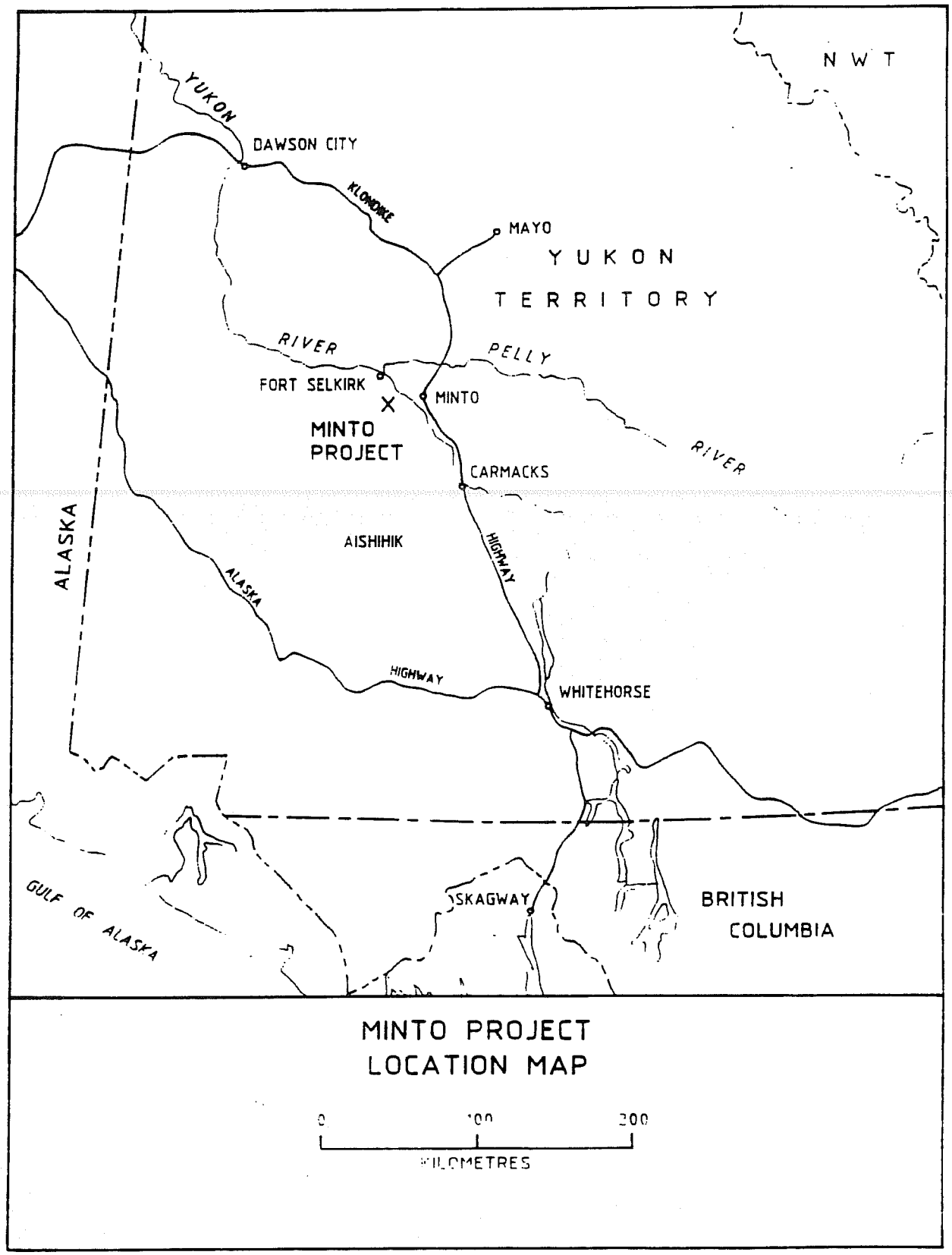
Minto Creek is a lesser tributary to Yukon River located approximately fifteen (15) kilometers downstream of Minto Landing (Figure 1). Minto Creek (formerly Copper Creek) was first explored by a consortium of companies in 1972 to 1974 for it's copper mineralization. In addition to diamond drilling and geophysical work, a winter tote road was constructed along the west side of the Yukon River from Carmacks to Minto Creek and up to Minto Creek's headwaters.

An initial environmental study of the watersheds was done at the same time by B.C. Research who categorized the vegetation in the upper water shed as small black spruce on north facing slopes and pine on south facing slopes.

In 1980 a forest fire burnt an area 4550 hectares including the top of the Minto Creek watershed and 85% of the area under mineral claims.

Minto Explorations obtained rights to the mineral property early in the 1990's and has had an exploration program underway in 1993 and 1994 along with environmental studies.

Figure 1: Minto Creek Location Map



Method

Initial assessment was done by photogrammetry using air photographs taken in June 1989 at a scale of 1 : 41,665. the burn area under quartz claims was classed into five categories according to the fuelwood potential. Volumes for each class were estimated at:

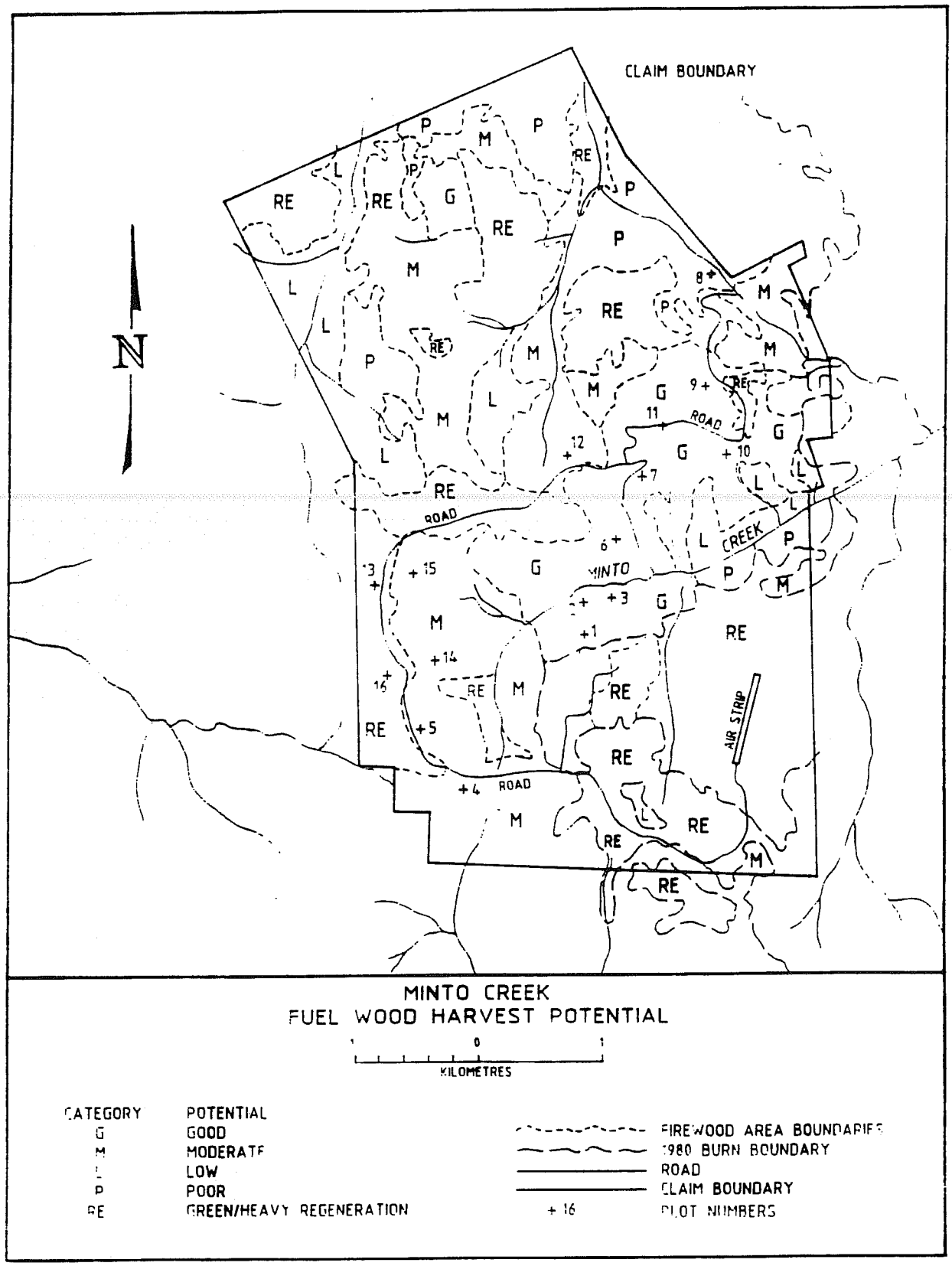
- Good - 100 to 135 cubic meters per hectare
- Moderate - 90 - 100
- Poor - 50 to 90
- Low - 9 to 50
- Leave - area not burnt, of heavy regen or steep slopes

After discussion with the Yukon Forest Service, Forest Management staff, a method based on the "Firewood Sampling Manual" (1981) was derived. Sixteen main triangular plots (30 meter sides) were established within the study area *(Figure 2)*. Most of the plots are located in areas of higher fuelwood potential (good and moderate classes). Each triangular plot was designated by a number, with each sub plot for standing or downed volume measurements also numbered. (Example: 2-1, 2-2, 2-3).

Each triangular plot consists of three (3) "standing volume" plots located at the triangle's apexs. Due to the lower number of standing trees in some plots, a fixed radius plot of 5.64 meters was used rather than Basal factor plots. Within each standing plots, all trees were measured for height using clinometer and diameter at breast height (DBH) with a diameter tape . Each of the triangle's 30 meter sides was used as a transect to determine "downed volume" for a total 90 meter transect. Within each downed transect every tree that intersected the 30 meter line (90 meters total) was measured for length and diameter (DBH). Any tree that intersected lines on both sides of the apex was tallied only once.

The standing and downed measurements were recorded along with whether the tree was "sound" or "rotten", site regeneration species, site slope and aspect. This field data is detailed in Appendix 1.

Figure 2. Minto Creek Fuelwood Plot Locations



Volume Calculations

Standing Volumes

Each standing plot with fixed radius of 5.64 meters has an area of 0.01 hectares. Using the field data on height/length and diameter, the volume of each standing tree was obtained from Forestry Canada's 1990 publication *"Taper-volume Equations for Major Tree Species in the Yukon Territory."*

All values for height and diameter were rounded down to provide a conservative volume figure.

The table used was based on lodgepole pine species within ecoregion 12 (Pelly River) of the Yukon. Lodgepole pine was selected due to B. C. Research data and site regeneration species.

Volumes for each standing plot were then calculated to a mean volume in cubic meters per hectare (Table 1).

Downed Volumes

For each plot the diameters of each downed tree that intersected the 90 meter line were divided into diameter classes of 7 - 10 cm, 10 - 15 cm or 15 - 20 cm. The number of stems in each diameter class for each plot was then calculated in the formula:

$$V = \frac{1.234 * \#\text{ of intersections} * \text{avg. diameter of class}}{90 \text{ meters}}$$

The resulting figure is the volume in cubic meters per hectare for each plot calculation. Each diameter class volume's were then added for a plot total *(Table 1).*

The total volume for each standing and downed plot were then combined for a total volume per hectare *(Table 1).*

For each potential class. the range and mean volumes per hectare are contained in Table 2.

The area of each harvest potential class were measured on the air photograph using a metric dot grid. The total area under quartz claims was also measured. The area of each class, the mean volume per class and the calculated total volumes are contained in Table 3.

Of the 587 individual tress measured, 13 (2.2%) were classed as "rotten"and unfit for chipping and burning. Due to the low percentage, this volume has not been subtracted from the total.

Table 1. Minto Creek Fuelwood Survey.

Calculated Volumes of
Standing and Downed Timber for Sixteen Plots

All volumes in cubic meters per hectare

Plot #	Standing Timber	Downed Timber	Total
#1	15.2	14.5	29.7
#2	68.3	13.4	81.7
#3	31.8	19.1	50.9
#4	25.5	3.1	28.6
#5	56.7	8.2	61.9
#6	88.1	61.9	150.0
#7	31.6	56.9	88.5
#8	8.5	22.8	31.3
#9	27.7	14.2	41.9
#10	105	14.2	119.2
#11	22.6	36.9	59.5
#12	32.5	22.9	55.4
#13	43.3	57.1	100.4
#14	56.9	28.2	85.1
#15	31.1	33.2	64.3
#16	45.4	25.1	70.5
	c.m/ha	c.m/ha	c.m/ha

Table 2. Minto Timber Volumes
Mean and Range of Plot Volumes.
July, 1994

Plot Class	No. Plots	Plot #'s	Volume Range cu.m	Volume Mean cu.m
Good	8	1, 2, 3, 6, 7 9, 10, 11	29.7 - 150	77.7
Moderate	7	4, 5, 12, 13 14, 15, 16	28.6 - 100	66.6
Poor	1	8	31	31
Low	0	-	-	-

Table 3. Minto Creek Fuelwood Survey
Calculated Mean Volumes
Areas and Total Volumes

Class	Mean Volume (c.m/ha)	Area (ha)	Total Volume (c.m)	Total Volume (cords)
Good	77.7	316	24,553	6,772
Moderate	66.6	639	42,557	11,739
Poor	31	361	11,191	3,086
Low	<10	183	1,830	505
Leave	-	518*	-	-
Total		2,017	80,131	22,102

* 250 hectares located in southeast corner by airstrip is unburnt by 1980 fire. Appears to have been burnt in previous (no date) fire. Area now heavily regenerated.

3.6524 cubic meters = 1 cord

Results

Based on the field data collected, a total volume of 80,131 cubic meters of firekilled timber could be harvested from the area under quartz claims held by Minto Explorations Ltd.

Fifty-three (53%) percent of the harvestable timber is located within areas classed as having moderate potential covering thirty-one (31%) percent of the total area. The largest tract of moderate class land is situated in the south west corner of the quartz claim block along side the access road to the airstrip.

Thirty-one (31%) percent of the timber is located within areas classed as having good harvest potential covering fifteen (15%) percent of the total area.

The largest area of "good" classification is situated midpoint of the quartz claim block running in a north-east to south-west direction, with the existing access road through much of it. The southwest section of this tract is situated in the proposed open pit area.

A majority of the poor, low and leave class areas are situated adjacent to Minto Creek (steep slopes and poor access) and in the northern third of the claim block in the watershed north of Minto Creek. The north area has limited access at present.

In the interest of potential fuelwood harvesters, the number of stems per each diameter class for each plot are presented in Appendix 2.

Initial mechanical engineering calculations by Apsco Engineering Ltd. of Whitehorse, indicate approximately 725 cubic meters (200 cords) of chipped firekilled wood is required annually to supply one to two (1-2) million BTU per hour boiler/furnace.

Based on the seven hundred and twenty-five (725) cubic meter per year requirement, a fuelwood supply in excess of 100 years exists within the quartz claim boundaries. A supply sufficient for 30 years exists within the area classed as having good "potential".

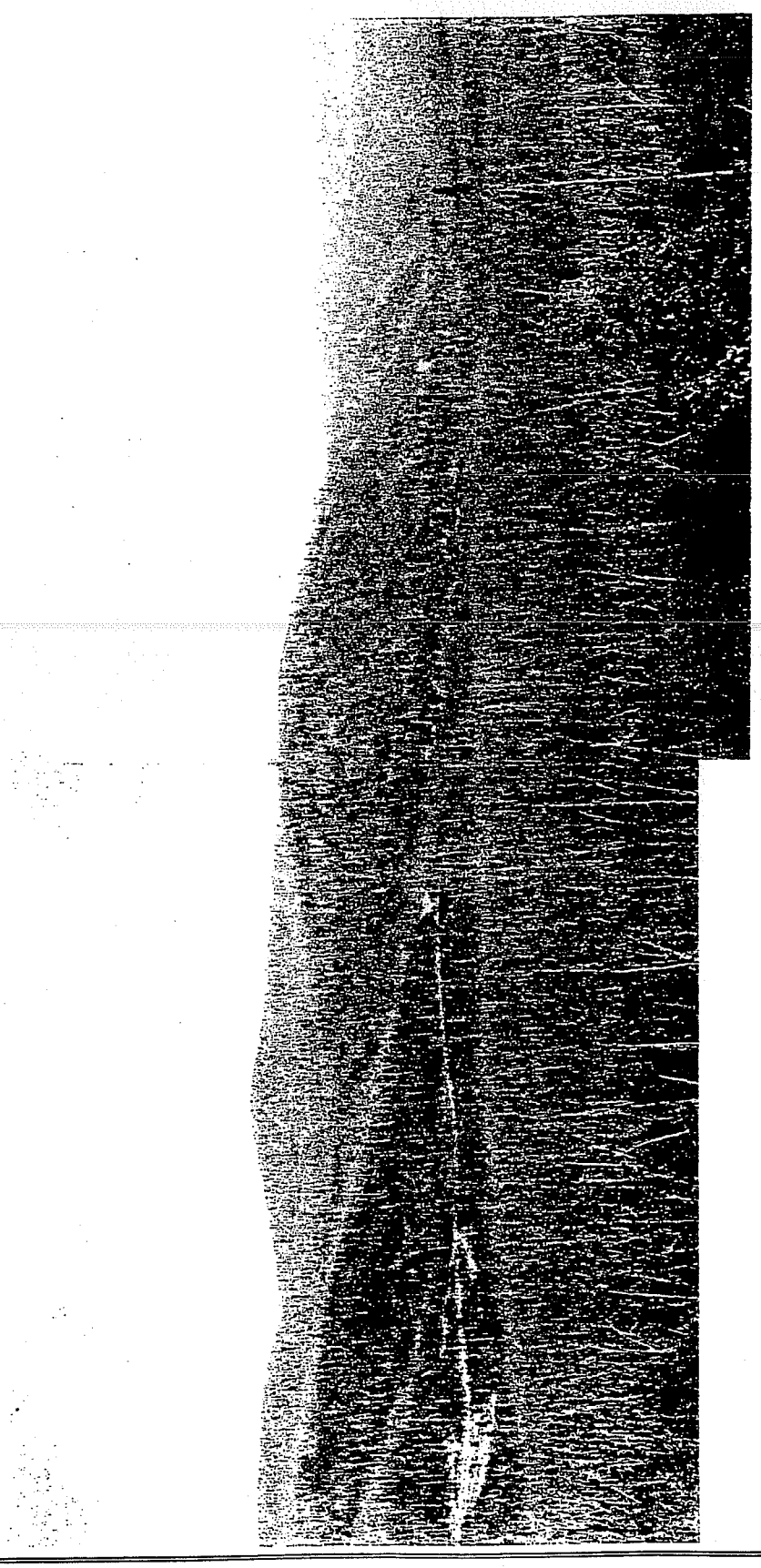


Figure 3. Minto Creek Valley with Proposed Open Pit area to the left foreground.



Figure 4. Minto Fuelwood Plot #2

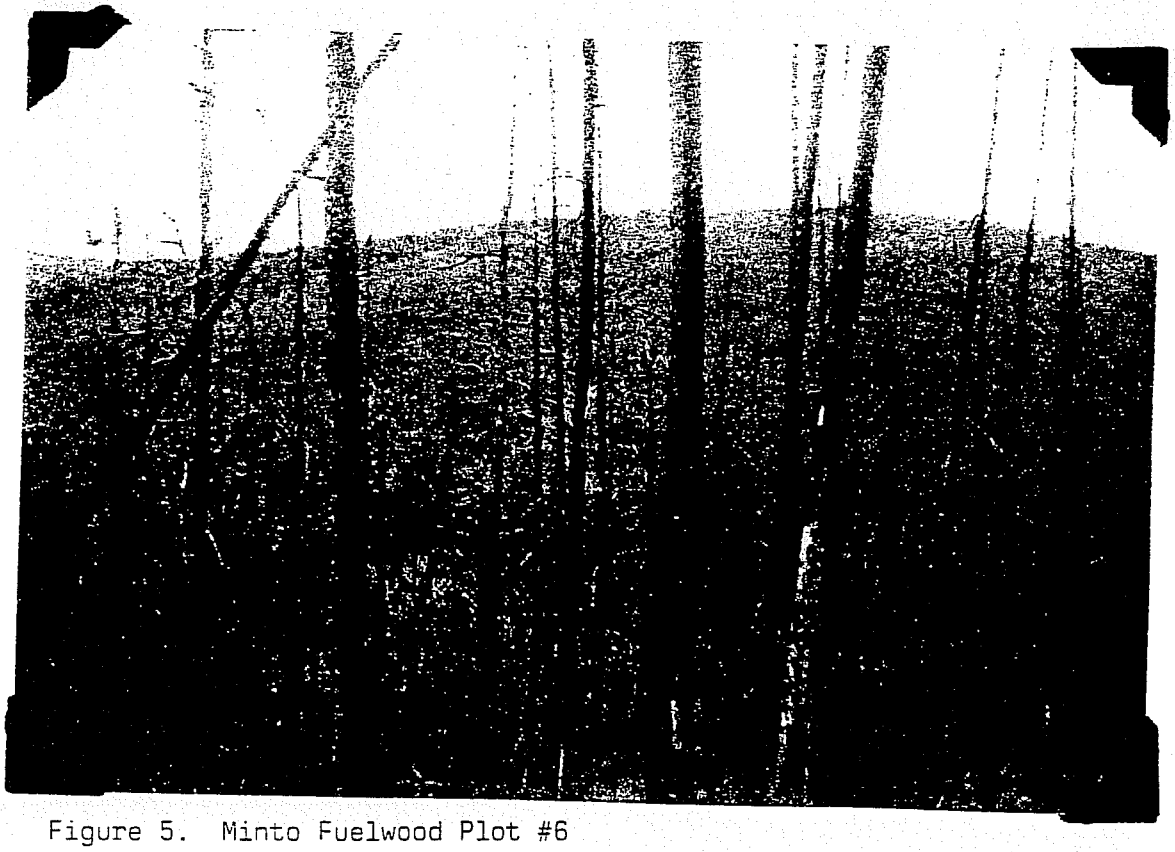


Figure 5. Minto Fuelwood Plot #6



Figure 6. Minto Fuelwood Plot # 7

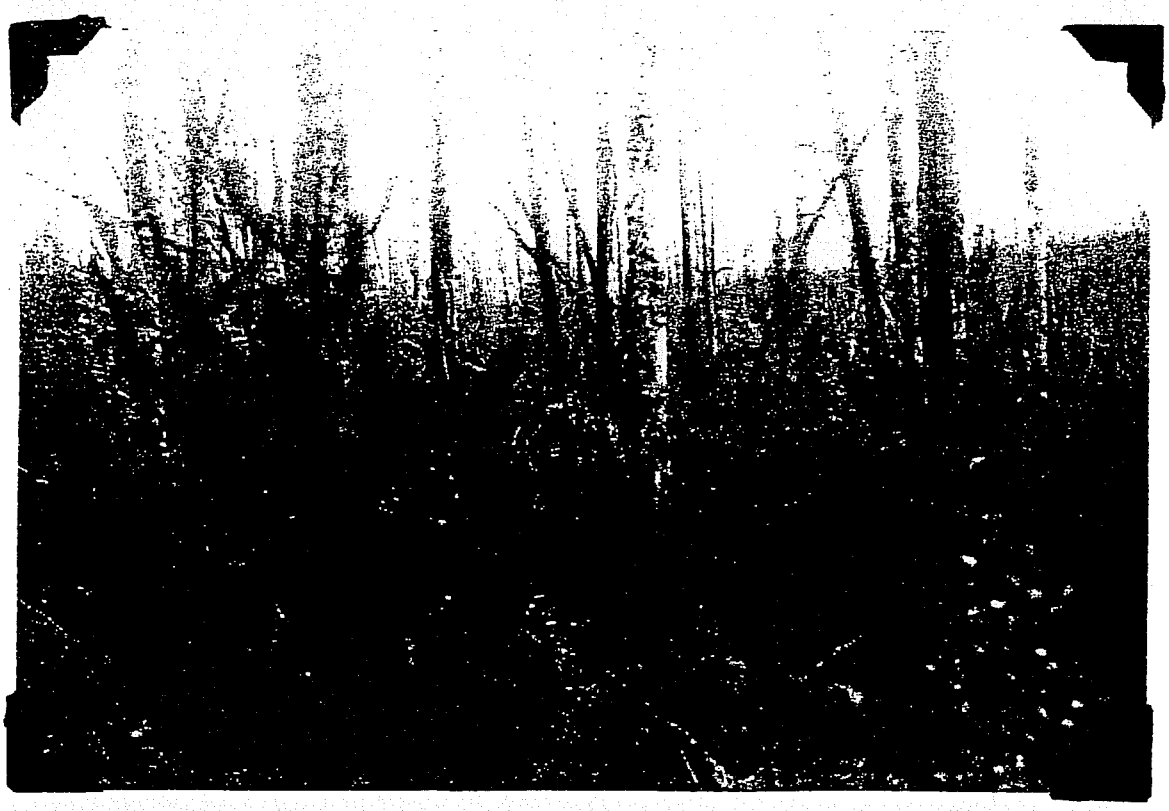


Figure 7. Minto Fuelwood Plot # 12

Recommendations

Fuelwood Harvest

1. Harvest and stockpiling of fuelwood in the open pit and associated facilities areas be done prior to any pit development. Harvest method and silviculture are not of concern in these areas.

2. With the exception of the pit area, a buffer zone should be left on both sides of natural stream channels. The width of this buffer will be determined by slope gradients, soil types and presence/absence of permafrost. A minimum buffer zone width of 20 meters is recommended.

3. Fuelwood harvest should be planned a year in advance of actual harvest. A cutting plan with specifics on volumes, locations and methods should be developed annually.

4. Secondary harvest (after pit area) should focus on areas adjacent to existing roads. The large area classed as "good potential" on both sides of the access road to the north east of the pit location is a prime target. Skid trails and landings should be located and spaced to minimize damage to existing regeneration and limit soil erosion. Proper spacing and location of skid trails will increase harvest efficiency and promote regeneration.

5. As there is no minimum diameter requirement for chipping, all firekilled fuelwood should be harvested.

Notification

1. **"An Act Respecting Quartz Mining in the Yukon Territory"** entitles the holder of a mineral claim under section 76 (1) (b) -

> "the right to cut free of dues such of the timber on the claim or such portion thereof as may be necessary for the working of the claim but not for sale or traffic ..."
>
> It is recommended the Whitehorse Mining Recorder be notified in writing of the intention to harvest and utilize the timber for use in the mining program. A brief summary of specifics should be included.

2. Notification of the Resource Management Officer for the Carmacks district (Northern Affairs - Field Operations) and of the Yukon Forest Service (Forest Management), including some specifics.

REFERENCES

Bonner G. M. and P. Boudwyn. **Taper Volume equations for major tree species in the Yukon Territory**. Pacific and Yukon Region information report BC-X-323. Forestry Canada 1990.

Yukon Forset Service, Forest Management. **Firewood Sampling Manual.** August 1981.

Appendix 1

Field Data Summary

MINTO CREEK
FIREKILL TIMBER CRUISE

Date July 5/6,1994
Crew Gibson/MacDougall

	Standing			Downed			
Plot #	Hgt m	DBH cm	Vol c.m.	Hgt m	DBH cm	Regen	Asp/slp
1-1	7.8	10	0.02	14	15	pine	N/8
	10.2	12	0.054	5.3	11	willow	
	10.2	12	0.054	7.9	12		
	10	8	0.026				
	3	7	0.006				
	3	7	0.006				
1-2	8.8	10	0.031	6.8	12		
	8.9	14	0.057				
	9.4	11	0.039				
1-3	8.6	1.1	0.057	5.5	11		
	8.7	14	0.043	6.7	9		
	8.9	12	0.043	10.1	14		
	8.6	12	0.02	7.2	12		
	8.1	8	0.01	12.5	14		
				12.9	13		
2-1	8	9	0.02	6.9	8	pine	NM/5
	6.1	8	0.015			wiilow	
	6.2	10	0.023				
	6.2	8	0.015				
	6.2	12	0.032				
	6.4	10	0.023				
	4.3	5	0.033				
	9.8	25	0.197				
	6.1	9	0.015				
	6.1	9	0.015				
	8.5	18	0.091				
	9	16	0.073				
	10.7	19	0.114				
2-2	9.6	9	0.026	5.3	6		
	9	13	0.043	6.9	7		
	13.5	10	0.056	6.5	11		
	9	13	0.043	7.6	9		
	9.1	9	0.026				
	8.9	13	0.043				
	8.9	11	0.043				
	8.6	11	0.031				

	Standing			Downed			
Plot #	Hgt m	DBH cm	Vol c.m.	Hgt m	DBH cm	Regen	Asp/slp
2-3	15.4	14	0.119	14.7	15		
	8.9	14	0.057	14	19		
	9.6	12	0.054	9.5	11		
	18	22	0.31	11.2	14		
	12.3	13	0.066	9.7	12		
	10.5	11	0.039				
	15	17	0.132				
	10.1	9	0.026				
	14.6	21	0.198				
	9.6	15	0.072				
3-1	13.8	20	0.198	9.7	14	pine	NW/5
	15.2	19	0.188	6.6	6	willow	
	14	18	0.163	9.3	8	alder	
	13.7	20	0.198	13	15		
				7.2	6		
				7.6	10		
				12.6	12		
				6.5	15		
				8.5	13		
				6.6	12		
3-2	6	16	0.054	11.2	14		
	10.8	16	0.092	6.5	17		
	12	13	0.066	10.7	17		
				11.9	19		
				9.4	10		
				8.5	13		
3-3	0	0	0	13.4	15		
				11.8	11		
				7.5	14		
				8.7	16		
				5.8	12		
				8.2	12		
4-1	7	9	0.015	9.25	11	pine	E/4
	10.4	9	0.026			willow	
	10.4	9	0.026			birch	
	10	10	0.039			aspen	
	6.8	8	0.015				
	4.2	9	0.01				
	8.6	8	0.02				
	8.5	9	0.02				
	9.2	11	0.039				
	10.4	11	0.026				

	Standing			Downed			
Plot #	Hgt m	DBH cm	Vol c.m.	Hgt m	DBH cm	Regen	Asp/slp
4-2	5.2	8	0.015	10.8	20		
	9	10	0.031				
	6.4	9	0.015				
	14.2	15	0.103				
	14.1	11	0.056				
4-3	5.6	12	0.023	0	0		
	8	11	0.031				
	10.1	14	0.072				
	10	12	0.054				
	8	11	0.031				
	6.6	20	0.068				
	6.9	9	0.015				
	6.9	9	0.015				
5-1	12	17	0.112	6.8	11	willow	NE/8
	13	33	0.413	13.5	20	pine	
	9.8	17	0.092	8	12	w.rose	
	8.2	16	0.073	10	15		
	17.6	18	0.214	9.3	9		
	8.6	11	0.031				
	13.4	13	0.078				
	10.8	15	0.072				
5-2	8.6	12	0.043	9.4	12		
	8.2	13	0.043	4.7	7		
	14	14	0.103				
	5	10	0.015				
	10.8	16	0.092				
5-3	9.4	19	0.114	0	0		
	6.6	14	0.042				
	7.8	10	0.031				
	13.2	16	0.132				
6-1	19	16	0.172	13	18	pine	S/21
	5.2	11	0.023	10.4	20	w.spruce	
	14	19	0.163	8.1	9		
	5	9	0.01	11.5	13		
	14	21	0.19	13	19		
	18	22	0.31	14.9	18		
				16.6	17		
				17	20		
				14	11		
				15.5	17		
				16	18		
				17.2	18		
				16.9	18		
				8.2	9		
				6.1	5		

Plot #	Standing			Downed		Regen	Asp/slp
	Hgt m	DBH cm	Vol c.m.	Hgt m	DBH cm		
6-2	17.5	13	0.101	12	15		
	16.2	18	0.188	10.5	10		
	14.5	10	0.056	10	12		
				10	11		
				13	12		
				12	13		
				8	8		
6-3	7.5	10	0.031	10.5	15		
	15	17	0.132	8.2	6		
	7.3	10	0.031	13.2	18		
	14.2	18	0.163	9.5	10		
	16	23	0.273	6.5	8		
	16.3	22	0.273	12	15		
	6.5	10	0.023				
	6.5	9	0.015				
	5.5	7	0.015				
	14.5	23	0.237				
	15	22	0.237				
7-1	9.8	10	0.039	10.2	12	pine	S/14
	9.5	12	0.054	9.5	12	willow	
	13.4	12	0.078	11	13	birch	
	9	13	0.043	6.2	7		
	18.4	14	0.135	8.3	8		
				9.3	16		
				7.8	13		
				6	9		
				6.5	9		
				8.6	12		
				9.3	15		
				7	9		
				6	9		
				13	19		
				9.3	10		
7-2	8	18	0.091	12.7	13		
	13.7	14	0.103	6.1	10		
				8.2	10		
				8	10		
				6.9	12		
				5.5	9		
				4.8	8		
				3	7		
				9.3	13		
				9.1	16		
				4.7	10		

	Standing			Downed			
Plot #	Hgt m	DBH cm	Vol c.m.	Hgt m	DBH cm	Regen	Asp/slp
7-3	10.6	16	0.092	8.9	14		
	8	13	0.043	11	14		
	15	14	0.103	11.2	14		
	16.2	13	0.09	10.7	16		
	14.5	12	0.078	11.2	15		
				7	7		
				7	7		
				7	7		
				12.4	19		
				13.5	10		
				13.8	18		
				12	13		
				11.5	10		
				13.9	18		
				10.5	10		
8-1	9.6	12	0.047	7.9	11	pine	SE/8
				6.5	10	aspen	
				4	6	birch	
				5.2	6		
				9	12		
				6	8		
				8.9	10		
				8.2	7		
				7.2	8		
				6.3	11		
				4.4	6		
				5.6	7		
				7.4	5		
8-2	6	8	0.015	4.8	5		
	4.5	5	0.003	6.2	6		
	8.4	9	0.02				
	8.3	9	0.02				
	8.1	8	0.02				
	5.4	8	0.015				
	6.1	5	0.004				
	8.3	9	0.02				
8-3	6.5	12	0.032	6	8		
	6	8	0.015	5.3	9		
	5.5	6	0.009	7.6	10		
	5.7	5	0.004	4.6	4		
	5.1	8	0.015	4.8	6		
	6.1	9	0.015	6.7	7		
				5.7	10		
				6.5	9		

Plot #	Standing			Downed		Regen	Asp/slp
	Hgt m	DBH cm	Vol c.m.	Hgt m	DBH cm		
9-1	20	12	0.113	10.8	13	birch	SE/12
	6	10	0.023	5.7	9	alder	
	14.8	15	0.103	8.6	10	pine	
	9	12	0.043	7	11		
				4	6		
9-2	12.8	16	0.112	4	8		
	12.6	17	0.112	6.8	10		
				8.3	15		
				8.6	10		
				3.6	9		
9-3	9	18	0.091	8.8	12		
	4.2	20	0.06	10.4	10		
	11.4	19	0.114				
	10.7	12	0.054				
10-1	15.4	13	0.09	12	16	pine	S\16
	16	14	0.119	10.9	12	birch	
	19.5	22	0.347	12.3	14		
	15.5	15	0.119	8.9	10		
				4.5	5		
				6.6	5		
				6.8	17		
				16	26		
				13	14		
				10.8	20		
				18.1	24		
10-2	12.8	14	0.087	8.4	9		
	20.8	24	0.407	14.3	20		
	15	20	0.198	13.5	24		
	21	32	0.699	14.2	18		
10-3	20	32	0.699	14.8	23		
				11	15		
				11	12		
11-1	12	12	0.066	8.2	11	pine	SSW/11
	108	12	0.054	8.4	12		
	12	11	0.047	9.1	10		
	4.2	7	0.006	8.3	13		
	12.2	15	0.07	12.7	10		
	6.8	10	0.023	11.9	15		
	11	13	0.054	13.2	19		
				11.4	14		
				13.3	16		
				10.3	14		
				14.5	20		
				11.8	20		

Plot #	Standing			Downed		Regen	Asp/slp
	Hgt m	DBH cm	Vol c.m.	Hgt m	DBH cm		
11-2	0	0	0	4.4	7		
				9.4	15		
				11.3	14		
				8.4	10		
				10	12		
				12.5	16		
				12	18		
11-3	8	12	0.043	11.2	12		
	13	12	0.066	8.8	10		
	12	12	0.066	7.3	13		
	13	12	0.066	8.2	10		
	8.5	13	0.043	11.5	14		
	9	9	0.02	11.6	14		
	7	11	0.023	11.2	14		
	8.5	10	0.031	9	15		
	9.5	15	0.072	8.9	15		
	12.8	14	0.07	11.5	14		
				10.7	10		
				7.6	6		
12-1	15.2	17	0.152	4.8	8	willow	N/14
	13.2	11	0.056	10.4	14	pine	
	10	11	0.039	9.8	11	birch	
	7	17	0.054	7.2	11		
	9.6	10	0.039	10.5	10		
				6.6	6		
12-2	2	7	0.003	10.3	12		
	5	12	0.021	10.7	20		
				14.5	14		
				4.6	8		
				6.4	10		
				4.3	7		
12-3	14.2	18	0.163	13.7	23		
	10.6	13	0.054	11.7	20		
	12.4	11	0.047	7.1	11		
	7.6	15	0.057				
	12.2	13	0.066				
	12.4	18	0.139				
	11.4	14	0.087				

	Standing			Downed			
Plot #	Hgt m	DBH cm	Vol c.m.	Hgt m	DBH cm	Regen	Asp/slp
13-1	16.4	20	0.229	10.2	15	pine	E/10
	10.8	13	0.054	11	17	willow	
	10	10	0.039	7.3	10	birch	
	12.2	15	0.087	12.9	14		
				6.5	10		
				8.9	11		
				10.5	12		
				7.6	12		
				7.5	12		
				9.3	10		
				8.2	11		
				8.4	10		
				7.8	10		
				10.6	14		
				10.3	13		
				9.3	14		
				8.1	10		
				10.6	12		
				10.2	15		
				10.2	12		
				11.2	13		
13-2	12.4	15	0.087	2.6	12		
				10	12		
				7.9	10		
				7.4	11		
				4.7	6		
				11.5	12		
				5.8	10		
				11.8	8		
				6	6		
				7.3	6		
				1	11		
				13.5	17		
				13	13		
				14.5	15		
				5.5	8		
				6.7	8		
				6.7	13		
				9.7	14		
				10.5	14		

	Standing			Downed			
Plot #	Hgt m	DBH cm	Vol c.m.	Hgt m	DBH cm	Regen	Asp/slp
13-3	10.6	11	0.039	10.2	7		
	13.4	17	0.132	8.3	7		
	13.5	15	0.103	6.5	11		
	16.8	13	0.09	5.2	4		
	17.2	13	0.101	9	10		
	17.8	15	0.135	11.8	13		
	14.4	15	0.103	8.8	6		
	4	9	0.101	8.9	6		
				8.5	11		
				5.3	7		
				4.9	6		
				9.7	8		
				9.2	11		
14-1	13.6	13	0.078	17.4	18	pine	E/11
	13	19	0.139	6.7	13	w.birch	
	15.2	8	0.043	14.1	20	willow	
	12.8	14	0.087	7.6	9		
	11	12	0.054	12.7	14		
				19	28		
				6.1	8		
14-2	10.2	6	0.015	8	14		
	7.2	7	0.012	12.9	20		
	6.5	10	0.023	15	23		
	15	12	0.078				
	14.3	13	0.078				
	16	22	0.273				
	8	16	0.073				
	7.5	12	0.043				
	7.8	12	0.043				
	7.5	11	0.031				
	10.8	12	0.072				
	16.8	17	0.152				
14-3	14.4	21	0.198	14.9	18		
	12	11	0.047	6	13		
	12	20	0.169	12.4	13		
				9.4	16		
				6	16		
15-1	12.2	19	0.139	6	5	pine	SE/13
	6.8	13	0.032	6.7	7	willow	
	6	12	0.032	8.8	11	w.birch	
	7.2	9	0.02	7.8	6		
				11.4	14		
				12.3	14		
				7	15		
				10.3	17		
				13.2	24		

	Standing			Downed			
Plot #	Hgt m	DBH cm	Vol c.m.	Hgt m	DBH cm	Regen	Asp/slp
15-2	8	9	0.02	5.7	12		
	18	16	0.172	8.4	8		
	6	12	0.032	6.2	5		
	16	16	0.152	10	10		
	16.5	19	0.188	13.8	12		
				6.4	10		
				7	9		
				12.6	17		
15-3	7.4	11	0.031	11.3	11		
	9.6	19	0.114	8.9	11		
				11.5	13		
				12.6	11		
				8.6	8		
				6.6	7		
16-1	8.4	9	0.02	11.1	12	w.birch	E/6
	15.4	12	0.09	8.1	10	pine	
	15.2	13	0.09	10	7	willow	
	6.4	9	0.015	6.9	12		
	10.4	10	0.039	7.2	9		
	11.2	12	0.066	9.1	9		
	15	14	0.103	8	5		
	12.5	10	0.047	6.5	12		
	12	11	0.047	11.9	11		
				8.3	10		
16-2	5.2	9	0.015	8.6	10		
	12	11	0.047	6.2	6		
	12.2	11	0.047	9.5	14		
	11	11	0.039	5.1	9		
	9	8	0.02	6.8	5		
	9.5	10	0.039				
	10.2	10	0.039				
16-3	13.4	18	0.163	4.4	10		
	5.8	10	0.023	7.5	10		
	5.6	17	0.054	9.5	8		
	10	13	0.054	9.8	11		
	3	8	0.005	5.4	8		
	12.8	18	0.139	6.4	11		
	8.5	12	0.043	7.6	8		
	12.8	20	0.169	9	12		

Appendix 2

Number of Stems per Diameter Class

Appendix 2

Number of stems per diameter class for standing and downed timber
Minto Creek fuelwood survey, July, 1994

Plot #	Standing Trees			Downed Trees		
	7-10cm	10-15cm	15-20cm	7-10cm	10-15cm	15-20cm
1	11	3	0	6	4	0
2	22	6	1	7	3	0
3	1	5	0	15	2	0
4	15	8	0	1	1	0
5	9	6	1	4	2	0
6	7	5	6	9	13	6
7	5	3	3	25	15	0
8	15	0	0	23	0	0
9	4	5	1	10	2	0
10	0	1	8	5	11	2
11	8	9	0	14	17	0
12	5	8	1	8	7	0
13	1	7	4	23	16	0
14	6	11	3	7	6	2
15	7	1	3	14	9	0
16	9	11	3	21	2	0

Minto Explorations Ltd.

Minto Project, Yukon

Environmental Effects Monitoring

FIRST STUDY DESIGN

Appendix D

Site Hydrology Update

(Clearwater Consultants Ltd., 2006)

Memorandum CCL-MC1

Date: October 6, 2006 **Our File:** 087.01

To: Access Consulting Group - Dan Cornett (dan@accessconsulting.ca)

From: Clearwater Consultants Ltd. - Peter S. McCreath P.Eng. (pmccreath@shaw.ca)

Subject: Minto Copper Project – Site Hydrology Update

1. Introduction

This memorandum presents an update to the Minto Creek area site hydrology using available site and regional data. Previous summaries of the estimated site hydrology were presented in Volume II of the IEE by Hallam Knight Piesold (December 1994). The purpose of the update presented herein is, based on the most recent available data, to present revised site hydrological design parameters that will be applied to the updated water balance analysis for the Minto Copper Project. The hydrology update includes precipitation, evaporation and streamflow distributions.

2. Available Data

The Minto Creek site is located about 240 km north of Whitehorse on the left (west) bank of the Yukon River. The site is about 40 km northwest of the proposed Carmacks Copper project at Williams Creek. The creek drains a total catchment area of about 42 km2 at the confluence with the Yukon River. Elevations within the catchment range up to about 1000 m with an average catchment elevation of about 760 m. Planned mining facilities will be located within the upper reaches of the catchment at elevations typically from 850 m to 900 m.

Limited climate data are available for the Minto Creek site. A few (partial) months of data were collected in 1993 and 1994. A complete meteorological station was established at the site in September 2005 and data for the station is available up to mid-July 2006. The data includes temperatures, solar radiation, wind speed and direction, relative humidity, barometric pressure, and rainfall: no winter snowfall data have been collected. Table MC1-1 and Figures MC1-1 to MC1-5 summarize the available site data.

Snow surveys have been carried out by J. Gibson & Associates in 1994, 1995, 1998 and 2006 at three locations in the Minto Creek catchment ranging in elevation from 890 m to 980 m.

Regional data were used in the update from the following stations:

- Pelly River Ranch at elevation 454 m: temperatures, precipitation, rainfall, snowfall and lake evaporation
- Snow survey data at Pelly Farm (elevation 472 m), Williams Creek (914 m), Mount Nansen (1021 m), Casino Creek (1065 m), and MacIntosh (1160 m).
- Whitehorse at elevation 703 m: solar radiation, pan evaporation

Due to the proximity to the proposed Carmacks Copper project site, methodologies developed during recent updates to the Williams Creek area hydrology (Clearwater Consultants Ltd. Memo CCL-CC6 Final Draft "Carmacks Copper Project – Williams Creek Site Hydrology Update" dated January 13, 2006) have been used and applied as appropriate to the Minto Creek hydrology update.

Streamflow data have been collected sporadically at several locations within Minto Creek since 1993. The primary locations used herein are station W1 "Minto Creek near the Mouth" (42 km^2) and station W3 "Minto Creek downstream of decant pond" (10.4 km^2). Data consist of various spot flow measurements at both stations as well as limited datalogger data for station W1 from July to October 2005.

Due to the proximity, regional streamflow data were evaluated for WSC Station 09AH003 "Big Creek near the mouth" (1750 km^2). Big Creek drains the catchment area immediately south of Minto Creek.

3. Precipitation

3.1 Average Conditions

Due to the lack of site-specific data for Minto Creek, orographic factors previously developed for the Williams Creek area were applied to the Minto Creek area with Pelly River Ranch (1955 to 2004, elevation 454 m) providing the base dataset. The assumptions and results presented herein are believed to be conservative and appropriate for design applications for the Minto Copper Project.

Orographic factors and estimated annual average rainfall, snowfall and total precipitation are summarized following for Pelly River Ranch and for two elevations within the Minto Creek drainage:

Item	Orographic Factor %/100 m	Pelly River Ranch (mm)	Minto at Elev 760 m		Minto at Elev 885 m	
			Factor	Depth	Factor	Depth
Annual Rainfall	0.94%	189.4	1.029	195	1.041	197
Annual Snowfall	6.26%	113.7	1.192	136	1.270	144
Total Precipitation	2.94%	303.1	1.090	331	1.127	341

Notes
1) Elevation 760 m corresponds to the average catchment elevation for Minto Creek at the mouth
2) Elevation 885 m is the approximate elevation of the proposed tailings pond for the project.
3) Pelly River Ranch data was collected at elevation 454 m
4) Depths are rounded to the nearest mm

Table MC1-2 summarizes estimated monthly average rainfall, snowfall and total precipitation for Pelly River and the two Minto Creek locations.

3.2 Wet and Dry Year Precipitation

Frequency analyses were carried out on Pelly River Ranch total annual precipitation and the orographic factor for total precipitation shown above was applied to estimate comparable values for the Minto Creek area. Results are shown in Table MC1-3, including estimated annual rainfall and snowfall for extreme wet and dry years for two locations in the Minto Creek drainage for a range of return periods from a 20 year dry year up to a 500 year return period wet year. Values shown on the Table are the expected values (best estimates) for each return period: lower and upper bounds for each estimate are within +/-5% to +/-9% of the values shown.

An evaluation of Pelly River Ranch precipitation data corrected for the effects of precipitation undercatch by Environment Canada suggests that annual average total precipitation could be about 5% higher with the increase due primarily to increased rainfall (i.e. more undercatch correction on rainfall data). Corrections on the Pelly River annual total precipitation each year varied from less than 3% to

about 9%. Frequency analyses on the corrected precipitation database yielded values from 3% to 5% higher than the results using the uncorrected database. This difference is not considered significant and is within the lower to upper bound range calculated for the results using the uncorrected database.

3.3 Wet Periods – One Day, One Month to 12 Month Duration

Total precipitation for wet periods for one day and from one month to 12 months duration were estimated based on the analyses above and assuming the following:

- One day wet periods will have an orographic factor of 1.30 times Pelly River Ranch as previously estimated for Williams Creek
- One month wet periods will have an orographic factor of 1.15 times Pelly River Ranch, also as previously estimated for Williams Creek;
- Orographic factors for wet periods with durations of 2, 3 and 4 months were estimated by interpolation as shown on Table MC1-4.
- The annual rainfall orographic factor of 1.03 will apply to five month duration wet periods extending from the start of May through to the end of September. This period is responsible for about 94% of the total annual rainfall recorded at Pelly Ranch;
- The snowfall orographic factor of 1.19 will apply to wet periods of six to seven months duration extending from the start of October through to the end of the following April;
- Wet periods starting in October and lasting more than seven months will be comprised of both snowfall and rainfall; therefore, the orographic factor will be less than the snowfall factor (1.19) but more than the annual precipitation factor (1.09). For wet periods of 8, 9, 10 and 11 months duration, the orographic factor was estimated by interpolation as shown on Table MC1-4.

Estimates of extreme wet and dry year and wet and dry period precipitation depths were prepared for the Minto Creek site at two elevations (760 m and 885 m) and are presented in Table MC1-4.

3.4 Snowmelt

Based on the Minto Creek snow survey data from 1994, 1995, 1998 and 2006, the maximum annual snowpack within the Minto Creek drainage was generally measured on either March 1 or April 1. For most years (except 2006) there was no snow remaining on the ground by May 1 (Table MC1-5). For design purposes it is recommended that the entire accumulated snowpack should be assumed to melt during April. The total snowmelt could occur over a period of as little as two weeks.

Based on comparisons with regional snow survey data, the average of the site data maximum snowpack measurements represented about 85% of the long term average maximum snowpack. As shown on Table MC1-5, the estimated long term average maximum snowpack at the Minto Creek sites may range from about 90 mm to 105 mm (water equivalent).

4. Other Climate Data

Table MC1-1 and Figures MC1-1 to MC1-5 summarize the measured climatic data at the Minto Creek site from September 2005 to July 2006. Figure MC1-2 compares the site temperature data to long-term average temperature data reported for Pelly Ranch and for Carmacks. Overall, the Minto Creek 2005 data indicates the site was significantly warmer than average Pelly and Carmacks temperatures for

December, January and February, slightly warmer from September to November, cooler in March and April, and essentially the same temperature in May, June and July. Based on typical temperature lapse rates, the Minto Creek site elevations (760 m to 885 m) would be expected to be about 2°C to 4°C cooler than Pelly Ranch.

5. Evapotranspiration and Lake Evaporation

Lake evaporation and areal evapotranspiration (including transpiration from vegetation) were estimated using the computer model WREVAP, which was developed by Environment Canada's National Hydrology Research Institute (NHRI, 1985). WREVAP is a semi-empirical, semi-physical model that estimates evaporation from meteorological data (humidity, air temperature and sunshine duration). The model uses different routines to estimate lake evaporation and land evapotranspiration. Estimates were prepared for Whitehorse Airport, Mayo Airport, Williams Creek, and Minto Creek using the available site climate data (September 2005 to July 2006) supplemented by regional data. Monthly values for Minto Creek were estimated for August based on regional data due to missing site climate data as indicated on Table MC1-6. Minor adjustments were also made to calculated monthly evapotranspiration values for April and June so as to be consistent with regional long-term average values. Table MC1-6 summarizes the calculated and adjusted values of lake evaporation and areal evapotranspiration for Minto Creek. Monthly values are shown on Figures MC1-6a and MC1-6B.

Annual calculated total lake evaporation ranges from 467 mm/year at Mayo to 528 mm/year at Williams Creek with Minto Creek falling midway between these values at 495 mm. During the typical open water season from May through September, calculated lake evaporation was 440 mm at Whitehorse and Williams Creek and 430 mm at Minto Creek, about 83% to 87% of the annual total. Pan evaporation data have been collected by Environment Canada for Pelly Ranch and for Whitehorse Airport. Table MC1-6 shows lake evaporation calculated from the pan evaporation data assuming a typical pan coefficient of 0.7. Lake evaporation calculated from the pan evaporation data from May to September was 480 mm at Whitehorse and 450 mm at Pelly Ranch, approximately 10% higher than calculated using the WREVAP program.

For application to the Minto Copper Project water balance it is recommended that lake (open water) evaporation losses be based on the values calculated using the WREVAP program and adjusted for regional consistency. For conservatism in design the following is recommended:

- For the evaluation of maximum design storage volumes a "low" estimate of open water season (May to September) annual lake evaporation of 390 mm corresponding to 10% less than the WREVAP calculated value.
- For average operating conditions and the evaluation of make-up water requirements annual open water season lake evaporation of 430 mm.

Evapotranspiration losses around the mine site will be a function of the type of ground cover and local elevation and aspect. Annual average calculated areal evapotranspiration ranges from about 175 mm/year at Minto Creek to 220 mm/year at Mayo with about 80% of the total occurring from May through September. At Minto Creek annual areal evapotranspiration is equal to about 35% of annual lake evaporation. Actual evapotranspiration losses of 175 mm/year are recommended for general application to the Minto Creek site for areas covered with natural, undisturbed vegetation. For areas that are swampy or are covered with some ponded water, a total evaporative loss of between 175 mm/year (evapotranspiration) and 430 mm/year (lake evaporation) would be appropriate: a value of 300 mm/year is suggested. For disturbed ground (i.e. mill area, waste dumps, open pit walls etc.) annual evaporative losses will be less than 175 mm/year: a value of 100 mm/year is suggested.

6. Monthly Streamflow Distributions and Mean Annual Runoff

The monthly distribution of streamflows within the Minto Creek drainage is required in order to evaluate and monitor potential impacts due to mine development and operation. The available site area streamflow data for stations W1 and W3 are summarized in Table MC1-7. The concurrent data for the WSC station at Big Creek are also shown on the table. The data indicate that the 1994 to 2004 period was typical of longer-term average conditions reported for Big Creek from 1974 to 2004.

Field observations indicate that Minto Creek experiences glaciations and essentially freezes solid during most winters between November and March. The measured streamflows from April through October were, therefore, assumed to represent the entire year's runoff from the Minto Creek catchment. Table MC1-8 shows the estimated monthly distribution of streamflows as a percent of mean annual runoff for the two Minto Creek stations and for Big Creek.

There have been periods when no streamflow has been observed at W1 (the downstream station) at times when flows were observed at the upstream station W3. Infiltration of Minto Creek flows into the alluvial materials of the Yukon River floodplain has been postulated as the reason for the observed zero flow condition in Minto Creek near the mouth.

Most available streamflow data for Minto Creek consists of spot measurements of flow: continuous datalogger records are only available for July to October 2005 for station W1. In addition April streamflows have only been measured in 2006 and personnel report that peak snowmelt streamflows have not been measured. Assuming that the available streamflow data collected since 1994 have been representative of long term average conditions would yield a minimum estimate of the mean annual runoff depth (MAR) for Minto Creek of about 75 mm (Table MC1-7). However, given the lack of continuous streamflow data, especially the limited data during snowmelt in April (Table MC1-5), the actual average MAR for Minto Creek may be closer to 100 mm. Figure MC1-7 shows average estimated monthly flows for Minto Creek at W1 and at W3 assuming a mean average annual runoff of 100 mm. The long term MAR at Big Creek has been about 143 mm, thus annual runoff in Minto Creek appears to be from 50% to 70% of the mean annual runoff in Big Creek. The difference is due to differing catchment characteristics: Big Creek is much larger (1750 km^2 v. less than 42 km^2) with a much high average catchment elevation (1150 m v. 760 m) and experiences a higher total precipitation.

For water balance modeling within the Minto Creek catchment an average annual runoff depth of 100 mm should be used. Table MC1-9 shows estimated wet and dry year runoff depths for Big Creek and Minto Creek for a range of return periods.

7. Conclusions

The estimated hydrologic characteristics of the Minto Creek site area have been updated using the available site and regional data. The updated site hydrology parameter values will be applied to the site water balance analysis of the project. The following conclusions are made:

1) The estimated annual average precipitation at the Minto Creek site is 330 to 340 mm, depending on elevation, and is comprised of 58% to 59% rainfall occurring from April to September.

2) Average estimated monthly rainfall, snowfall and total precipitation depths for the Minto Creek area are shown on Table MC1-2.

3) Frequency analyses for annual precipitation and one day and one to twelve month duration wet and dry periods are shown on Table MC1-4.

4) For average conditions the annual snowmelt should be assumed to occur in April. The average maximum snowpack in upper Minto Creek is from about 90 mm to 105 mm

5) Average potential lake evaporation for the Minto Creek area is estimated to be 495 mm/year with about 87% of the lake evaporation (430 mm) occurring during the open water season from May to September. A 10% lower value is recommended as a conservative design parameter to evaluate maximum design reservoir storage volumes.

6) Average areal evapotranspiration for natural vegetated undisturbed ground in the Minto Creek catchment is estimated to be 175 mm/year (35% of lake evaporation). Evaporative losses for differing ground cover conditions may vary from 100 mm/year for disturbed ground to more than 300 mm/year for swampy ground.

7) The Minto Creek site appears slightly warmer than Pelly Ranch and Carmacks from September to February and slightly cooler from March to May based on the limited available site data.

8) Monthly average streamflow distributions for the Minto Creek catchment area are shown on Table MC1-8.

9) Mean annual runoff depth for Minto Creek is estimated to be about 100 mm. Table MC1-9 shows estimated wet and dry year runoff for a range of return periods.

CLEARWATER CONSULTANTS LTD.



Peter S. McCreath P.Eng.

APPENDIX 1

Minto Creek Area Hydrology Update

Tables

Table MC1-1 – Minto Camp Climate Station – Monthly Summary September 2005 to July 2006

Table MC1-2 – Average Monthly Precipitation Conditions – Minto Creek Areas

Table MC1-3 – Annual Precipitation Frequency Analyses

Table MC1-4 – Wet Period Precipitation – One Day to 12 Month Duration

Table MC1-5 – Comparison of Snow Survey Data

Table MC1-6 – Estimated Average Areal Evapotranspiration and Lake Evaporation

Table MC1-7 – Available Monthly Streamflow Data – Minto Creek and Big Creek

Table MC1-8 – Summary of Average Monthly Streamflows and Runoff

Table MC1-9 – Wet and Dry Year Runoff

Table MC1-1 - Minto Camp Climate Station - Monthly Data Summary September 2005 to July 2006

	Rainfall (mm)		Wind Speed (m/s)					Air Temperature (°C)					
Month	Total Monthly	Maximum Daily	Average Monthly	Maximum Gust	Average Wind Direction (ø)	Total Solar Radiation (W/m^2)	Average Soil Temperature (*C)	Extreme Maximum	Extreme Minimum	Average Monthly	Average Dew Point (oC)	Average RH (%)	Average Pressure (mbar)
Sep-05	21.6	1.6	1.63	15.77	193.9	52,873	7.3	15.23	-0.61	6.89	1.95	72.6	914.1
Oct-05	23.0	2.8	1.80	17.63	173.6	32,319	1.3	7.43	-10.56	-0.94	-3.74	82.8	907.2
Nov-05	11.6	4.8	1.57	19.48	231.0	9,506	-0.6	7.43	-28.05	-12.70	-15.34	82.0	908.6
Dec-05	4.6	2.4	0.78	17.25	207.7	2,911	-6.8	6.22	-29.10	-10.21	-12.61	84.0	907.5
Jan-06	0.0	0.0	0.23	7.79	240.3	6,441	-10.7	-3.85	-36.50	-19.25	-21.19	84.6	904.7
Feb-06	0.4	0.4	1.82	19.11	207.5	27,202	-9.5	5.81	-30.20	-11.80	-16.35	71.4	918.0
Mar-06	2.8	1.6	1.71	11.32	214.8	78,691	-9.0	5.40	-28.05	-12.10	-17.80	63.9	915.3
Apr-06	0.0	0.0	3.43	20.22	212.3	81,660	m	7.03	-14.10	-1.03	-8.96	56.9	898.4
May-06	0.9	0.1	3.27	18.37	209.3	162,958	m	19.04	-2.44	7.32	-3.28	50.1	908.0
Jun-06	1.4	0.1	3.17	16.14	204.2	90,487	m	25.95	-0.61	13.56	0.65	45.9	909.7
Jul-06	0.3	0.1	2.29	13.36	151.7	m	m	23.63	8.23	15.55	5.77	53.9	910.6

Notes

1) Station data collection halted on March 30th at 1726 hrs
2) Station re-started on April 12, 2006, 0027 hrs, station relocated to airstrip
3) Data to July 19, 2006 at 1344 hrs
4) Apparent Solar Radiation sensor error starting June 15, 2006 at 1744 hrs
5) Average Soil Temperature sensor disabled March 30, 2006 at 1727 hrs
6) November to March precipitation is not accurate. Sensor measures rainfall only.

Table MC1-2 - Average Monthly Precipitation Conditions - Minto Creek Areas

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Pelly River Ranch at Elevation 454 m													
Average Conditions - Monthly Depths - mm													
Average Rainfall	0.0	0.0	0.2	3.5	22.6	36.3	53.5	38.1	27.6	7.1	0.4	0.1	189.4
Average Snowfall	20.0	14.7	11.1	6.7	0.0	0.0	0.0	0.0	0.0	15.8	24.2	21.2	113.7
Average Precipitation	20.0	14.7	11.3	10.2	22.6	36.3	53.5	38.1	27.6	22.9	24.6	21.3	303.1
Percent per month of Total Annual Precipitation													
Average Rainfall	0.0%	0.0%	0.1%	1.2%	7.5%	12.0%	17.6%	12.6%	9.1%	2.3%	0.1%	0.0%	62.5%
Average Snowfall	6.6%	4.9%	3.7%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	5.2%	8.0%	7.0%	37.5%
Total Precipitation	6.6%	4.9%	3.7%	3.4%	7.5%	12.0%	17.6%	12.6%	9.1%	7.6%	8.1%	7.0%	100.0%
Minto Creek Catchment (42 km2) at Average Elevation 760 m													
Percent per month of Total Annual Precipitation													
Average Rainfall	0.0%	0.0%	0.0%	1.7%	7.1%	11.7%	16.9%	12.2%	9.4%	0.0%	0.0%	0.0%	59.0%
Average Snowfall	6.4%	4.8%	4.0%	2.9%	0.0%	0.0%	0.0%	0.0%	0.0%	8.1%	7.9%	6.9%	41.0%
Total Precipitation	6.4%	4.8%	4.0%	4.6%	7.1%	11.7%	16.9%	12.2%	9.4%	8.1%	7.9%	6.9%	100.0%
Average Conditions - Monthly Depths - mm													
Average Rainfall	0.0	0.0	0.0	5.6	23.5	38.6	55.8	40.3	31.0	0.0	0.0	0.0	194.8
Average Snowfall	21.1	15.9	13.2	9.6	0.0	0.0	0.0	0.0	0.0	26.8	26.1	22.8	135.5
Total Precipitation	21.1	15.9	13.2	15.2	23.5	38.6	55.8	40.3	31.0	26.8	26.1	22.8	330.3
Minto Creek Tailings (9.6 km2) at Average Elevation 885 m													
Percent per month of Total Annual Precipitation													
Average Rainfall	0.0%	0.0%	0.0%	1.0%	7.1%	11.7%	16.9%	12.2%	8.8%	0.0%	0.0%	0.0%	57.7%
Average Snowfall	6.4%	4.8%	4.0%	3.8%	0.0%	0.0%	0.0%	0.0%	0.0%	8.5%	7.9%	6.9%	42.3%
Total Precipitation	6.4%	4.8%	4.0%	4.8%	7.1%	11.7%	16.9%	12.2%	8.8%	8.5%	7.9%	6.9%	100.0%
Average Conditions - Monthly Depths - mm													
Average Rainfall	0.0	0.0	0.0	3.4	24.2	40.0	57.7	41.7	30.1	0.0	0.0	0.0	197.1
Average Snowfall	21.9	16.4	13.7	13.0	0.0	0.0	0.0	0.0	0.0	29.0	27.0	23.6	144.4
Total Precipitation	21.9	16.4	13.7	16.4	24.2	40.0	57.7	41.7	30.1	29.0	27.0	23.6	341.5

NOTES

1) Minto Creek % per month for rainfall, snowfall and total precipitation estimated assuming
annual rainfall = 57.7% and annual snowfall = 42.3% of total annual precipitation for Tailings area, and
annual rainfall = 59% and annual snowfall = 41% of total annual precipitation for Total Minto Creek catchment
2) Assumed orographic factors of: Rainfall 0.94%/100 m, Snowfall 6.26%/100 m above Pelly River Ranch, and

Table MC1-3 - Annual Precipitation Frequency Analyses

Return Period (years)	Annual Percent Probability	Pelly Ranch Total Annual Precipitation	Minto Creek Total Catchment			Minto Creek Tailings Area		
			Total Precipitation	Rainfall	Snowfall	Total Precipitation	Rainfall	Snowfall
		(Elev. 454 m)	(Average Elev 760 m)			(Average Elev. 885 m)		
		(Note 1)						
20 (Dry)	95%	222	242	143	99	250	144	106
10 (Dry)	90%	238	259	153	106	268	155	113
5 (Dry)	80%	258	281	166	115	291	168	123
Average	50%	303	330	195	135	341	197	144
5 (Wet)	20%	346	377	223	155	390	225	165
10 (Wet)	10%	373	407	240	167	420	242	178
20 (Wet)	5%	397	433	255	177	447	258	189
25 (Wet)	4%	404	440	260	181	455	263	193
50 (Wet)	2%	424	462	273	189	478	276	202
100 (Wet)	1%	444	484	286	198	500	289	212
200 (Wet)	0.5%	462	504	297	206	521	300	220
				59.0%			57.7%	

Notes

1) Frequency analyses results for Pelly Ranch based on 3-parameter lo-Normal distribution with 47 points, Mean = 303 mm, Standard Deviation = 53.3 mm.
2) Annual total precipitation assumed to increase at 2.94% per 100 m elevation increase. Annual factors are 1.09 for Minto Creek at elevation 760 m and 1.1267 for elevation 885 m.
3) Annual Percent Probability is the probability of the indicated value being equalled or exceeded in any single year

Table MC1-4- Wet Period Precipitation - One Day and One to Twelve Month Duration

Table MC1-4A - Pelly River Ranch

			Wet Periods Starting on May 1					Wet Periods Starting October 1			Annual
Return Period (years)	Annual Percent Probability	One Day	1 -Month Rainfall	2 -Month Rainfall	3 -Month Rainfall	4 -Month Rainfall	5 -Month Rainfall	6 -Month Snowfall	7 -Month Snowfall	8 -Month Precipitation	12 -Month Precipitation
20 (Dry)	95.0%	9.0	37	58	80	99	112	76	83	92	222
5 (Dry)	80.0%	12.7	47	78	104	125	142	88	85	116	258
Average	50.0%	17.6	63	104	138	163	181	115	125	147	299
5 (Wet)	20.0%	24.1	78	128	169	198	218	137	150	176	346
10 (Wet)	10.0%	28.3	89	144	190	221	242	157	176	199	373
20 (Wet)	5.0%	32.2	99	157	209	241	262	178	199	220	397
50 (Wet)	2.0%	37.2	113	173	231	267	287	207	227	247	424
100 (Wet)	1.0%	40.9	122	185	247	284	304	229	248	267	444
200 (Wet)	0.5%	44.6	132	195	262	302	321	252	270	287	462

Table MC1-4B - Minto Creek Area at Elevation 760 m

			Wet Periods Starting on May 1					Wet Periods Starting October 1			Annual
Return Period (years)	Annual Percent Probability	One Day	1 -Month Rainfall	2 -Month Rainfall	3 -Month Rainfall	4 -Month Rainfall	5 -Month Rainfall	6 -Month Snowfall	7 -Month Snowfall	8 -Month Precipitation	12 -Month Precipitation
Orographic Factor		**1.30**	**1.15**	**1.12**	**1.09**	**1.06**	**1.029**	**1.192**	**1.192**	**1.17**	**1.090**
20 (Dry)	95.0%	11.7	42.6	65.0	87.2	105	115	90.6	98.9	108	242
5 (Dry)	80.0%	16.5	54.1	87.4	113	133	146	105	101	136	281
Average	50.0%	22.9	72.5	116	150	173	186	137	149	172	326
5 (Wet)	20.0%	31.3	89.7	143	184	210	224	163	179	206	377
10 (Wet)	10.0%	36.8	102	161	207	234	249	187	210	233	407
20 (Wet)	5.0%	41.9	114	176	228	255	270	212	237	257	433
50 (Wet)	2.0%	48.4	130	194	252	283	295	247	271	289	462
100 (Wet)	1.0%	53.2	140	207	269	301	313	273	296	312	484
200 (Wet)	0.5%	58.0	152	218	286	320	330	300	322	336	504

Table MC1-4C - Minto Creek Area at Elevation 885 m

			Wet Periods Starting on May 1					Wet Periods Starting October 1			Annual
Return Period (years)	Annual Percent Probability	One Day	1 -Month Rainfall	2 -Month Rainfall	3 -Month Rainfall	4 -Month Rainfall	5 -Month Rainfall	6 -Month Snowfall	7 -Month Snowfall	8 -Month Precipitation	12 -Month Precipitation
Orographic Factor		**1.30**	**1.15**	**1.12**	**1.09**	**1.06**	**1.041**	**1.27**	**1.27**	**1.24**	**1.127**
20 (Dry)	95.0%	11.7	42.6	65.0	87.2	105	117	96.5	105.4	114	250
5 (Dry)	80.0%	16.5	54.1	87.4	113	133	148	112	108	144	291
Average	50.0%	22.9	72.5	116	150	173	188	146	159	182	337
5 (Wet)	20.0%	31.3	89.7	143	184	210	227	174	191	218	390
10 (Wet)	10.0%	36.8	102	161	207	234	252	199	224	247	420
20 (Wet)	5.0%	41.9	114	176	228	255	273	226	253	273	447
50 (Wet)	2.0%	48.4	130	194	252	283	299	263	288	306	478
100 (Wet)	1.0%	53.2	140	207	269	301	316	291	315	331	500
200 (Wet)	0.5%	58.0	152	218	286	320	334	320	343	356	521

Notes
1) Orographic Factors *times* Pelly River values *equals* Minto Creek values
2) Snowmelt for 6 to 8 month duration wet periods will allow for 20 mm sublimation loss from the snowpack
3) Orographic factors determined as follows:
   One Day and One Month factors assumed the same as for Williams Creek due to lack of site data at Minto Creek
   Five month factor equal to annual rainfall factors of 1.029 and 1.041
   Six- and Seven-month factors equal to annual snowfall factors of 1.192 and 1.270
   12-month factor equal to annual total precipitation factors of 1.090 and 1.127
   Other factors estimated by interpolation.
4) Factors for other elevations may be estimated assuming annual orographic increases of:
   Rainfall 0.94%/100 m, Snowfall 6.26%/100 m, and Total Precipitation 2.94% per 100 m above Pelly River Ranch

Table MC1- 5 - Comparison of Snowsurvey Data

Concurrent Minto Creek and Regional Data

			1994				1995				1998				2006			
Station	Elevation	Location	Mar-01	Apr-01	May-01	May-15	Mar-01	Apr-01	May-01	May-15	Mar-01	Apr-01	May-01	May-15	Mar-01	Apr-01	May-01	May-15
Minto #1	980	Site	98	**112**	0	0	53	**73**	54	0	75	**76**	0	0	81	**99**	51	
Minto #2	890	Site	87	**93**	0	0	**63**	53	0	0	61	**66**	0	0	72	101	**107**	
Minto #3	890	Site	**84**	78	0	0	**56**	48	0	0	59	**70**	0	0	65	**93**	0	
Pelly Farm	472	20 km NW	**62**	60	0	0	**52**	52	0	0	**59**	56	0	0	**70**	61	19	
Williams Ck	914	45 km SE	m	m	m	m	55	**78**	20		80	**92**	0	0	71	**90**	61	
Mt Nansen	1021	70 km SW	**73**	73	0	0	**50**	49	0	0	56	**81**	0		56	**84**	0	
Casino Creek	1065	90 km W	**83**	83	56	0	75	m	**104**		61	**88**			89	**134**	121	
MacIntosh	1160	120 km S	87	**88**	23	0	56	**78**	13		50	**74**			60	**92**	76	
Average - Minto 1, 2 & 3			90	**94**	0	0	57	**58**	18	0	65	**71**	0	0	73	**98**	53	
Average - Regional Data			76	76	20	0	58	64	27	0	61	78	0	0	69	92	55	
Ratio - Minto/Average Regional			1.18	1.24	0.00		1.00	0.90	0.66		1.06	0.90			1.05	1.06	0.95	

Average Maximum Snowpacks each year (mm water equivalent)

Station	1994/5/8/06 Avg	Ratio to Long Term	Estimated Long Term Average
Minto #1	90	-	106
Minto #2	82	-	97
Minto #3	76	-	89
Pelly Farm	61	0.77	79
Williams Creek	87	0.98	88
Mt Nansen	72	0.95	76
Casino Creek	102	0.72	142
MacIntosh	83	0.84	99

Average Ratio = **0.85**

Minto stations estimated long term Average Maximum Snowpack = (1994/5/8/2006 Average) / (Average Regional Ratio to long term)

Table MC1-6 - Minto Creek - Estimated Average Areal Evapotranspiration and Lake Evaporation

Average Monthly Areal Evapotranspiration (mm)

Month	Williams Creek	Mayo A	Whitehorse A	Minto Camp (calculated)	Minto Camp (adjusted)
Jan	0	0	0	0	0
Feb	0	0	0	0	0
Mar	16.7	0	12.8	5.6	5.6
Apr	16.5	19.3	24	28	***20***
May	27	33.2	35.1	32.4	32.4
Jun	40.5	49.9	45.2	28.7	***40***
Jul	38.3	55.9	44.5	34.5	34.5
Aug	18.4	38.7	23.9		***22***
Sep	15.3	17.3	15.3	15.5	15.5
Oct	4.6	6	8.1	4	4
Nov	0	0	0	0	0
Dec	0	0	0	0	0
Total	177.3	220.3	208.9		174

Average Monthly Lake Evaporation (mm)

Month	Williams Creek (WREVAP)	Mayo A (WREVAP)	Whitehorse A (WREVAP)	Whitehorse A (adjusted Class	Pelly Ranch (adjusted Class	Minto Camp (WREVAP)	
						Calculated	Adjusted
Jan	0	0	0			0	0
Feb	0	0	0			0	0
Mar	21.6	0	15.3			5.3	5.3
Apr	61.6	47.8	58.4			55.9	55.9
May	99.7	90.6	97.3	104.3	107.6	95.1	95.1
Jun	119.4	110.5	118.7	124.8	120.3	119.2	119.2
Jul	110.7	108.4	113.1	109.9	108	111.9	111.9
Aug	76.5	77.9	81.2	96	79.8		***80***
Sep	34	26.2	34.1	47.7	37.2	24.4	24.4
Oct	4.1	5.7	10.3			3.5	3.5
Nov	0	0	0			0	0
Dec	0	0	0			0	0
Annual	527.6	467.1	528.4				495.3
May-Sept	440.3	413.6	444.4	482.7	452.9		430.6

Notes

1) Minto Camp "calculated" values calculated using available climate data from Minto Camp station in 2005
2) Minto Camp "Adjusted" values (in bold italics) estimated based on regional values.

Table MC1- 7 - Available Monthly Streamflow Data - Minto Creek and Big Creek

Monthly Averages - All Flows - Minto Creek W1 & W2 (42 km2)

	Apr	May	Jun	Jul	Aug	Sep	Oct	
1993						0.069		
1994		0.312	0.058	0.095	0.007	0.073		
1995		0.027	0.001	0.091		0.133		
1996		0.031	0.024	0.324		0.146		
1997		1.447			0.265			
1998		0.161			0.003			
1999					0.033			
2000		1.004						
2001		0.467						
2002								
2003					0.129			
2004				0.118				
2005		0.097	0.012	0.127	0.209	0.219	0.134	
2006	0.203	0.354	0.150	0.020				
Average Flow m3/s	0.203	0.433	0.049	0.129	0.108	0.128	0.134	
Average Runoff mm	12.5	27.6	3.0	8.2	6.9	7.9	8.6	74.7
% of Annual	16.7%	37.0%	4.1%	11.0%	9.2%	10.6%	11.5%	

Monthly Averages - All Flows - Minto Creek W3 (10.4 km2)

	Apr	May	Jun	Jul	Aug	Sep	Oct	
1993						0.028		
1994		0.101	0.028	0.039	0.011	0.028		
1995			0.0035	0.017		0.027	0.008	
1996		0.013		0.087		0.021		
1997		0.554						
1998					0.006			
1999					0.006			
2000								
2001		0.16						
2002								
2003					0.037			
2004				0.026				
2005		0.046	0.008	0.014	0.017	0.022	0.02	
2006	0.018	0.128	0.042	0.006				
Average Flow m3/s	0.018	0.167	0.020	0.032	0.015	0.025	0.014	
Average Runoff mm	4.6	43.0	5.1	8.1	4.0	6.3	3.6	74.7
% of Annual	6.1%	57.6%	6.8%	10.9%	5.3%	8.4%	4.8%	

Monthly flows calculated by averaging all available flow data for a given month. Average flow in months with only a single spot flow measurement assumed equal to the spot flow measurement.

Big Creek (1750 km2) - 1993 to 2004

	Apr	May	Jun	Jul	Aug	Sep	Oct	
1993	5.33	36	10	12.6	13.5	7.22	2.04	
1994	7.91	19.1	9.01			3.03	2.27	
1995								
1996	0.003	6.34	6.03	22.5	21.2	12.1	2.91	
1997	0.049	28.7	38.8	26.5	24.4	11	3.85	
1998	0.224	8.61	8.29	2.67	1.87	2.37	1.19	
1999	0.173	9.6	22	6.31	4.18	8.94	3.12	
2000	0.682	58	27.6	30	32.6	37	12.8	
2001	1.76	15.3	37	38.2	19.5	14.8	5.42	
2002	0.732	19.4	9.12	9.15	14.8	16.4	4.62	
2003	3.98	12.3	18.5	20.1	11.7	7.09	4.67	
2004	2.38	40.2	6.27	4.79	7.13	6.14	4.82	
2005								
2006								
Averages - 1993 to 2004								
Flow m3/s	2.11	23.1	17.5	17.3	15.1	11.5	4.34	
Runoff mm	3.1	35.3	25.9	26.5	23.1	17.0	6.6	137.5
Averages - 1974 to 2004 (all available data)								
Flow m3/s	1.83	25.0	17.6	18.9	13.8	10.6	3.98	
Runoff mm	2.7	38.3	26.1	28.9	21.1	15.7	6.1	138.9
Monthly % of Annual Total								
1993 to 2004	2.2%	24.4%	17.9%	18.3%	15.9%	11.7%	4.6%	94.9%
1974 to 2004	1.9%	26.8%	18.3%	20.2%	14.8%	11.0%	4.3%	97.4%

Big Creek 1993 to 2004 - April to October represents 95% of the average annual total runoff of 142.1 mm
1974 to 2004 - April to October represents 97% of the annual total runoff of 142.6 mm
Conclude that 1993 to 2004 period is comparable to the longer term 1974 to 2004 period.

Table MC1-8 - Summary of Average Monthly Streamflows and Runoff

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Big Creek 09AH003, 1750 km2													
Average Flow m3/s	0.31	0.18	0.15	1.83	25.0	17.6	18.9	13.8	10.6	3.98	1.29	0.59	8.01
Average Runoff mm	0.5	0.2	0.2	2.7	38.3	26.1	28.9	21.1	15.7	6.1	1.9	0.9	142.6
Minto Creek at W1 (42 km2)													
Average Flow m3/s				0.203	0.433	0.049	0.129	0.108	0.128	0.134			
Average Runoff mm				12.5	27.6	3.0	8.2	6.9	7.9	8.6			74.7
Minto Creek at W3 (10.4 km2)													
Average Flow m3/s				0.018	0.167	0.020	0.032	0.015	0.025	0.014			
Average Runoff mm				4.6	43.0	5.1	8.1	4.0	6.3	3.6			74.7
Monthly Percent of Annual Average Flow													
Big Creek nr mouth	0.3%	0.2%	0.2%	1.9%	26.8%	18.3%	20.2%	14.8%	11.0%	4.3%	1.3%	0.6%	
Minto Creek at W1	0%	0%	0%	16.7%	37.0%	4.1%	11.0%	9.2%	10.6%	11.5%	0%	0%	
Minto Creek at W3	0%	0%	0%	6.1%	57.6%	6.8%	10.9%	5.3%	8.4%	4.8%	0%	0%	

Notes

1) Minto Creek assumed to glaciate with zero flow from November to March on average.
2) April flows for W1 and W3 probably underestimate actual average monthly April flow due to lack of data during snowmelt.

Table MC1-9 - Wet and Dry Year Runoff

Return Period	Annual Percent	Big Creek Annual Runoff (mm)	Minto Creek Catchment Annual Runoff (mm)
20 (Dry)	95%	62	43
10 (Dry)	95%	75	53
5 (Dry)	80%	94	66
Average	50%	143	100
5 (Wet)	20%	190	133
10 (Wet)	10%	224	157
20 (Wet)	5%	255	179
25 (Wet)	4%	265	186
50 (Wet)	2%	294	206
100 (Wet)	1%	323	226
200 (Wet)	0.5%	351	246
Percent of Big Creek Annual Runoff			70%

Notes

1) Frequency analysis for Big Creek annual runoff based on 3-parameter log-Normal distribution with 27 points, Mean = 144 mm, Standard Deviation 60.4 mm.
2) Ratio of runoff for Minto Creek catchment based on flow data comparison with Big Creek and stations W1 and W3 over the period 1993 to 2006.
3) Annual Percent Probability is the probability of the indicated value being equalled or exceeded in any single year.

APPENDIX 2

Minto Creek Site Hydrology Update

Figures

Figure MC1-1 – Minto Camp – Air Temperature

Figure MC1-2 – Monthly Temperature Comparison

Figure MC1-3 – Minto Camp – Dew Point Temperature

Figure MC1-4 – Minto Camp – Relative Humidity

Figure MC1-5 – Minto Camp – Barometric Pressure

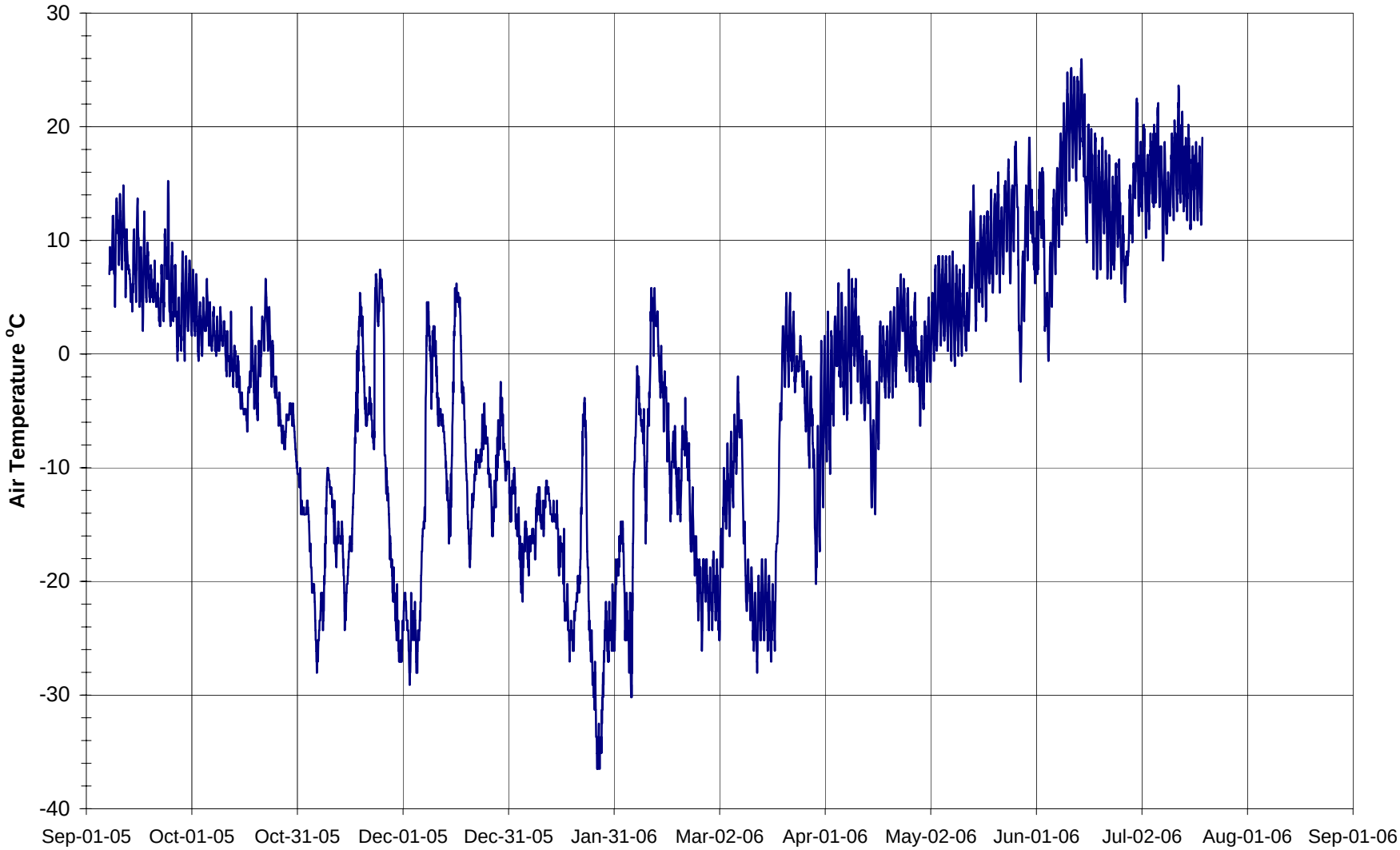
Figure MC1-6A – Estimated Mean Monthly Areal Evapotranspiration

Figure MC1-6B – Estimated Mean Monthly Lake Evaporation

Figure MC1-7 – Average Monthly Flows – Minto Creek at W1 and W3

October 6, 2006

Figure MC1 - 1 : Minto Camp - Air Temperature ^{o}C



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Figure MC1 - 2 : Monthly Temperature Comparison

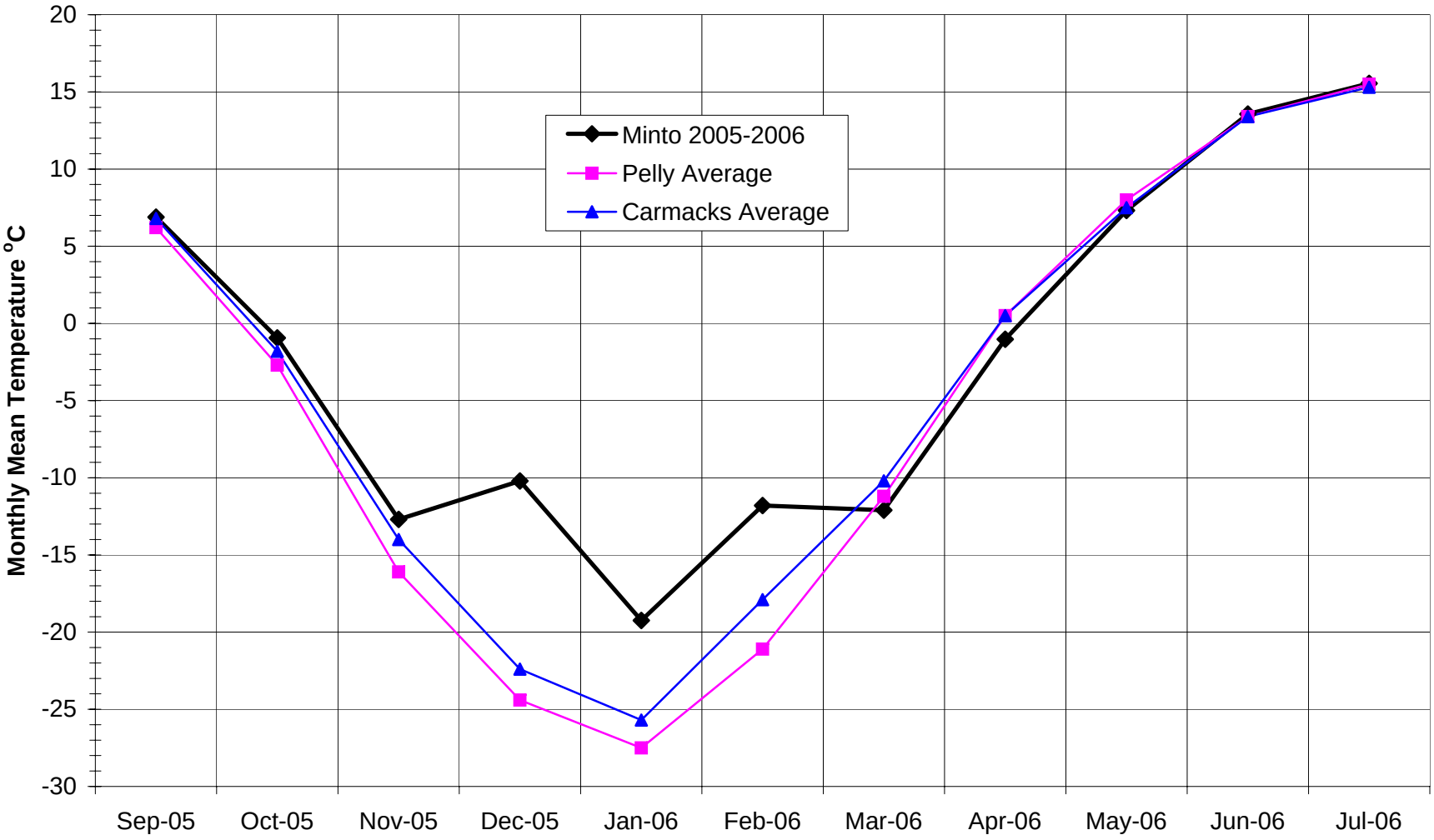


Figure MC1 - 3 : Minto Camp - Dew Point Temperature ^{o}C

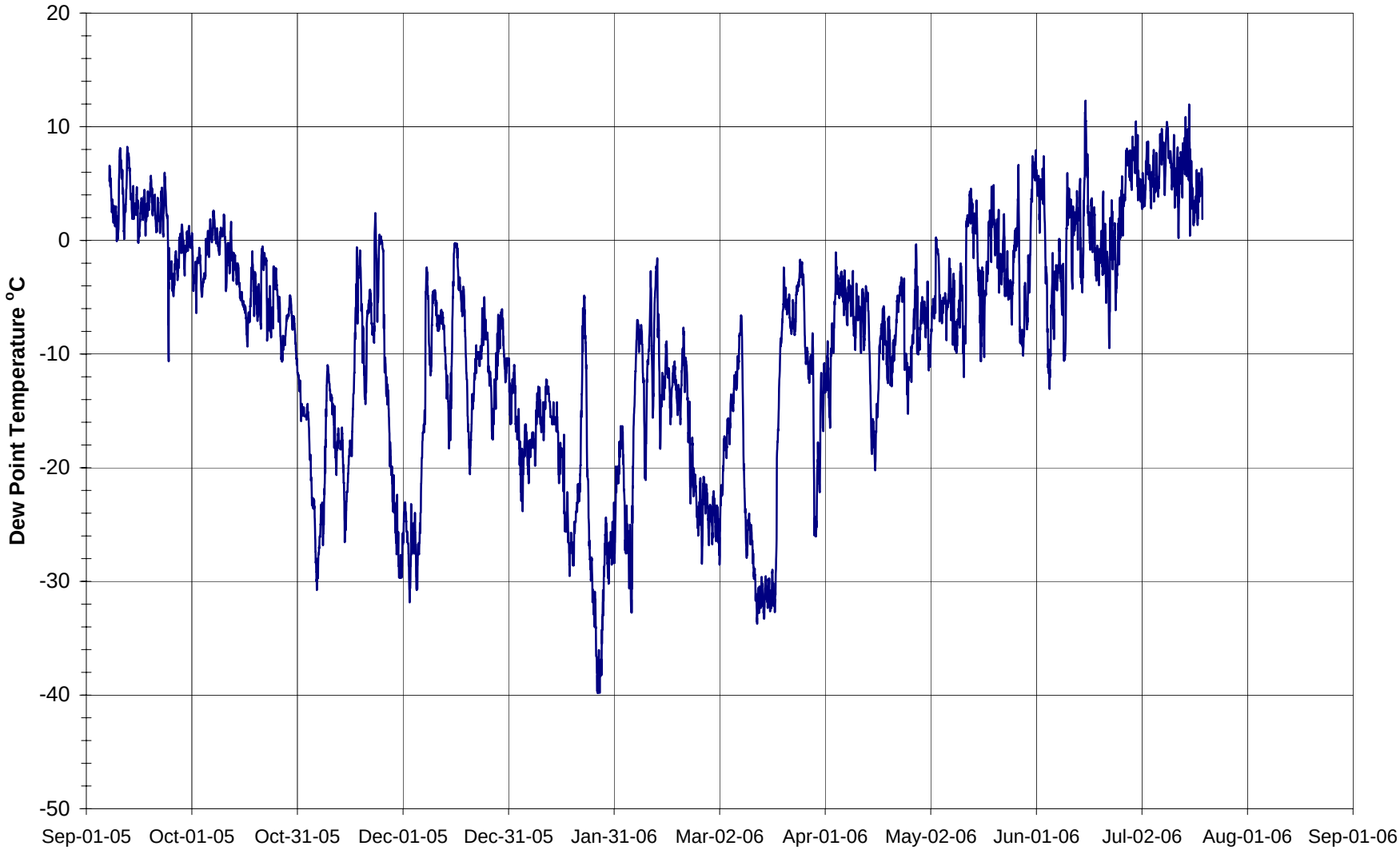


Figure MC1 - 4 : Minto Camp - Relative Humidity %

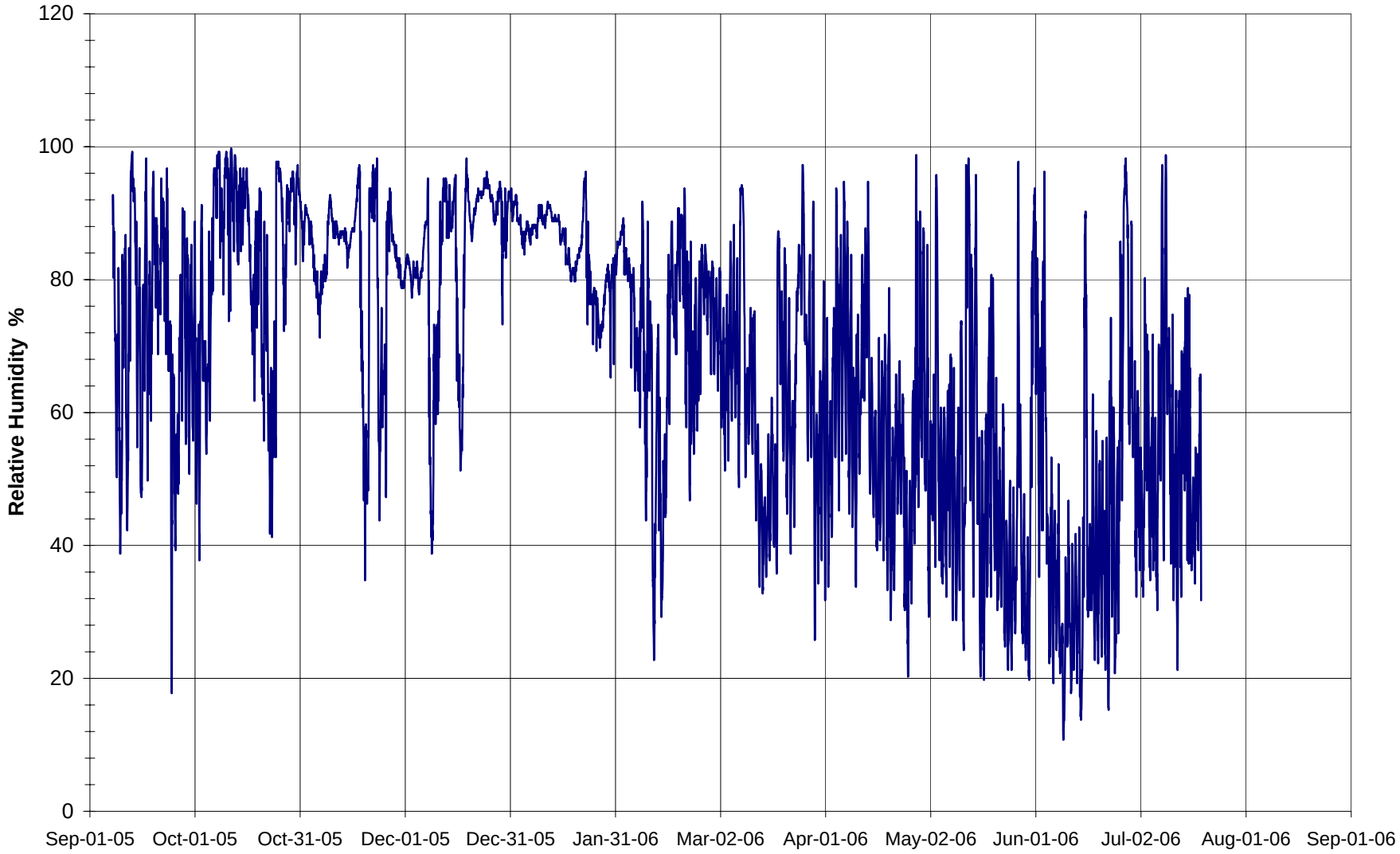


Figure MC1 - 5 : Minto Camp - Barometric Pressure (mbar)

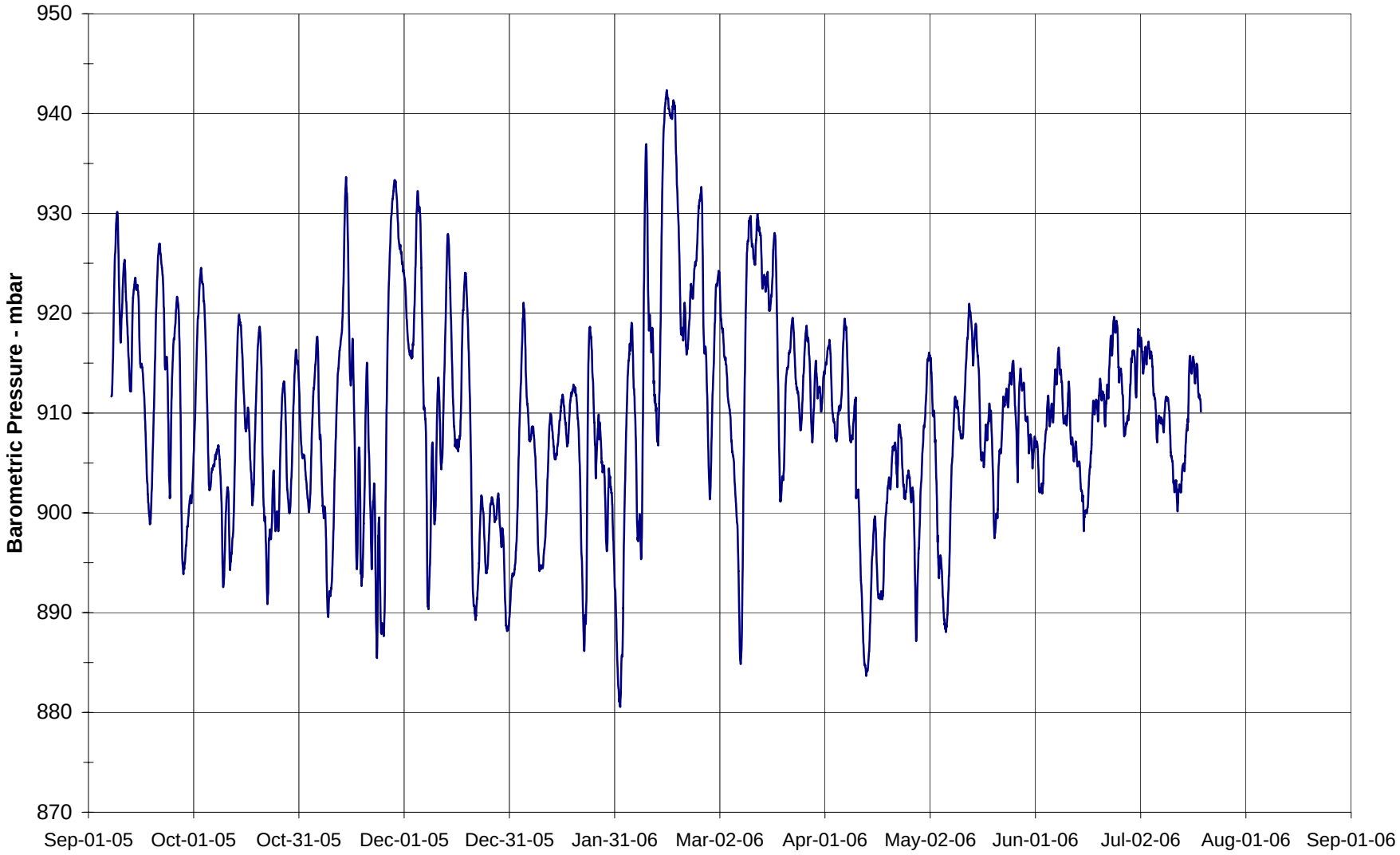


Figure MC1 - 6A: Estimated Mean Monthly Areal Evapotranspiration

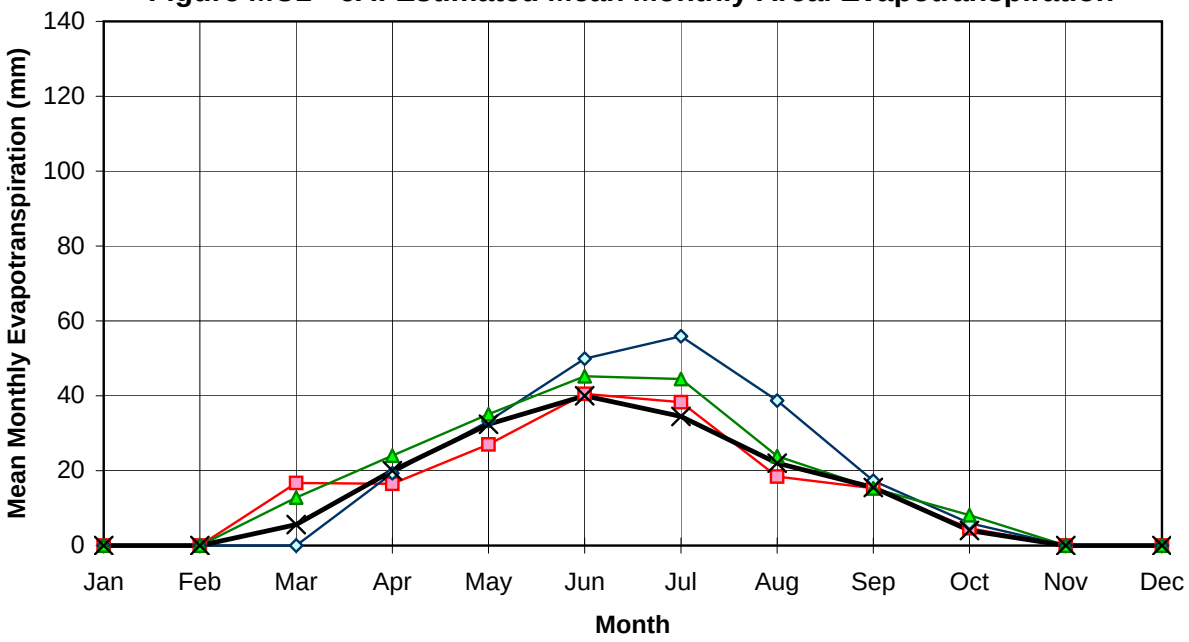


Figure MC1 - 6B: Estimated Mean Monthly Lake Evaporation

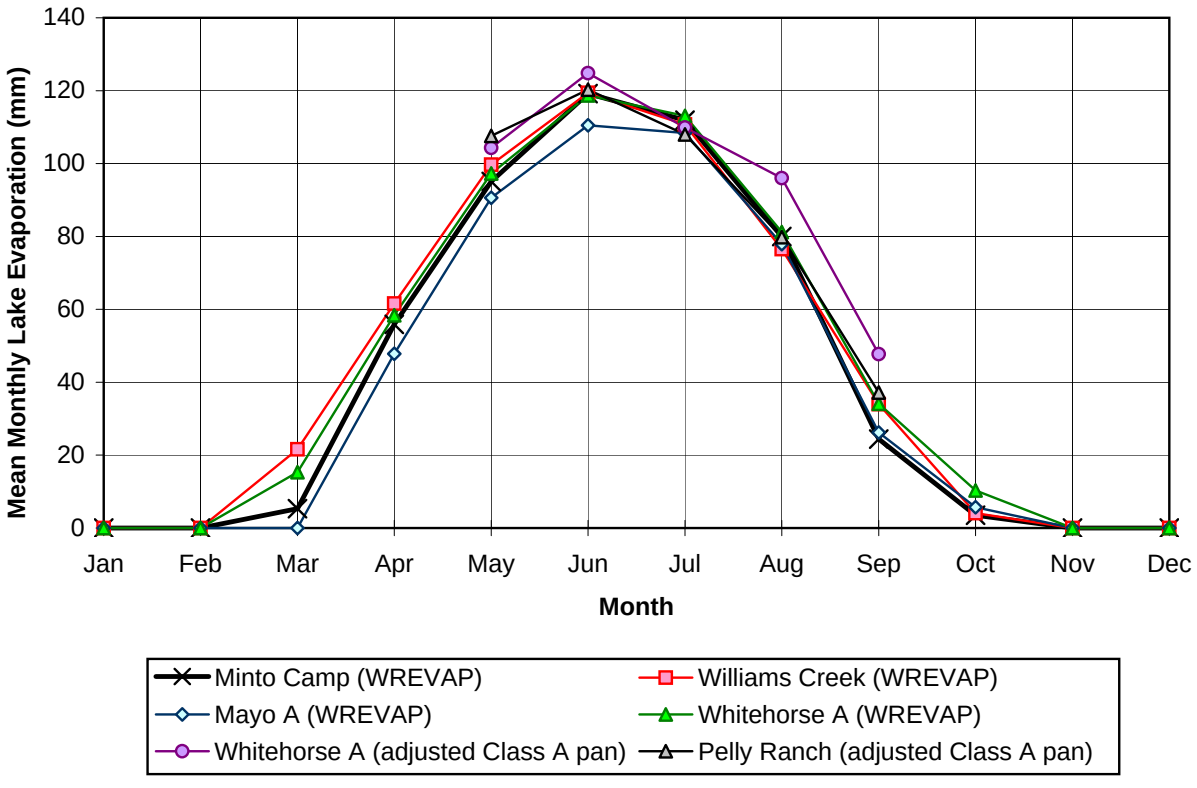


Figure MC1 - 7 Average Monthly Flows - Minto Creek at W1 and W3
(assuming MAR = 100 mm, distribution based on flows measured/estimated from 1993 to 2006)

