2012 ANNUAL WATER LICENCE REPORT

Submitted to the Yukon Water Board

Water Use Licence QZ96-006

2012 ANNUAL QUARTZ MINING LICENCE REPORT

Submitted to Yukon Government, Energy, Mines and Resources

Yukon Quartz Mining Licence QML-0001

Appendices

Prepared by:

Minto Explorations Ltd.

Minto Mine

March 2013

Appendix A: 2012 Minto Mine Spill Contingency Plan

SPILL CONTINGENCY PLAN

VERSION 2012-12

March 11, 2013

Spill Contingency Plan

Minto Project, Yukon Territory

Submitted by:

CAPSTONE MINING CORP.
MINTO MINE

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PROJECT CONTACTS

CAPSTONE MINING CORP. MINTO MINE. Suite 900, 999 West Hastings Street Vancouver B.C. V6C 2W2 Telephone: (604) 684-8894 Site: (604) 759-0860 Fax: (604) 688-2180 www.capstonemining.com	**Ronald K Light** General Manager Email: rlight@capstonemining.com **Mark Goebel** Health and Safety Superintendent Email: markg@mintomine.com **Jennie Gjertsen** Environmental Manager Email: jennieg@mintomine.com

* Additional copies of the plan can be obtained by contacting the company using the above contact information

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1.0 INTRODUCTION

Minto Mine has prepared this Spill Contingency Plan (SPC) for operational activities being undertaken at the Minto Property within the Minto Creek drainage basin. The Minto Property, shown in Figure 1, is centered at approximately 62°37'N latitude and 137°15'W longitude (NAD 83, UTM Zone 8 coordinates 6945000N, 384000E). The Project is located on the west side of the Yukon River on Selkirk First Nation (SFN) Category "A" Settlement Land under the Selkirk Land Claims Agreement.

2.0 DEFINITIONS

1. **"Deposit out of the normal course of events"** means a deposit that can reasonably be expected to occur at the mine and that can reasonably be expected to result in damage or danger to fish habitat or fish or the use by man of fish , and the identification of the damage or danger. (*Metal Mining Effluent Regulations, Part 3, SOR/2002-222)*

2. "**Spill"** means a release of a substance in to the natural environment that is abnormal in quantity or quality in light of all circumstances of the release; or is in excess of an amount specified in the regulations (*Yukon Environment Act, Part 11*)

   i) "**Emergency Spill"** A release of a hazardous product where there is potential for that product to enter a waterway or cause significant danger to life, health or environment

   ii) **"Non-Emergency Spill"** all spills that do not meet criteria of i) or a spill of any diesel product, blasting agent, oil, lubricant or coolant that the responsible party is competent to manage safely and efficiently in terms of assessment, prevention, containment and clean-up.

3. **"Discoverer"** means the person that discovers an incident that could possibly result in a spill or has resulted in a spill

4. **“Substance”** means a hazardous substance, pesticide, contaminant or special waste often referred to as a “**deleterious substance”**

5. **“Spill Contingency Plan”** means a plan devised for an exceptional risk that, though unlikely, would have catastrophic consequences**.**

6. **“Dangerous Good**” means a product , substance or organism included by its nature or by the regulations in any of the classes listed in the schedule to the act (*Transportation of Dangerous Goods Act)*

3.0 PURPOSE AND SCOPE

This Spill Contingency Plan is prepared in accordance with Minto Mine’s Type “A” Water Use License QZ96-006 (WUL):

> *“The Licensee shall apply the relevant procedures in the Spill Contingency Plan. The Licensee shall review the spill contingency plan annually and shall provide a summary of that review, including any revisions to the plan, as a component of the annual report.”*

As well as *Part 3 – Deposits Out of the Normal Course of Events*, Section 30 of the Metal Mining Effluent Regulations (MMER):

> *“The owner or operator of a mine shall prepare an emergency response that describes the measures to be taken in respect of a deleterious substance within the meaning of subsection 34(1) of the Act to prevent any deposit out of the normal course of events of such a substance or to mitigate the effects of such a deposit.”*

And finally to satisfy the requirements of the Quartz Mining License QML-0001 Schedule B:

> *“A plan that describes the measures designed to minimize the potential impact to the environment following a fuel or chemical spill.”*

This Plan will apply to Minto Mine and the main access route for one year, whereby the owner or operator shall update and test the Plan to ensure it continues to meet the requirements of both the WUL and subsection 30(2) of the MMER.

3.1 Purpose

The purpose of this plan is to outline a general set of procedures to be followed to assess, prevent, contain and clean-up (APCC) a spill at the Minto Mine. For that procedure to be effective Minto Mine must ensure that employees and contractors through either their experience or training possess the skills necessary to safely APCC a spill or potential spill. These procedures are necessary to ensure continuity and develop the foundation for a robust and effective Spill Contingency Plan. The plan is also designed to establish clear reporting and clean up procedures as they apply to emergency vs. non-emergency spills and incidents. The *Minto Mine Emergency Response Plan* details the specific spill response procedures though the Emergency Response Team (ERT) Guidelines to Hazmat Spills. It is beyond the scope of this document to define the specific Spill Response Procedures and decision loops involved in an ERT response. Any details pertaining to a response from ERT to APCC at a spill incident is the responsibility of the Site Safety Department. Only general procedures for Spill Response to emergency spills will be discussed. For a complete list of procedures for emergency response at Minto Mine refer to the Emergency Response Plan in Appendix 1.

This document also begins to address opportunities to improve spill preparedness, response, and mitigation for deposits out of the normal course of events (DONCE) that have the potential to impact the Yukon River and its tributaries within the project site.

All Minto Mine employees and contract staff must be familiar with the general spill reporting procedures outlined in this document and will be introduced to them as part of their site orientation. Hazmat and Transportation of Dangerous Goods training will be required to the National Fire Protection Association (NFPA) 472 Awareness Level for all departments and major contractors. Employees will understand the potentially hazardous situations that spills can create to the health and safety of workers and the environment. They will understand their responsibilities as employees to APCC as well as report any spills. This document will be made available for viewing by all employees. Capstone Mining Corp. Minto Mine will advise employees of revisions or changes to the Plan.

An Emergency Response Team (ERT) has been established to, among other duties, respond to emergency spills. The Emergency Response Team will receive training to the NFPA 472 Operations Level Responder and be required to thoroughly understand this document in order to immediately respond to spills or incidents of a specific nature. This training is required as a foundation to developing site specific contingency planning for response tactics, for areas specific to the activities associated with the project that present a risk to the Yukon River and its tributaries.

Minto Mine through its carriers of dangerous goods has contracts in place with Spill Responders including Quantum Murray Emergency Response and Enviro-Hazmat. These are full service response agencies that have commitments to mobilize fully trained Emergency Response Teams and equipment 24 hours a day 7 days a week.

3.2 Scope

The objectives of the Plan are to:

- identify potentially hazardous materials located on site;
- identify spill prevention measures;
- establish a high order of preparedness in the event that a spill occurs;
- ensure an orderly and timely decision-making, response and reporting process; and
- detail the steps Minto Mine is taking to develop a detailed action plan specific to an emergency spill involving Minto Creek, Big Creek, the Yukon River and its tributaries and to assess ERT tactics and equipment to respond to such an event.

Maps of the project site are provided as follows: Figure 1 provides a general location map for the Minto property and Figure 2 depicts a project area overview. The areas covered by the Plan are the access road from the highway to the mine including the barge, ice bridge and the Big Creek bridge plus the mine, mill, ancillary facilities and site services.

Figure 1. General Location Map

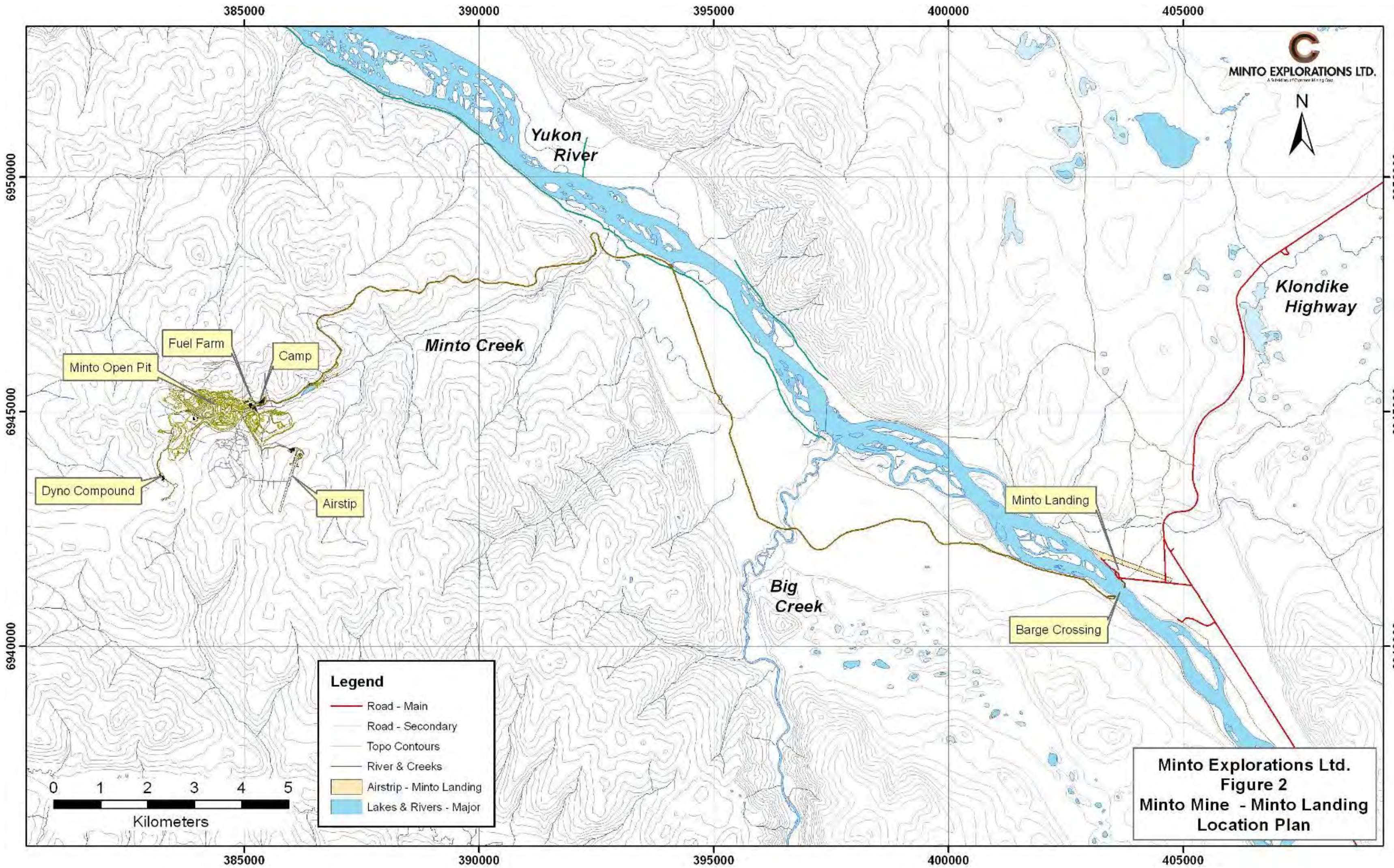


Figure 2. Project Area Overview

3.3 Statutory and Regulatory Responsibilities

There are several regulatory requirements and guidelines that are directly or indirectly linked to spill contingency planning. Related regulatory requirements are:

- Type A Water Use License (Section 5-10)
- Yukon Quartz Mining Production License (Section 17.1 and Schedule C – Related Documents and Plans)
- Metal Mining Effluent Regulations (Section 30)
- Yukon Environment Act (Part 11)

Minto Mine will ensure that all requirements related to APCC and reporting within these regulated documents are implemented throughout the property for the life of mine. These statutory and regulatory responsibilities may change over time and will therefore result in the updating of this Plan.

Spill kits are located throughout the Minto Mine Property at locations indicated in Figure 3. The contents, which are described below in Table 1, are contained within re-sealable blue and yellow barrels. Contractor supervisor trucks have spill kits permanently affixed to the truck body. All Minto trucks have spill kits in yellow truck bags. All contract trucking agencies coming to the mine are required to carry spill kits within or affixed to the truck.

Table 1. Contents of Spill Kits

Spill Kit Item	Yellow Barrel	Blue Barrel	Yellow Truck Bag
Tyvek splash suits	2	2	
Chemical master gloves	2	2	1
Garbage bags with ties	10	5	3
Oil only booms (5” x 10’)	4	2	1
Oil only mats (16” x 20”)	100	100	
Universal sorbent mat	20	20	10
Sorbent socks	20	20	
Sorbent pads (pillows)	10	10	

Spill Kit Item	Yellow Barrel	Blue Barrel	Yellow Truck Bag
Absorb-all pellet bags	2	2	
Tarp	2	1	
Duct tape	1	1	
Utility knife	1	1	
Field notebook and pencil	1	1	
Rake	1		
Pick axe	1		
Aluminum scoop shovels	2	2	
Instruction binder	1	1	1

Minto Mine has a 1991 Chevrolet Top Kick Fire truck with an 840 gpm pump with 1000 gallon supply tank and 800 gallon drop tank. This truck would support all spill response activities with SCBA, Class A and B foam capabilities, decontamination needs as well as fire suppression/protection tools and equipment common to a truck of this nature. All ERT members are trained to competency on the operation of this fire truck and related equipment in accordance with NFPA standards. After consultation with ERAP providers Minto Mine will be better positioned to assess equipment needs but anticipates procuring sufficient containment boom and related equipment to deal with a catastrophic diesel spill. Further training and skill development will take place in Spill Response Evolutions that will be staged in 2012. Minto Mine is also investigating the opportunity to join in with the Yukon Government's annual coordinated Spill Response training exercise (Arrell, 2011).

Earth moving and other equipment located at Minto Mine are listed in Table 2. All contractor equipment is available for use in spills and clean-up operations.

Table 2. Spill contingency equipment located at Minto Mine

Quantity of units	Equipment	Future acquisitions
1	416 Backhoe	Containment Boom
1	1000 Gal. Vacuum Truck	Oil/Fuel skimmer
13	Dozer (various)	Emergency Fuel Storage
9	Excavator (various)	Response Vessel
7	Loader (various)	Transfer Pumps/hose
1	769C Truck	
1	740 Wagon	

4	773DTruck	
9	777 Truck	
2	Hazmat trailers (14’ and 20’)	
1	Top Kick fire truck	
500’	Sorbent Boom (various sizes)	
1	Storage Sea Can at Landing	
250’	2” layflat hose	
3	Trash pumps	

Table 3: Commonly transported hazardous materials

Deleterious Substance	Maximum transported volume	Frequency of exposure
Ammonium Nitrate Prill	43 500 Kg	High
Bagged Ammonium Nitrate Prill	39 000 Kg (26 bags x 1500 kg)	High
Ammonium Nitrate Emulsion Explosives	20 000 Kg	Medium
CFE Conditioner	30 000 L	Low
Nitric Acid	14 400 L (72 Drums)	High
All other mill reagents*	20 000 Kg (Super sacks ~1000 Kg)	High
Diesel	50 000 L	High
Gasoline	6 000 L	Low
Copper concentrate	40 000 Kg	High

*MIBC-Frother, AM28-Collector, PAX, Potassium Hydroxide, Nitric Acid, Sodium Sulfide.

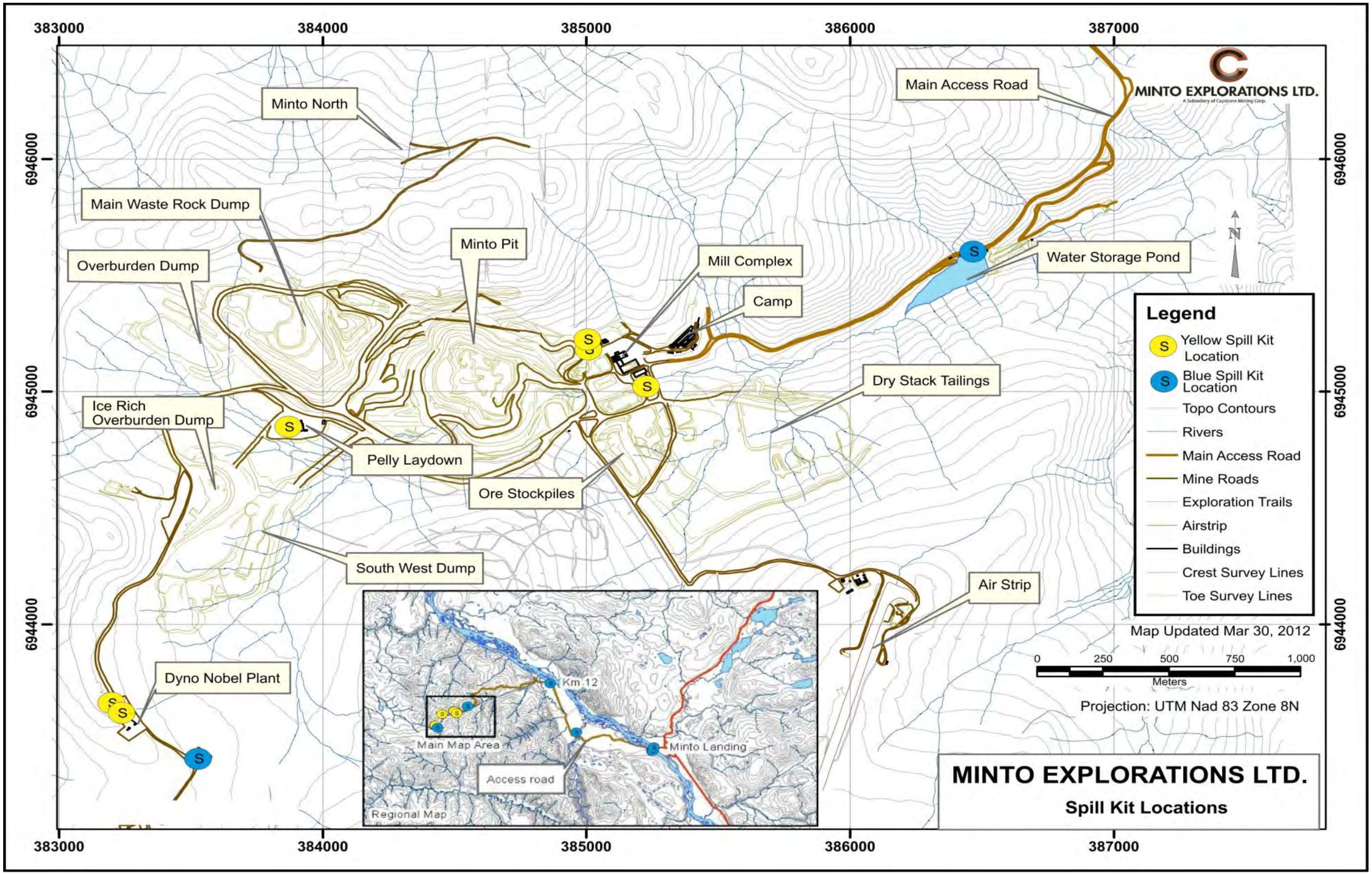


Figure 3. Spill Kit Locations

3.4 Hardcopy and Electronic Copy Locations of Plan

Copies of this Plan are kept on-site at all times in the following locations; Mill Control Room, Site Safety Office, Environmental Office, General Manager's Office, Site Service's Office and on the Copper Queen Tug. A copy is also held at Capstone Mining Corporation's head office in Vancouver, B.C and the Yukon Water Board head office. Electronic copies can be obtained from the head office of Capstone Mining Corporation. Contact information is provided on Page ii of this document.

4.0 COMMUNICATION AND SPILL REPORTING

Under federal and territorial regulations, the environmental lead will call the 24-hour Yukon Spill Report line should a spill of a reportable quantity occur (Table 4). Any spill of an amount greater than those listed in Table 4 or a spill of any amount that enters the Yukon River or a tributary of the river is a "reportable spill". Minto Mine is registered with CANUTEC for 24 hour Spill Response support and information to deal with emergency situations.

The Selkirk First Nations' Lands Director will also be contacted in the event of a reportable spill at 867-537-3331.

A spill in excess of the following thresholds or any spill that is abnormal in quality or quantity is considered a spill under the *Yukon Spill Regulations* (O.I.C. 1996/193), pursuant to the Environment Act. In this table, the listed regulations, "Federal Regulations" mean the *Transportation of Dangerous Goods Regulations* (Canada) Sor/85/77 of January 18, 1985.

Table 4. Reportable Spill Quantities

Product	TDG Code	Quantity
All petroleum products		> 200 liters
Waste discharges		Any quantity exceeding license
Explosives	1	Any amount
Flammable gases	2.1	> 100 liters
Non-flammable gases	2.2	> 100 liters
Poisonous gases	2.3	Any amount
Non-poisonous gases	2.2	> 100 liters
Corrosive gases	2.4	Any amount
Non-corrosive gases	2.2	> 100 liters

Product	TDG Code	Quantity
Flammable liquids	3	> 200 liters
Flammable solids	4	> 25 kg
Spontaneously combustibles	4	> 25 kg
Dangerous when wet	4	> 25 kg
Oxidizers	5.1	> 50 kg or 50 liters
Organic peroxides	5.2	> 1 kg or 1 liter
Poisonous substances	6.1	> 5 kg or 5 liters
Infectious substances	6.2	Any amount
Radioactive material	7	Surface : > 10 mSv/h At 1 meter : >200 Sv/h
Corrosive materials	8	> 5 kg or 5 liters
Miscellaneous Dangerous Goods	9.1	> 50 kg
"Hazardous to Environment" material		> 1 kg
Dangerous wastes	9.3	> 5 kg or 5 liters

4.1 Internal Reporting and Contact Information

Spills must be reported by the discoverer to their immediate supervisor and then to either Site Safety or the Environmental Department by radio or telephone after the scene has been assessed. Under the discretion of the Environmental Lead the General Manager will be notified.

Minto Mine – Communications Contact Information

Arjen Spruit / Dave Crottey, Safety Coordinators
Office Tel. (604) 759-0860 ext. 444

Jasmine Dobson / Martin Crill / Phil Emerson, Environmental Officers
Office Tel. (604) 759-0860 ext. 463

Alternate #1 James Spencer / Ryan Herbert, Environmental Coordinator
Office Tel. (604) 759-0860 ext. 462

Alternate #2: Jennie Gjertsen, Environmental Manager
Office Tel. (604) 759-0860 ext. 226

Responsible department heads will be required to document the spill on an Environmental Incident Report (EIR), available through the Environmental Department.

External Reporting and Contact Information

Table 5 provides a summarized list of external contacts.

Table 5. Spill Related Resources and Contact Numbers

Resource	Contact Number
Yukon 24- Hour Spill Line	(867) 667-7244
Nursing Station - Pelly	(867) 537-4444
Fire Department – Pelly (Emergency)	(867) 537-3000
Police – Pelly	(867) 537-5555
Hospital – Whitehorse	(867) 667-8700
Fire Department – Whitehorse	(867) 668-8699 or (867) 668-2462
Quantum Murray – Parkland Spill Response	1-800-251-7773 (24/7-Emergency Number)
Enviro-Hazmat – Wiebe Spill Response	1-866-249-7583 (24/7-Emergency Number)
CANUTEC – 24 hour TDG Support	(613) 996-6666
Police – Whitehorse	(867) 667-5555
Access Consulting Group	(867) 668-6463
YG Department of Environment, Water Resources Branch	(867) 667-3227
YG Environmental Protection Branch	(867) 667-3436
Selkirk First Nation, Lands Director	(867) 537-3331
YG EMR, Carmacks Natural Resource Officer	(867) 863-5271
YG EMR, Client Services and Inspections	(867) 667-3199

4.2 Yukon Department of Environment

Although several government agencies at the federal, territorial and municipal levels may ultimately be involved, only one government contact is required for mine site spills:

YUKON TERRITORIAL 24-HOUR EMERGENCY SPILL RESPONSE NUMBER
Telephone: 1 - 867 - 667 – 7244

4.3 +CANUTEC (TDG)

The Safety Department may also call CANUTEC for assistance in handling dangerous goods emergencies. One of the responsibilities of this organization is the sharing of resources, consumables, equipment and personnel in the event of a spill. This organization is a branch of Transport Canada that provides 24 hour help on Dangerous Goods.

CANUTEC - Dangerous Goods Help
Telephone Collect: 0 - 613 - 996 - 6666

A “dangerous occurrence” is defined as:

- Any loss of dangerous goods in excess of specified amounts or which represents a danger.
- Damage to any container of dangerous goods.
- A transportation accident in which radioactive goods are involved.
- An unintentional explosion or fire involving dangerous goods.

Notification must also be reported immediately to the owner of the transport trucks and the owner or consignor of the dangerous goods. It is the responsibility of the transporter of the goods to report this type of incident, and is the responsibility of the Area Manager to ensure it has been carried out properly.

4.4 Selkirk First Nation

The Environmental Department Lead will inform the Selkirk First Nation Lands Department if a spill or the potential for a spill of a reportable quantity occurs. The Lands Department will contact the Chief and leaders of the SFN. The Environmental Department Lead or General Manager will keep SFN informed of the situation.

Selkirk First Nation Lands Department Telephone: (867) 537 - 3331

4.5 Surrounding and Downstream Communities

Notification of downstream water users if required is normally the responsibility of the Yukon Government, Environmental Protection Branch. Minto Mine will engage the Yukon Government in the upcoming year to provide guidance in this regard should such notification be required.

4.6 Public Relations

The General Manager is the designated spokesman for Minto Mine. The General Manager may delegate his responsibility for public relations if forced to do so by the scale of the incident.

The following are key elements of a public relations strategy:

a. Provide information to the news media and the public on a timely basis;
b. Co-ordinate the release of information with a release by a government official to avoid duplication and/or confusion. Inform the RCMP if necessary;
c. Provide facts only;
d. Avoid potentially controversial subjects; and
e. Ensure that next-of-kin have been informed before the name of an injured person or a casualty is released.

5.0 EMERGENCY SPILL RESPONSE GENERAL PROCEDURES

When a spill is discovered the first step is to assess the scene for safety and **if safe to do so** immediately control and contain the spill, by any means necessary, if the "Discoverer" of the incident does not have the training, resources or equipment to do so then it is policy that the individual report a "Code 1" callout. This protocol will initiate response of the Safety Department, Environmental Lead and the Emergency Response Team. The "Code 1" callout procedure is defined in the *Minto Mine Emergency Response Plan*, Version 2012-11, while the Emergency Spill Response Command Structure and General Spill Procedure are detailed in Figures 4 and 5. If the scene is safe and the "discoverer" of the incident and the immediate supervisor has the means necessary to control, contain and recover the spill then they will mitigate the spill.

The Safety Coordinator/Medic will respond to the scene and conduct an initial assessment and assume command of the scene. If Safety Coordinator/Medic is required to treat patients, command is transferred to Health and Safety Superintendent/Officer or Emergency Response Team Captain. Unified Command Structure will be initiated once the General Manager, Area Manager, or Environmental Lead is on scene. Unified Command is a cooperative effort command between the General Manager, Health and Safety Superintendent/Officer, Area Manager of involved Department and the Environmental Lead. Transfer of command includes a detailed verbal report of the incident and activities conducted and underway.

A Code One Protocol initiated by an emergency spill or incident will trigger the Specific Spill Response Procedure based on the product type, quantity and environmental and safety conditions. A review of deleterious substances transported to/from the Minto Mine Site and specific response procedures are covered in the following section.

Initial spill response will be conducted in accordance to Transport Canada's 2008 Emergency Response Guidebook (Transport Canada, 2008). This Guidebook will assist incident command (IC) with information to identify the material, use the guide to reference potential hazards, public safety and emergency response information. The Table of Initial Isolation and Protective Action Distances will be used to dictate isolation and protection for large and small spills. However this is not a comprehensive spill mitigation and response document and will only assist responders in making initial decisions upon arriving at the scene of a dangerous goods incident. It should not be considered as a substitute for emergency response training, knowledge or sound judgment. The Emergency Response Guidebook does not address all possible circumstances that may be associated with a dangerous goods incident.

Consultation with MSDS, CANUTEC, Transport Canada, The Yukon Department of Environment and a professional spills consultant will help define our capabilities, preventative tools, specific equipment and response tactics and additional training and education.

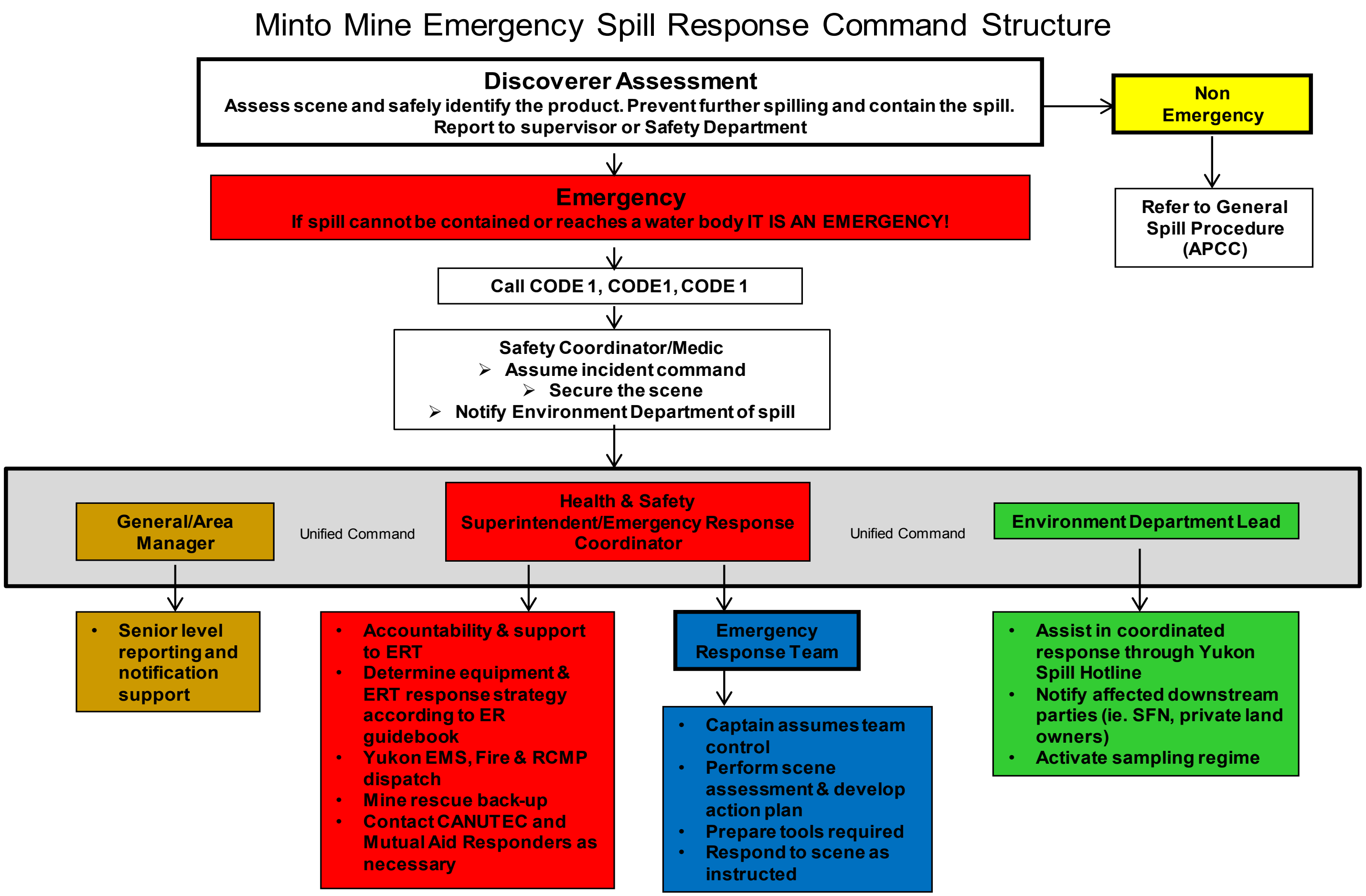


Figure 4. Minto Mine Emergency Spill Response Command Structure

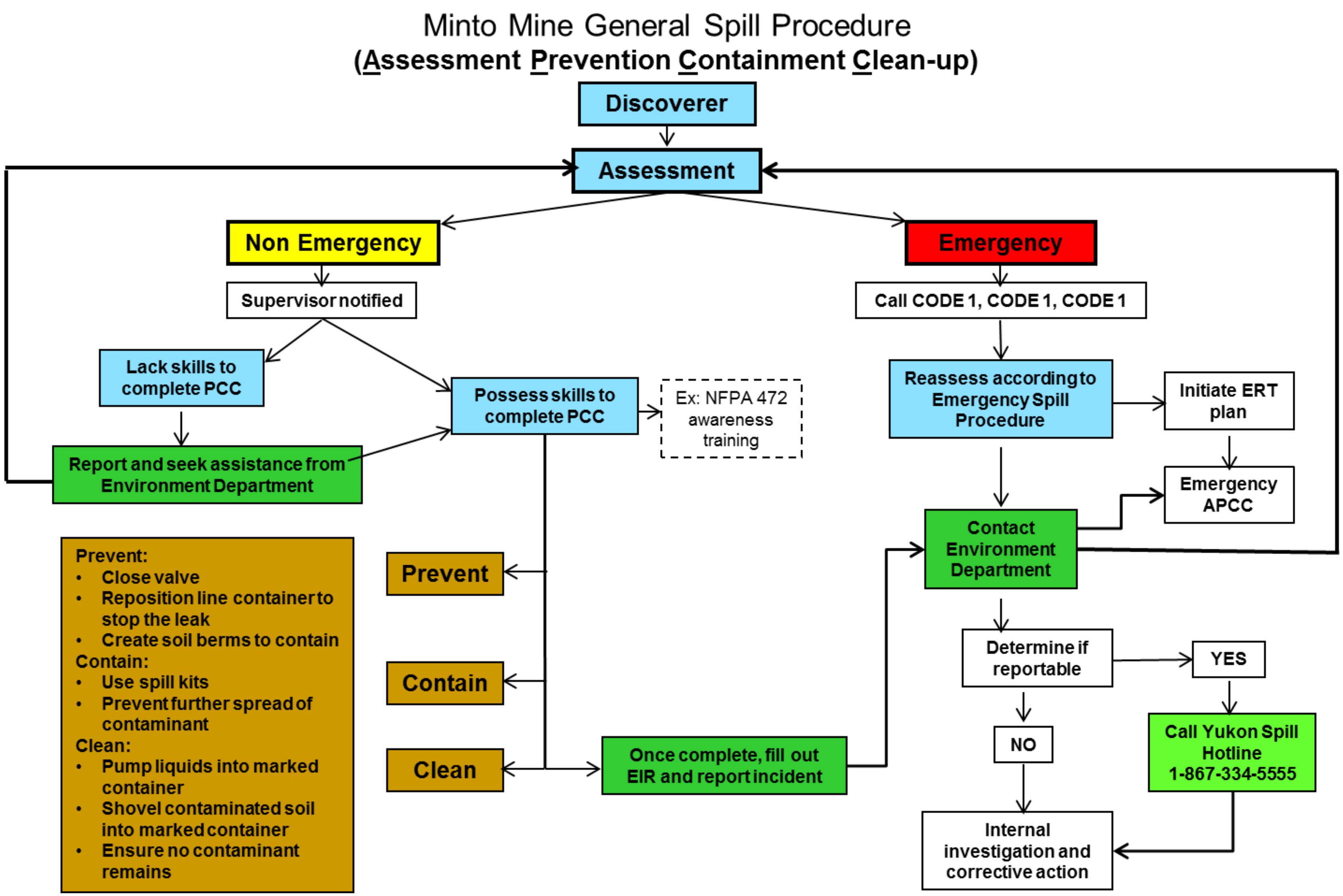


Figure 5. Minto Mine General Spill Procedure

6.0 NON- EMERGENCY SPILL RESPONSE GENERAL PROCEDURES

The majority of spills that are likely to occur on the Minto Mine Site will include a simple stepwise process initiated by the discoverer. If the safety at the scene is in doubt then it is imperative that Site Safety is notified immediately. A non-emergency spill is defined as a spill of any diesel product, blasting agent, oil, lubricant or coolant that the responsible party is competent to manage safely and efficiently in terms of assessment, prevention, containment and clean-up. Once the scene is assessed for safety by the discoverer or supervisor and deemed non-emergency, they should prevent, contain and clean-up (PCC) and contact the environmental team as soon as practical. If they are unable to deal with the incident and PCC, the environmental team will be notified by radio/telephone immediately.

Major contractors have personnel trained to NFPA 472 Awareness level and are able to respond to non-emergency spills.

7.0 SPILL RESPONSE BEST MANAGEMENT PRACTICES

This section will serve to provide managers with the tools and materials available at the Minto Mine site necessary to adequately contain and clean-up a spill. Site supervisors and managers will be required to thoroughly understand and have knowledge of specific spill response procedures outlined within this report.

7.1 Containment of Spills

Spills containment on the property will require specific spill responses based on the location and surface composition. This section will focus on general spill containment practices on land, water and snow. The primary focus should always be in stemming the source of the spill, containing and recovering the product to minimize environmental damage.

7.2 Containment of Spills on Land

Spills on land include spills on rock, gravel, soil and/or vegetation. It is important to note that soil is a natural sorbent, thus spills on soil are generally less serious than spills on water as contaminated soil can be more easily recovered. However, larger spills have the ability saturate land and flow across land, making containment measures as described below very important. It is important that all measures be undertaken to avoid spills reaching open water bodies.

Dykes

Dykes can be created using soil surrounding a spill on land. These dykes are constructed around the perimeter or down slope of the spilled fuel. A dyke needs to be built up to a size that will ensure containment of the maximum quantity of fuel that may reach it. A plastic tarp can be placed on and at the base of the dyke such that fuel can pool up and subsequently be removed with sorbent materials or by pump into barrels or bags. If the spill is migrating very slowly a dyke may not be necessary and sorbents can be used to soak up fuels before they migrate away from the source of the spill.

Trenches

Trenches can be dug out to contain spills as long as the top layer of soil is thawed. Shovels pick axes, an excavator or a loader can be used depending on the size of trench required, fuel can then be recovered using a pump or sorbent materials.

7.3 Containment of Spills on Water

Spills on water such as rivers, streams or lakes are the most serious types of spills as they can negatively impact water quality and aquatic life. In addition the water resources have other user groups involved.

Booms

Booms are commonly used to contain fuel floating on the surface of lakes or slow moving streams. They are released from the shore of a water body to contain the spill. If a spill is located offshore booms can be used to contain and prevent from reaching the shoreline. More than one boom may be used at once. Booms may also be used in streams and should be set out at an angle to the current. Booms are designed to float and have sorbent materials built into them to absorb fuels at the edge of the boom. Fuel contained within the circle of the boom will need to be recovered using sorbent materials or skimmers/pumps and placed into barrels or bags for disposal.

Weirs

Weirs/underflow dams can be used to contain spills in streams and to prevent further migration downstream. Plywood or other materials found on site can be placed into and across the width of the stream, such that water can still flow under the weir. Spilled fuel will float on the water surface and be contained at the foot of the weir. It can then be removed using sorbents, booms or pumps and placed into barrels or plastic bags.

Barriers

In some situations barriers made of netting or fence material can be installed across a stream, and sorbent materials placed at the base to absorb spilled fuel. Sorbents will need to be replaced as soon as they are saturated. Water will be allowed to flow through. This is very similar to the weir option discussed above.

7.4 Containment of Spills on Ice

Spills on ice are generally the easiest spills to contain due to the predominantly impermeable nature of the ice. For small spills, sorbent materials are used to soak up spilled fuel. Remaining contaminated ice/ slush can be scraped and shoveled into a plastic bag or barrel. However, all possible attempts should be made to prevent spills from entering ice covered waters as no easy method exists for containment and recovery of spills it reaches the water under ice.

Dykes

Dykes can be used to contain fuel spills on ice. By collecting surrounding snow, compacting it and mounding it to form a dyke down slope of the spill, a barrier is created thus helping to contain the spill. If the quantity of spill is fairly large, a plastic tarp can be placed over the dyke such that the spill pools at the base of the dyke. The collected fuel can then be pumped into barrels or collected with sorbent materials.

7.5 Containment of Spills on Snow

Snow is a natural sorbent, thus as with spills on soil, spilled fuel can be more easily recovered. Generally, small spills on snow can be easily cleaned up by raking and shoveling the contaminated snow into plastic bags or empty barrels, and storing these at an approved location.

Dykes

Dykes can be used to contain fuel spills on snow. By compacting snow down slope from the spill, and mounding it to form a dyke, a barrier or berm is created thus helping to contain the spill. If the quantity of spill is fairly large, a plastic tarp can be placed over the dyke such that the spill pools at the base of the dyke. The collected fuel/snow mixture can then be shoveled into barrels or bags, or collected with sorbent materials.

7.6 Procedures for Transferring, Storing, and Managing Spill Wastes

In most cases, spill cleanups are initiated once the spill is contained. Sorbent socks and pads are generally used for small spill clean-up. A pump with attached fuel transfer hose can suction spills from leaking containers or large accumulations on land or ice, and direct these larger quantities into empty drums or tanks. Hand tools such as cans, shovels, and rakes are also very effective for small spills or hard to reach areas. Spill response equipment mentioned in this section, including the mentioned tools, are available in spill kits deployed at designated areas. A vacuum truck with 1000 gallon tank is available for recovery of bulk fluids. In addition there are two 2” transfer pumps and one 3” transfer pump available to assist with product recovery. Spilled petroleum products and materials used for containment will be placed into empty waste oil containers or plastic bags and sealed for proper disposal at an approved disposal facility. Following clean up, any tools or equipment used will be properly washed and decontaminated to prevent the spread of contamination to other areas of the site. Contaminated soil will be moved to the onsite land treatment facility and will be sampled for contamination characterization as per the Environment Act Contaminated Sites Regulations.

8.0 SPILL PREVENTION AND MONITORING

Spill prevention strategies are the first line of defense to avoid potentially catastrophic spills and costly clean-ups. Some strategies for prevention and monitoring relevant to our site are listed below.

8.1 Containment Strategies

The storage areas for diesel fuel and gasoline are lined with impermeable liners and bermed with 110% containment. Planking is used to protect the liner from the fuel drums and cylinders. Spill kits are located wherever fuel is stored or dispensed and at several other strategic locations.

Portable drip trays and appropriately sized fuel transfer hoses with pumps are used when refueling aircraft or other motorized equipment, to avoid any leaks/drips onto the land. Site Services Department conducts weekly visual inspections to check for leaks or damage to the fuel storage containers, as well as for stained or discolored soils around the fuel storage areas and adjacent motorized equipment. Regular maintenance and oil checks of all motorized equipment are also undertaken to avoid preventable leaks.

8.2 Tug and Barge Improvements

A complete refit of the Copper Queen was undertaken to prepare it for service in 2012. New control systems and a complete rewiring of the major instruments and controls including an electronic control package. New propellers and steering upgrades to the rudders will provide for better steerage and control. Ramp service upgrades were completed in July 2012 as part of the safety and prevention initiatives. The tug and barge staff completed their Vessel Operator Proficiency training as well as Marine Emergency Duties. A tug and barge emergency contingency plan was also created in 2012 and has been included in appendix 1.

8.3 Monitoring of Affected Area

Once the spill is contained, trained personnel in sampling procedures will sample areas thought to be contaminated. Once area is excavated conformation samples will be taken to ensure the extent of the contaminated area has been cleaned up. Immediately after a spill is discovered to reach a waterway, trained personnel in sampling procedures will sample water downstream of the contaminate discharge point.

8.4 Transportation of Dangerous Goods (TDG)

Transporter Qualifications

Transporters will be carefully selected, and are required to have Department of Transport certification, acceptable spill response programs, hazardous materials safety and handling procedures (including material safety data sheets [MSDS]), and driver training programs. Each approved transporter will be periodically reviewed to assure that they continue to carry valid Department of Transport certification.

Delivery Scheduling

The potential for spills will be minimized to the greatest extent possible by scheduling deliveries to avoid any regular or temporary congestion that may occur along routes leading to Minto Mine. Transporters will be required to advise the operations of any delays or schedule changes that occur. Deliveries will be timed during daylight hours to coincide with warehousing hours and to minimize offloading problems.

Regulatory Compliance

Transporters making deliveries to Minto Mine will be required to follow all federal and territorial Department of Transportation regulations for the transportation of dangerous goods, as defined in the Transportation of Dangerous Goods Act (TDGA). This will include all placarding, packaging, manifests, etc.

Radio Controlled Main Access Road

The main access road into Minto Mine is controlled by radio. Each transporter will be required to program their in-truck radios to the Minto Mine frequencies at Omega Communications Ltd. Transporters will call out their kilometers as per signs located at the sides of the Minto access road.

8.5 Workplace Hazardous Materials Information System (WHMIS)

Employees that will be handling potential hazardous materials will require WHMIS training. The training will identify hazardous materials in their section. Classification of hazardous material, supplier labels, work site labels and Material Safety Data Sheets will be covered in the training. Employees will have updates to the system and MSDS information every year or when new products are to be used.

8.6 In-Bound Freight

Minto Mine regularly purchases goods from a number of suppliers and these goods are delivered to the mine by truck. The most important products delivered are fuel such as diesel fuel, and propane in bulk, ammonium nitrate in bulk, various lubricants and reagents in drums and packaged explosives (Class 1.1 and 1.5).

Minto Mine has identified the most significant volumes of deleterious substances that are transported to the mine site (Table 5). Using experimental eco-toxicity data based on lethal doses, and estimated flow volumes Minto Mine is provided with guidelines for what type of spill in a chosen water body could exceed CCME standards. It is the policy of Minto Mine, in its contractual arrangements with suppliers, to take possession of goods only upon delivery to the mine. It is further the policy of Minto Mine to purchase goods only from suppliers who have the resources to respond to a spill and have filed Spill Contingency Plans under the Transportation of Dangerous Goods Act for designated substances. Therefore, although Minto Mine will assist with communication and the clean-up of a spill which may occur along the access road between the highway turnoff and the mine, Minto Mine will not assume liability for a spill which is the result of an incident which occurs before goods have been delivered to the mine.

8.7 Out-Bound Freight

The concentrate is loaded into trucks at the mine under the supervision of the concentrate shed operator. Each truck holds approximately 48 tonnes. The loaded trucks are hauled to Skagway, Alaska under contract with Lynden Trucking. Responsibility for the concentrate is accepted by

Mineral Services Incorporated once loading had been completed. It is expected that on average six to twenty loads of concentrate will be hauled per day depending on the season.

Lynden Trucking is responsible for notification and clean-up in case of a concentrate spill as per the Spill Contingency Plan filed by Lynden. Therefore, although Minto Mine will assist with communication and the clean-up of a concentrate spill which may occur along the access road between the mine and the highway turnoff, Minto Mine does not accept liability for a spill which is the result of an incident which occurs after the truck has left the mine.

8.8 Spills On-Site

If a spill does occur on site, it will be the responsibility of the discoverer, their supervisor or manager, environmental department and site safety to ensure that APCC measures and reporting procedures are conducted in strict accordance with this plan. Non- emergency spill containment will utilize BMP's outlined in Section 7.0. Emergency spill response will be activated through the Emergency Response Plan and in sensitive areas through a detailed action plan (ie. Big Creek, Minto Creek, Yukon River).

8.9 Spills Off-Site

Offsite spills will most often be caused by transportation companies and therefore will be the responsibility of the transportation company; however, Minto Mine will be available for support if requested by the transportation company in the form of spill reporting and spill communication. Minto Mine will not be responsible for clean-up of spills but may assist on a case by case basis in the emergency response phase.

9.0 SPILL RESPONSE TRAINING AND CONSULTATION

Hazmat and Dangerous Goods Response training will be provided to site personnel with the objective of achieving satisfactory targets for all departments and contractors to the NFPA 472 Awareness Level. Emergency Response Team, Incident Command Personnel, Environmental Department Team Leaders and Mitigation/Clean up Team Leaders will be trained to the NFPA 472

Operations Level Responder. A Contractor has been identified to provide this training. Reference material has been sourced and time/date planning is underway.

Emergency Response Team (ERT) personnel are trained to the BC Mine Rescue – Surface standard which includes Standard First Aid with CPR-C. Once trained to this level, they will keep their certification current through practical and theory scenario training. Training exercises for the ERTs are organized by the Minto Health and Safety Superintendent. A list of names, training modules, and specialized simulations completed are maintained by the superintendent. .

A contractor will be sourced for site specific spill action plans within the project area specific to the Yukon River, and its tributaries, paying particular attention to our dangerous goods products. The contractor will also further develop portions of the spill plan that require more specific procedures and identification of risk areas including recovery of product and or vessels and vehicles. This will require identification of additional equipment and tools specific to the planned responses and recommendations regarding the staging and location of such response equipment and tools at the most strategic locations for rapid, safe and effective spill response.

In 2012 through consultation with Emergency Response Assistance Plan providers (ERAP) as well as through consultation at the corporate level for risk management the company will be better positioned to assess in more detail the risks and liabilities involved and develop more refined response prevention and clean-up procedures. It is anticipated that through cooperation with our material goods providers and with government agencies such as the Environment Canada Environmental Emergencies division.

10.0 REFERENCES

Access Consulting Group (March 14, 2006). "Minto Mine – Phase 1 Water Treatment Contingency Plan." Water Use License QZ96-006.

Hallam Knight Piesold Ltd (1994). Minto Project, Initial Environmental Evaluation, Supporting Volume II, Environmental Setting. Prepared for Minto Mine

Indian and Northern Affairs Canada (April 2007). Guidelines for Spill Contingency Planning. Prepared by Water Resources Division, Indian and Northern Affairs, Yellowknife, NT.

Metal Mining Effluent Regulations. P.C. 2002-987. 6 June, 2002.

Water Use License – QZ96-001, Minto Explorations Ltd. November 2005. Yukon Territory Water Board.

Water Use License Application – QZ96-001, Minto Explorations Ltd. Exhibits 1 to 1.2.13 (vol. 1 of 3). April 14, 1997. Yukon Territory Water Board.

Yukon Environment Act (2002). Revised Statutes of the Yukon 2002.

Appendix 1: EMERGENCY RESPONSE PLAN

NOVEMBER 2012

MINTO MINE

EMERGENCY RESPONSE PLAN

November 2012

This controlled document will be regularly updated to reflect revisions.

Next scheduled update – November 2013

- Updated Emergency Response Plan (ERP) documents will be bound and distributed to all authorized personnel.
- All Minto Mine personnel must have ERP training and know where to gain access to the document in the event of an emergency.

Authorized Distribution / Location List

Minto Explorations Ltd. – Minto Mine:

Health and Safety Office
ERT Facility
General Manager Office
First Aid Room
Mill Control Room
Refuge Stations
Muster stations

Capstone Mining Corp

Capstone Mining Corp. Vancouver Office

Community:

Yukon EMS Dispatch Whitehorse
Pelly Nursing Station
Carmacks Nursing Station
Yukon Wildland Fire Management Carmacks

Government:

Yukon Workers Compensation Health and Safety Board

Primary Partners/On-site Contractors:

Selkirk First Nation – Pelly Crossing
Pelly Construction Site Office
Dyno Nobel Site Office
SGS Site Office
Sodexo Site Office
Dumas Mining

Contractor Specific Emergency Response Plans Related to Minto Site

Dyno Nobel
Pelly Construction Ltd

Table of Contents

1. PURPOSE

This guide sets out the response protocol in the event of an Emergency as defined in the following section.

It is intended for use as a quick reference handbook for managers and supervisors. Incident reporting and investigating is also outlined.

In an emergency situation it is imperative that safety and due diligence is exercised as well as discretion. The priorities are the protection of Life, Environment and Property – in that order.

2. DEFINITIONS

2.1. "Emergency"

An "**Emergency**" is defined as any occurrence meeting one or more of the following criteria:

1. Any "serious injury" or "serious accident" as defined in Yukon OH&S 30 (1)
2. Any incident requiring first aid or rescue response to the scene, depleting resources to respond to secondary emergency.
3. Any fire requiring more action that initial suppression deployment
4. Landslide, earthquake, avalanche, forest fire or flooding where injury or property damage results or may result.
5. Major power failure
6. Missing person
7. Loss of life
8. Spill Emergency – Reference Spill Contingency Plan

2.2. "Serious Injury" and "Serious Accident" under OH&S act

(Excerpt from Occupational Health & Safety Act)

"**Serious Injury**" means:

- **a)** an injury that results in death,
- **b)** fracture of a major bone, including the skull, the spine, the pelvis, or the thighbone,
- **c)** amputation other than of a finger or toe,
- **d)** loss of sight of an eye,
- **e)** internal bleeding,
- **f)** full thickness (third degree) burns,
- **g)** dysfunction that results from concussion, electrical contact, lack of oxygen, or poisoning, or
- **h)** an injury that results in paralysis (permanent loss of function);

"**Serious Accident**" means:

- **a)** an uncontrolled explosion,
- **b)** failure of a safety device on a hoist, hoist mechanism, or hoist rope,
- **c)** collapse or upset of a crane
- **d)** collapse or failure of a load-bearing component of a building or structure regardless of whether the building or structure is complete or under construction,
- **e)** collapse or failure of a temporary support structure,
- **f)** an inrush of water in an underground working,
- **g)** fire or explosion in an underground working,
- **h)** collapse or cave-in, of a trench, excavation wall, underground working, or stockpile,
- **i)** accidental release of a controlled product,
- **j)** brake failure on mobile equipment that causes a runaway,
- **k)** any accident that likely would have caused serious injury but for safety precautions, rescue measures, or chance. (As amended by SY 1988, c.22, s. 5; SY 1989, c. 19, s.6)

Reprinted from Yukon Workers' Compensation Health and Safety Board. Occupational Health and Safety Act and Regulations.

3. INITIAL RESPONSE TO EMERGENCY MINTO MINE

All references to Minto personnel by position are defaulted to defined designate if position vacant at time of emergency.

SITE MAP

CAMP, OFFICE and MILL MUSTER LOCATIONS

ACTIVE MINE MUSTER

UNDERGROUND MUSTER (SURFACE)

3.1. Code One Protocol

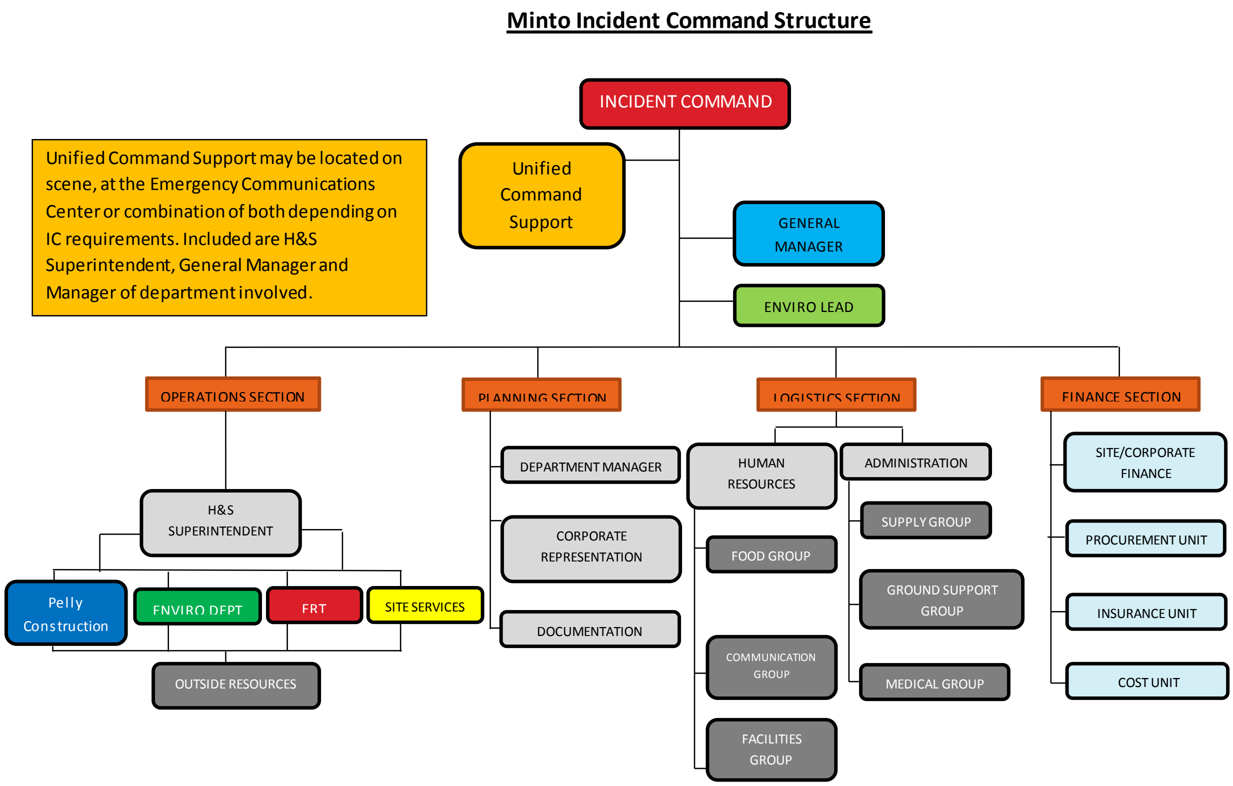
In the event of an emergency, the following protocol will be followed.

1. Any employee witnessing an emergency will call out on their current radio channel "Code 1, Code 1, Code 1" and state the nature and location of the emergency. (In the event of an injury, first aid certified worker in the area would be alerted to the incident and could respond directly to the scene) The employee immediately changes his radio to channel 1 (Emergency Channel) and calls out "Code1, Code 1, Code 1" and state the nature and location of the emergency. Employee remains on Channel 1 for a response from Site Safety/Medic.
2. Safety Coordinator/Medic will arrange for "Code 1, Code 1, Code 1" to be announced on all radio channels.
3. Upon hearing a Code 1, all personnel will safely stop work, all equipment is to be shut off and all vehicles will safely pull over to the side of the road. Mill and assay lab and water treatment plant personnel will report to control rooms and lunch rooms, while the mill remains operational. Radio silence will be recognized until Code 1 has been cleared.
4. Safety Coordinator/Medic will respond to caller with "What is the nature and location of the Emergency" on channel 1.
5. Employee will then state their name, the nature and location of the emergency.
6. Employee will then offer all available information and follow all instructions given to them by Safety Coordinator/Medic.
7. Safety Coordinator/Medic will coordinate the control room operator to send out a page for the ERT with nature and location of the emergency.
8. The Safety Coordinator/Medic will respond to the scene and conduct an initial assessment and assume command of the scene. Command will be declared on the radio and instructions to response team Captain including staging location. If Safety Coordinator/Medic is required to treat patients, command is transferred to an alternate member of the Health and Safety Department or Mine Rescue Team Captain. **Any transfer of command requires a detailed verbal report of the incident and activities conducted and underway and a formal communication to all responders.**
9. Unified Command Support will be initiated once the Health and Safety Superintendent, General Manager and Area Manager are on scene. Incidents involving an Environmental release will include the Environmental Lead in the Unified Command Support. **Unified Command Support is a cooperative effort for the purpose of support to the Safety Department Incident Command. If Unified Command Support is deemed not to be required on the scene, the support team will report to the Emergency Communications Center (ECC) to monitor radio and provide for support from the EEC location.**
10. An update on the response will be provided to the Mill control room within 30 minutes of initial arrival to the scene and a decision to allow non-hazardous critical work will be made by Incident Command. This may include resumption of crusher feed at half speed or two members of Mill Operations to conduct floor patrol or

operating area. Updates will be provided to the Mill control room every 30 minutes of the response.

11. Only Safety Department personnel can release the Code One by declaring an "all clear" for employees to return to regular work.

3.2. Minto Incident Command Structure



3.3. Code 1 Procedure for Control Room

1. When a Code 1 is called, listen for Site Safety to respond to the Code 1 on channel 1.
2. Once Site Safety has confirmed the details of the Code 1, they will direct the control room operator to activate the ERT pagers and call "Code 1, Code 1, Code1" on channels 5,8,14 &16. Operator will also call Code 1 on the Telephone Paging System. To do so pick up the receiver and dial 499 you will hear one ring then announce the Code 1 as you would on the radio.
3. If no reply heard from Site Safety, activate ERT pagers; announce event and location (if known), e.g.; "Code 1 –Medical emergency in kitchen", call "Code1, Code1, Code1" on channels 5,8,14 & 16, and then attempt to contact Site Safety on channel 1.
4. Confirm that all Mill personal are aware and have moved to the lunchrooms or muster station if mill involved. (Except control room operator who remains if safe, to provide for critical monitoring and controlled equipment shut down as required.)

5. If control room deemed unsafe, control room operator can request permission from IC to relocate to Tailings or Crusher control room to provide for critical monitoring and controlled equipment shut down as required. Must take radio and Satellite phone with him.
6. Confirm on all channels that the Code 1 has been heard by calling Code 1 a second time channels 5,8,14 & 16.
7. Monitor the radio during the Code 1 as emergency crews may use the control room as a communications resource. Have emergency contact list ready in case external resources are required to be contacted.
8. Complete a time and event log of activity on the emergency ground to the best of your ability.
9. Site Safety will take responsibility for instruction to clear the Code 1 on all channels and the telephone paging system.

3.4. ECC detail

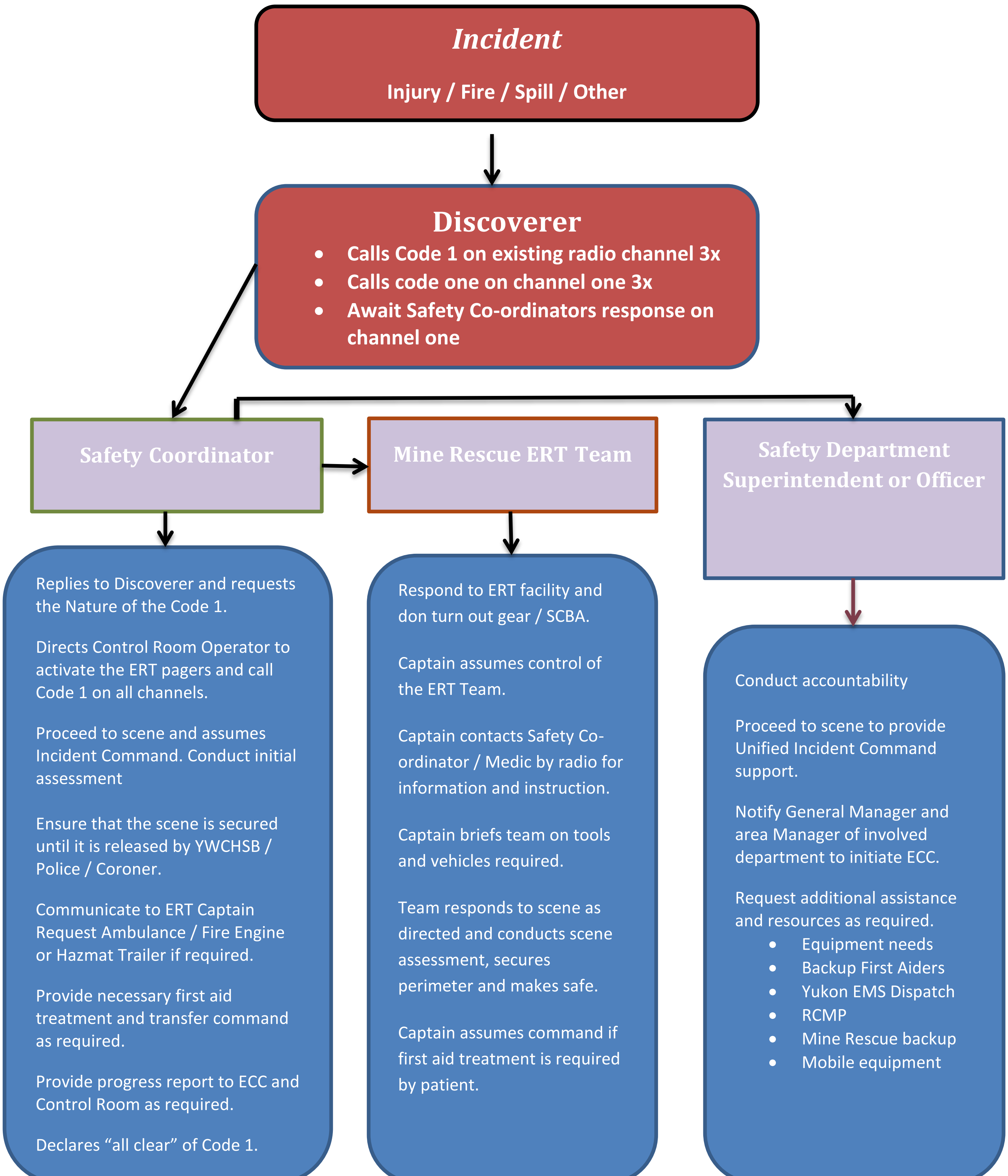
- Where - GM office or Safety Superintendent Office if Mill involved. Phone, Lync, Radio, Sat Phone for use available to these locations.
- Who –GM, H&S Superintendent, Manager of area involved (Planning), HR (Logistics), Manager of Administration (Finance),Manager of Environment (if not on scene)
- What –
    - Control communications off site; maintain communications with IC, communications off site as required such as corporate, regulators, support agencies, media, neighbors, etc.
    - Notify families when warranted.
    - Source materials, supplies, mutual aid, resources.
    - Arrange for evacuation and general transportation and logistics.
    - Develop business continuity plans.
    - Advise and support scene IC as required.
    - Provide updates to site

3.5. Major Power Failure

1. In the event of a major power failure affecting any portion of the operating facilities at the mine, the employees within the working areas need to be aware of the hazards of unexpected loss of power and safely retreat to the nearest control room, lunch room or office to be accounted for by their supervisor.
2. Electrical supervisor needs to be contacted as soon as reasonably possible to assess the reason for the outage, provide alternate power if able and to contact YEC to report outage if applicable. Control room has satellite phone available for this reason.
3. Minimizing radio traffic is essential during a Power failure so the bulk of communication related to accountability should be done face to face.
4. Supervisors will attempt to locate and account for all workers under their control and be available to report the accountability check to Site Safety when requested for it.
5. Ambulance and Fire bay doors need to be manually opened by Safety department personnel.

6. Safety Department Personnel will coordinate a sweep through the affected operating area with a source of light to ensure no workers are trapped in a location they could not safely retreat from or are injured from the power failure event and that there is no sign of fire.
7. Safety Department Personnel will make contact with area supervisor to confirm accountability of the respective workers.
8. Any missing or identified as injured workers will require search and rescue efforts. **This would require initiation of Code 1.**
9. Once all people are accounted for and it has been confirmed that there is no risk to life by the power outage operating supervisors will be advised and work can continue or reassigned depending on the job and the location of power failure.
10. Once the power has been restored safe start up procedures must be followed and all work must be directed by the supervisor in charge of the affected areas.
11. If a major power failure occurs underground, all work stops and workers will report to refuge station or surface and report to the shift boss for accountability purposes.
12. UG workers will remain in the safe refuge locations until instructed to proceed back to work by shift boss.
13. Any coordination of emergency information related to the power failure will be provided to the shift boss by the Safety Department.

3.6. Discovery and Activation of Code 1 Protocol



4. INITIAL INCIDENT RESPONSIBILITY MATRIX

POSITION	RESPONSIBILITIES
Safety Coordinator/Medic	Initial scene assessment and Incident Command Coordinate initial response Provide first aid treatment if necessary Mobilize ambulance to scene, if required E.R.T. and specialized resources mobilization & consultation Attend and coordinate response for all incidents involving "serious injury" and "serious accident", as defined in Sec. 33, OHS Act Notify Area Supervisor, Health and Safety Superintendent, Request additional external resources as necessary and provide history and assessment for medical evacuations
Mine Rescue Team	Maintain team safety as priority Rescue and protect human life Protect and mitigate loss to mine property Assist with rehabilitation of mine property and equipment
Area Supervisor	Coordinate evacuation of work area Account of workers under his/her responsibility Be available to Incident Command for information and assistance requests. Participate with Incident Investigation
Department Manager	Respond to scene and provide Unified Command Support Attend at all incidents involving "serious injury" and "serious accident", as defined in Sec. 33, OHS Act Coordinate and participate in incident investigation process. Ensure follow up action is completed
H&S Superintendent	Notify General Manager and Department Manager and provide follow up report of progress Assist with accountability Provide for unified incident command support Provide direction as required Coordinate recovery and investigative activity Ensure all government reporting has been completed Provide follow up reports to regulatory bodies as required Organize and conduct post-incident debriefings Assist with Incident Investigation
General Manager	Receive briefings on incident details Provide for unified incident command support Provide direction as required Verify notification of regulatory agencies, government and Minto Explorations Ltd. corporate office as required Verify scene remains secure until released by regulators (if applicable) Verify compliance with standards and government regulatory requirements Follow up communication to corporate and media Responsible to authorize all off site communication

5. FOLLOW UP RESPONSIBILTY MATRIX
Incident – Injury / Fire / Spill / Other

Health & Safety Superintendent	Maintain Scene Security at incident. Instruct ERT / Mine rescue of further requirements or stand down / all clear. Notify Authorities. Ensure legislative compliance. Assist with site incident investigation and evidence gathering. Report progress to GM and Department Manager. Co-ordinate plan to get all rescue equipment back to a state of emergency preparedness. Debrief rescue team.
Safety Co-ordinator / Medic	Roll out plan to ERT to get all rescue equipment back to a state of emergency preparedness.
Mine Rescue Team / ERT	Support debrief of incident. Ensure all rescue equipment is back to a state of emergency preparedness. ERT complex clean up. Captain to ensure that all team members are provided the time and assistance needed to recuperate from the response. Captain to release the team upon completion.
General Manager	Ensure necessary notifications are made. Minto Explorations Ltd. Corporate Office / Yukon OH&S Mines Inspector / External Family / Media.
Department Manager	Organise and participate in the incident investigation and gathering of evidence.
Environmental Representative	Ensure necessary notifications are made. Yukon Spill Response Line
Human Resources	Arrange for transportation of site personnel if required.

6. MEDICAL EMERGENCY EVACUATION

Yukon EMS dispatch is a critical resource in the event of a medical evacuation. Safety Coordinator/Medic will inform Yukon EMS dispatch every instance that there is a change to the site access such as barge removal, ice bridge closure, or the initiation of Ice Bridge or barge operation.

1. Minto Explorations Ltd. Medic will control all medical / trauma emergencies.
2. Upon patient assessment, Medic will determine course of action, including return to work or further medical assessment and evacuation.
3. If medical evacuation is deemed necessary, the Medic will contact Yukon EMS Dispatch @ 867-667-3333 and provide history and assessment findings. EMS dispatch call is a two element call and Medic will need to provide history and assessment twice. The first element dictates the triage of the transfer and the second element is directly to a medical professional responsible for the transfer. These two elements should be available back to back. Yukon EMS Dispatch is responsible for transfer method decision.

Yukon EMS Dispatch	(867) 667-3333
Pelly Crossing Nursing Station	(867) 537-4444
Carmacks Nursing Station	(867) 863-4444
Whitehorse General Hospital	(867) 393-8700

4. All Yukon EMS transfer either by road, air or combination is provided with nursing and paramedic personnel. Air transport is provided flight nurse and flight paramedic. Triage decisions will be made based on patient condition and other emergencies taking place in the area. We are a high priority community as deemed by Yukon EMS and all efforts to supply our needs will be made. One hour plus flight time is the mandate for response by EMS so medic needs to consider that as part of his treatment and care. EMS dispatch provides all patch call information to receiving facilities if they are involved in the transfer in any way.

5. In the event that a transport decision is made without or outside of consultation with Yukon EMS Dispatch, they need to be notified as soon as reasonably possible to provide for additional transport from destination and/or to document transfer decisions made.

6.1. Non-Emergency Transfers

Ice Bridge + Minto Barge available

1. Non-critical, stable patients that require further medical assessment and do not require medical attention during transfer will be taken off site by a designated Minto Explorations employee at the first available time.

2. Non-critical, stable patients that require further assessment and medical attention during transfer must be taken off site via Ambulance. EMS dispatch must be contacted prior to departure to coordinate the transfer, receiving facility and the possibility of further transfer requirement. If EMS dispatch will not be involved in the actual transfer operation, a call to the receiving facility by Minto Medic is required (patch). If EMS dispatch is involved in any way with the actual transfer they will make the patch calls.

3. Emergency, unstable patients will be evacuated off site through coordination between Minto Medic and Yukon EMS Dispatch. In cases of extreme weather that does not permit landing at the Minto Air Strip, the government Air Strip may be utilized on the east side of the Yukon River.

Alternate helicopter services if required (500ft ceiling, daylight only), only after exhausting options through Yukon EMS dispatch.

- HeliDynamics: 867-668-3536
- TransNorth Helicopters: 867-668-2177 (Whitehorse) 867-863-5551 (Carmacks)

6.2. Site or Camp Evacuation

In the event of requiring partial or total evacuation of site, several options are available and must be considered depending on the time of year and availability of transport company provision.

With the exception of medical aid incidents, external resources including evacuation arrangements will be authorized by the General Manager or his designate. Travel arrangements should be coordinated through the travel department or HR and Purchasing department should be involved in all decisions that will result in costs being associated. Designated travel coordinator needs to begin arranging connecting flights or hotel accommodations as soon as evacuation is suspected.

Options for evacuation are by road or air, depending on the time of year and availability of barge or Ice Bridge. Air transportation is dependent on weather and availability of aircraft. Early notification of airlines is critical for preparation of staff and aircraft.

Accurate weather assessment from site is critical to incoming aircraft. Designated person to provide must be arranged.

Road accessible

- Transportation by Coach (47passenger/bus) – Whitehorse (Yukon Alaska Charters)
- Transportation by Van – Pelly Crossing (Tom Gill)
- Transportation by onsite bus – Carmacks (on site)
- Transportation by air – Pelly Crossing/Whitehorse (Alkan Air, Air North, Combination)

Staging of people can be accommodated at Yukon Alaska Tours Recreation Facility, Whitehorse airport or local hotels as available. Arrangement for staging needs to be planned and documented to provide a location to communicate further travel or housing options for individuals once arranged by travel coordinator. Consider supplying food and drink to people in staging and ensure communication is available. Documented list of who is where needs to be maintained.

Road not accessible

- Transportation by air – Pelly Crossing/Carmacks/Whitehorse (Alkan Air, Air North, Combination)
- Transportation by air/road combination – Air to Carmacks and Air/Coach to White horse. Fuel may need to be arranged to be delivered to Carmacks to refuel planes for multiple flights. The designated air agency will arrange for fuel transfer. Mackenzie Petroleum -867-668-4441 or 867-332-3755 cell, Pace Setter – 867-633-5908, North of 60 – 867-633-8820.
- Bus to river crossing and helicopter (Trans North Helicopters) transfer across river to Coach (Yukon Alaska Charters).

Staging of people can be accommodated at Carmacks Air Terminal. Consider supplying food and drink to people in staging and ensure communication is available. Documented list of who is where needs to be maintained.

7. MILL/TAILINGS FIRE ALARM PROCEDURE

1. Activation of Code 1by Control Room Personnel
2. All non-control room personnel in Mill/Tailings are to proceed to nearest exit point and proceed to MUSTER STATION located at mine office complex.
3. Control Room will advise Incident Command of Alarm location.
4. Incident Command will advise Control Room personnel on whether or not to evacuate Control Room.
5. Control room operator can request to be repositioned at either Tailings or Crusher Control room to monitor operations on terminal and complete controlled shut down operation. to provide for critical monitoring and controlled equipment shut down as required. Incident Command to allow based on safety of initial scene assessment.
6. Once evacuated from Mill, all personnel are to proceed to MUSTER STATION.
7. All personnel are to remain located at MUSTER STATION unless advised by Safety department designate.
8. ERT will operate under the direction of Incident Command. Team Captain responsible for team tactical operation and direct accountability of team.
9. No personnel are to block Emergency Response vehicles, Ambulance or Equipment.
10. Health and Safety Superintendent will request accountability report from all area supervisors responsible for work within the affected area.
11. Only Incident Command can advise Control Room to disengage Fire Alarm after investigation of cause.
12. No personnel will be allowed back into Mill or Tailings complex without authorization of Incident Command.
13. Failure to evacuate Mill will result in disciplinary action, which may result in termination.

8. CAMP FIRE ALARM PROCEDURE

1. Activation of Code 1 by Kitchen Staff or first person recognizing alarm
2. All personnel in Camp affected by alarm are to proceed to nearest exit point and proceed to Muster Station.
3. Camp unit manager will bring accountability sheets to Muster Station and meet Health and Safety Superintendent/Officer to assist with roll call (roster sheets are updated daily and are located on the board just inside kitchen entrance). Area supervisors will assist as required and directed by camp unit manager or H&S Superintendent/Officer.
4. Employees working in camp (site services, Sodexo, maintenance) will report to muster station and be accounted for by their supervisor or most senior worker on crew. The supervisors will advise H&S Superintendent/Officer of any missing people.
5. H&S Superintendent will relay accountability information to Incident Command (Safety Coordinator or ERT Captain).
6. ERT will respond to the ERT facility and don turnout gear and prepare SCBA. Once sufficient number of team members is prepared, ERT captain will contact Safety Coordinator/Medic on radio Chanel 1 for response and staging instructions.
7. ERT will respond to defined staging area with the fire truck and ambulance in a safe manner.
8. ERT Captain will utilize accountability tag board maintaining control the team. ERT Captain will report to IC the status and location of the alarm.
9. IC will develop plan of action with the ERT captain. ERT captain will direct team in conducting interior search, rescue and firefighting operations.
10. ERT captain will inform IC of standard benchmark fire ground activities such as entering building, time under air, smoke/fire found, victims located, fire stop, etc.
11. IC will delegate the documentation of a time and event log to the best of their ability. (Control room operator, ECC or on scene team member)
12. All employees will remain at Muster Station until “All Clear” is given by Site Safety or instructed to move to alternate location.
13. Failure to evacuate Camp will result in disciplinary action, which may result in termination.

9. "Serious Injury" and "Serious Accident" under OH&S act

(Excerpt from Occupational Health & Safety Act)

"**Serious Injury**" means:

i) an injury that results in death,

j) fracture of a major bone, including the skull, the spine, the pelvis, or the thighbone,

k) amputation other than of a finger or toe,

l) loss of sight of an eye,

m) internal bleeding,

n) full thickness (third degree) burns,

o) dysfunction that results from concussion, electrical contact, lack of oxygen, or poisoning, or

p) an injury that results in paralysis (permanent loss of function);

"**Serious Accident**" means:

(l) an uncontrolled explosion,

(m) failure of a safety device on a hoist, hoist mechanism, or hoist rope,

(n) collapse or upset of a crane

(o) collapse or failure of a load-bearing component of a building or structure regardless of whether the building or structure is complete or under construction,

(p) collapse or failure of a temporary support structure,

(q) an inrush of water in an underground working,

(r) fire or explosion in an underground working,

(s) collapse or cave-in, of a trench, excavation wall, underground working, or stockpile,

(t) accidental release of a controlled product,

(u) brake failure on mobile equipment that causes a runaway,

(v) any accident that likely would have caused serious injury but for safety precautions, rescue measures, or chance. (As amended by SY 1988, c.22, s. 5; SY 1989, c. 19, s.6)

Reprinted from "Occupational Health and Safety with Mine Safety Regulations."
Yukon Workers' Compensation Health and Safety Board. Department of Justice, Government of the Yukon. 1992

10. Reporting the Emergency

Where an EMERGENCY exists that may affect mine personnel, evacuation procedures must be initiated.

10.1. Underground Emergency – Other than Fire

Any person discovering an emergency shall:

1. If safe to do so try to rectify the situation with the tools you have at the scene
2. Perform first aid if safe to do so
3. Rope off or barricade the area if possible
4. Escape to nearest refuge station following up cast ventilation or out of the mine and warn all others along the way.
5. Report the emergency by calling the appropriate numbers from the Emergency Contact Number sheet located in the refuge station
    - When reporting the incident it is of extreme importance that you include the following information.
    - Who is calling and who is involved?
    - What happened and what have you done?
    - When did this happen?
    - Where are you and where is the emergency?
    - Who and what do you need for a response? First aid, rescue stench gas, other assistance?
    - Stand by the phone and wait for further instructions

10.2. Underground Emergency - Fire:

Where a fire exists that may affect other personnel working in the area, evacuation procedures must be initiated:

Anyone discovering a fire shall:

1. Activate fire suppression system if fire is on equipment.
2. If safe to do so, use nearby fire extinguishers to extinguish the fire.
3. Warn all personnel in the immediate area (voice, radio, and phone) to evacuate to a safe location.
4. Initiate the Stench Warning System.
5. Do not expose yourself to unnecessary risk and keep a clear area of retreat behind you.
6. If the fire is too big, do not hesitate, leave the area immediately and evacuate.
7. Proceed in up cast direction to nearest refuge station, fresh air base or out of the mine if safe to do so.
8. Utilize self-rescue device to protect from smoke exposure.
9. If unable to travel safely to refuge station, take refuge in heading and utilize compressed air header and any available material – vent tubing, clothing, etc. to construct a shield around yourself. Remain in the location until mine rescue team arrives.
10. Once you have reached the refuge station or fresh air base follow refuge station protocols and provide for accountability.

10.3. Under Ground Emergency Evacuation

Upon being notified of a mine emergency evacuation either by radio, phone or stench warning system:

1. Stop work immediately,
2. Note the time you received the warning
3. Calmly proceed in an up cast direction to the nearest refuge station or out of the mine
4. Utilize self-rescue device at the first sign of smoke or fire.
5. Once safely at the refuge station or central muster location, follow the refuge station protocol and provide for accountability.
6. Review the refuge station emergency procedures posted inside the refuge chamber.
7. Check the mine phone for operation and call outside the mine. Report the following information:
   - Your name and name of others in refuge.
   - Refuge Chamber location.
   - Outside conditions.
   - That you are safe in refuge.
8. Remain in the refuge station, even if communication is cut off.
9. Stay calm, conserve energy and cap lamps, sit down on benches.
10. Have one person walk around room periodically to stir up the air.
11. Do not be tempted to wander about the mine seeking safe passage out.
12. Remain in the refuge until you are rescued by mine rescue personnel or contact is made declaring it safe to leave the refuge station by mine official in charge of the emergency.

10.4. Refuge Stations

Portable and permanent refuge stations are maintained in locations of mine development to include refuge < 15 minute travel time by foot. All underground personnel will follow fresh air and escape to surface or take refuge in a refuge station during all emergencies that affect the underground. Refuge station posted “code of conduct” must be followed by all in the refuge station.

10.5. Main Ventilation Control in Event of a Fire

In the event of an underground fire, efforts will be undertaken to ensure ventilation to the mine is maintained.

Operation of the main ventilation fans in will be guarded and monitored to ensure continuous operation of the fans at all times.

The effects of the alteration to the main ventilation fans shall be clearly understood before any changes are made.

During a mine fire:

There will be no alteration to the operation of the main fans without the authorization of the Mine Manager or Designate and Notification to YWCHSB Safety Officer as defined under the regulations.

11. Underground Emergency Response

Underground Emergency – System of response

1. Initiate mine rescue/emergency response notification procedures as directed by UG Shift boss or designate.
2. Upon completion of the emergency response notification procedure:
   a) Assign designate to initiate and maintain a log of events.
   b) Establish the EMERGENCY COMMUNICATION CENTER (ECC).
   c) Keep all Communication Equipment on Standby.
   d) Direct operations personnel to ECC.
   e) Confirm Incident Command (IC) has been initiated.
   f) Complete the EMERGENCY DATA SHEET by obtaining the following information:
      - Name of person reporting the emergency
      - Nature and severity of injuries and/or incident
      - Assistance required
      - Location of emergency
      - Number of people involved
3. Operations personnel will delegate a mine official in charge of the rescue operation and develop a preliminary plan.
4. Mine rescue team will respond to the mine rescue room
5. Mine rescue team captain will assume command of the team
6. Team will don all protective gear and bench test SCBA
7. Team will prepare all equipment needed to respond UG
8. Team will await instructions by Mine Rescue Coordinator (Safety Coordinator/Medic/Health and Safety Superintendent)
9. Team will be advised of plan
10. Back up Mine Rescue team respond to mine rescue room for briefing and preparation for back up assistance.
11. Tertiary back up mine rescue team(s) must be considered and depending on the initial assessment of situation contact needs to be made for mutual aid as soon as reasonably possible.

12. Mine Ventilation Action Plan

In the event of fan failure due to a malfunction, accident, power failure, or other such unplanned or unscheduled event, this action plan applies to all underground employees and contractors whose work areas are affected by the temporary interruption of the operation of the main, booster, or auxiliary fans in the mine.

Main Ventilation Interruption Procedure:

<u>**Less Than 2 Hours:**</u>

1. Diesel mobile equipment, mucking operations, will cease in all active production and development headings supplied by mechanical ventilation until the main ventilation system is restored. ... OR ... The active heading is continually monitored for air quality and is maintained in compliance with the applicable standards.
2. All other work relevant (scaling, clean-up, maintenance, etc.) to the active heading may continue per normal operations provided the air quality remains in compliance with the applicable standards.
3. Diesel mobile equipment for access to, or egress from, the mine will continue per normal mine operations provided air quality remains within compliance of the standards. **If the ventilation is forced the diesel equipment must be shut down until ventilation is re-established.**

<u>**Two Hours or More:**</u>

1. Air quality testing will be performed by Supervision in all active headings affected by the ventilation interruption. Where air quality is not within compliance of the standards for mine ventilation, all personnel shall be withdrawn from the active heading affected.
2. Ventilation to the affected active headings shall be restored to normal and the air quality in the affected active workings shall be tested by Supervision to ensure the air quality meets the requirements of the standards prior to the return to work in the area.
3. Prolonged ventilation interruption will require air quality testing in the affected active workings at least every four hours until ventilation has been restored.
4. In areas where air quality prevents continued testing, normal ventilation shall be restored for a minimum of two hours before persons enter the area to test air quality ... OR ...Suitable self-contained breathing apparatus and procedures consistent with YWCHSB Regulations will be followed by competent persons to perform air quality testing the affected area.
5. Diesel mobile equipment for access to, or egress from, the mine on the main haulage ways will continue per normal mine operations provided air quality remains within compliance of the standards.
    a. **This is contingent on the mine having flow through exhaust. If the ventilation is forced the diesel equipment must be shut down and the mine evacuated until ventilation is re-established.**

13. MINE RESCUE

Minto Mine will retain a compliment of trained surface and underground mine rescue personnel on site at all times. This will include two full UG teams as a minimum. A required third UG team would consist of a mutual aid response from YWCHSB and neighboring mines with a mutual aid agreement in place.

The mine rescue unit consists of a minimum of three mine rescue teams summoned to a mine disaster; if the operation extends beyond 6 to 8 hours, the additional third team must be called in. In order to reduce fatigue, the teams are rotated to allow one team at work, one team on hand as backup and the third team at rest.

A typical rotation for a three team unit is as follows:

Team Working/Backup Team/ Team at Rest (2 hour maximums)

A team/ B team/ C team

B team/C team/ A team

C team/A team/ B team

Teams have approximately 4 hours rest prior to working for 2 hours.

13.1. Mine Rescue Personnel

Name	Company	Capacity
Bissell, Keith	Minto Mine	Surface Mine Rescue/ERT/ Hazmat Op.
Christian, Tyler	Minto Mine	UG/Surface Mine Rescue/ERT/ Hazmat Op.
Crottey, David	Minto Mine	Surface Mine Rescue/ERT/OFA 3/ EMR / Hazmat Op.
Daley, Mike	Minto Mine	UG/Surface Mine Rescue Instructor/OFA 3
Dunfield, Steve	Minto Mine	ERT / Hazmat Op.
Emerson, Phil	Minto Mine	ERT / OFA3 / Hazmat Op.
Goebel, Mark	Minto Mine	UG/Sur. Mine Rescue Instructor/OFA 3/PCP/Hazmat Tech
Henry, Garth	Minto Mine	Surface Mine Rescue/ERT/EMR / Hazmat Op.
Jimmo-Dixon, Anna	Pelly Construction	ERT
Kerr, Dan	Minto Mine	Surface NWT
Moloney, Brendan	Minto Mine	ERT
Monteith, Tyrone	Minto Mine	Surface Mine Rescue/ERT/ Hazmat Op.
Moretti, Troy	Minto Mine	ERT
Silverfox, Ryan	Minto Mine	Surface Mine Rescue/ERT
Spruit, Arjen	Minto Mine	Surface Mine Rescue/ERT/OFA 3/EMR/ Hazmat Op.
Stewart, Mike	Minto Mine	UG/Surface Mine Rescue/ERT/OFA 3
Sutton, Rob	Minto Mine	UG/Sur. Mine Rescue /ERT/OFA 3 Instr./PCP/ Hazmat Tech
Taylor, Steeve	Minto Mine	UG/ NWT / ERT/ OFA3/ Hazmat Op.
Vandenhoek, Craig	Fountain Tire	ERT/ Hazmat Op.
West, David	Pelly Construction	ERT / Hazmat Op.
Wettstein, Curtis	Minto Mine	Surface Mine Rescue/ERT

13.2. EMERGENCY RESPONSE EQUIPMENT

Emergency Response Equipment	Location	Use Authorized By:
Minto Mine Ambulance	ERT Complex	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain
Minto Mine Fire Engine 8 Emergency / Rescue / Tender	ERT Complex	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain
Minto Mine Hazmat Trailer	ERT Complex	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain
Minto Mine 4 Wheel Drive Tundra	ERT Complex	Safety Coordinator - Medic Emergency Response Coordinator

		Safety Superintendent / Officer ERT Captain
Medical Jump Kits	ERT Complex First Aid Room Medics room Ambulance	Safety Coordinator-Medic
2 Automatic External Defibrillators	Minto Ambulance First Aid Room	Safety Coordinator-Medic PCP
Oxygen Airway Adjuncts (OPA) Nasopharyngeal Airway King Extraglottic Airways	First Aid Room Jump Kits Ambulance	Safety Coordinator-Medic PCP ERT Captain
Spinal Precautions Spine Boards & Head Blocks Stiff Collars Spider Straps KED – Vehicle extrication device	Minto Ambulance First Aid Room	Safety Coordinator/Medic PCP ERT Captain
Splints Regular Sager traction splint	Minto Ambulance First Aid Room	Safety Coordinator/Medic PCP ERT Captain
Wound Management Burn Dressings Sterile Water Bandages & Dressings	First Aid Room Jump Kits Ambulance	Safety Coordinator / Medic PCP ERT Captain
EPI Pens Anaphylactic Shock / Allergies Additional Medications Entonox Vent Olin Nitro SL Epi SC Narcan SC, IV D10W IV 0.9% NaCl IV	First Aid Room Jump Kits Ambulance First Aid Room Jump Kits Ambulance	Safety Coordinator/Medic EMR PCP PCP PCP PCP PCP PCP
SCBA 6- Scott 2.2 2 – Scott 4.5 12 – Spare bottles	ERT Complex & Fire Engine 8	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain
3 Lifting/Moving Bags & Manifold	Fire Engine 8	Safety Coordinator – Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain
Chain Saw- Roof Saw –Recipro. Saw	Fire Engine 8	Safety Coordinator – Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain
Hydraulic Spreaders & Jaws	Fire Engine 8	Safety Coordinator – Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain

Ground Monitor – Piercing Nozzle and PPV Fan	Fire Engine 8	Safety Coordinator – Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain
Generator and Flood Lights	Fire Engine 8	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain
Gas Detection 4- BW Gas Alert Micro 5 Multi Gas 1 Draeger Bellows multi gas detector	ERT Complex Electronics Room	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain
Radios 10 – Motorola Hand Held Radios 1 VHF Air Band Transceiver Radio 2 Satellite Radios	ERT Complex Electronics Room	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain
Rope Rescue Equipment 2 complete rope rescue bags 8 – Rescue Ropes Compliment of hardware including descending devices, pulleys, mechanical advantages, rope grabs, harnesses, helmets, etc.	ERT Complex	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain
NFPA Turn Out Gear 16 sets including boots, gloves, Helmets and balaclavas.	ERT Complex	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain
Hazmat Response Equipment Protective clothing, sorbents, booms, Over pack, hand tools.	Minto Mine Hazmat Trailer	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain
Confined Space Rescue Gear SKED Stretcher /Oregon Spin Splint Rescue Tripod / Ventilation Fan Stokes basket with spider straps / Mule Litter Wheel	ERT Complex	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer ERT Captain
Underground Rescue Equipment	ERT Complex	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer Mine Rescue Captain
6 Draeger BG 4 SCCBAs and all equipment to clean / test / refill	ERT Complex	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer Mine Rescue Captain
6 Ocenco EBA 6.5 Self Rescuers (1 trainer)	ERT Complex	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer Mine Rescue Captain
12 MSA W65 Self Rescuers **12 Underground Camp Lamps** **12 Miners Belts**	ERT Complex	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer

12 Link Lines		Mine Rescue Captain
1 Stretcher Basket fully equipped	ERT Complex	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer Mine Rescue Captain
Rope Rescue Equipment 1 complete rope rescue bag	ERT Complex	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer Mine Rescue Captain
1 Multi Gas Detector	ERT Complex	Safety Coordinator - Medic Emergency Response Coordinator Safety Superintendent / Officer Mine Rescue Captain

13.3. BACK UP MINE RESCUE

13.3.1. Back up Mine Rescue Teams

If the operation extends beyond 6 to 8 hours, additional mine rescue teams must be called in. A mutual agreement with other mines will have to be drafted to ensure backup if required. A list of local mine rescue personnel could serve as back up in the event these individuals are on their rotation off and are in fact home.

Minto Mine has in place cooperative agreements with the Alexco Resource Corp. at the Bellekeno Mine as well as divisions of Procon Mining and Tunnelling.

If the incident requires Mine Rescue back up response the YWCHSB Mine Inspector and Alexco Resource Corp must be notified immediately, advised of the situation and to prepare to respond immediately pending available resources.

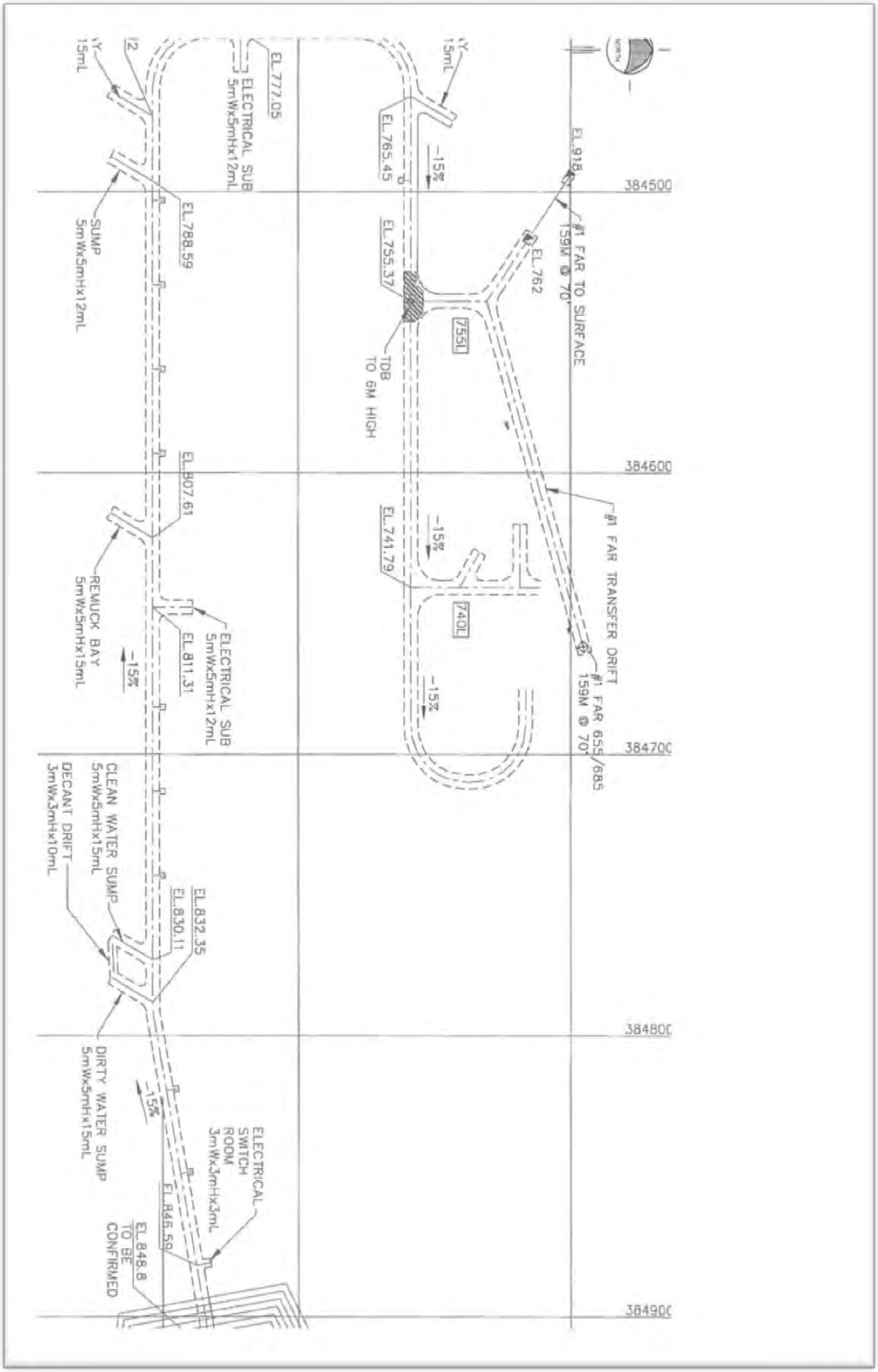
Agency	Contact Personnel	Office Contact Number	Home Contact Number
YWCHSB	Bruce Milligan	867-667-8739	1-800-661-0443 (toll free)
Alexco Resource Corp	formal plan in place	867-996-2330	
Procon Mining	formal plan in place	604-291-8292	

Reference Mutual Assistance Agreement for more details

14. Minto Mine Underground Decline Capital Development

14.1. Mine Safety Plan for first 4500 meters

The Minto Mine Capital Decline will be of a five by five meter dimension by 4500 meters in dept. Safety bays and sumps will be set up on the right side of the drift with all the remucks on the left side. The drift will be driven by an experienced rotating work crew of 16 miners. Work crews will be all ticketed and experienced mine rescue personnel. Each work crew will consist of four men and will have a ticketed shift boss in addition to the four man crew. At any given time there should only be two men working at the face. The target is to advance 100 to 125 meters per month.


NORTH
EL.918
#1 FAR TO SURFACE
159M @ 70°
EL.762
755L
TDB
TO 6M HIGH
EL.765.45
EL.755.37
-15%
15mL
EL.777.05
ELECTRICAL SUB
5mWx5mHx12mL
12
15mL
EL.788.59
SUMP
5mWx5mHx12mL
EL.807.61
EL.741.79
740L
#1 FAR TRANSFER DRIFT
#1 FAR 655/685
159M @ 70°
REMUCK BAY
5mWx5mHx15mL
ELECTRICAL SUB
5mWx5mHx12mL
EL.811.31
CLEAN WATER SUMP
5mWx5mHx15mL
DECANT DRIFT
3mWx3mHx10mL
EL.832.35
EL.830.11
DIRTY WATER SUMP
5mWx5mHx15mL
ELECTRICAL
SWITCH
ROOM
3mWx3mHx3mL
EL.846.59
EL.848.8
TO BE
CONFIRMED
384500
384600
384700
384800
384900

Safety

A single ***vent fan*** set up at the portal entrance a safe distance away will provide adequate ventilation for the first phase of the drift. A standard stench gas warning system will be tied into the surface ventilation system with the ability to manual activate from surface. A back up Alimak vent raise 3 meters by 5 meters will eventually be driven to the surface as development progresses. This vent raise will be equipped with ladders and metal landings and will also serve as the back-up emergency escape route. A firefighting hose station will be set up in proximity of the portal. Safety bays will be located along the drift every 30 meters equipped with reflective signs for identification and scaling bars. The safety bay closest to the working face will be equipped with an industrial sized metal "Job Box "with emergency equipment inside. Basic contents;

- Six Ocenco EBA 6.5 Escape breathing apparatuses good for 8 hours each.
- Six spare MSA W65 Self –Rescuers
- One level 3 first aid kit
- One oxygen therapy unit
- Splints, c-collar, six spare emergency blankets
- Five gallon jug of fresh water
- Mainstay Freeze dried dehydrated food bars (good for 5 years)
- Back up emergency lighting
- Toiletries as required.

Communication will be via Leaky Feeder or Fiber Optics. Upon reaching the 250 meter mark in the drift a **C-CAN Refuge Station** will be stationed to protect miners in the event of dangers. The refuge station will be equipped with posted emergency procedures, telephone emergency communication systems, firefighting equipment, piped‑in fresh air, piped in water, stretcher, spine board, trauma kit, emergency blankets, first aid supplies, emergency breathing apparatus, drinking water and such other emergency supplies as circumstances at the mine may dictate.

Rescue

The contractor responsible for the mining of the decline will provide 6 certified underground mine rescue personnel. In addition six existing Minto Mine employees presently possess valid underground mine rescue certification. This will bring the total to 26 ticketed underground mine rescue personnel. Mine Rescue training and instruction will be conducted in a cooperative effort between the contractor and Minto Mine utilizing underground certified mine rescue instructors.

Rescue Equipment are stored on surface and consist of 6 Draeger BG4 self-contained closed circuit breathing apparatuses, 2 fully equipped stretcher baskets, picks, shovels, scaling bars, rechargeable saws, rope, tackle, mechanical advantage hardware, foam fire suppression equipment, fire hoses, nozzles, axe, hammers, nails, etc.

A firefighting hose station will be set up in proximity to the portal. The design will be that of a 2.5 inch water valve with ability run several lengths of 2.5 inch fire hose off of it to a gated "Y". The gated "Y" reduces from 2.5 inches to 1.5 inches and splits to two 1.5 inch fire lines to the fire, foam nozzles utilized if required. A supply of AFF foam, nozzles, hoses and extinguishers will be stored in the hose station and readily available. A wheeled foam machine will be available for filling a drift in the event of equipment fires underground.

15. MISSING PERSON ACTION PLAN

Potential exists where persons may become lost on or traveling to and from the property. Such incidents can occur under the following circumstance:

- Employee or Contractor personnel engaged in surface exploration, travel or any other activities are overdue and cannot be located or contacted.

Upon notification that personnel are unaccounted for on the property you should:

1. Immediately advise the Area Supervisor, Safety Department Personnel and Area Manager
    - Designate a mine official in charge of the search and communications/planning.
    - Assess and determine the level of response required.
    - Gather all available information about the missing persons including last known location.
    - Advise the RCMP of the circumstances and request further assistance
    - Designate ERT/Mine Rescue to stand-by and assist the RCMP in search efforts as directed
    - Any search activity needs to be coordinated through the mine official in charge of the search. Search by vehicle should be conducted with two people in each vehicle, in coordination with RCMP and have effective communication and plan in place prior to conducting search.
    - Survival gear, rescue tools, tow straps, fuel, etc. should all be considered and taken along during search activities.
2. Stand-by to provide further information and assistance as required.
3. Once search is complete follow up notification to all involved must be conducted including RCMP.
4. Provide for follow up investigation to identify contributing factors and recommend future prevention actions.

16. OUTBREAK OF SICKNESS/GASTROENTERITIS ACTION PLAN

(Yukon Center for Communicable Disease Guideline)

Case Definition for Outbreak:

- At least one of the following must be met: Two or more liquid or watery
- stools above what is normal for the person within a 24-hour period, OR
- Two or more episodes of vomiting in a 24-hour period, OR
- Both of the following: (a) lab confirmation of a known enteric pathogen and (b) At least one symptom compatible with gastrointestinal tract infection (I.e. nausea, vomiting, diarrhea, abdominal pain or tenderness)

Outbreak definition:

- Three or more cases of gastroenteritis infection (as defined above), potentially related, occurring within a four day period, within the facility.

Case characteristics:

- Abrupt onset of diarrhea and vomiting
- Fatigue and occasional low-grade fever
- Average duration 18-24 hours, rapid recovery

Suspected etiology:

- Noro type virus. Confirmation by obtaining sample and sending in for analysis. Sample kit available in first aid and instructions are attached.

Response measures:

1. Sick bay and isolated washroom facilities needs to be provided. Minto Manor and Exterior Wash car need to be readied for service by Sodexo.
2. A second area made available for post-acute, recovering patients.
3. Communication to site informing of the situation and requesting people to report illness and use strict personal hygiene practices.
4. Cleaning of the quarantine areas undertaken by people informed of the risks and trained in the protection required. Food must be delivered, provisions for hydration need to be ensured. Electrolyte replacement fluids should be provided. Squincher is currently being placed into warehouse stock.
5. Cleaning of all other areas using Virox or bleach solution: 3x per day bathrooms and corridors and common rooms.
6. Kitchen and dining areas are cleaned on a continual basis
7. Discontinue communal food dispensing (salads, etc.) All food portions individually wrapped.
8. Contact Yukon Communicable Disease Control to advise of outbreak.
9. Consider notification of offsite personnel that may be scheduled to come into camp during outbreak and decide on travel restrictions, interruptions during the period

16.1. Recommendations for ongoing management of outbreak

If decline in case numbers to sporadic or nil:

- Laundering of all bedding: sheets, pillow cases, and quilts or blankets
- Laundering of all clothes used by or exposed to sick individuals.
- Cleaning of all surfaces with standard veridical disinfectants (bleach or Virox).
- Clothes that have been stored and unexposed to sick persons can be left in place
- Any drawers, shelves, etc. used by sick individuals should be cleaned.

If sporadic new cases (1 to 2 per day):

- Continue use of Sick Bay and isolation area
- Continue food preparation precautions
- Allow new staff in but with briefing on situation and need for vigilant personal hygiene

When no new cases reported for at least 48 hours:

- Terminal cleaning of isolation areas, cleaned as above with Virox or bleach solution. Designate and maintain a smaller isolation area for possible new cases over next 2 to 4 weeks
- Allow new staff to come in for normal tour of duty
- Return to normal food preparation

If continued high numbers (more than 3 new cases per day) or escalation of cases:

- Continue isolation/sick bay area with appropriate cleaning regimen
- Continue daily monitoring of new cases and their origin (bunk house)
- If more than one new case per bunk house, undertake intense cleaning of entire affected bunk.
- Close non-essential common areas
- Allow no in-rotation in of new personnel
- Consider camp closure according to demands on personnel

If continued high or increasing numbers despite measures in B. being followed:

- Close camp with clean out of entire camp: bunkhouses, food preparation and consumption areas, offices, common rooms and all non-industrial sites.
- Allow reopening of site following clean up.

If apparent cessation of outbreak followed by new cases after 48 hours or more:

- Follow recommendations as in B and C above.

17. EMERGENCY CONTACT INFORMATION

CAPSTONE MINING CORP
MINTO MINE

MINTO MINE – MLU PERMIT #LQ00004

EMERGENCY CONTACT INFORMATIO

LOCATION

LEGAL DESCRIPTION: N 62 37.210 E 137.14.042

NAD 83 EASTING 385371 NORTHING 6945190

DIRECTIONS

FROM WHITEHORSE, HEAD WEST ON ALASKA HIGHWAY, TURN NORTH (RIGHT) ONTO HIGHWAY #2, TRAVEL TO APPROXIMATELY KILOMETRE 430, and TURN WEST (LEFT) ONTO ROAD MARKED BY MINTO MINE SIGN, WAIT FOR RIVER BARGE ENTER ON MINE ROAD AT KM27. BARGE OR BRIDGE CREW WILL PROVIDE ROAD RADIO PROTOCOLS AND FURTHER INSTRUCTIONS.

FREQUENCIES

RADIO FREQUENCY	CHANNEL	RECEIVE	TRANSMIT
Access Road	16	162.075	167.055
Emergency	1	162.03	167.01

Amb Sat Phone 011-881-651-434-147 Control Room Sat Phone – 011-881-641-436-239 Spare Sat Phone – 011-881-622-452-217

ALL EMERGENCIES ANNOUNCE 'CODE 1, CODE 1, CODE 1' ON CHANNEL 1

MEDICAL

DEPARTMENT	PERSONNEL	COMPANY	PHONE #	EXT.	E-MAIL	RADIO
Dispatch	Control Room	Minto Ex.	604-759-0860	458		7
Safety /Medical	Arjen Spruit	Minto Ex.	604-759-0860	444	arjens@mintomine.com	1
Safety/Medical	David Crottey	Minto Ex.	604-759-0860	444	davidc@mintomine.com	1

OFF-SITE MEDICAL CONTACTS

AGENCY	PHONE NUMBER	ALTERNATE PHONE #
Nursing Station – Pelly Crossing	867-537-4444	24 hrs/day
Nursing Station – Carmacks	867-863-4444	After hours call forwarding
Whitehorse General Hospital	867-393-8700	24hrs/day
Yukon Communicable Disease Control	867-667-8178	
Poison Control Centre	867-393-8700	CANUTEC – 613-992-4624 (collect)

EVACUATION / RESCUE

Yukon EMS Dispatch – **All medical transfers here**	867-667-3333	24hrs/day
Air North	867-456-8300	867-335-1210 24hrs/day
Trans North Helicopter	867-668-2177	
Alkan Air	867-668-2107	24hrs/day
Yukon Alaska Tours – Coach Transportation	867-668-5944	24hrs/day
Search and Rescue (RCMP)	867-537-5555	867-667-5555
RCMP - Pelly Crossing	867-537-5555	867-667-5555
RCMP - Carmacks	867-863-5555	867-667-5555

MINE

DEPARTMENT	PERSONNEL	COMPANY	PHONE #	EXT.	E-MAIL	RADIO
General Manager	Ron Light	Minto Ex.	604-759-0860	439	ronl@capstonemining.com	
Health and Safety	Mark Goebel	Minto Ex.	604-759-0860	441	markg@mintomine.com	1
Mine Manager	Sebastien Tolgyesi	Minto Ex.	604-759-0860	453	SebastienT@mintomine.com	
Mill Manager	Ted Kenney	Minto Ex.	604-759-0860	477	tedk@mintomine.com	
Environmental	Jennie Gjertsen	Minto Ex.	604-759-0860	462	jennieg@mintomine.com	
Mill General Forman	Barrett/Johnston	Minto Ex.	604-759-0860	454	daveb@mintomine.com	8
Maintenance/Project	Martin Mann	Minto Ex.	604-759-0860	457	martinm@mintomine.com	
Site Services	Steven Maunder	Minto Ex.	604-759-0860	224	stephenm@mintomone.com	16/5
Human Resources	TJ Silliker	Minto Ex.	604-759-0860	448	tjs@mintomine.com	
Explorations Group	Brian Willet	Minto Ex.	604-759-0860	228	brianw@mintomine.com	
Pelly Superintendent	Declan McGovern	Pelly Const.	604-759-0860	466	declan@pelly.net	14
Pelly Superintendent	John Garvice	Pelly Const.	778-785-3184	466	john@pelly.net	14
Sodexo Manager	Michel Bourget	Sodexo	604-759-0860	230	Minto.Noram@sodexo.com	
Dyno Supervisor	Dale Wearmouth	Dyno Nobel	403-775-6143		dnna.minto@am.dynonobel.com	14
Dyno Supervisor	Rene Mercereau	Dyno Nobel	403-775-6143		dnna.minto@am.dynonobel.com	14
Assay Lab Manager	Bella Ocampo	SGS	604-759-0860	447	bella.ocampo@sgs.com	
Assay Lab Manager	Erin Slack	SGS	604-759-0860	447	Erin.slack@sgs.com	

Satellite Phones: Ambulance – 011-881-651-434-147 Control Room – 011-881-641-436-239 Spare – 011-881-622-452-217

OTHER

Superior Propane	867-334-1627	
Yukon Energy	1-800-676-2843	24hrs
Yukon Spill Response Line	867-667-7244	
YTG Disaster and Emergency	867-667-5220	
Yukon WCB	800-661-0443	
Forest Fire Reporting	888-798-3473	Carmacks Duty Officer – 867-332-1989
Conservation Officer	867-996-2202	867-335-2327 cell
Coroner	867-667-5310	
WCB Mines Inspector	867-667-8739	867-334-2002 cell or 867-667-5450 24hr

Appendix A

Attached copy of Mutual Assistance Agreement for UG Mine Rescue

Appendix 2: Tug and Barge Emergency Contingency Plan

MINTO MINE
Tug and Barge Emergency Contingency Plan
VERSION 2013-01

Prepared by:

Capstone Mining Corporation

Minto Mine

January 15, 2013

Table of Contents

List of Appendices

1.0 Introduction

Minto Mine (Minto) a subsidiary of Capstone Mining Corporation is pleased to submit the following contingency plan (plan) as per requirements of the access and land use permit "*Minto Landing Ice Bridge and Marshalling Area and West Side Barge Landing and Marshalling Area"* (the permit). It is Minto's intention that this plan will fulfill the requirement as stated in Schedule 2, Section 9.0 Contingency Plan of the permit. It is not Minto's objective for this plan to mitigate all possible accidents or malfunction in regards to the in stream operation of the Copper Queen tug and barge.

The plan as prepared is adaptive and will be amended as is practicable. This plan is intended to deliver the best possible means of mitigating an accident or malfunction of the loading/unloading or in-stream operation of the tug and barge with the resources available at Minto. Preventing such an occurrence requires a combination of: procedural and engineering controls, based on an awareness of at risk conditions. These documents exist in the form of the Spill Contingency Plan, Emergency Response Plan, any procedures or plans on the tug or barge from Site Services. This document serves as a contingency plan in the event that an accident or malfunction occurs when loading, unloading, and in-stream operations of the Copper Queen tug and barge (CQTB).

2.0 General Procedures

Any Response to an Emergency condition will be based on a priority sequence of Life, Environment and Property. Therefore every event will be regarded with these priorities in mind. Initial on scene assessment of the accident or malfunction will be called out on channel one as a "Code 1". The Emergency Response Team will be dispatched, communication established and the barge operator and deckhand will respond to control the scene.

Deckhands will mitigate all emergencies on the barge to the best of their ability given the resources available. General procedure in the event of an emergency would have the barge move to the west landing if possible or practical unless otherwise communicated to the barge captain. To mitigate an emergency in offloading or loading vehicles onto the barge the deckhand will utilize the anchor points on both landings. Slack will be left in the rope to ensure the barge captain is able to maneuver when docked at the landing. Tying off to the anchor points will mitigate complete catastrophe if the barge loses power during loading and offloading and will be discussed further under the specific procedures section of this plan.

Minto is currently in discussion with JDS about a mutual aid agreement. It is Minto's intention to have the agreement in place before the 2013 barge operating season. The mutual aid agreement will be for assistance on the east side landing (equipment, manpower etc.) as well as in-stream support. To mitigate the risk of losing control of the barge downstream Minto will be installing an anchor on the barge. In the event of an emergency the deckhand would be able to deploy the anchor allowing the barge a safety contingency if control was lost.

3.0 Specific Procedures

Below is a list of the current on site procedures for dealing with various emergencies in regards to the CQTB at Minto Mine. For supporting documents of the below procedures see Appendix B.

1. Emergency Response to Sinking
2. Emergency Response to Loss of Power or Control
3. Emergency Response to Fire Onboard
4. Emergency Response to Man Overboard
5. Emergency Response to Freight or Vehicle Overboard
6. Emergency Response to Medical Emergency on Board of the Barge
7. Emergency Response to Spill Response

3.1 Emergency Response to Sinking of CQTB

1. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
2. Captain and deckhand will deploy Canadian Coast Guard approved life rafts.
3. As per Emergency Response Plan, Incident command (IC) will communicate with Deckhand by radio to determine any further details of events, number of injured or trapped people, risks to property and environment.
4. IC will respond to scene in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs based on initial assessment and evaluation by IC will be communicated to the Emergency Communications Center (ECC) as per Emergency Response Plan.
5. Incident Accountability will be established and adhered to throughout the operation.
6. IC will determine the need for rescue of people downstream. Option to deploy rescue ropes via launcher considered for KM 12.
7. Alternate access to river to be determined by nature of incident, KM 20 provides a second potential access. All other access would require trail cutting which is possible but would take more time.
8. IC, ERT Captain, and Environmental Lead (Unified Incident Command Support) will assess ongoing situation and need for additional or fewer resources.
9. Alternate man boat (see Appendix A for details on man boat) will be deployed from landing as needed to support rescue and/or to gain more information regarding location of sunken vessel and determine possible plan for retrieval/securing. Man boat operator will work under the direction of IC.
10. If available and a benefit, Minto would exercise the use of the mutual aid agreement with JDS.
11. Once rescued, all patients will be treated as per OFA3/EMR protocols transported as per Yukon EMS dispatch confirmation aligned with Minto Emergency Response Plan.

3.2 Emergency Response to Loss of Power or Control of CQTB

The tug operates on two engines so total loss of power is not likely; however, is still possible and below is the emergency procedure that would be activated in the event that total loss or control of the CQTB was to occur.

1. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response. Captain will also communicate freight details and passenger numbers on board.
2. Passengers and crew will follow instructions from Captain and remaining on board if deemed safe. The Captain and deckhand will follow MED protocol in decision making in regards to passenger safety.
3. Captain and deckhand will deploy Canadian Coast Guard approved life rafts if deemed unsafe to stay on board by Captain.
4. IC will respond to scene or as close to it, in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs and downstream communication and reporting requirements based on initial assessment and evaluation by IC will be communicated to the Emergency Communications Center (ECC) as per Emergency Response Plan.
5. Incident Accountability will be established and adhered to throughout the operation.
6. Captain will navigate to the best of his ability to the safest downstream location possible. Under the direction of the Captain the deckhand may deploy the anchor to assist in stopping the barge and tug.
7. Captain will communicate to IC location and details of condition of vessel and people and assist in determining plans for action.
8. Once vessel is secured to shore or where landed in river, Man boat will be deployed to assist with additional securing and remove non-essential people to location where they can be transferred back to site or alternate safe location.
9. If available and a benefit, Minto would exercise the use of the mutual aid agreement with JDS.
10. Plan for retrieval will be based appropriate to the conditions and location of vessel. Plan to be developed cooperatively through Barge Captain, Minto ECC and Mutual Aid resources. Equipment and additional resources will be sourced through ECC as per Minto Emergency Response Plan.

3.3 Emergency Response to Fire on the CQTB

1. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
2. If safe to do so, deckhand will attempt to supress fire using equipment on board following Marine Emergency Duty (MED) protocol.

3. Captain and deckhand will deploy Canadian Coast Guard approved life rafts if vessel in immediate danger. If possible and practical the Captain will position barge so that wind is blowing port to star board, to keep smoke/flames away from life raft.
4. If able to do so Barge will cross to West Bank of crossing and continue to use barge supplied fire suppression equipment. All passengers will disembark under direction of deckhand.
5. IC will respond to scene in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs based on initial assessment and evaluation by IC will be communicated to the Emergency Communications Center (ECC) as per Emergency Response Plan.
6. Incident Accountability will be established and adhered to throughout the operation.
7. Once IC on scene and vessel safely secured, fire suppression will be conducted under the direction of the IC following NFPA 1081 standards. Industrial Fire Brigade.
8. Consideration of environmental sensitivity need to be considered by IC in cooperation with the Environmental Lead (unified incident command support).
9. Defensive spill containment methods to be utilized to control run off and releases from firefighting operations. This may include tactics such as extinguishing agent selection, damming and berming on barge, boom placement around vessel, removal of burning equipment once fire controlled, etc.

3.4 Emergency Response to Man Overboard

1. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
2. Captain and deckhand will throw out provided Canadian Coast Guard approved life-rings to all personnel overboard. The response from the barge crew will conducted as per their MED training.
3. If able to successfully rescue person overboard, deckhand will treat person based on marine first aid protocols awaiting response by ERT and site Medic.
4. If unable to successfully achieve rescue, vessel will continue to West landing and man boat deployed for downstream rescue. Communication to IC on Radio Channel 1 must be available at all times. Man boat operation will be conducted under the direction of IC once in place.
5. Captain will communicate to IC of possible downstream rescue requirement.
6. IC will instruct ERT to stage at KM 12 with option to deploy rescue ropes via launcher considered for KM 12.
7. Incident Accountability will be established and adhered to throughout the operation.
8. IC to stage ambulance for patient pick up.
9. IC will communicate the need for mutual aid to ECC who will follow the Minto ERP by contacting local agencies for assistance on East side of river.
10. Once rescued, all patients will be treated as per OFA3/EMR protocols transported as per Yukon EMS dispatch confirmation aligned with Minto Emergency Response Plan.

3.5 Emergency Response to Freight or Vehicle Overboard of the CQTB

1. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response. Captain will also communicate freight details and passenger numbers on board.
2. Passengers and crew will follow instructions from Captain (Captain will respond as per MED training) remaining on board if deemed safe.
3. Captain and deckhand will deploy Canadian Coast Guard approved life rafts if deemed unsafe to stay on board by Captain. If at landing passengers will be offloaded to safe location on shore.
4. IC will respond to scene or as close to it, in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs and downstream communication and reporting requirements based on initial assessment and evaluation by IC will be communicated to the Emergency Communications Center (ECC) as per Emergency Response Plan.
5. Incident Accountability will be established and adhered to throughout the operation.
6. Captain will navigate to the best of his ability to the landing, preferably west landing.
7. Once vessel is secured to shore, man boat will be deployed by deckhand or ERT members to assist with additional securing of vessel and freight, and deployment of containment booms located at landing and on vessel. Man boat operation under the direction of IC once in place.
8. Plan for retrieval of freight will be determined appropriate to the condition and location of freight. Plan developed cooperatively through Barge Captain, Minto ECC and Mutual Aid resources.
9. Equipment and additional resources will be sourced through ECC as per Minto Emergency Response Plan including manpower, expertise, heavy equipment, etc.
10. Special considerations for support in the event of incident occurring on East side of river to include Yukon Emergency Measures Organization, local first responders and alternate equipment operations contractor.

3.6 Emergency Response to Medical Emergency on board CQTB

1. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
2. For serious injury as defined in the ERP, Yukon EMS will be notified immediately.
3. Deckhand will treat patient per Marine Emergency First Aid protocols.
4. Captain will navigate barge to west bank of Yukon River and all vehicles will offload on west bank, giving clear passage for Ambulance.
5. ERT response will include medic, ambulance, fire truck and compliment of team members to assist with patient transfer and packaging.
6. Incident Accountability will be established and adhered to throughout the operation.
7. Yukon EMS dispatch will be updated of situation once history and assessment confirmed.

8. Upon arrival, Minto Medic will take control of scene and advise ERT Captain of resources needed on scene.
9. Upon history and assessment, patient will be treated, packaged and transferred as per OFA3/EMR protocols transported as per Yukon EMS dispatch confirmation aligned with Minto Emergency Response Plan.

3.7 Emergency Response to a Spill

1. Activation of Emergency Protocol onboard CQTB calling code 1 to initiate ERT response.
2. Deckhand will attempt to contain spill using on board spill kit, to prevent spill into Yukon River.
3. IC will respond to scene in one emergency vehicle ahead of remaining ERT. IC will upon arrival to scene provide initial scene assessment and gather any additional information available. Minimum ERT response will include full ERT member compliment, Environmental Lead, Hazardous materials response trailer, fire truck, ambulance and all associated equipment. ERT operations to be under the control of the ERT Captain. Additional response needs, downstream communication, communication with CANUTEC and reporting requirements based on initial assessment and evaluation by IC will be communicated to the ECC as per Emergency Response Plan and Spill Contingency Plan.
4. Incident Accountability will be established and adhered to throughout the operation.
5. If practical the barge captain will navigate the barge to west landing.
6. All passengers will disembark vessel.
7. All vehicles and machinery that is not in the spill zone will disembark.
8. Deckhand and ERT members under the direction of IC will use the man boat to deploy containment booms around the barge.
9. IC with advice from the Environment Lead will develop and implement the plan for stopping the spill if possible.
10. If the spill cannot be stopped a plan to mitigate the quantity of contaminant spilt to environment will be developed and implemented.
11. If safe and practical to do so Environment Lead will deploy environment staff to sample downstream of spill to measure contamination concentration.
12. IC with advice from the Environment Lead will oversee cleanup of the spill.
13. Special considerations for support in the event of incident occurring on East side of river to access the barge with ERT by man boat.

4.0 Minto Mine Training

The barge crew were trained and certified in Marine Emergency Duties (MED) A1 and A2 in 2012. The MED course meets the standards of training, certification and watchkeeping and is run by Transport Canada. The A1 MED course covers basic safety with a focus on hazards and emergencies awareness, firefighting, emergency response, lifesaving appliances and abandonment, survival and rescue. The A2 MED course covers small passenger-carrying vessel safety with the same focus as A1 with the addition of maintenance and inspection of emergency equipment and passenger control. As well the barge crew is trained in Marine First Aid.

The ERT team and environment staff has been trained in NFPA 472 Hazardous Materials Response Certification, awareness and operations for responders. In 2013 Minto is planning to host a table top and field exercise in regards to Yukon River response. The table top and field exercise will be held in conjunction with ERT, barge crew, environment department, management, and consultants.

Appendix A

Man Boat Specifications

- Brand/Model: Munson Packman Landing Craft
- Hull Length: 24 feet (7.3 meters)
- Beam: 8 feet 6 inches (2.6 meters)
- Hull Type: Packman mono hull
- Power: Twin Yamaha 150hp
- Propulsion: Outboard (25” shaft)
- Outfitting: 52” bow door

Appendix B

Minto Mine Emergency Response Plan

Minto Mine Safe Job Procedure for Loading and Unloading the Barge

Minto Mine Spill Contingency Plan

Appendix B: 2012 Minto Creek Hydrology

3 Calcite Business Centre, 151 Industrial Road
Whitehorse, Yukon Y1A 2V3
Phone (867) 668-6463 Fax (867) 667-6680
www.accessconsulting.ca

Memorandum

To: James Spencer, Minto Explorations Ltd. Minto Mine

From: Anthony Bier, Access Consulting Group

CC: Scott Keesey, Access Consulting Group

Date: February 28, 2013

Re: Minto Creek and McGinty Creek Surface Water Hydrology Update

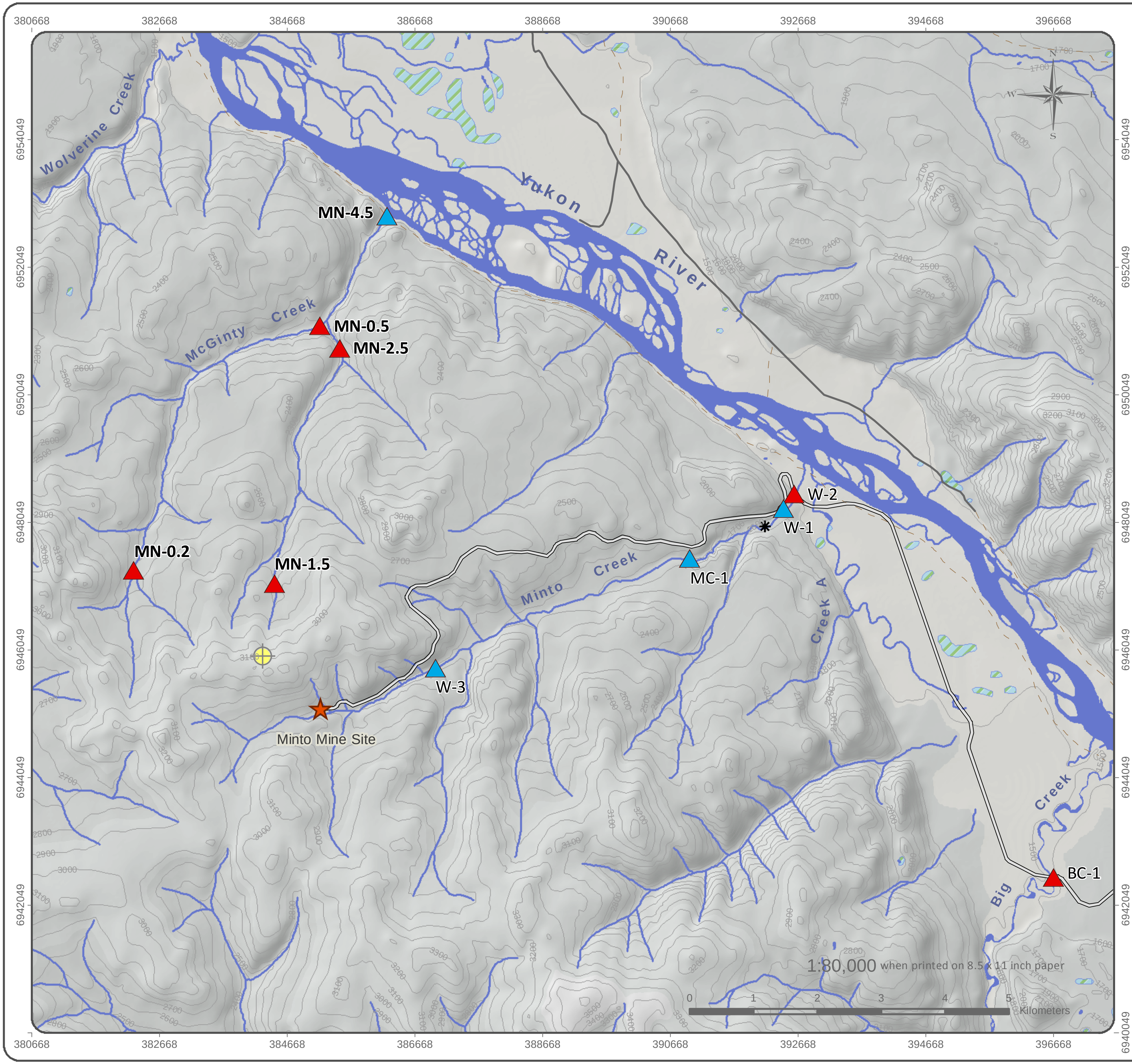
1 Introduction

Three hydrometric stations on Minto Creek underwent regular hydrometric monitoring during the 2012 open water season at Minto Mine. These included W3 (flume below dam), MC-1, a station in the low angle mid catchment and W1, lower Minto Creek above the road crossing and approximately 1 km upstream of the confluence with the Yukon River (Figure 1). Minto Mine personnel conducted regular discharge measurements and deployed Solinst Level Loggers and Barometric Loggers in order to capture a continuous stage record for discharge calculations.

McGinty Creek located north of Minto Creek drains in the Yukon River downstream of Minto Creek. There are four locations where discharge has been measured approximately once a month during open water since 2009 (MN-0.5, MN-1.5, MN-2.5, MN-4.5). An additional station was added in 2011, MN-0.2 (Figure 1).

2 Methods

Rating measurements (paired staff gauge and discharge observations) and barometrically compensated Solinst water level data were imported into Aquatic Informatics (Aquarius) time series software. Aquarius allows ACG to adjust the Solinst record to match the staff gauge observations, develop rating curves with the field data and automatically process the stage into a continuous discharge record. This preserved the raw data in an easy to reference format and changes can be made to the data at any time which cascade through the various time series. This is essentially a database to which future data will be added.



MINTO MINE
2012 HYDROLOGY UPDATE

FIGURE 1
MINTO AND MCGINTY CREEK HYDROMETRIC MONITORING NETWORK

- Water Quality Station
- Hydrometric Station
- Obeserved Fish Barrier - Minto Creek
- Minto North Deposit
- Minto Access Road
- Limited-use road
- Trail
- Contours (ft)
- Watercourse
- Waterbody
- Wetland

NAD 83 UTM Zone 8N

Minto Explorations Ltd.
A SUBSIDIARY OF CAPSTONE MINING LTD.
ACCESS

I:\Minto\gis\mxd\Phase_5-6\YESAB\Surface-Hydrology\MintoMcGintyHydrometricMonitoring_20130227.mxd
(Last edited by: jlindeman;28/02/2013/14:14 PM)

3 MINTO CREEK

Hydrographs for 2012 and mean monthly flows are presented below. Tables showing the individual field measurements at each site from 2012 are presented in Appendix A.

3.1 W1 - MINTO CREEK ABOVE ROAD CROSSING

The 2012 continuous discharge record for Minto Creek at W1 extends from May till October. Figure 2 shows the calculated discharge time series. Data for May is partial due to stage levels beyond the extrapolation range of the stage-discharge curve. Mean monthly flows have been tabulated (Table 1) and while no mean monthly flow is given for May it is estimated to be more than double the June mean.

Table 1. Mean Monthly Discharge (m^3/s), Minto Creek at W1

	Month				
Year	**May**	**Jun**	**Jul**	**Aug**	**Sep**
2011	-	0.229	0.200	0.200	0.082
2012	0.174	0.071	0.048	0.048	0.077

Note: Grey numbers indicate estimate due to incomplete data.

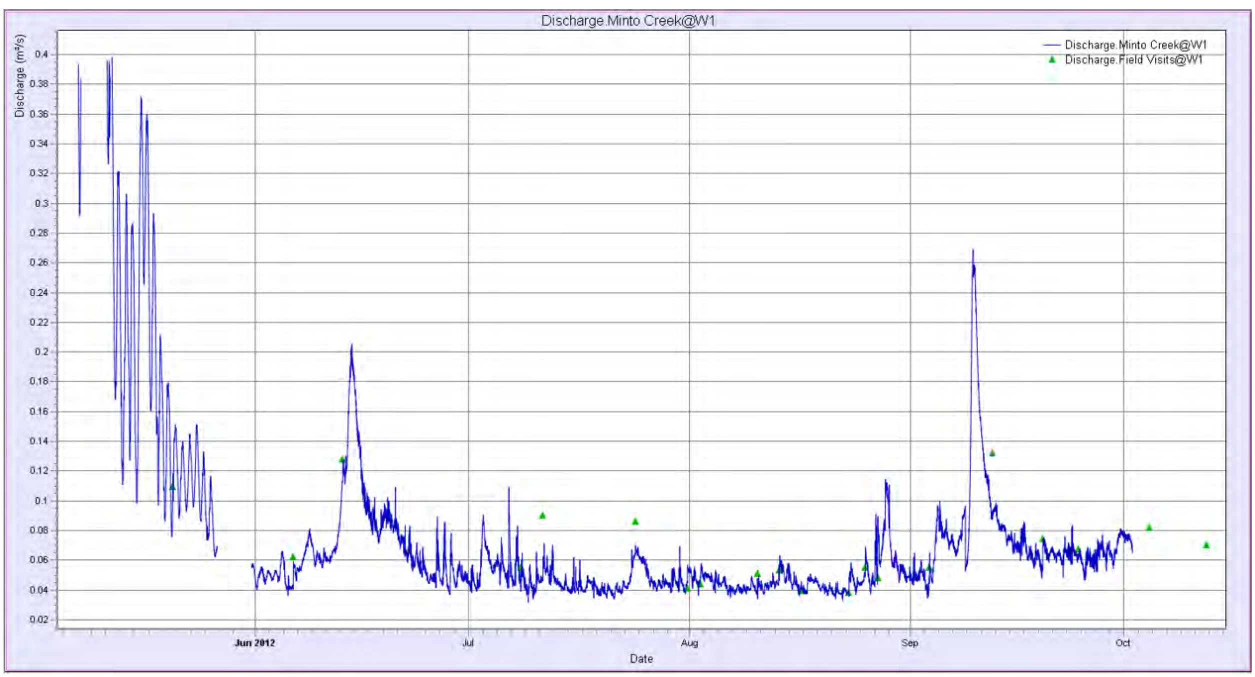


Figure 2. Minto Creek at W1 2012 open water season hydrograph

3.2 W3 - FLUME AT TOE OF DAM

Water level is continuously monitored in the flume at the toe of the Minto mine dam via a Solinst Level Logger in combination with a barometric logger. Frequent observations by Minto staff allow for correction of the level logger to the actual height of water in the flume and confirmation of the manufacturer specified stage discharge relationship. This provides a record which a high degree of accuracy. Figure 3 shows the discharge time series for the 2012 open water season and Table 2 summarizes these data as mean monthly flows.

Table 2. Mean monthly discharge (m^3/s), Minto Creek at W3

	Month				
Year	**May**	**Jun**	**Jul**	**Aug**	**Sep**
2011	-	0.005	0.005	0.006	0.005
2012	0.02	0.003	0.004	0.004	0.004

Note: Grey numbers indicate estimate due to incomplete data.

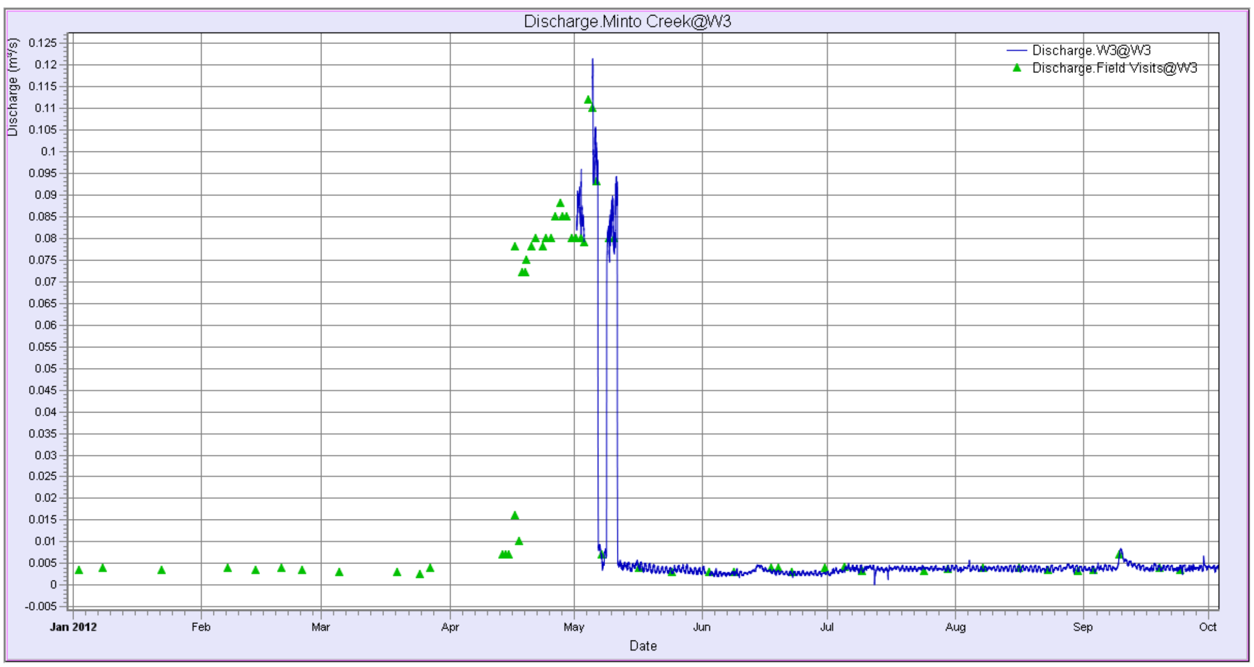


Figure 3. Minto Creek at W3 2012 open water season hydrograph

3.3 MC1 - MINTO CREEK MID CATCHMENT

Hydrometric station MC1 is located between the flume at W3 and W1. This site is characterized by shallower channel angles and slower moving water. Figure 4 shows the discharge time series for the 2012 open water season and Table 3 summarizes these data as mean monthly flows. Of note is that this area is far enough downstream that it still shows large responses to rainfall events, although run-off from the upper catchment is controlled.

Table 3. Mean monthly discharge (m^3/s), Minto Creek at MC1

	Month				
Year	**May**	**Jun**	**Jul**	**Aug**	**Sep**
2012	0.153	0.059	0.048	0.038	0.096

Figure 4. Minto Creek at MC1 2012 open water season hydrograph

4 MCGINTY CREEK

4.1 MN 4.5 - MCGINTY CREEK NEAR THE MOUTH

Solinst data from 2011 and 2012 for McGinty Creek at station MN-4.5 were processed into continuous discharge for the period of measurement. Previously, the stage-discharge relationship had too few data points to process the data. Additionally, there was a shift in the relationship from 2011 to 2012, which is common in small systems with very large freshet volumes due to changing channel shape each season. The data for 2012 shows a much better agreement than 2011 (Figure 4, Figure 5 and Figure 6).

Mean monthly discharge calculations for MN-4.5 from 2011 and 2012 open seasons is provided below. These means are based on the instantaneous measurements and are not in agreement with means calculated by the continuous data record, which is not unexpected. Further continuous data from other stations in coming years (see section 4.2) will help to qualify and quantify this discrepancy.

Table 4 summarized the monthly mean values from the continuous record.

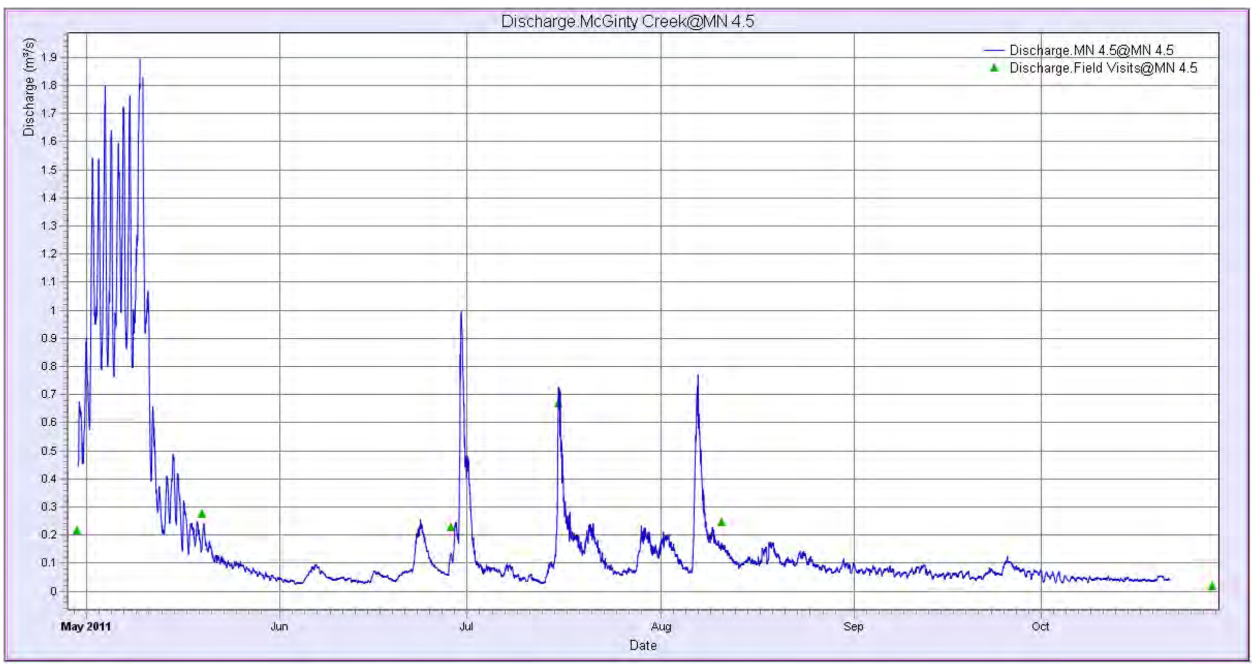


Figure 5. McGinty Creek at MN 4.5 2011 open water season hydrograph

Figure 6. McGinty Creek at MN 4.5 2012 open water season hydrograph

Mean monthly discharge calculations for MN-4.5 from 2011 and 2012 open seasons is provided below. These means are based on the instantaneous measurements and are not in agreement with means calculated by the continuous data record, which is not unexpected. Further continuous data from other stations in coming years (see section 4.2) will help to qualify and quantify this discrepancy.

Table 4. Mean monthly discharge (m^3/s), McGinty Creek at MN-4.5

		Month				
Year	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
2011	-	0.482	0.096	0.13	0.138	0.068
2012	0.224	0.245	0.189	0.082	0.052	0.173

Note: Grey numbers indicate estimate due to incomplete data.

4.2 STATIONS MN 2.5, MN 1.5, MN 0.5 AND MN 0.2

At the time of this report there are no continuous discharge records available for these sites. Solinst Level Loggers were installed September 7th, 2012 at MN 2.5 and MN 0.5 and the record extends to October 1st, 2012. No field data were available to correct this record and there are no paired rating measurements to develop a rating curve.

Table 5 shows the individual discharge measurements taken at all the McGinty Creek sites since 2009.

Table 5. Individual discharge measurements on McGinty Creek, 2009-2012

	Site				
Date	**MN-0.2**	**MN-0.5**	**MN-1.5**	**MN-2.5**	**MN-4.5**
03/05/2009		0.6304	0.0235	0.4875	
06/05/2009		0.660652	0.052018	0.536666	1.230389
13/05/2009		0.299	0.023	0.151	0.435
21/05/2009		0.14399586	0.00779908	0.070	0.211
28/05/2009		0.040	0.009	0.069	0.118
25/06/2009		0.023	0.004	0.019	0.036
28/07/2009		0.012	0.002	0.007	0.002
29/08/2009		0.080	0.005	0.023	0.077
29/09/2009				0.012	0.007
23/10/2009		0.015	0.008	0.007	0.008
27/11/2009		0.021		0.003	
21/04/2010			0.024		
22/04/2010					0.796
28/05/2010		0.020	0.0002	0.007	0.025
28/06/2010		0.023	0.004	0.008	0.009
21/07/2010			0.008	0.023	0.041
15/09/2010		0.054	0.005	0.023	0.127
21/10/2010		0.017		0.012	0.023
29/04/2011					0.214
19/05/2011	0.005	0.266	0.023	0.13	0.274
28/06/2011	0.07	0.125	0.01	0.077	0.207
15/07/2011	0.0479	0.2847	0.0486	0.2202	0.667
10/08/2011	0.0035	0.1429	0.0186	0.0766	0.2461
28/10/2011					0.016
19/04/2012					0.3307
24/05/2012	0.0005	0.0799	0.073		0.1372
14/06/2012	0.0402	0.2157	0.0407	0.0667	0.3556
12/07/2012	0.0008	0.0513	0.0044	0.0285	0.056

APPENDIX A

RATING MEASUREMENTS MINTO CREEK 2012

W1			
Date	Time	Stage (m)	Discharge (m^3/s)
20/05/2012	11:45	0.224	0.109
25/05/2012	11:30	0.239	
06/06/2012	9:11	0.184	0.062
13/06/2012	7:46	0.245	0.128
22/06/2012	14:27	0.195	0.066
08/07/2012	9:35	0.179	0.055
11/07/2012	10:49	0.203	0.09
24/07/2012	9:43	0.219	0.086
31/07/2012	17:26		0.041
02/08/2012	14:56	0.169	0.044
10/08/2012	13:20	0.17	0.051
13/08/2012	16:35	0.17	0.053
16/08/2012	16:48	0.175	0.039
23/08/2012	9:55	0.17	0.038
25/08/2012	17:05	0.171	0.055
27/08/2012	11:39	0.176	0.048
03/09/2012	16:33	0.18	0.055
12/09/2012	14:03	0.293	0.132
19/09/2012	14:29	0.238	0.074
24/09/2012	16:53	0.245	0.067
04/10/2012	14:05	0.269	0.082
12/10/2012	15:10	0.371	0.07
19/10/2012	17:18	0.321	0.046

MC1			
Date	Time	Stage (m)	Discharge (m^3/s)
02/05/2012	14:07	0.675	
03/05/2012	9:50	0.56	
06/05/2012	8:00	0.485	
10/05/2012	15:19	0.558	
19/05/2012	16:50	0.38	0.125
25/05/2012	14:55	0.368	
02/06/2012	14:48	0.378	
09/06/2012	16:53	0.323	0.069
15/06/2012	10:23	0.411	0.142
22/06/2012	16:17	0.32	0.047
08/07/2012	17:37	0.269	0.043
15/07/2012	14:28	0.266	0.04

W3			
Date	Time	Stage (m)	Discharge (m^3/s)
02/01/2012	14:01		0.0035
08/01/2012	9:15		0.0038
22/01/2012	13:15		0.0035
07/02/2012	13:30		0.0040
14/02/2012	8:00		0.0035
20/02/2012	12:08		0.0040
25/02/2012	12:30		0.0035
05/03/2012	12:10		0.0030
19/03/2012	10:30		0.0030
24/03/2012	18:00		0.0025
27/03/2012	9:30		0.0040
13/04/2012	18:25	0.172	0.0070
14/04/2012	10:35	0.163	0.0070
15/04/2012	9:15	0.160	0.0070
16/04/2012	17:15	0.222	0.0160
16/04/2012	17:59	0.421	0.0780
17/04/2012	17:53	0.186	0.0100
18/04/2012	10:15	0.387	0.0720
19/04/2012	9:21	0.393	0.0720
19/04/2012	13:45	0.405	0.0750
20/04/2012	15:56	0.408	0.0780
21/04/2012	16:19	0.411	0.0800
23/04/2012	14:32	0.409	0.0780
24/04/2012	8:06	0.412	0.0800
25/04/2012	11:10	0.411	0.0800
26/04/2012	9:50	0.419	0.0850
27/04/2012	15:25	0.422	0.0880
28/04/2012	8:45	0.418	0.0850
29/04/2012	8:45	0.417	0.0850
30/04/2012	10:36	0.412	0.0800
01/05/2012	14:10	0.413	0.0800
02/05/2012	15:07	0.411	0.0800
03/05/2012	10:15	0.410	0.0790
04/05/2012	14:30	0.472	0.1120
05/05/2012	9:15	0.469	0.1100
06/05/2012	14:00	0.439	0.0930
07/05/2012	15:15	0.152	0.0070
09/05/2012	13:57	0.405	0.0800

22/07/2022	8:18	0.246	
29/07/2012	11:15	0.255	
08/08/2012	16:50	0.249	0.032
17/08/2012	10:55	0.246	0.033
03/09/2012	17:27	0.296	0.049
13/09/2012	17:00	0.413	0.106
19/09/2012	15:12	0.352	0.065
24/09/2012	15:04	0.332	0.059

10/05/2012	16:50	0.407	0.0800
16/05/2012	15:30	0.132	0.0040
24/05/2012	16:45	0.116	0.0029
02/06/2012	15:10	0.116	0.0029
08/06/2012	15:40	0.116	0.0030
17/06/2012	12:03	0.126	0.0040
19/06/2012	10:10	0.126	0.0039
22/06/2012	17:12	0.119	0.0030
30/06/2012	11:20	0.125	0.0039
05/07/2012	8:15	0.130	0.0041
09/07/2012	11:43	0.122	0.0032
24/07/2012	10:54	0.125	0.0033
30/07/2012	8:10	0.122	0.0037
07/08/2012	15:00	0.122	0.0038
16/08/2012	9:35	0.122	0.0038
23/08/2012	8:35	0.116	0.0035
30/08/2012	17:18	0.125	0.0033
03/09/2012	8:05	0.125	0.0035
09/09/2012	16:20	0.158	0.0070
19/09/2012	7:40	0.125	0.0038
24/09/2012	9:05	0.125	0.0035

Appendix C: Spring and Fall Seepage Laboratory Results

Maxxam

Success Through Science®

Your P.O. #: 113976
Your Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your C.O.C. #: EB467712

Attention: James Spencer
MINTO EXPLORATIONS LTD.
Yukon/Whitehorse
2 - 25 Pilgrim Way
Whitehorse, YT
CANADA Y1A 6E6

Report Date: 2012/06/11

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B244998
Received: 2012/05/31, 09:20

Sample Matrix: Water
Samples Received: 12

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	8	2012/06/01	2012/06/01	BBY6SOP-00026	SM2320B
Alkalinity - Water	4	2012/06/01	2012/06/02	BBY6SOP-00026	SM2320B
Chloride by Automated Colourimetry	12	N/A	2012/06/01	BBY6SOP-00011	SM-4500-Cl-
Carbon (DOC)	1	N/A	2012/06/01	BBY6SOP-00003	SM-5310C
Carbon (DOC)	5	N/A	2012/06/06	BBY6SOP-00003	SM-5310C
Carbon (DOC)	5	N/A	2012/06/07	BBY6SOP-00003	SM-5310C
Carbon (DOC)	1	N/A	2012/06/11	BBY6SOP-00003	SM-5310C
Conductance - water	8	N/A	2012/06/01	BBY6SOP-00026	SM-2510B
Conductance - water	4	N/A	2012/06/02	BBY6SOP-00026	SM-2510B
Fluoride	12	N/A	2012/06/06	BBY6SOP-00038	SM - 4500 F C
Hardness Total (calculated as CaCO3)	2	N/A	2012/06/06	BBY WI-00033	Calculated Parameter
Hardness Total (calculated as CaCO3)	2	N/A	2012/06/07	BBY WI-00033	Calculated Parameter
Hardness (calculated as CaCO3)	1	N/A	2012/06/04	BBY WI-00033	Calculated Parameter
Hardness (calculated as CaCO3)	11	N/A	2012/06/05	BBY WI-00033	Calculated Parameter
Mercury (Dissolved) by CVAF	12	N/A	2012/06/04	65-A-002-10	EPA 1631B
Mercury (Total) by CVAF	4	2012/06/05	2012/06/05	65-A-002-10	EPA 1631B
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	1	N/A	2012/06/04	BBY7SOP-00002	EPA 6020A
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	10	N/A	2012/06/05	BBY7SOP-00002	EPA 6020A
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	1	N/A	2012/06/08	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (dissolved)	11	N/A	2012/06/04	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (dissolved)	1	N/A	2012/06/08	BBY7SOP-00002	EPA 6020A
Na, K, Ca, Mg, S by CRC ICPMS (total)	2	2012/05/31	2012/06/06	BBY7SOP-00002	EPA 6020A
Na, K, Ca, Mg, S by CRC ICPMS (total)	2	2012/05/31	2012/06/07	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (total)	2	2012/06/05	2012/06/06	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (total)	2	2012/06/05	2012/06/07	BBY7SOP-00002	EPA 6020A
Ammonia-N	12	N/A	2012/06/01	BBY6SOP-00009	SM-4500NH3G
Nitrate + Nitrite (N)	7	N/A	2012/06/01	BBY6SOP-00010	USEPA 353.2
Nitrate + Nitrite (N)	5	N/A	2012/06/02	BBY6SOP-00010	USEPA 353.2
Nitrite (N) by CFA	12	N/A	2012/06/01	BBY6SOP-00010	EPA 353.2
Nitrogen - Nitrate (as N)	12	N/A	2012/06/05	BBY6SOP-00010	Based on EPA 353.2
Filter and HNO3 Preserve for Metals	12	N/A	2012/05/31	BBY6WI-00001	EPA 200.2
pH Water	8	N/A	2012/06/01	BBY6SOP-00026	SM-4500H+B
pH Water	4	N/A	2012/06/02	BBY6SOP-00026	SM-4500H+B
Sulphate by Automated Colourimetry	12	N/A	2012/06/01	BBY6SOP-00017	SM4500-SO42
Total Dissolved Solids (Filt. Residue)	12	2012/06/01	2012/06/01	BBY6SOP-00033	SM 2540C
Carbon (Total Organic)	6	N/A	2012/06/06	BBY6SOP-00003	SM-5310C
Carbon (Total Organic)	6	N/A	2012/06/07	BBY6SOP-00003	SM-5310C
Total Phosphorus	12	N/A	2012/06/05	BBY6SOP-00013	SM 4500 PE
Total Suspended Solids-LowLevel	12	2012/06/01	2012/06/01	BBY6SOP-00034	SM-2540 D

../2

Maxxam Job #: B244998
Report Date: 2012/06/11

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: EN

* Results relate only to the items tested.

Encryption Key

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

Kelly Janda, B.Sc, Burnaby Project Manager
Email: KJanda@maxxam.ca
Phone# (604) 638-5019

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

Total cover pages: 2

Maxxam Job #: B244998
Report Date: 2012/06/11

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: EN

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		DN9702			DN9703			DN9704		DN9705		
Sampling Date		2012/05/27			2012/05/27			2012/05/27		2012/05/27		
	UNITS	**SS5**	**RDL**	**QC Batch**	**SS6**	**RDL**	**QC Batch**	**SS7**	**QC Batch**	**SS8**	**RDL**	**QC Batch**
ANIONS												
Nitrite (N)	mg/L	0.262 (1)	0.0050	5888734	0.304 (1)	0.0050	5888734	0.311 (1)	5888734	0.277 (1)	0.0050	5888734
Calculated Parameters												
Filter and HNO3 Preservation	N/A	FIELD	N/A	ONSITE	FIELD	N/A	ONSITE	FIELD	ONSITE	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	47.1	1.0	5882778	47.2	2.0	5882778	45.9	5882778	42.8	1.0	5882778
Misc. Inorganics												
Fluoride (F)	mg/L	0.430	0.010	5900259	0.450	0.010	5900259	0.460	5900259	0.470	0.010	5900259
Dissolved Organic Carbon (C)	mg/L	13.5	0.50	5902155	10.0	0.50	5900196	14.7	5902155	11.9	0.50	5911144
Alkalinity (Total as CaCO3)	mg/L	375	0.50	5887766	378	0.50	5887766	404	5887766	410	0.50	5887766
Total Organic Carbon (C)	mg/L	14.5	0.50	5902221	11.5	0.50	5900211	15.8	5902221	12.4	0.50	5900211
Alkalinity (PP as CaCO3)	mg/L	<0.50	0.50	5887766	<0.50	0.50	5887766	<0.50	5887766	<0.50	0.50	5887766
Bicarbonate (HCO3)	mg/L	458	0.50	5887766	461	0.50	5887766	492	5887766	501	0.50	5887766
Carbonate (CO3)	mg/L	<0.50	0.50	5887766	<0.50	0.50	5887766	<0.50	5887766	<0.50	0.50	5887766
Hydroxide (OH)	mg/L	<0.50	0.50	5887766	<0.50	0.50	5887766	<0.50	5887766	<0.50	0.50	5887766
Anions												
Dissolved Sulphate (SO4)	mg/L	132	0.50	5888423	131	0.50	5888423	127	5888423	134	0.50	5888423
Dissolved Chloride (Cl)	mg/L	5.1	0.50	5888361	5.2	0.50	5888361	5.1	5888361	4.5	0.50	5888361
Nutrients												
Ammonia (N)	mg/L	0.47	0.0050	5888453	0.38	0.0050	5888453	0.55	5888453	0.48	0.0050	5888453
Nitrate plus Nitrite (N)	mg/L	47.4 (1)	1.0	5889363	47.5 (1)	2.0	5889363	46.3 (1)	5889363	43.1 (1)	1.0	5889363
Total Phosphorus (P)	mg/L	0.0808	0.0050	5894165	0.0116	0.0050	5894165	0.0399	5894165	0.0892	0.0050	5894165
Physical Properties												
Conductivity	uS/cm	1250	1.0	5887868	1250	1.0	5887868	1260	5887868	1270	1.0	5887868
pH	pH Units	8.07		5887906	7.99		5887906	8.08	5887906	8.03		5887906
Physical Properties												
Total Suspended Solids	mg/L	16.2	1.0	5884883	80.8	1.0	5884883	57.4	5884883	90.6	1.0	5884883
Total Dissolved Solids	mg/L	796	10	5887303	802	10	5887303	804	5887303	858	10	5887303

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Sample arrived to laboratory past recommended hold time.

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Success Through Science®

Maxxam Job #: B244998
Report Date: 2012/06/11

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: EN

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		DN9706			DN9707			DN9708		DN9709		
Sampling Date		2012/05/27			2012/05/27			2012/05/27		2012/05/27		
	UNITS	**TDD**	**RDL**	**QC Batch**	**SS9**	**RDL**	**QC Batch**	**LDP**	**RDL**	**SS10**	**RDL**	**QC Batch**
ANIONS												
Nitrite (N)	mg/L	<0.0050(1)	0.0050	5888734	0.134(1)	0.0050	5888734	0.0164(1)	0.0050	0.260(1)	0.0050	5888734
Calculated Parameters												
Filter and HNO3 Preservation	N/A	FIELD	N/A	ONSITE	FIELD	N/A	ONSITE	FIELD	N/A	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.035	0.020	5882778	5.58	0.20	5882778	1.03	0.020	7.36	0.20	5882778
Misc. Inorganics												
Fluoride (F)	mg/L	0.150	0.010	5900259	0.790	0.010	5900259	0.440	0.010	0.450	0.010	5900259
Dissolved Organic Carbon (C)	mg/L	13.3(2)	5.0	5886120	22.3	0.50	5900196	8.55	0.50	7.67	0.50	5902155
Alkalinity (Total as CaCO3)	mg/L	139	0.50	5887766	123	0.50	5887766	191	0.50	322	0.50	5887766
Total Organic Carbon (C)	mg/L	8.1(2)	5.0	5900211	21.6	0.50	5902221	12.1	0.50	8.92	0.50	5902221
Alkalinity (PP as CaCO3)	mg/L	1.19	0.50	5887766	<0.50	0.50	5887766	<0.50	0.50	3.83	0.50	5887766
Bicarbonate (HCO3)	mg/L	167	0.50	5887766	151	0.50	5887766	233	0.50	383	0.50	5887766
Carbonate (CO3)	mg/L	1.43	0.50	5887766	<0.50	0.50	5887766	<0.50	0.50	4.60	0.50	5887766
Hydroxide (OH)	mg/L	<0.50	0.50	5887766	<0.50	0.50	5887766	<0.50	0.50	<0.50	0.50	5887766
Anions												
Dissolved Sulphate (SO4)	mg/L	<0.50	0.50	5888423	73.7	0.50	5888423	37.7	0.50	80.9	0.50	5888423
Dissolved Chloride (Cl)	mg/L	2.4	0.50	5888361	2.2	0.50	5888361	4.4	0.50	2.8	0.50	5888361
Nutrients												
Ammonia (N)	mg/L	0.052	0.0050	5888453	0.20	0.0050	5888453	0.097	0.0050	0.24	0.0050	5888453
Nitrate plus Nitrite (N)	mg/L	0.035(1)	0.020	5888729	5.71(1)	0.20	5889363	1.04(1)	0.020	7.62(1)	0.20	5888729
Total Phosphorus (P)	mg/L	0.111	0.0050	5894165	0.103	0.0050	5894165	0.0068	0.0050	0.187	0.0050	5894165
Physical Properties												
Conductivity	uS/cm	271	1.0	5887868	432	1.0	5887868	454	1.0	775	1.0	5887868
pH	pH Units	8.33		5887906	7.81		5887906	8.05		8.35		5887906
Physical Properties												
Total Suspended Solids	mg/L	1.7	1.0	5884883	20.1	1.0	5884883	<1.0	1.0	78.2	1.0	5884883
Total Dissolved Solids	mg/L	188	10	5887303	288	10	5887303	270	10	460	10	5887303

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Sample arrived to laboratory past recommended hold time.
(2) - RDL raised due to sample matrix interference.

Maxxam

Maxxam Job #: B244998
Report Date: 2012/06/11

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: EN

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		DN9710		DN9711			DN9712			DN9713		
Sampling Date		2012/05/26		2012/05/26			2012/05/27			2012/05/27		
	UNITS	**WTP**	**RDL**	**WTPI**	**RDL**	**QC Batch**	**WTP**	**RDL**	**QC Batch**	**WTPI**	**RDL**	**QC Batch**
ANIONS												
Nitrite (N)	mg/L	0.0055(1)	0.0050	0.0585(1)	0.0050	5888734	0.0080(1)	0.0050	5888734	0.0645(1)	0.0050	5888734
Calculated Parameters												
Filter and HNO3 Preservation	N/A	FIELD	N/A	FIELD	N/A	ONSITE	FIELD	N/A	ONSITE	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	1.56	0.020	14.6	0.20	5882778	2.40	0.040	5882778	15.0	0.20	5882778
Misc. Inorganics												
Fluoride (F)	mg/L	0.016	0.010	0.470	0.010	5900259	0.030	0.010	5900259	0.470	0.010	5900259
Dissolved Organic Carbon (C)	mg/L	<0.50	0.50	10.5	0.50	5900196	2.20	0.50	5902155	12.0	0.50	5900196
Alkalinity (Total as CaCO3)	mg/L	28.3	0.50	125	0.50	5887766	31.1	0.50	5887766	128	0.50	5887766
Total Organic Carbon (C)	mg/L	<0.50	0.50	13.7	0.50	5900211	1.19	0.50	5900211	14.5	0.50	5902221
Alkalinity (PP as CaCO3)	mg/L	<0.50	0.50	<0.50	0.50	5887766	<0.50	0.50	5887766	<0.50	0.50	5887766
Bicarbonate (HCO3)	mg/L	34.5	0.50	152	0.50	5887766	38.0	0.50	5887766	156	0.50	5887766
Carbonate (CO3)	mg/L	<0.50	0.50	<0.50	0.50	5887766	<0.50	0.50	5887766	<0.50	0.50	5887766
Hydroxide (OH)	mg/L	<0.50	0.50	<0.50	0.50	5887766	<0.50	0.50	5887766	<0.50	0.50	5887766
Anions												
Dissolved Sulphate (SO4)	mg/L	1.19	0.50	73.3	0.50	5888423	4.66	0.50	5888423	75.5	0.50	5888423
Dissolved Chloride (Cl)	mg/L	1.4	0.50	10	0.50	5888361	3.0	0.50	5888361	11	0.50	5888361
Nutrients												
Ammonia (N)	mg/L	0.062	0.0050	0.23	0.0050	5888453	0.079	0.0050	5888453	0.14	0.0050	5888453
Nitrate plus Nitrite (N)	mg/L	1.56(1)	0.020	14.7(1)	0.20	5888729	2.41(1)	0.040	5888729	15.1(1)	0.20	5888729
Total Phosphorus (P)	mg/L	<0.0050	0.0050	0.0652	0.0050	5894165	<0.0050	0.0050	5894165	0.0723	0.0050	5894165
Physical Properties												
Conductivity	uS/cm	74.4	1.0	534	1.0	5887868	102	1.0	5887868	548	1.0	5887868
pH	pH Units	7.58		8.10		5887906	7.67		5887906	8.20		5887906
Physical Properties												
Total Suspended Solids	mg/L	<1.0	1.0	5.1	1.0	5884883	1.0	1.0	5884883	4.6	1.0	5884883
Total Dissolved Solids	mg/L	40	10	348	10	5887303	54	10	5887303	358	10	5887303

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Sample arrived to laboratory past recommended hold time.

Maxxam

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Maxxam Job #: B244998
Report Date: 2012/06/11

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: EN

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		DN9702		DN9703		DN9704	DN9705	DN9706	DN9707	DN9708		
Sampling Date		2012/05/27		2012/05/27		2012/05/27	2012/05/27	2012/05/27	2012/05/27	2012/05/27		
	UNITS	**SS5**	**RDL**	**SS6**	**RDL**	**SS7**	**SS8**	**TDD**	**SS9**	**LDP**	**RDL**	**QC Batch**
Misc. Inorganics												
Dissolved Hardness (CaCO3)	mg/L	626	0.50	670	0.50	642	667	144	143	211	0.50	5882750
Elements												
Dissolved Mercury (Hg)	ug/L	<0.010	0.010	<0.010	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	5891737

RDL = Reportable Detection Limit

Maxxam Job #: B244998
Report Date: 2012/06/11

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: EN

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		DN9702		DN9703		DN9704	DN9705	DN9706	DN9707	DN9708		
Sampling Date		2012/05/27		2012/05/27		2012/05/27	2012/05/27	2012/05/27	2012/05/27	2012/05/27		
	UNITS	**SS5**	**RDL**	**SS6**	**RDL**	**SS7**	**SS8**	**TDD**	**SS9**	**LDP**	**RDL**	**QC Batch**
Dissolved Metals by ICPMS												
Dissolved Aluminum (Al)	ug/L	3.0	3.0	549	6.0	17.8	11.9	34.0	21.1	7.2	3.0	5886220
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	<1.0	1.0	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	5886220
Dissolved Arsenic (As)	ug/L	0.53	0.10	0.84	0.20	0.52	0.50	0.52	0.85	0.41	0.10	5886220
Dissolved Barium (Ba)	ug/L	71.0	1.0	93.1	2.0	93.0	81.4	34.7	56.8	74.2	1.0	5886220
Dissolved Beryllium (Be)	ug/L	<0.10	0.10	<0.20	0.20	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	5886220
Dissolved Bismuth (Bi)	ug/L	<1.0	1.0	<2.0	2.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	5886220
Dissolved Boron (B)	ug/L	<50	50	<100	100	52	56	<50	<50	<50	50	5886220
Dissolved Cadmium (Cd)	ug/L	0.168	0.010	0.397	0.025	0.501	0.325	0.031	0.074	0.016	0.010	5886220
Dissolved Chromium (Cr)	ug/L	<1.0	1.0	<2.0	2.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	5886220
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	<1.0	1.0	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	5886220
Dissolved Copper (Cu)	ug/L	182	0.20	393	0.40	180	140	42.6	86.9	6.85	0.20	5886220
Dissolved Iron (Fe)	ug/L	17.4	5.0	656	10	95.9	36.4	67.8	109	17.8	5.0	5886220
Dissolved Lead (Pb)	ug/L	<0.20	0.20	1.93	0.40	0.37	<0.20	<0.20	<0.20	<0.20	0.20	5886220
Dissolved Lithium (Li)	ug/L	<5.0	5.0	<10	10	<5.0	5.1	<5.0	<5.0	<5.0	5.0	5886220
Dissolved Manganese (Mn)	ug/L	439	1.0	690	2.0	664	489	141	102	238	1.0	5886220
Dissolved Molybdenum (Mo)	ug/L	16.0	1.0	16.4	2.0	18.3	17.8	2.2	3.2	7.1	1.0	5886220
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	<2.0	2.0	<1.0	<1.0	1.1	<1.0	1.1	1.0	5886220
Dissolved Phosphorus (P)	ug/L	<10	10	880	20	12	<10	12	53	<10	10	5886220
Dissolved Selenium (Se)	ug/L	22.3	0.10	23.0	0.20	21.4	26.3	0.15	7.83	0.67	0.10	5886220
Dissolved Silicon (Si)	ug/L	7610	100	8680	200	7550	7760	6000	3980	5670	100	5886220
Dissolved Silver (Ag)	ug/L	0.076	0.020	0.064	0.040	0.060	0.054	<0.020	<0.020	<0.020	0.020	5886220
Dissolved Strontium (Sr)	ug/L	2760	1.0	3570	2.0	3350	2760	207	983	574	1.0	5886220
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	<0.10	0.10	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	5886220
Dissolved Tin (Sn)	ug/L	<5.0	5.0	<10	10	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	5886220
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	<10	10	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	5886220
Dissolved Uranium (U)	ug/L	9.44	0.10	5.74	0.20	5.52	5.61	0.67	0.40	2.57	0.10	5886220
Dissolved Vanadium (V)	ug/L	<5.0	5.0	<10	10	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	5886220
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	<10	10	5.7	<5.0	<5.0	<5.0	<5.0	5.0	5886220
Dissolved Zirconium (Zr)	ug/L	<0.50	0.50	<1.0	1.0	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	5886220
Dissolved Calcium (Ca)	mg/L	183	0.050	183	0.10	182	196	42.5	41.6	56.1	0.050	5882751
Dissolved Magnesium (Mg)	mg/L	41.2	0.050	45.5	0.10	45.3	43.5	9.12	9.61	17.1	0.050	5882751
Dissolved Potassium (K)	mg/L	6.31	0.050	5.93	0.10	6.50	7.21	2.03	5.35	3.51	0.050	5882751
Dissolved Sodium (Na)	mg/L	21.9	0.050	22.1	0.10	22.6	22.6	4.93	35.4	16.7	0.050	5882751
Dissolved Sulphur (S)	mg/L	47.2	3.0	2070	6.0	43.7	48.5	<3.0	25.8	13.8	3.0	5882751

RDL = Reportable Detection Limit

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		DN9709		DN9710		DN9711	DN9712	DN9713		
Sampling Date		2012/05/27		2012/05/26		2012/05/26	2012/05/27	2012/05/27		
	UNITS	**SS10**	**QC Batch**	**WTP**	**QC Batch**	**WTPI**	**WTP**	**WTPI**	**RDL**	**QC Batch**
Misc. Inorganics										
Dissolved Hardness (CaCO3)	mg/L	362	5882750	5.19	5882750	218	16.4	222	0.50	5882750
Elements										
Dissolved Mercury (Hg)	ug/L	<0.010	5891737	<0.010	5891737	<0.010	<0.010	<0.010	0.010	5891737

RDL = Reportable Detection Limit

Maxxam

Maxxam Job #: B244998
Report Date: 2012/06/11

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: EN

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		DN9709		DN9710		DN9711	DN9712	DN9713		
Sampling Date		2012/05/27		2012/05/26		2012/05/26	2012/05/27	2012/05/27		
	UNITS	**SS10**	**QC Batch**	**WTP**	**QC Batch**	**WTPI**	**WTP**	**WTPI**	**RDL**	**QC Batch**
Dissolved Metals by ICPMS										
Dissolved Aluminum (Al)	ug/L	9.9	5903881	16.0	5886220	47.9	24.2	52.2	3.0	5888014
Dissolved Antimony (Sb)	ug/L	<0.50	5903881	<0.50	5886220	0.70	<0.50	0.72	0.50	5888014
Dissolved Arsenic (As)	ug/L	0.56	5903881	<0.10	5886220	0.73	<0.10	0.66	0.10	5888014
Dissolved Barium (Ba)	ug/L	49.4	5903881	4.0	5886220	115	9.2	114	1.0	5888014
Dissolved Beryllium (Be)	ug/L	<0.10	5903881	<0.10	5886220	<0.10	<0.10	<0.10	0.10	5888014
Dissolved Bismuth (Bi)	ug/L	<1.0	5903881	<1.0	5886220	<1.0	<1.0	<1.0	1.0	5888014
Dissolved Boron (B)	ug/L	<50	5903881	<50	5886220	<50	<50	<50	50	5888014
Dissolved Cadmium (Cd)	ug/L	0.055	5903881	<0.010	5886220	0.049	<0.010	0.039	0.010	5888014
Dissolved Chromium (Cr)	ug/L	<1.0	5903881	<1.0	5886220	<1.0	<1.0	<1.0	1.0	5888014
Dissolved Cobalt (Co)	ug/L	<0.50	5903881	<0.50	5886220	<0.50	<0.50	<0.50	0.50	5888014
Dissolved Copper (Cu)	ug/L	99.5	5903881	0.68	5886220	61.7	1.03	61.9	0.20	5888014
Dissolved Iron (Fe)	ug/L	18.3	5903881	<5.0	5886220	33.2	5.5	31.2	5.0	5888014
Dissolved Lead (Pb)	ug/L	<0.20	5903881	<0.20	5886220	<0.20	<0.20	<0.20	0.20	5888014
Dissolved Lithium (Li)	ug/L	9.4	5903881	<5.0	5886220	<5.0	<5.0	<5.0	5.0	5888014
Dissolved Manganese (Mn)	ug/L	103	5903881	2.9	5886220	96.8	9.4	118	1.0	5888014
Dissolved Molybdenum (Mo)	ug/L	5.5	5903881	<1.0	5886220	16.0	1.2	16.8	1.0	5888014
Dissolved Nickel (Ni)	ug/L	<1.0	5903881	<1.0	5886220	<1.0	<1.0	<1.0	1.0	5888014
Dissolved Phosphorus (P)	ug/L	10	5903881	<10	5886220	60	<10	69	10	5888014
Dissolved Selenium (Se)	ug/L	9.07	5903881	0.13	5886220	5.40	0.33	5.44	0.10	5888014
Dissolved Silicon (Si)	ug/L	6440	5903881	147	5886220	4580	374	4670	100	5888014
Dissolved Silver (Ag)	ug/L	<0.020	5903881	<0.020	5886220	<0.020	<0.020	<0.020	0.020	5888014
Dissolved Strontium (Sr)	ug/L	1970	5903881	28.5	5886220	1280	94.7	1340	1.0	5888014
Dissolved Thallium (Tl)	ug/L	<0.050	5903881	<0.050	5886220	<0.050	<0.050	<0.050	0.050	5888014
Dissolved Tin (Sn)	ug/L	<5.0	5903881	<5.0	5886220	<5.0	<5.0	<5.0	5.0	5888014
Dissolved Titanium (Ti)	ug/L	<5.0	5903881	<5.0	5886220	<5.0	<5.0	<5.0	5.0	5888014
Dissolved Uranium (U)	ug/L	2.50	5903881	<0.10	5886220	2.18	<0.10	2.19	0.10	5888014
Dissolved Vanadium (V)	ug/L	<5.0	5903881	<5.0	5886220	<5.0	<5.0	<5.0	5.0	5888014
Dissolved Zinc (Zn)	ug/L	<5.0	5903881	<5.0	5886220	8.7	<5.0	5.6	5.0	5888014
Dissolved Zirconium (Zr)	ug/L	<0.50	5903881	<0.50	5886220	<0.50	<0.50	<0.50	0.50	5888014
Dissolved Calcium (Ca)	mg/L	70.1	5898527	1.42	5882751	59.5	4.39	61.1	0.050	5882751
Dissolved Magnesium (Mg)	mg/L	45.4	5898527	0.401	5882751	16.9	1.31	16.8	0.050	5882751
Dissolved Potassium (K)	mg/L	6.19	5898527	0.898	5882751	4.59	1.17	4.57	0.050	5882751
Dissolved Sodium (Na)	mg/L	32.1	5898527	13.6	5882751	17.2	13.0	17.3	0.050	5882751
Dissolved Sulphur (S)	mg/L	29.4	5898527	<3.0	5882751	28.3	<3.0	29.2	3.0	5882751

RDL = Reportable Detection Limit

Maxxam Job #: B244998
Report Date: 2012/06/11

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: EN

CCME TOTAL METALS IN WATER (WATER)

Maxxam ID		DN9710		DN9711		DN9712		DN9713		
Sampling Date		2012/05/26		2012/05/26		2012/05/27		2012/05/27		
	UNITS	**WTP**	**QC Batch**	**WTPI**	**QC Batch**	**WTP**	**QC Batch**	**WTPI**	**RDL**	**QC Batch**
Calculated Parameters										
Total Hardness (CaCO3)	mg/L	4.97	5882774	184	5882774	16.2	5882774	212	0.50	5882774
Elements										
Total Mercury (Hg)	ug/L	<0.010	5893588	<0.010	5893588	<0.010	5893588	<0.010	0.010	5893588

RDL = Reportable Detection Limit

CCME TOTAL METALS IN WATER (WATER)

Maxxam ID		DN9710		DN9711		DN9712		DN9713		
Sampling Date		2012/05/26		2012/05/26		2012/05/27		2012/05/27		
	UNITS	**WTP**	**QC Batch**	**WTPI**	**QC Batch**	**WTP**	**QC Batch**	**WTPI**	**RDL**	**QC Batch**
Total Metals by ICPMS										
Total Aluminum (Al)	ug/L	49.1	5895489	231	5897474	153	5895489	171	3.0	5897474
Total Antimony (Sb)	ug/L	<0.50	5895489	0.51	5897474	<0.50	5895489	0.58	0.50	5897474
Total Arsenic (As)	ug/L	<0.10	5895489	0.67	5897474	<0.10	5895489	0.64	0.10	5897474
Total Barium (Ba)	ug/L	3.9	5895489	94.9	5897474	9.2	5895489	106	1.0	5897474
Total Beryllium (Be)	ug/L	<0.10	5895489	<0.10	5897474	<0.10	5895489	<0.10	0.10	5897474
Total Bismuth (Bi)	ug/L	<1.0	5895489	<1.0	5897474	<1.0	5895489	<1.0	1.0	5897474
Total Boron (B)	ug/L	<50	5895489	<50	5897474	<50	5895489	<50	50	5897474
Total Cadmium (Cd)	ug/L	<0.010	5895489	0.050	5897474	0.014	5895489	0.043	0.010	5897474
Total Chromium (Cr)	ug/L	<1.0	5895489	<1.0	5897474	<1.0	5895489	<1.0	1.0	5897474
Total Cobalt (Co)	ug/L	<0.50	5895489	<0.50	5897474	<0.50	5895489	<0.50	0.50	5897474
Total Copper (Cu)	ug/L	1.14	5895489	79.7	5897474	3.61	5895489	83.4	0.20	5897474
Total Iron (Fe)	ug/L	6.3	5895489	259	5897474	30.4	5895489	188	5.0	5897474
Total Lead (Pb)	ug/L	<0.20	5895489	<0.20	5897474	<0.20	5895489	<0.20	0.20	5897474
Total Lithium (Li)	ug/L	<5.0	5895489	<5.0	5897474	<5.0	5895489	<5.0	5.0	5897474
Total Manganese (Mn)	ug/L	3.0	5895489	105	5897474	10.0	5895489	115	1.0	5897474
Total Molybdenum (Mo)	ug/L	<1.0	5895489	13.6	5897474	1.1	5895489	16.0	1.0	5897474
Total Nickel (Ni)	ug/L	<1.0	5895489	<1.0	5897474	<1.0	5895489	<1.0	1.0	5897474
Total Phosphorus (P)	ug/L	<10	5895489	58	5897474	<10	5895489	68	10	5897474
Total Selenium (Se)	ug/L	0.12	5895489	3.87	5897474	0.33	5895489	4.39	0.10	5897474
Total Silicon (Si)	ug/L	140	5895489	3960	5897474	349	5895489	4350	100	5897474
Total Silver (Ag)	ug/L	<0.020	5895489	<0.020	5897474	<0.020	5895489	0.037	0.020	5897474
Total Strontium (Sr)	ug/L	28.6	5895489	1070	5897474	92.1	5895489	1250	1.0	5897474
Total Thallium (Tl)	ug/L	<0.050	5895489	<0.050	5897474	<0.050	5895489	<0.050	0.050	5897474
Total Tin (Sn)	ug/L	<5.0	5895489	<5.0	5897474	<5.0	5895489	<5.0	5.0	5897474
Total Titanium (Ti)	ug/L	<5.0	5895489	9.9	5897474	<5.0	5895489	5.1	5.0	5897474
Total Uranium (U)	ug/L	<0.10	5895489	2.05	5897474	<0.10	5895489	2.30	0.10	5897474
Total Vanadium (V)	ug/L	<5.0	5895489	<5.0	5897474	<5.0	5895489	<5.0	5.0	5897474
Total Zinc (Zn)	ug/L	<5.0	5895489	13.8	5897474	<5.0	5895489	5.0	5.0	5897474
Total Zirconium (Zr)	ug/L	<0.50	5895489	<0.50	5897474	<0.50	5895489	<0.50	0.50	5897474
Total Calcium (Ca)	mg/L	1.33	5882847	48.9	5882847	4.25	5882847	56.5	0.050	5882847
Total Magnesium (Mg)	mg/L	0.398	5882847	15.0	5882847	1.34	5882847	17.3	0.050	5882847
Total Potassium (K)	mg/L	0.856	5882847	3.67	5882847	1.07	5882847	3.93	0.050	5882847
Total Sodium (Na)	mg/L	13.2	5882847	15.6	5882847	13.8	5882847	17.6	0.050	5882847
Total Sulphur (S)	mg/L	<3.0	5882847	20.4	5882847	<3.0	5882847	23.0	3.0	5882847

RDL = Reportable Detection Limit

General Comments

Sample DN9702-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DN9703-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DN9704-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DN9705-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DN9706-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DN9707-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DN9708-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DN9709-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DN9710-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DN9711-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DN9712-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DN9713-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

CCME DISSOLVED METALS IN WATER (WATER) Comments

Sample DN9703-03 Elements by CRC ICPMS (dissolved): RDL raised due to sample matrix interference.

Maxxam

Success Through Science®

Maxxam Job #: B244998
Report Date: 2012/06/11

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: EN

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5884883	Total Suspended Solids	2012/06/01			103	80 - 120	<1.0	mg/L		
5886120	Dissolved Organic Carbon (C)	2012/06/01	NC	80 - 120	102	80 - 120	<0.50	mg/L	NC	20
5886220	Dissolved Aluminum (Al)	2012/06/04	102	80 - 120	105	80 - 120	<3.0	ug/L	NC	20
5886220	Dissolved Antimony (Sb)	2012/06/04	104	80 - 120	100	80 - 120	<0.50	ug/L	NC	20
5886220	Dissolved Arsenic (As)	2012/06/04	104	80 - 120	102	80 - 120	<0.10	ug/L	NC	20
5886220	Dissolved Barium (Ba)	2012/06/04	96	80 - 120	99	80 - 120	<1.0	ug/L	NC	20
5886220	Dissolved Beryllium (Be)	2012/06/04	99	80 - 120	95	80 - 120	<0.10	ug/L	NC	20
5886220	Dissolved Bismuth (Bi)	2012/06/04	100	80 - 120	103	80 - 120	<1.0	ug/L	NC	20
5886220	Dissolved Cadmium (Cd)	2012/06/04	103	80 - 120	100	80 - 120	<0.010	ug/L	NC	20
5886220	Dissolved Chromium (Cr)	2012/06/04	97	80 - 120	98	80 - 120	<1.0	ug/L	NC	20
5886220	Dissolved Cobalt (Co)	2012/06/04	96	80 - 120	96	80 - 120	<0.50	ug/L	NC	20
5886220	Dissolved Copper (Cu)	2012/06/04	95	80 - 120	97	80 - 120	<0.20	ug/L	NC	20
5886220	Dissolved Iron (Fe)	2012/06/04	108	80 - 120	108	80 - 120	<5.0	ug/L	NC	20
5886220	Dissolved Lead (Pb)	2012/06/04	96	80 - 120	98	80 - 120	<0.20	ug/L	NC	20
5886220	Dissolved Lithium (Li)	2012/06/04	107	80 - 120	105	80 - 120	<5.0	ug/L	NC	20
5886220	Dissolved Manganese (Mn)	2012/06/04	99	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
5886220	Dissolved Molybdenum (Mo)	2012/06/04	100	80 - 120	99	80 - 120	<1.0	ug/L	NC	20
5886220	Dissolved Nickel (Ni)	2012/06/04	98	80 - 120	98	80 - 120	<1.0	ug/L	NC	20
5886220	Dissolved Selenium (Se)	2012/06/04	109	80 - 120	100	80 - 120	<0.10	ug/L	NC	20
5886220	Dissolved Silver (Ag)	2012/06/04	100	80 - 120	99	80 - 120	<0.020	ug/L	NC	20
5886220	Dissolved Strontium (Sr)	2012/06/04	NC	80 - 120	96	80 - 120	<1.0	ug/L	0.7	20
5886220	Dissolved Thallium (Tl)	2012/06/04	107	80 - 120	107	80 - 120	<0.050	ug/L	NC	20
5886220	Dissolved Tin (Sn)	2012/06/04	100	80 - 120	101	80 - 120	<5.0	ug/L	NC	20
5886220	Dissolved Titanium (Ti)	2012/06/04	99	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
5886220	Dissolved Uranium (U)	2012/06/04	97	80 - 120	96	80 - 120	<0.10	ug/L	NC	20
5886220	Dissolved Vanadium (V)	2012/06/04	98	80 - 120	96	80 - 120	<5.0	ug/L	NC	20
5886220	Dissolved Zinc (Zn)	2012/06/04	110	80 - 120	93	80 - 120	<5.0	ug/L	NC	20
5886220	Dissolved Boron (B)	2012/06/04					<50	ug/L	NC	20
5886220	Dissolved Phosphorus (P)	2012/06/04					<10	ug/L	NC	20
5886220	Dissolved Silicon (Si)	2012/06/04					<100	ug/L	NC	20
5886220	Dissolved Zirconium (Zr)	2012/06/04					<0.50	ug/L	NC	20
5887303	Total Dissolved Solids	2012/06/01	NC	80 - 120	94	80 - 120	<10	mg/L	4.9	20
5887766	Alkalinity (Total as CaCO3)	2012/06/02	NC	80 - 120	95	80 - 120	<0.50	mg/L	1.7	20
5887766	Alkalinity (PP as CaCO3)	2012/06/02					<0.50	mg/L	NC	20
5887766	Bicarbonate (HCO3)	2012/06/02					<0.50	mg/L	1.7	20
5887766	Carbonate (CO3)	2012/06/02					<0.50	mg/L	NC	20
5887766	Hydroxide (OH)	2012/06/02					<0.50	mg/L	NC	20
5887868	Conductivity	2012/06/02			100	80 - 120	<1.0	uS/cm	0.4	20
5888014	Dissolved Aluminum (Al)	2012/06/04	94	80 - 120	98	80 - 120	<3.0	ug/L	NC	20

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5888014	Dissolved Antimony (Sb)	2012/06/04	110	80 - 120	104	80 - 120	<0.50	ug/L	NC	20
5888014	Dissolved Arsenic (As)	2012/06/04	103	80 - 120	106	80 - 120	<0.10	ug/L	NC	20
5888014	Dissolved Barium (Ba)	2012/06/04	NC	80 - 120	103	80 - 120	<1.0	ug/L	1.4	20
5888014	Dissolved Beryllium (Be)	2012/06/04	103	80 - 120	99	80 - 120	<0.10	ug/L	NC	20
5888014	Dissolved Bismuth (Bi)	2012/06/04	73 (1, 2)	80 - 120	103	80 - 120	<1.0	ug/L	NC	20
5888014	Dissolved Cadmium (Cd)	2012/06/04	107	80 - 120	102	80 - 120	<0.010	ug/L	NC	20
5888014	Dissolved Chromium (Cr)	2012/06/04	91	80 - 120	97	80 - 120	<1.0	ug/L	NC	20
5888014	Dissolved Cobalt (Co)	2012/06/04	88	80 - 120	95	80 - 120	<0.50	ug/L	NC	20
5888014	Dissolved Copper (Cu)	2012/06/04	85	80 - 120	93	80 - 120	<0.20	ug/L	NC	20
5888014	Dissolved Iron (Fe)	2012/06/04	97	80 - 120	105	80 - 120	<5.0	ug/L	NC	20
5888014	Dissolved Lead (Pb)	2012/06/04	97	80 - 120	102	80 - 120	<0.20	ug/L	NC	20
5888014	Dissolved Lithium (Li)	2012/06/04	97	80 - 120	99	80 - 120	<5.0	ug/L	NC	20
5888014	Dissolved Manganese (Mn)	2012/06/04	NC	80 - 120	107	80 - 120	<1.0	ug/L	1.3	20
5888014	Dissolved Molybdenum (Mo)	2012/06/04	97	80 - 120	96	80 - 120	<1.0	ug/L	NC	20
5888014	Dissolved Nickel (Ni)	2012/06/04	87	80 - 120	96	80 - 120	<1.0	ug/L	NC	20
5888014	Dissolved Selenium (Se)	2012/06/04	107	80 - 120	102	80 - 120	<0.10	ug/L	NC	20
5888014	Dissolved Silver (Ag)	2012/06/04	99	80 - 120	107	80 - 120	<0.020	ug/L	NC	20
5888014	Dissolved Strontium (Sr)	2012/06/04	NC	80 - 120	102	80 - 120	<1.0	ug/L	0.9	20
5888014	Dissolved Thallium (Tl)	2012/06/04	107	80 - 120	109	80 - 120	<0.050	ug/L	NC	20
5888014	Dissolved Tin (Sn)	2012/06/04	95	80 - 120	105	80 - 120	<5.0	ug/L	NC	20
5888014	Dissolved Titanium (Ti)	2012/06/04	97	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
5888014	Dissolved Uranium (U)	2012/06/04	91	80 - 120	91	80 - 120	<0.10	ug/L	NC	20
5888014	Dissolved Vanadium (V)	2012/06/04	96	80 - 120	99	80 - 120	<5.0	ug/L	NC	20
5888014	Dissolved Zinc (Zn)	2012/06/04	99	80 - 120	100	80 - 120	<5.0	ug/L	NC	20
5888014	Dissolved Boron (B)	2012/06/04					<50	ug/L	NC	20
5888014	Dissolved Phosphorus (P)	2012/06/04					<10	ug/L		
5888014	Dissolved Silicon (Si)	2012/06/04					<100	ug/L	2.8	20
5888014	Dissolved Zirconium (Zr)	2012/06/04					<0.50	ug/L	NC	20
5888361	Dissolved Chloride (Cl)	2012/06/01	NC	80 - 120	103	80 - 120	<0.50	mg/L	1.2	20
5888423	Dissolved Sulphate (SO4)	2012/06/01	NC	80 - 120	101	80 - 120	<0.50	mg/L	0.2	20
5888453	Ammonia (N)	2012/06/01	NC	80 - 120	100	80 - 120	0.0070, RDL=0.0050	mg/L	1.5	20
5888729	Nitrate plus Nitrite (N)	2012/06/01	97	80 - 120	108	80 - 120	<0.020	mg/L	3.1 (3)	25
5888734	Nitrite (N)	2012/06/01	90	80 - 120	102	80 - 120	<0.0050	mg/L	0.5 (3)	20
5889363	Nitrate plus Nitrite (N)	2012/06/02	102	80 - 120	105	80 - 120	<0.020	mg/L	4.2 (4)	25
5891737	Dissolved Mercury (Hg)	2012/06/04	89	80 - 120	105	80 - 120	<0.010	ug/L	NC	20
5893588	Total Mercury (Hg)	2012/06/05	102	80 - 120	100	80 - 120	<0.010	ug/L	NC	20
5894165	Total Phosphorus (P)	2012/06/05	NC	80 - 120	105	80 - 120	<0.0050	mg/L	0.2	20
5895489	Total Aluminum (Al)	2012/06/06	NC	80 - 120	100	80 - 120	<3.0	ug/L	1.0	20
5895489	Total Antimony (Sb)	2012/06/06	105	80 - 120	102	80 - 120	<0.50	ug/L	NC	20

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Maxxam Job #: B244998
Report Date: 2012/06/11

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: EN

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5895489	Total Arsenic (As)	2012/06/06	101	80 - 120	100	80 - 120	<0.10	ug/L	11.2	20
5895489	Total Barium (Ba)	2012/06/06	NC	80 - 120	98	80 - 120	<1.0	ug/L	3.1	20
5895489	Total Beryllium (Be)	2012/06/06	96	80 - 120	95	80 - 120	<0.10	ug/L	NC	20
5895489	Total Bismuth (Bi)	2012/06/06	97	80 - 120	98	80 - 120	<1.0	ug/L	NC	20
5895489	Total Cadmium (Cd)	2012/06/06	100	80 - 120	98	80 - 120	<0.010	ug/L	0.06	20
5895489	Total Chromium (Cr)	2012/06/06	101	80 - 120	96	80 - 120	<1.0	ug/L	NC	20
5895489	Total Cobalt (Co)	2012/06/06	NC	80 - 120	97	80 - 120	<0.50	ug/L	0.5	20
5895489	Total Copper (Cu)	2012/06/06	NC	80 - 120	97	80 - 120	<0.20	ug/L	0.5	20
5895489	Total Iron (Fe)	2012/06/06	NC	80 - 120	105	80 - 120	<5.0	ug/L	1.9	20
5895489	Total Lead (Pb)	2012/06/06	102	80 - 120	99	80 - 120	<0.20	ug/L	NC	20
5895489	Total Lithium (Li)	2012/06/06	NC	80 - 120	97	80 - 120	<5.0	ug/L		
5895489	Total Manganese (Mn)	2012/06/06	NC	80 - 120	98	80 - 120	<1.0	ug/L	0.7	20
5895489	Total Molybdenum (Mo)	2012/06/06	83	80 - 120	98	80 - 120	<1.0	ug/L	NC	20
5895489	Total Nickel (Ni)	2012/06/06	NC	80 - 120	97	80 - 120	<1.0	ug/L	1.4	20
5895489	Total Selenium (Se)	2012/06/06	101	80 - 120	103	80 - 120	<0.10	ug/L	8.1	20
5895489	Total Silver (Ag)	2012/06/06	103	80 - 120	100	80 - 120	<0.020	ug/L	4.4	20
5895489	Total Strontium (Sr)	2012/06/06	NC	80 - 120	98	80 - 120	<1.0	ug/L	1.5	20
5895489	Total Thallium (Tl)	2012/06/06	106	80 - 120	100	80 - 120	<0.050	ug/L	NC	20
5895489	Total Tin (Sn)	2012/06/06	102	80 - 120	100	80 - 120	<5.0	ug/L	NC	20
5895489	Total Titanium (Ti)	2012/06/06	114	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
5895489	Total Uranium (U)	2012/06/06	103	80 - 120	100	80 - 120	<0.10	ug/L	NC	20
5895489	Total Vanadium (V)	2012/06/06	102	80 - 120	99	80 - 120	<5.0	ug/L	NC	20
5895489	Total Zinc (Zn)	2012/06/06	NC	80 - 120	100	80 - 120	<5.0	ug/L	0.7	20
5895489	Total Boron (B)	2012/06/06					<50	ug/L	NC	20
5895489	Total Phosphorus (P)	2012/06/06					<10	ug/L	NC	20
5895489	Total Silicon (Si)	2012/06/06					<100	ug/L	4.3	20
5895489	Total Zirconium (Zr)	2012/06/06					<0.50	ug/L	NC	20
5897474	Total Aluminum (Al)	2012/06/07	NC	80 - 120	103	80 - 120	<3.0	ug/L	2.4	20
5897474	Total Antimony (Sb)	2012/06/07	NC	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
5897474	Total Arsenic (As)	2012/06/07	93	80 - 120	95	80 - 120	<0.10	ug/L	4.1	20
5897474	Total Barium (Ba)	2012/06/07	NC	80 - 120	97	80 - 120	<1.0	ug/L	0.9	20
5897474	Total Beryllium (Be)	2012/06/07	94	80 - 120	93	80 - 120	<0.10	ug/L	NC	20
5897474	Total Bismuth (Bi)	2012/06/07	99	80 - 120	102	80 - 120	<1.0	ug/L	NC	20
5897474	Total Cadmium (Cd)	2012/06/07	91	80 - 120	92	80 - 120	<0.010	ug/L	NC	20
5897474	Total Chromium (Cr)	2012/06/07	97	80 - 120	96	80 - 120	<1.0	ug/L	NC	20
5897474	Total Cobalt (Co)	2012/06/07	97	80 - 120	98	80 - 120	<0.50	ug/L	NC	20
5897474	Total Copper (Cu)	2012/06/07	NC	80 - 120	96	80 - 120	<0.20	ug/L	0.8	20
5897474	Total Iron (Fe)	2012/06/07	NC	80 - 120	117	80 - 120	<5.0	ug/L	3.1	20
5897474	Total Lead (Pb)	2012/06/07	98	80 - 120	100	80 - 120	<0.20	ug/L	NC	20

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Success Through Science®

Maxxam Job #: B244998
Report Date: 2012/06/11

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: EN

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5897474	Total Lithium (Li)	2012/06/07	102	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
5897474	Total Manganese (Mn)	2012/06/07	NC	80 - 120	102	80 - 120	<1.0	ug/L	0.6	20
5897474	Total Molybdenum (Mo)	2012/06/07	NC	80 - 120	104	80 - 120	<1.0	ug/L	1.8	20
5897474	Total Nickel (Ni)	2012/06/07	97	80 - 120	99	80 - 120	<1.0	ug/L	NC	20
5897474	Total Selenium (Se)	2012/06/07	103	80 - 120	95	80 - 120	<0.10	ug/L	7.8	20
5897474	Total Silver (Ag)	2012/06/07	103	80 - 120	101	80 - 120	<0.020	ug/L	NC	20
5897474	Total Strontium (Sr)	2012/06/07	NC	80 - 120	99	80 - 120	<1.0	ug/L	0.2	20
5897474	Total Thallium (Tl)	2012/06/07	110	80 - 120	108	80 - 120	<0.050	ug/L	NC	20
5897474	Total Tin (Sn)	2012/06/07	103	80 - 120	102	80 - 120	<5.0	ug/L	NC	20
5897474	Total Titanium (Ti)	2012/06/07	NC	80 - 120	95	80 - 120	<5.0	ug/L	NC	20
5897474	Total Uranium (U)	2012/06/07	101	80 - 120	99	80 - 120	<0.10	ug/L	0.5	20
5897474	Total Vanadium (V)	2012/06/07	97	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
5897474	Total Zinc (Zn)	2012/06/07	NC	80 - 120	89	80 - 120	<5.0	ug/L	NC	20
5897474	Total Boron (B)	2012/06/07					<50	ug/L	NC	20
5897474	Total Phosphorus (P)	2012/06/07					<10	ug/L	4.0	20
5897474	Total Silicon (Si)	2012/06/07					<100	ug/L	1.7	20
5897474	Total Zirconium (Zr)	2012/06/07					<0.50	ug/L	NC	20
5900196	Dissolved Organic Carbon (C)	2012/06/06	NC	80 - 120	111	80 - 120	<0.50	mg/L	0.8	20
5900211	Total Organic Carbon (C)	2012/06/06	117	80 - 120	111	80 - 120	<0.50	mg/L	3.2	20
5900259	Fluoride (F)	2012/06/06	100	80 - 120	104	80 - 120	<0.010	mg/L	0	20
5902155	Dissolved Organic Carbon (C)	2012/06/07	NC	80 - 120	110	84 - 120	<0.50	mg/L	3.2	20
5902221	Total Organic Carbon (C)	2012/06/07	109	80 - 120	107	80 - 120	<0.50	mg/L	NC	20
5903881	Dissolved Aluminum (Al)	2012/06/08			105	80 - 120	<3.0	ug/L		
5903881	Dissolved Antimony (Sb)	2012/06/08			101	80 - 120	<0.50	ug/L		
5903881	Dissolved Arsenic (As)	2012/06/08			99	80 - 120	<0.10	ug/L		
5903881	Dissolved Barium (Ba)	2012/06/08			102	80 - 120	<1.0	ug/L		
5903881	Dissolved Beryllium (Be)	2012/06/08			95	80 - 120	<0.10	ug/L		
5903881	Dissolved Bismuth (Bi)	2012/06/08			106	80 - 120	<1.0	ug/L		
5903881	Dissolved Cadmium (Cd)	2012/06/08			100	80 - 120	<0.010	ug/L		
5903881	Dissolved Chromium (Cr)	2012/06/08			101	80 - 120	<1.0	ug/L		
5903881	Dissolved Cobalt (Co)	2012/06/08			100	80 - 120	<0.50	ug/L		
5903881	Dissolved Copper (Cu)	2012/06/08			100	80 - 120	<0.20	ug/L		
5903881	Dissolved Iron (Fe)	2012/06/08			110	80 - 120	<5.0	ug/L		
5903881	Dissolved Lead (Pb)	2012/06/08			100	80 - 120	<0.20	ug/L		
5903881	Dissolved Lithium (Li)	2012/06/08			106	80 - 120	<5.0	ug/L		
5903881	Dissolved Manganese (Mn)	2012/06/08			104	80 - 120	<1.0	ug/L		
5903881	Dissolved Molybdenum (Mo)	2012/06/08			101	80 - 120	<1.0	ug/L		
5903881	Dissolved Nickel (Ni)	2012/06/08			99	80 - 120	<1.0	ug/L		
5903881	Dissolved Selenium (Se)	2012/06/08			104	80 - 120	<0.10	ug/L		

Maxxam Job #: B244998
Report Date: 2012/06/11

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: EN

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5903881	Dissolved Silver (Ag)	2012/06/08			100	80 - 120	<0.020	ug/L		
5903881	Dissolved Strontium (Sr)	2012/06/08			98	80 - 120	<1.0	ug/L		
5903881	Dissolved Thallium (Tl)	2012/06/08			101	80 - 120	<0.050	ug/L		
5903881	Dissolved Tin (Sn)	2012/06/08			101	80 - 120	<5.0	ug/L		
5903881	Dissolved Titanium (Ti)	2012/06/08			101	80 - 120	<5.0	ug/L		
5903881	Dissolved Uranium (U)	2012/06/08			95	80 - 120	<0.10	ug/L		
5903881	Dissolved Vanadium (V)	2012/06/08			100	80 - 120	<5.0	ug/L		
5903881	Dissolved Zinc (Zn)	2012/06/08			101	80 - 120	<5.0	ug/L		
5903881	Dissolved Boron (B)	2012/06/08					<50	ug/L		
5903881	Dissolved Phosphorus (P)	2012/06/08					<10	ug/L		
5903881	Dissolved Silicon (Si)	2012/06/08					<100	ug/L		
5903881	Dissolved Zirconium (Zr)	2012/06/08					<0.50	ug/L		
5911144	Dissolved Organic Carbon (C)	1899/12/30	TBA	80 - 120	108	80 - 120	<0.50	mg/L	TBA	20

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

Maxxam

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

CHAIN OF CUSTODY RECORD

Click here to get the COC number

Maxxam Job #: B244998 **COC #:** EB467712 Page: 1 of 1

Invoice To: Require Report? Yes ☐ No ☐

Company Name: Minto Explorations Ltd
Contact Name: Elvina Wong
Address: Suite 900 - 999 West Hastings St
Vancouver, B.C. PC: V6C 2W2
Phone / Fax#: Ph: 604-684-8894 Fax: 604-688-2120
E-mail

Report To:

Company Name: Minto Explorations Ltd
Contact Name: Minto Environment
Address: Suite 900-999 West Hastings St
Vancouver, B.C. PC: V6C 2W2
Phone / Fax#: Ph: 604-684-8894 Fax: 604-688-2120
E-mail minto_environment@mintomine.com

PO #: 113796
Quotation #:
Project # :
Proj. Name: Minto Env. Monitoring
Location: Yukon
Sampled by: Elise Neumann

REGULATORY REQUIREMENTS:

- ☐ CSR
- ☑ CCME
- ☐ BC Water Quality
- ☐ Other
- ☐ DRINKING WATER

SERVICE REQUESTED:

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

SPECIAL INSTRUCTIONS:
Return Cooler ☐ **Ship Sample Bottles (please specify)** ☐

ANALYSIS REQUESTED

#	Sample Identification	Lab Identification (Lab Use Only)	Sample Type	Date/Time(24hr) Sampled	Dissolved Metals (DM) / Field Filtered? ☑Y ☐N	Field Acidified? ☑Y ☐N	Total Metals / Field Acidified? ☑Y ☐N	Nitrate ☑ Nitrite ☑ Ammonia ☑	Total Suspended Solids (TSS) ☑ TDS ☑	pH ☑ Conductivity ☑ Alkalinity ☑	Chloride ☑ Fluoride ☑ Sulphate ☑	Phosphate	DOC (Diss'd Organic Carbon)	TOC (Total Organic Carbon)	Ra 226	Number of Containers
1	SS5	DNA702	water	27-May-12	X	X		X	X	X	X	X	X	X		4
2	SS6	703	water	27-May-12	X	X		X	X	X	X	X	X	X		4
3	SS7	704	water	27-May-12	X	X		X	X	X	X	X	X	X		4
4	SS8	705	water	27-May-12	X	X		X	X	X	X	X	X	X		4
5	TDD	706	water	27-May-12	X	X		X	X	X	X	X	X	X		4
6	SS9	707	water	27-May-12	X	X		X	X	X	X	X	X	X		4
7	LDP	708	water	27-May-12	X	X		X	X	X	X	X	X	X		4
8	SS10	709	water	27-May-12	X	X		X	X	X	X	X	X	X		4
9	WTP	710	water	26-May-12	X	X	X	X	X	X	X	X	X	X		5
10	WTPI	711	water	26-May-12	X	X	X	X	X	X	X	X	X	X		5
11	WTP	712	water	27-May-12	X	X	X	X	X	X	X	X	X	X		5
12	WTPI	713	water	27-May-12	X	X	X	X	X	X	X	X	X	X		5

B244998

Print name and sign / Print name and sign / Laboratory Use Only

*Relinquished By:	Date (yy/mm/dd):	Time (24hr):	Received by :	Date (yy/mm/dd):	Time (24 hr):	Time Sensitive	Temperature on Receipt (°C)	Custody Seal	Yes	No
Elise Neumann	12-May-29	9:00	Andy Andy Leung	2012/05/31	09:20	☑	A) 3 B) 4 C) 5	Present?	☐	☐
							Just sampled & rec'd on ice: ☐	Intact?	☐	☐

*IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORDS. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS. 4, 5, 6

CS:NA

BBY FCD-00077R2_C Maxxam Analytics Success Through Science ©

Your P.O. #: 113976
Your Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your C.O.C. #: EB542412

Attention: MINTO DISTRIBUTION LIST
MINTO EXPLORATIONS LTD.
Yukon/Whitehorse
2 - 25 Pilgrim Way
Whitehorse, YT
CANADA Y1A 6E6

Report Date: 2012/10/03

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B285312
Received: 2012/09/22, 12:30

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	1	2012/09/24	2012/09/24	BBY6SOP-00026	SM2320B
Chloride by Automated Colourimetry	1	N/A	2012/09/25	BBY6SOP-00011	SM-4500-Cl-
Conductance - water	1	N/A	2012/09/24	BBY6SOP-00026	SM-2510B
Fluoride	1	N/A	2012/09/25	BBY6SOP-00038	SM - 4500 F C
Hardness Total (calculated as CaCO3)	1	N/A	2012/09/28	BBY WI-00033	Calculated Parameter
Hardness (calculated as CaCO3)	1	N/A	2012/09/28	BBY WI-00033	Calculated Parameter
Mercury (Dissolved) by CVAF	1	N/A	2012/09/28	65-A-002-10	EPA 1631B
Mercury (Total) by CVAF	1	2012/09/30	2012/09/30	65-A-002-10	EPA 1631B
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	1	N/A	2012/09/28	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (dissolved)	1	N/A	2012/09/27	BBY7SOP-00002	EPA 6020A
Na, K, Ca, Mg, S by CRC ICPMS (total)	1	2012/09/24	2012/09/28	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (total)	1	2012/09/25	2012/09/26	BBY7SOP-00002	EPA 6020A
Ammonia-N (Preserved)	1	N/A	2012/09/26	BBY6SOP-00009	SM-4500NH3G
Nitrate + Nitrite (N)	1	N/A	2012/09/24	BBY6SOP-00010	USEPA 353.2
Nitrite (N) by CFA	1	N/A	2012/09/24	BBY6SOP-00010	EPA 353.2
Nitrogen - Nitrate (as N)	1	N/A	2012/09/25	BBY6SOP-00010	Based on EPA 353.2
Filter and HNO3 Preserve for Metals	1	N/A	2012/09/22	BBY6WI-00001	EPA 200.2
pH Water	1	N/A	2012/09/24	BBY6SOP-00026	SM-4500H+B
Sulphate by Automated Colourimetry	1	N/A	2012/09/25	BBY6SOP-00017	SM4500-SO42
Total Dissolved Solids (Filt. Residue)	1	2012/09/27	2012/09/27	BBY6SOP-00033	SM 2540C
Total Suspended Solids-LowLevel	1	2012/09/26	2012/09/26	BBY6SOP-00034	SM-2540 D

* Results relate only to the items tested.

Encryption Key

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

Kelly Janda, B.Sc, Burnaby Project Manager
Email: KJanda@maxxam.ca
Phone# (604) 638-5019

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

Total cover pages: 1

Maxxam Job #: B285312
Report Date: 2012/10/03

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: CH

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		EN7301		
Sampling Date		2012/09/20 08:15		
	UNITS	**SS4**	**RDL**	**QC Batch**
ANIONS				
Nitrite (N)	mg/L	0.0407(1)	0.0050	6196636
Calculated Parameters				
Filter and HNO3 Preservation	N/A	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	34.8	0.40	6191687
Misc. Inorganics				
Fluoride (F)	mg/L	0.230	0.010	6199995
Alkalinity (Total as CaCO3)	mg/L	455	0.50	6196580
Alkalinity (PP as CaCO3)	mg/L	<0.50	0.50	6196580
Bicarbonate (HCO3)	mg/L	556	0.50	6196580
Carbonate (CO3)	mg/L	<0.50	0.50	6196580
Hydroxide (OH)	mg/L	<0.50	0.50	6196580
Anions				
Dissolved Sulphate (SO4)	mg/L	86.8	0.50	6200155
Dissolved Chloride (Cl)	mg/L	7.2	0.50	6200129
Nutrients				
Ammonia (N)	mg/L	0.052	0.0050	6203681
Nitrate plus Nitrite (N)	mg/L	34.9(1)	0.40	6196598
Physical Properties				
Conductivity	uS/cm	1200	1.0	6196583
pH	pH Units	8.11		6196584
Physical Properties				
Total Suspended Solids	mg/L	6.6	1.0	6201584
Total Dissolved Solids	mg/L	802	10	6206350

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Sample analysed past recommended hold time.

Maxxam Job #: B285312
Report Date: 2012/10/03

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: CH

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		EN7301		
Sampling Date		2012/09/20 08:15		
	UNITS	**SS4**	**RDL**	**QC Batch**
Misc. Inorganics				
Dissolved Hardness (CaCO3)	mg/L	645	0.50	6191542
Elements				
Dissolved Mercury (Hg)	ug/L	<0.010	0.010	6209351

RDL = Reportable Detection Limit

Maxxam Job #: B285312
Report Date: 2012/10/03

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: CH

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		EN7301		
Sampling Date		2012/09/20 08:15		
	UNITS	**SS4**	**RDL**	**QC Batch**
Dissolved Metals by ICPMS				
Dissolved Aluminum (Al)	ug/L	20.0(1)	3.0	6201622
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	6201622
Dissolved Arsenic (As)	ug/L	0.52	0.10	6201622
Dissolved Barium (Ba)	ug/L	140	1.0	6201622
Dissolved Beryllium (Be)	ug/L	<0.10	0.10	6201622
Dissolved Bismuth (Bi)	ug/L	<1.0	1.0	6201622
Dissolved Boron (B)	ug/L	<50	50	6201622
Dissolved Cadmium (Cd)	ug/L	0.114	0.010	6201622
Dissolved Chromium (Cr)	ug/L	<1.0	1.0	6201622
Dissolved Cobalt (Co)	ug/L	1.14	0.50	6201622
Dissolved Copper (Cu)	ug/L	121	0.20	6201622
Dissolved Iron (Fe)	ug/L	110	5.0	6201622
Dissolved Lead (Pb)	ug/L	<0.20	0.20	6219035
Dissolved Lithium (Li)	ug/L	<5.0	5.0	6201622
Dissolved Manganese (Mn)	ug/L	3360	1.0	6201622
Dissolved Molybdenum (Mo)	ug/L	4.8	1.0	6201622
Dissolved Nickel (Ni)	ug/L	1.5	1.0	6201622
Dissolved Phosphorus (P)	ug/L	56	10	6201622
Dissolved Selenium (Se)	ug/L	4.71	0.10	6201622
Dissolved Silicon (Si)	ug/L	10500	100	6201622
Dissolved Silver (Ag)	ug/L	0.030	0.020	6201622
Dissolved Strontium (Sr)	ug/L	1070	1.0	6201622
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	6201622
Dissolved Tin (Sn)	ug/L	<5.0	5.0	6201622
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	6201622
Dissolved Uranium (U)	ug/L	4.92	0.10	6201622
Dissolved Vanadium (V)	ug/L	<5.0	5.0	6201622
Dissolved Zinc (Zn)	ug/L	6.8	5.0	6201622
Dissolved Zirconium (Zr)	ug/L	<0.50	0.50	6201622
Dissolved Calcium (Ca)	mg/L	197	0.050	6191543
Dissolved Magnesium (Mg)	mg/L	37.4	0.050	6191543
Dissolved Potassium (K)	mg/L	6.25	0.050	6191543
Dissolved Sodium (Na)	mg/L	16.2	0.050	6191543
Dissolved Sulphur (S)	mg/L	26.9	3.0	6191543

RDL = Reportable Detection Limit
(1) - Dissolved greater than total. Reanalysis yields similar results.

Maxxam Job #: B285312
Report Date: 2012/10/03

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: CH

CCME TOTAL METALS IN WATER (WATER)

Maxxam ID		EN7301		
Sampling Date		2012/09/20 08:15		
	UNITS	**SS4**	**RDL**	**QC Batch**
Calculated Parameters				
Total Hardness (CaCO3)	mg/L	625	0.50	6193962
Elements				
Total Mercury (Hg)	ug/L	<0.010	0.010	6213782

RDL = Reportable Detection Limit

Maxxam Job #: B285312
Report Date: 2012/10/03

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: CH

CCME TOTAL METALS IN WATER (WATER)

Maxxam ID		EN7301		
Sampling Date		2012/09/20 08:15		
	UNITS	**SS4**	**RDL**	**QC Batch**
Total Metals by ICPMS				
Total Aluminum (Al)	ug/L	12.9	3.0	6199645
Total Antimony (Sb)	ug/L	<0.50	0.50	6199645
Total Arsenic (As)	ug/L	0.54	0.10	6199645
Total Barium (Ba)	ug/L	136	1.0	6199645
Total Beryllium (Be)	ug/L	<0.10	0.10	6199645
Total Bismuth (Bi)	ug/L	<1.0	1.0	6199645
Total Boron (B)	ug/L	<50	50	6199645
Total Cadmium (Cd)	ug/L	0.111	0.010	6199645
Total Chromium (Cr)	ug/L	<1.0	1.0	6199645
Total Cobalt (Co)	ug/L	1.11	0.50	6199645
Total Copper (Cu)	ug/L	125	0.20	6199645
Total Iron (Fe)	ug/L	129	5.0	6199645
Total Lead (Pb)	ug/L	<0.20	0.20	6199645
Total Lithium (Li)	ug/L	<5.0	5.0	6199645
Total Manganese (Mn)	ug/L	3280	1.0	6199645
Total Molybdenum (Mo)	ug/L	5.0	1.0	6199645
Total Nickel (Ni)	ug/L	2.0	1.0	6199645
Total Phosphorus (P)	ug/L	61	10	6199645
Total Selenium (Se)	ug/L	4.56	0.10	6199645
Total Silicon (Si)	ug/L	10500	100	6199645
Total Silver (Ag)	ug/L	0.034	0.020	6199645
Total Strontium (Sr)	ug/L	1050	1.0	6199645
Total Thallium (Tl)	ug/L	<0.050	0.050	6199645
Total Tin (Sn)	ug/L	<5.0	5.0	6199645
Total Titanium (Ti)	ug/L	<5.0	5.0	6199645
Total Uranium (U)	ug/L	4.90	0.10	6199645
Total Vanadium (V)	ug/L	<5.0	5.0	6199645
Total Zinc (Zn)	ug/L	<5.0	5.0	6199645
Total Zirconium (Zr)	ug/L	<0.50	0.50	6199645
Total Calcium (Ca)	mg/L	189	0.050	6194266
Total Magnesium (Mg)	mg/L	37.0	0.050	6194266
Total Potassium (K)	mg/L	6.08	0.050	6194266
Total Sodium (Na)	mg/L	15.9	0.050	6194266
Total Sulphur (S)	mg/L	24.7	3.0	6194266

RDL = Reportable Detection Limit

General Comments

Sample EN7301-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample EN7301, Elements by CRC ICPMS (dissolved): Test repeated.

Maxxam

Maxxam Job #: B285312
Report Date: 2012/10/03

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: CH

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6196580	Alkalinity (Total as CaCO3)	2012/09/24	NC	80 - 120	97	80 - 120	<0.50	mg/L	3.2	20
6196580	Alkalinity (PP as CaCO3)	2012/09/24					<0.50	mg/L	NC	20
6196580	Bicarbonate (HCO3)	2012/09/24					<0.50	mg/L	3.2	20
6196580	Carbonate (CO3)	2012/09/24					<0.50	mg/L	NC	20
6196580	Hydroxide (OH)	2012/09/24					<0.50	mg/L	NC	20
6196583	Conductivity	2012/09/24			99	80 - 120	<1.0	uS/cm	0.4	20
6196598	Nitrate plus Nitrite (N)	2012/09/24	NC	80 - 120	105	80 - 120	<0.020	mg/L	0.9	25
6196636	Nitrite (N)	2012/09/24	99	80 - 120	100	80 - 120	<0.0050	mg/L	2.2	20
6199645	Total Aluminum (Al)	2012/09/28	102	80 - 120	101	80 - 120	<3.0	ug/L	NC	20
6199645	Total Antimony (Sb)	2012/09/26	107	80 - 120	98	80 - 120	<0.50	ug/L		
6199645	Total Arsenic (As)	2012/09/28	NC	80 - 120	96	80 - 120	<0.10	ug/L	7.3	20
6199645	Total Barium (Ba)	2012/09/26	NC	80 - 120	96	80 - 120	<1.0	ug/L		
6199645	Total Beryllium (Be)	2012/09/26	102	80 - 120	95	80 - 120	<0.10	ug/L		
6199645	Total Bismuth (Bi)	2012/09/26	102	80 - 120	98	80 - 120	<1.0	ug/L		
6199645	Total Cadmium (Cd)	2012/09/28	102	80 - 120	94	80 - 120	<0.010	ug/L	12.1	20
6199645	Total Chromium (Cr)	2012/09/28	103	80 - 120	95	80 - 120	<1.0	ug/L	NC	20
6199645	Total Cobalt (Co)	2012/09/28	100	80 - 120	92	80 - 120	<0.50	ug/L	NC	20
6199645	Total Copper (Cu)	2012/09/28	84	80 - 120	93	80 - 120	<0.20	ug/L	NC	20
6199645	Total Iron (Fe)	2012/09/28	130(1)	80 - 120	106	80 - 120	<5.0	ug/L	NC	20
6199645	Total Lead (Pb)	2012/09/28	90	80 - 120	97	80 - 120	<0.20	ug/L	6.0	20
6199645	Total Lithium (Li)	2012/09/26	103	80 - 120	96	80 - 120	<5.0	ug/L		
6199645	Total Manganese (Mn)	2012/09/28	NC	80 - 120	101	80 - 120	<1.0	ug/L	7.3	20
6199645	Total Molybdenum (Mo)	2012/09/28	NC	80 - 120	95	80 - 120	<1.0	ug/L	NC	20
6199645	Total Nickel (Ni)	2012/09/28	95	80 - 120	103	80 - 120	<1.0	ug/L	NC	20
6199645	Total Selenium (Se)	2012/09/28	104	80 - 120	95	80 - 120	<0.10	ug/L	NC	20
6199645	Total Silver (Ag)	2012/09/28	92	80 - 120	86	80 - 120	<0.020	ug/L	NC	20
6199645	Total Strontium (Sr)	2012/09/26	NC	80 - 120	95	80 - 120	<1.0	ug/L		
6199645	Total Thallium (Tl)	2012/09/26	98	80 - 120	104	80 - 120	<0.050	ug/L		
6199645	Total Tin (Sn)	2012/09/26	105	80 - 120	97	80 - 120	<5.0	ug/L		
6199645	Total Titanium (Ti)	2012/09/26	126(1)	80 - 120	108	80 - 120	<5.0	ug/L		
6199645	Total Uranium (U)	2012/09/26	100	80 - 120	94	80 - 120	<0.10	ug/L		
6199645	Total Vanadium (V)	2012/09/26	102	80 - 120	95	80 - 120	<5.0	ug/L		
6199645	Total Zinc (Zn)	2012/09/28	NC	80 - 120	96	80 - 120	<5.0	ug/L	NC	20
6199645	Total Boron (B)	2012/09/28					<50	ug/L	NC	20
6199645	Total Phosphorus (P)	2012/09/26					<10	ug/L		
6199645	Total Silicon (Si)	2012/09/26					<100	ug/L		
6199645	Total Zirconium (Zr)	2012/09/26					<0.50	ug/L		
6199995	Fluoride (F)	2012/09/25	111	80 - 120	106	80 - 120	<0.010	mg/L	0	20
6200129	Dissolved Chloride (Cl)	2012/09/25	NC	80 - 120	102	80 - 120	<0.50	mg/L	NC	20

Maxxam Job #: B285312
Report Date: 2012/10/03

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: CH

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6200155	Dissolved Sulphate (SO4)	2012/09/25	NC	80 - 120	98	80 - 120	<0.50	mg/L	3.0	20
6201584	Total Suspended Solids	2012/09/26			103	80 - 120	<1.0	mg/L		
6201622	Dissolved Aluminum (Al)	2012/09/27	108	80 - 120	110	80 - 120	<3.0	ug/L	NC	20
6201622	Dissolved Antimony (Sb)	2012/09/27	108	80 - 120	101	80 - 120	<0.50	ug/L	NC	20
6201622	Dissolved Arsenic (As)	2012/09/27	NC	80 - 120	105	80 - 120	<0.10	ug/L	0.6	20
6201622	Dissolved Barium (Ba)	2012/09/27	NC	80 - 120	104	80 - 120	<1.0	ug/L	0.5	20
6201622	Dissolved Beryllium (Be)	2012/09/27	107	80 - 120	105	80 - 120	<0.10	ug/L	NC	20
6201622	Dissolved Bismuth (Bi)	2012/09/27	101	80 - 120	105	80 - 120	<1.0	ug/L	NC	20
6201622	Dissolved Cadmium (Cd)	2012/09/27	103	80 - 120	104	80 - 120	<0.010	ug/L	NC	20
6201622	Dissolved Chromium (Cr)	2012/09/27	103	80 - 120	103	80 - 120	<1.0	ug/L	NC	20
6201622	Dissolved Cobalt (Co)	2012/09/27	99	80 - 120	103	80 - 120	<0.50	ug/L	NC	20
6201622	Dissolved Copper (Cu)	2012/09/27	95	80 - 120	105	80 - 120	<0.20	ug/L	NC	20
6201622	Dissolved Iron (Fe)	2012/09/27	NC	80 - 120	110	80 - 120	<5.0	ug/L	0.3	20
6201622	Dissolved Lithium (Li)	2012/09/27	NC	80 - 120	102	80 - 120	<5.0	ug/L	2.3	20
6201622	Dissolved Manganese (Mn)	2012/09/27	NC	80 - 120	105	80 - 120	<1.0	ug/L	0.5	20
6201622	Dissolved Molybdenum (Mo)	2012/09/27	NC	80 - 120	100	80 - 120	<1.0	ug/L	1.7	20
6201622	Dissolved Nickel (Ni)	2012/09/27	98	80 - 120	104	80 - 120	<1.0	ug/L	NC	20
6201622	Dissolved Selenium (Se)	2012/09/27	110	80 - 120	106	80 - 120	<0.10	ug/L	NC	20
6201622	Dissolved Silver (Ag)	2012/09/27	103	80 - 120	101	80 - 120	<0.020	ug/L	NC	20
6201622	Dissolved Strontium (Sr)	2012/09/27	NC	80 - 120	101	80 - 120	<1.0	ug/L	1.5	20
6201622	Dissolved Thallium (Tl)	2012/09/27	106	80 - 120	103	80 - 120	<0.050	ug/L	NC	20
6201622	Dissolved Tin (Sn)	2012/09/27	112	80 - 120	106	80 - 120	<5.0	ug/L	NC	20
6201622	Dissolved Titanium (Ti)	2012/09/27	109	80 - 120	99	80 - 120	<5.0	ug/L	NC	20
6201622	Dissolved Uranium (U)	2012/09/27	105	80 - 120	99	80 - 120	<0.10	ug/L	1.6	20
6201622	Dissolved Vanadium (V)	2012/09/27	104	80 - 120	101	80 - 120	<5.0	ug/L	NC	20
6201622	Dissolved Zinc (Zn)	2012/09/27	100	80 - 120	112	80 - 120	<5.0	ug/L	NC	20
6201622	Dissolved Boron (B)	2012/09/27					<50	ug/L	NC	20
6201622	Dissolved Phosphorus (P)	2012/09/27					<10	ug/L		
6201622	Dissolved Silicon (Si)	2012/09/27					<100	ug/L	1.9	20
6201622	Dissolved Zirconium (Zr)	2012/09/27					<0.50	ug/L	NC	20
6203681	Ammonia (N)	2012/09/26	NC	80 - 120	100	80 - 120	<0.0050	mg/L	1.1	20
6206350	Total Dissolved Solids	2012/09/27	NC	80 - 120	98	80 - 120	<10	mg/L	3.5	20
6209351	Dissolved Mercury (Hg)	2012/09/28	80	80 - 120	87	80 - 120	<0.010	ug/L	NC	20

Maxxam Job #: B285312
Report Date: 2012/10/03

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: CH

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6213782	Total Mercury (Hg)	2012/09/30	95	80 - 120	99	80 - 120	<0.010	ug/L	NC	20
6219035	Dissolved Lead (Pb)	2012/10/02			101	80 - 120	<0.20	ug/L		

N/A = Not Applicable

RPD = Relative Percent Difference

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

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

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

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

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

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

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

Maxxam

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

CHAIN OF CUSTODY RECORD

Click here to get the COC number

Maxxam Job #: B285312 **COC #:** EB542412 Page: 1 of 1

Invoice To: Require Report? Yes ☐ No ☐

Company Name: Minto Explorations Ltd
Contact Name: Elvina Wong
Address: Suite 900 - 999 West Hastings St
Vancouver, B.C. PC: V6C 2W2
Phone / Fax#: Ph: 604-684-8894 Fax: 604-688-2120
E-mail:

Report To:

Company Name: Minto Explorations Ltd
Contact Name: Minto Environment
Address: Suite 900-999 West Hastings St
Vancouver, B.C. PC: V6C 2W2
Phone / Fax#: Ph: 604-684-8894 Fax: 604-688-2120
E-mail: minto_environment@mintomine.com

PO #:	113796
Quotation #:	
Project # :	
Proj. Name:	Minto Env. Monitoring
Location:	Yukon
Sampled by:	Chris Harry

REGULATORY REQUIREMENTS:

- ☐ CSR
- ☑ CCME
- ☐ BC Water Quality
- ☐ Other
- ☐ DRINKING WATER

SERVICE REQUESTED:

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

SPECIAL INSTRUCTIONS:

Return Cooler ☐ Ship Sample Bottles (please specify) ☐

ANALYSIS REQUESTED

Field Filtered? ☐Y ☑N; Field Acidified? ☐Y ☑N; Field Acidified? ☑Y ☑N

#	Sample Identification	Lab Identification (Lab Use Only)	Sample Type	Date/Time(24hr) Sampled	Dissolved Metals (DM)	Field Acidified?	Total Metals	☑ Nitrate ☑ Nitrite ☑ Ammonia	Total Suspended Solids (TSS) ☑ TDS ☑	☑ pH ☑ Conductivity ☑ Alkalinity	☑ Chloride ☑ Fluoride ☑ Sulphate	DOC (Diss'd Organic Carbon)	TOC (Total Organic Carbon)	Phosphate	Ra 226	Number of Containers
1	SS4	EN7301	water	9/20/12 8:15	x	x		x	x	x	x					4
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																

B285312

*Relinquished By: (Print name and sign)	Date (yy/mm/dd):	Time (24hr):	Received by: (Print name and sign)	Date (yy/mm/dd):	Time (24 hr):	Time Sensitive	Temperature on Receipt (°C) (Laboratory Use Only)	Custody Seal	Yes	No
Chris Harry	21-Sep-12	10:00	Andy Leung	2012/09/22	12:30	☑	A) 6 B) 6 C) 6	Present?	☐	☐
							Just sampled & rec'd on ice: ☐	Intact?	☐	☐

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

Appendix D: 2012 Annual Biological Report – Sediment, Periphyton, Chlorophyll a, and Benthic Invertebrates

Minto Creek Sediment, Periphyton and Benthic Invertebrate Community Assessment - 2012

Report Prepared for:

Minto Explorations Limited
Suite 900 - 999 West Hastings Street
Vancouver, BC
V6C 2W2

Report Prepared by:

Minnow Environmental Inc.
101 - 1025 Hillside Ave.
Victoria, BC
V8T 2A2

March 2013

Minto Creek Sediment, Periphyton and Benthic Invertebrate Community Assessment - 2012

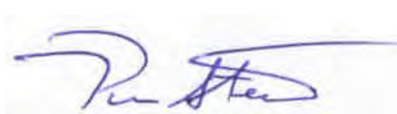
Report Prepared for:

Minto Explorations Limited

Report Prepared by:

Minnow Environmental Inc.

Lisa Bowron, M.Sc.
Project Manager



Pierre Stecko, M.Sc., EP, RPBio
Project Principal

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1.0 INTRODUCTION

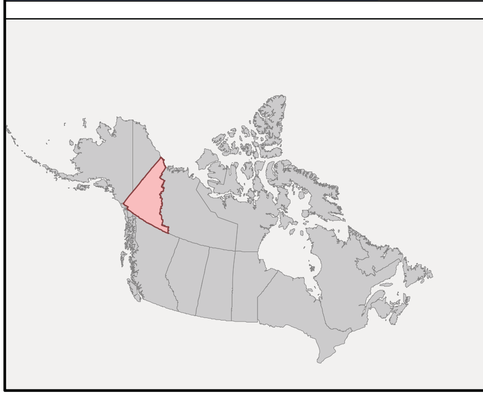
1.1 Site Description

The Minto Mine is a high-grade copper mine located within Selkirk First Nation (SFN) Category A Settlement Land Parcel R-6A approximately 240 km northwest of Whitehorse, Yukon Territory (62°37'N latitude and 137°15'W longitude; Figure 1.1). It is owned and operated by Minto Explorations Ltd. (MintoEx), a wholly owned subsidiary of Capstone Mining Corporation (Capstone). Development of the mine was initiated in 1997, commercial operations started in October 2007 and the anticipated operating life is to the year 2020. The facility is permitted to conduct open pit mining and milling at a rate of 3,600 tonnes of copper/gold/silver ore per day, which is currently expected to produce a total of approximately 6.1 million tonnes (Mt) of ore and 30.5 Mt of waste (e.g., waste rock and tailings) during the mine's operating life. Mine-impacted seepage from the Tailings Storage Facility and under the Mill Valley Fill Expansion (MVFE) is collected at the Minto Creek Detention Structure at the toe of the MVFE (Figure 1.2) and pumped to the water treatment plant or the open pit. Non-impacted water and treated mine-impacted water are collected in a Water Storage Pond (WSP; Figure 1.2). Effluent from the WSP is periodically discharged to Minto Creek under conditions specified in Water Use Licence (WUL) QZ96-006 (Amendment 7, April 2011 and Amendment 8, September 2012). Minto Creek, in turn, discharges to the Yukon River approximately 12 km south-east of the mine site (Figure 1.2).

1.2 Background

Under the WUL, the Minto Mine implements a routine water quality surveillance program in Minto Creek and reference tributaries at sampling frequencies that vary from weekly to monthly during the ice-free period (typically from April to October or November). In accordance with the WUL, the Minto Mine submits water quality data as original laboratory reports and monthly summary reports within 30-days of month-end. Water quality monitoring data have indicated that total suspended solids concentrations can increase dramatically during high flow events and that concentrations of a number of metals (including aluminum, chromium, copper and iron) are generally concurrently higher than national water quality guidelines for the protection of aquatic life even under background and reference conditions (e.g., HKP 1994; Minnow 2009a, 2010a, 2010b).

Recent interpretations of water quality data have documented an influence of the Minto Mine on Minto Creek even in the absence of mine effluent discharge (Minnow/Access



MINTO PROJECT

Minto Explorations Ltd.

A SUBSIDIARY OF CAPSTONE MINING LTD.

ACCESS CONSULTING GROUP

Figure 1.1

minnow environmental inc.

Location of the Minto Mine

Ref: 2461
Date: March 2013

Source: Access Consulting Group

MINTO MINE

Minto Explorations Ltd.
A SUBSIDIARY OF CAPSTONE MINING LTD.

- Minto Creek Detention Structure
- Watercourse
- Intermittent Flow
- Water Storage Pond

ACCESS

Aerial imagery obtained from Challenger Geomatics.
Imagery acquired September 9th 2011.
Hydrology data provided by Minto Explorations Ltd, May 2010.

Inset topography compiled by Natural Ressource Canada.

Projection : UTM Zone 8N
Datum: NAD 83

I:\Minto\gis\mxd\Studies\EEM\2011\Cycle 2 December\Property Overview 20111212.mxd
(Last edited by: mducharme; 12/12/2011/11:48 AM)

Figure 1.2

minnow environmental inc.

Minto Mine Site and Receiving Environment, Minto Mine WUL, 2013

Ref: 2461
Date: March 2013

Source: Access Consulting

2012). This influence was evident in conductivity and in concentrations of nitrate, sulphate, chloride, molybdenum and sodium that were greater in Minto Creek than at reference areas. During effluent discharge, concentrations of bromide and nitrite, and to a lesser extent, selenium and total Kjeldahl nitrogen (TKN), were also elevated in Minto Creek relative to reference concentrations. Although mean concentrations of a number of analytes were greater than water quality guidelines in Minto Creek over the 2009-2011 period, only nitrate and selenium were consistently greater than both guidelines and reference (Minnow/Access 2012).

The Minto Mine also implements annual biological monitoring under the WUL, which includes monitoring of sediment, periphyton, benthic invertebrates, fish and fish habitat. The biological monitoring program has been modified over time, but data from 1994 (baseline) and 2006-2011 have been reported previously. The sediment and benthic program conducted in September 2011 demonstrated that a few analytes measured in sediments of Minto Creek had concentrations that were greater than Interim Sediment Quality Guidelines (ISGQs) for the protection of aquatic life (Minnow 2012a). However, only copper in upper Minto Creek was elevated to concentrations greater than ISQGs, baseline and reference. In lower Minto Creek, no sediment analytes were elevated to concentrations greater than ISQGs, baseline and reference. Sediments of lower Minto Creek were also non-toxic to *Hyalella azteca* (an amphipod) and *Chironomus dilutus* (a midge larva). The periphyton community of lower Minto Creek differed from that of the reference creek (lower Wolverine Creek), but general taxonomic dominance was similar. Subtle differences in depositional benthic invertebrate community composition between Minto Creek and the reference area (lower Wolverine Creek) were apparent, but interpretation of erosional benthic community composition based on control-impact comparisons and the reference condition approach indicated no clear evidence of mine-related impact to the erosional benthic invertebrate community of lower Minto Creek.

1.3 Objectives

The objectives of this study and report are to characterize and interpret current sediment quality, the periphyton community and the benthic invertebrate community of Minto Creek relative to reference conditions and conditions documented in previous years. Additional data on the quality of biological tissues (periphyton, benthic invertebrates and slimy sculpin) are also reported. At the time of preparation of this report, periphyton community data were not available due to a backlog at the taxonomy laboratory. These data, and associated interpretation, will be provided under separate cover when they become available.

1.4 Report Overview

This report is presented in eight sections, the first of which is this introduction. Section 2.0 presents the methods used in sample collection, sample analysis and data analysis. Section 3.0 provides a description of the sampling areas and a summary of supporting physical and chemical data collected in the field. Section 4.0 provides the sediment quality results. Benthic invertebrate community results are presented in Section 5.0. Tissue chemistry results are presented in Section 6.0. Conclusions and recommendations of the study are provided in Section 7.0. All the references cited throughout this report are listed in Section 8.0.

2.0 METHODS

Minnow Environmental Inc. implemented the Minto Creek sediment, periphyton and benthic invertebrate community assessment from September 5th to 8th, 2012 with the assistance of Minto Mine staff. The study design was consistent with the design submitted to the Yukon Water Board in June 2011 in accordance with the Minto Mine Water Use Licence (QZ06-006 - Amendment 7). Sediment sampling was undertaken in upper Minto Creek, lower Minto Creek and corresponding reference areas (Table 2.1; Figure 2.1). Periphyton and benthic invertebrate community sampling were undertaken in erosional habitat of lower Minto Creek and a corresponding reference area (Table 2.1; Figure 2.1). Tissue sampling (periphyton, benthic invertebrate and slimy sculpin) was also undertaken in lower Minto Creek and corresponding reference areas (Table 2.1; Figure 2.1). Supporting measures (e.g., habitat characteristics, field meter measures, water quality samples, etc.) were collected at all sampling stations.

2.1 Supporting Measures

2.1.1 Field Collection

A number of environmental variables were measured to support the sediment quality, periphyton and benthic invertebrate community data collected for the Minto Creek assessment. The location of each station was recorded using a Geographic Positioning System (GPS) with coordinates recorded in latitudes and longitudes (degrees, minutes and decimal seconds using the North American Datum of 1983).

Supporting measures collected concurrent with sediment sampling (i.e., at depositional areas) included sediment redox potential, core penetration depth (lower creek areas only), sample texture, and the presence or absence of organic detritus. *In situ* measurements of temperature, dissolved oxygen, conductivity, and pH were also taken at each station using either a YSI 650 MDS (Multiparameter Display System) field meter equipped with a YSI 6600 Sonde (Yellow Springs Instruments, Yellow Springs, OH) or a Hanna 4M multiparameter meter (Woonsocket, RI).

At each periphyton and benthic invertebrate community station, *in situ* measurements were taken using a field meter (described above), water depth was measured using a meter stick and water velocity was measured using a Marsh-McBirney Flo-Mate 2000 portable flow meter (Marsh-McBirney Ltd., Frederick, MD). Creek wetted and bankfull widths were measured at each sampling station using a tape measure. Additional data collected to characterize each periphyton and benthic invertebrate sampling station

Table 2.1: Minto Mine Water Use License program summary, September 2012.

Area Type	Area	Station	Water	Sediment by Spoon [1]	Sediment by Hand Corer [2]	Periphyton Chlorophyll 'a'	Periphyton Community	Benthic Community by Hess Sampler [3]	Tissue Chemistry
Lower Creek Areas	Lower Minto Creek (Exposed)	LMC-1	X		X	X	X	X	X [4]
		LMC-2			X	X	X	X	
		LMC-3			X	X	X	X	
		LMC-4			X	X	X	X	
		LMC-5			X	X	X	X	
	Lower Wolverine Creek (Reference)	LWC-1	X		X	X	X	X	X [5]
		LWC-2			X	X	X	X	
		LWC-3			X	X	X	X	
		LWC-4			X	X	X	X	
		LWC-5			X	X	X	X	
	Lower Big Creek (Reference)	LWC-1	X						X [4]
		LWC-2							
		LWC-3							
		LWC-4							
		LWC-5							
Upper Creek Areas	Upper Minto Creek (Exposed)	UMC-1	X	X					
		UMC-2		X					
		UMC-3		X					
		UMC-4		X					
		UMC-5		X					
	Upper McGuinty Creek (Reference)	URC-1	X	X					
		URC-2		X					
		URC-3		X					
		URC-4		X					
		URC-5		X					

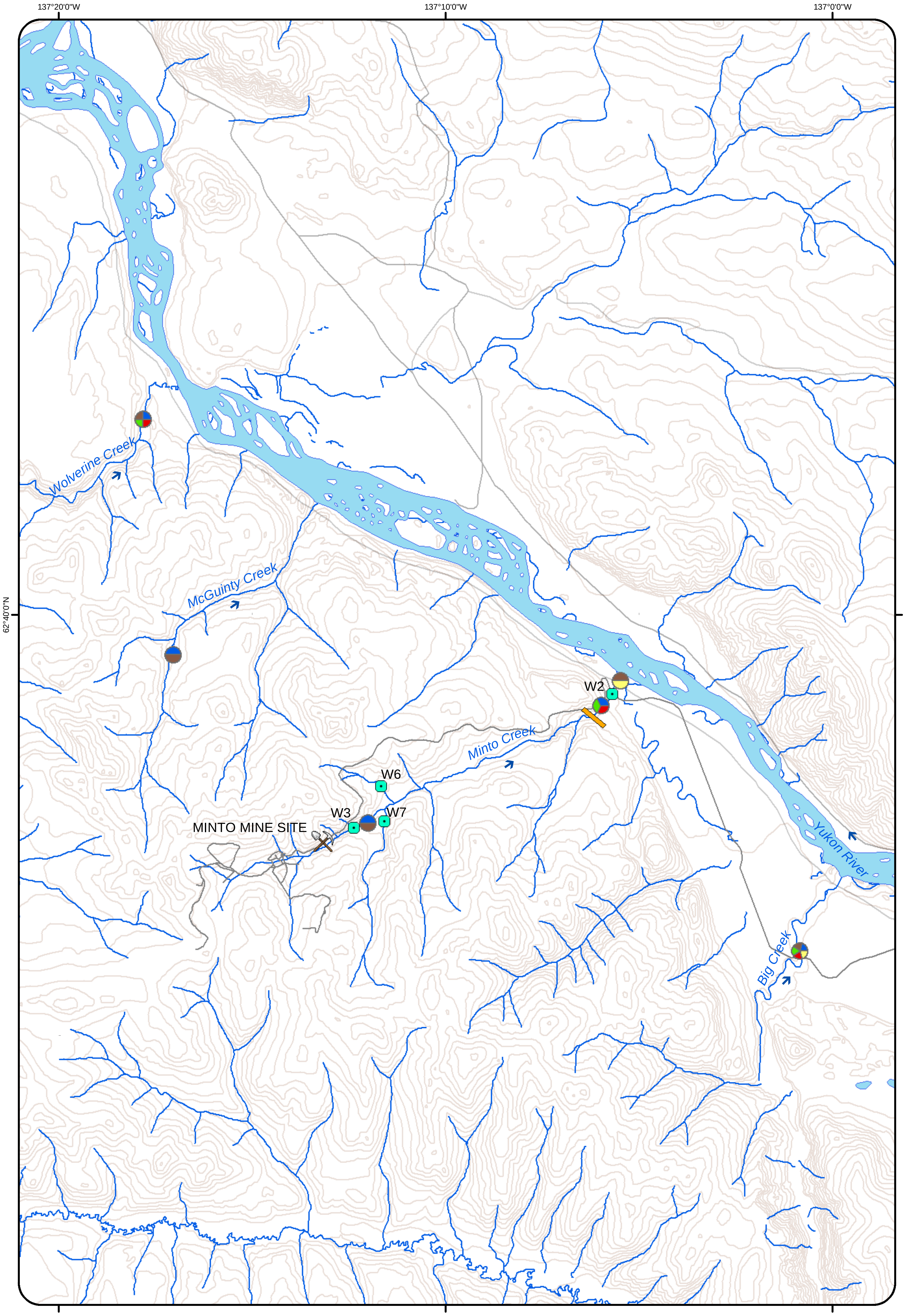
[1] top 2 centimeters collected; minimum 3-grab composite

[2] top 2 centimeters collected; 3-grab composite

[3] 500 um mesh; 3-grab composite

[4] periphyton, benthic invertebrates and slimy sculpin; target sample sizes 5, 5 and 8, respectively.

[5] periphyton and benthic invertebrates; target sample sizes 5 and 5, respectively.



N
W E
S

3,000 0 3,000
Meters

MAP INFORMATION
Map Projection: NAD 1983
Data Source: Department of Natural Resources Canada. All rights reserved.
Created By: J.Wilson
Creation Date: March 2013
Project No.: 2461

Features

Mine Site

SAMPLES COLLECTED

- Water
- Sediment
- Periphyton
- Benthos
- Fish

- Water Quality Station
- Fish Barrier
- Water Flow
- Contours (30m interval)
- Roads

Figure 2.1: Monitoring Areas for the Minto Creek Sediment, Periphyton, and Benthic Invertebrate Community Assessment – 2012

Created by:
minnow environmental inc.

included: elevation, gradient, water appearance, creek morphology, bank condition, substrate texture, instream cover, residual pool depth, instream features, overhead canopy, aquatic vegetation, riparian vegetation, surrounding land use and anthropogenic disturbance. In addition, at each benthic invertebrate station, the intermediate axis length of 100 rocks that were washed during the benthic invertebrate sampling were measured and recorded, and the percent embeddedness of ten randomly selected rocks was also evaluated and recorded. This type of substrate characterization is similar to the Canadian Aquatic Biomonitoring Network (CABIN) protocol (CABIN 2010) for characterizing benthic invertebrate habitat and provided additional information to assess and standardize habitat conditions among sampling stations. Summary statistics of intermediate axis lengths were calculated for each station including the median and geometric mean as per CABIN protocol.

Water samples for chemical analysis were collected at each periphyton and benthic sampling area. Samples were collected into pre-labeled sample bottles that were triple rinsed and preservatives were added to the sample bottles, as required. Water samples for dissolved organic carbon (DOC) and for dissolved ICP-MS (Inductively Coupled Plasma-Mass Spectrometry) analytes were filtered in the field using 0.45 µm polypropylene filters.

The productivity of lower Minto Creek and lower Wolverine Creek was evaluated through measurements of chlorophyll *a*, in addition to collection of periphyton (Section 2.3), at each periphyton and benthic station. Chlorophyll *a* is the primary photosynthetic pigment of all oxygen-evolving photosynthetic organisms (Wetzel 2001) and therefore provides an indicator of the standing stock of photosynthetic organisms representing the lowest trophic level. In 2012, chlorophyll *a* was measured in periphyton instead of water. Minto Creek is a lotic system, so measuring chlorophyll *a* in periphyton is considered to be more representative of productivity. A stainless steel razor blade was used to scrape periphyton from rocks and transfer it to labeled sampling jars. The surface area sampled at each station was carefully recorded. All samples were maintained in coolers with ice packs during transportation and then at 4°C in a refrigerator on site until submission to the ALS Group Environmental Laboratory (ALS; Whitehorse, Yukon). Chlorophyll a samples arrived at the laboratory within one day of collection.

2.1.2 Data Analysis

Water chemistry data quality was assessed prior to data analysis and interpretation, and was judged to be acceptable (Appendix A). Water quality of Minto Creek was evaluated relative to WUL standards, concentrations measured in reference areas, applicable water quality guidelines, and previous water quality (e.g., water quality results included in previous annual reports).

Supporting field measures (temperature, dissolved oxygen, pH and specific conductivity) and chlorophyll *a* results were tested for differences in the lower creek areas using by t-testing. Prior to t-testing, data were transformed as necessary to meet assumptions of normality and homogeneity of variance. Statistical comparisons were conducted using SPSS software (SPSS 2011). Creek productivity was also characterized by comparing chlorophyll *a* concentration against the Dodds et al. (1998) classification system for temperate streams.

2.2 Sediment Quality

2.2.1 Sample Collection and Laboratory Analysis

Sediment samples were collected for analysis of particle size and for chemical analysis at depositional areas within Minto Creek and reference creeks (Table 2.1; Figure 2.1). At lower Minto Creek and lower Wolverine Creek, sediment samples for particle size analysis were collected using a 15.24 cm x 15.24 cm (6" x 6") stainless steel ponar grab (0.023 m^2 sampling area). A composite sample was created by collecting the surficial two centimeters of sediment from each of three acceptable grabs (i.e., full to each edge of the sampler) using a stainless steel spoon. Sediment samples for physical characterization were then placed into pre-labeled 500 mL PET (polyethylene) jars. Sediment samples for chemical analyses were collected using a 4.7 cm (2") (inside diameter) Lexan® core tube, which was carefully inserted into sediment deposits, capped using a fitted plastic cap and retrieved by hand. From each acceptable core (i.e., each core containing an intact, representative sediment-water interface), the surficial two centimeters of sediment was manually extruded upwards into a graded core collar, cut with a stainless steel core knife, and placed into a pre-labeled 250 mL glass jar. Samples from three cores treated in this manner were composited to form a single sample from each station. At upper Minto Creek and upper McGinty Creek, sediment deposits were rare and were typically very shallow (i.e., deposits were less than three centimeters in depth). Accordingly, collection by ponar or by coring, as described above, was not effective in the upper creek areas and sediments were collected using a stainless steel spoon. Specifically, at locations of sediment deposition, surficial sediment was carefully collected by slowly spooning the sediment into a sample jar, with care taken to avoid the loss of fine material. In order to be as consistent as possible with the sediment collected in the lower Creek areas, samples included only the top 2 centimeters of deposited sediment. Immediately after collection, sediment samples were placed in a cooler, and later placed in a refrigerator at approximately 4°C until they were submitted to the ALS Group Environmental Laboratory in Burnaby, BC, for analysis of particle size, total organic carbon, metals (by ICP-MS and ICP-OES [Inductively Coupled Plasma-Mass Spectrometry and Inductively Coupled Plasma-Optical Emission Spectroscopy] scans) and mercury.

2.2.2 Data Analysis

Sediment data quality was assessed prior to data analysis and interpretation, and was judged to be acceptable (Appendix A). Sediment quality data were evaluated relative to sediment quality guidelines (SQGs) for the protection of aquatic life (e.g., CCME 1999) and reference concentrations to identify metals with the potential to adversely affect aquatic life and/or whose concentrations were elevated due to mine activity. Sediment quality data were also evaluated by comparison to results obtained in previous years of sampling (1994 and 2006-2011). However, interpretation was conducted with careful consideration of a significant methodological change made in 2010 and carried through to 2012 (sediments collected as described above) relative to previous years. When calculating descriptive statistics and a value was reported as less than method detection limit (i.e., <0.1 mg/kg) a value of the method detection limit (i.e., 0.1 mg/kg) was used for calculation purposes. Sediments collected in all years previous to 2010 were collected within the active channel of the creek using an aluminum or Teflon scoop. Samples were submitted whole for analysis of particle size distribution, which generally included significant quantities of gravel and sand. Only material passing through a 230 mesh sieve (<63 um; silt and clay) was digested and analyzed for metals. While this approach does result in the analysis of geochemically-relevant fine sediment (e.g., Horowitz 1991), it represents an impediment to the interpretation of the biological significance of sediment chemistry as organisms are exposed to whole sediment, and sediment quality guidelines (SQGs) for the protection of aquatic life (e.g., CCME 1999) apply to whole sediment.

2.3 Periphyton Community

2.3.1 Sample Collection and Laboratory Analysis

Periphyton is the assemblage of algae, bacteria, fungi, and meiofauna attached to submerged substrate in freshwaters. However, periphyton communities are generally characterized on the basis of the attached algae community. Attached algal communities are representative of the lowest trophic level and are indicators of productivity. Periphyton was collected from randomly selected rocks at each station with the use of a stainless steel razor blade. The surface area sampled was inversely proportional to the periphyton coverage in order to provide a consistent sample weight for analysis (2-5 grams). Samples were preserved with Lugol's iodine solution and shipped to Fraser Environmental Services (Surrey, BC) for analysis to species/variant level.

2.3.2 Data Analysis

Data from Fraser Environmental Services laboratory are pending due to a backlog. Use of an alternate lab may be explored next year. An update letter report will be provided once data are available.

2.4 Benthic Invertebrate Community

2.4.1 Sample Collection and Laboratory Analysis

Benthic invertebrate community samples were collected in erosional habitat of lower Minto Creek and lower Wolverine Creek as required under the WUL. Benthic invertebrate community samples were collected from riffle/run habitat with cobble and gravel substrate using a Hess sampler (0.1 m^2) outfitted with 250 µm mesh. Five replicate samples were collected at each monitoring location and consisted of a three-grab composite (0.3 m^2 of bottom area in total). For each grab, the substrate within the sampler was disturbed and scrubbed (by hand and nail brush) with care taken to ensure that all dislodged organic material was swept into the sampler collection net. The substrate was disturbed to a depth of approximately 10 cm over a period of approximately five minutes. This procedure was repeated for the second and third grab, following which all of the material contained in the collection net was carefully transferred to a pre-labeled 2 litre wide-mouth plastic jar using a stainless steel spoon and a wash bottle while working over a plastic tub to avoid any potential loss of organisms. Any organisms that adhered to the sieve bag were removed by hand and added to the sample. All samples were labeled internally (using wooden sticks) and externally with the station number, area identifier, Minnow project number, date and field personnel in order to ensure correct identification at the laboratory. Samples were preserved within six hours of collection using buffered formalin solution to a nominal concentration of 10% in ambient water.

All benthic invertebrate samples were shipped to Cordillera Consulting in Summerland, BC. At the laboratory, samples were split using sieves to allow separate evaluation of >250 µm and >500 µm size fractions. Each sample was elutriated to remove sand, gravel and clay, and the remaining organic material was preserved in 70% ethanol. The elutriate was examined for any mollusc or trichopteran cases then each sample was examined to estimate the total number of invertebrates. If the estimated number was greater than 600 individuals and the sample was fine and non-clumping, a subsample was taken using a

Folsom Plankton Splitter (Motodo 1959; Van Guelpen et al. 1982). Empty snail or bivalve shells, empty caddisfly cases, invertebrate fragments such as legs, gills, antennae etc. were not removed or counted. When organism fragments were encountered, only the heads were counted towards the total. Larval and pupa exuviae were not counted while terrestrial stages and terrestrial drop-ins were indicated as such and do not contribute to the total count. Benthic invertebrates were identified to the "lowest practicable taxonomic level" (which in most cases was genus) and counted. Following identification and counting, representative specimens of each taxon were preserved in a museum quality vial with a polyseal lid to create a voucher collection. The interior labels were used to identify the taxa, the client, date collected, site code and the project. Laboratory quality assurance/quality control (QA/QC) included an assessment of sub-sampling error and sorting efficiency on at least 10% of the samples.

2.4.2 Data Analysis

Benthic invertebrate community data quality was assessed prior to data analysis and interpretation, and was judged to be acceptable (Appendix A). Benthic invertebrate communities were evaluated using summary metrics including invertebrate density (number of organisms per m^2 calculated based on a sample area of 0.3 m^2), number of taxa, Simpson's Diversity, Simpson's Evenness and Bray-Curtis Index. For each benthic invertebrate sample, total organism density (individuals/m^2) was calculated. The diversity metric "number of taxa" (also known as taxon richness) included all separate taxa identified to the species/variant level, excluding any organisms that could not be conclusively identified as separate taxa. Simpson's Diversity ("D") and Simpson's Evenness ("E") indices were computed according to formulae presented by Smith and Wilson (1996) and recommended by Environment Canada (2012). These indices take into account both the relative abundance of taxa, and the number of taxa, with values ranging from 0 (low diversity or evenness) to 1 (high diversity or evenness). Bray-Curtis (B-C) index was also calculated according to Environment Canada (2012). This metric takes into account the abundance of each taxon at each station compared to the median abundance computed from the reference stations (lower Wolverine Creek), to compute an index of the relative "dissimilarity" of each station from the hypothetical reference median station. Larger B-C index values indicate greater dissimilarity from reference.

The relative proportions of the most abundant taxa were calculated relative to the total number of organisms in the sample. Dominant taxon groups were defined as those groups representing greater than 10% of total organism abundance in one or more areas or any groups considered to be important indicators of environmental stress. In this study, relative proportions of oligochaetes (worms), chironomids (non-biting midges), nematans (roundworms), and EPT taxa (Ephemeroptera [mayfly], Plecoptera [stonefly], Trichoptera [caddisfly] taxa) were examined. It is often possible to relate low relative abundance of sensitive taxonomic groups (e.g., EPT taxa) to environmental stress (e.g., Taylor and Bailey 1997). Similarly, high relative abundance of tolerant taxonomic groups (e.g., oligochaetes) may indicate higher environmental stress (Chapman et al. 1982a; 1982b).

All benthic invertebrate community endpoints were summarized by reporting mean, median, minimum, maximum, standard deviation, standard error and sample size for each study area. Differences among effluent-exposed and reference areas were tested using ANOVA. Prior to ANOVA, all data were transformed as necessary to meet assumptions of normality and homogeneity of variance. All statistical comparisons were conducted using SPSS software (SPSS 2011). Following the statistical comparisons, the magnitude of difference between effluent-exposed and reference area means was calculated for each benthic invertebrate community metric where a significant difference was detected. If a significant difference between areas was not detected, then the minimum effect size that could be detected was calculated.

Community structure was also assessed by examining the proportions of key taxonomic groups using a multivariate ordination technique known as Correspondence Analysis (CA). CA is used to calculate axes, which can be thought of as new variables summarizing variation in the relative abundance of benthic taxa. When depicted in two-dimensional plots, taxa that tend to co-occur will have similar CA axis scores and will plot together, while those that rarely co-occur plot farther apart. Similarly, stations sharing many taxa plot closest to one another, while those with little in common plot farther apart. The greatest variation among either taxa or stations is explained by the first axis, with other axes accounting for progressively less variation. This type of multivariate analysis describes not only which stations have distinct benthic communities but also how these benthic communities differ among stations (i.e., which particular taxa differ). CA is influenced by rare species, so those taxa occurring at only one of the ten stations were removed. After screening and data reduction, abundances were log (x+1) transformed. Scores for both stations and taxa were calculated using the ADE-4 package (Thioulouse et al. 1997) to evaluate the associations of organisms and stations.

Benthic invertebrate community data were also evaluated in comparison to results obtained in previous years of sampling (1994, 2006, 2008, 2010 and 2011). Prior to making comparisons, summary metrics from earlier years were re-calculated (Minnow 2011) to ensure consistency and appropriate comparisons over time.

2.5 Tissue Chemistry

2.5.1 Sample Collection and Laboratory Analysis

Periphyton and benthic invertebrate samples were collected from lower Minto Creek (exposed), lower Wolverine Creek (reference) and lower Big Creek (reference), and slimy sculpin samples were collected from lower Minto Creek (exposed), lower Wolverine Creek (reference; Table 2.1; Figure 2.1). Periphyton samples were collected by scraping submerged cobble-size rocks using a stainless steel razor blade. A total of five samples were targeted per area, but due to very low periphyton coverage at lower Minto Creek and lower Big Creek, only one sample could be obtained from these areas. Scraped material (periphyton) was placed in pre-labelled sample jars. Benthic invertebrate tissue samples were collected in areas with cobble substrate using a kick-net and by overturning rocks and collecting organisms by hand. A total of five samples were targeted per area, but due to very low productivity, only one sample could be obtained per area. Benthic invertebrate samples were placed into pre-labelled Whirl-Pak™ bags until the desired sample size (2-5 grams) was achieved. Slimy sculpin tissue samples were collected by the Access Consulting Group using a Smith-Root LR-24 battery-powered backpack electrofisher. The operator was supported by a dip netter dedicated to capturing fish shocked by the electrofisher. Upon capture, fish were placed in buckets containing aerated water. At the completion of each electrofishing run, total shocking time was recorded. Slimy scuplin were then dispatched followed by measurement of length using digital calipers, weight using a portable electronic balance and removal of head for ageing. The remaining headless carcasses were placed into pre-labelled Whirl-Pak™ bags.

Immediately after collection, all tissue samples were placed in a cooler, and later in a freezer until they were submitted to the ALS Laboratory Group in Burnaby, BC. Samples were analyzed for wet and dry weight for metals by High-Resolution ICP-MS.

2.5.2 Data Analysis

The primary objective of the tissue collections was to support a selenium assessment reported under separate cover (Minnow 2013). Accordingly, data are reported within this report for future reference with limited interpretation. Data interpretation was limited to qualitative comparison of metal concentration in samples collected from lower Minto Creek to those collected from reference creeks. Only were slimy sculpin collected at a level of replication (n=7) sufficient to support statistical analysis and these data were interpreted by statistically comparing metal concentrations in fish collected at the exposed area to those collected at the reference area using the student's t-test.

3.0 SUPPORTING MEASURES

3.1 Field Measures

Mean temperature in lower Minto Creek (5.7°C) was significantly higher than in lower Wolverine Creek (4.1°C; Figure 3.1; Appendix Table B.3). Specific conductance followed a gradient from the mine downstream and was slightly greater in upper Minto Creek (285 µS/cm) than in lower Minto Creek (207 µS/cm). Water in all areas was well oxygenated with a slightly alkaline pH; both dissolved oxygen and pH were well within water quality guidelines as well as the WUL standard for pH.

3.2 Water Chemistry and Chlorophyll *a*

At lower Minto Creek five analytes (aluminum, cadmium, chromium, copper and iron) were present at concentrations that did not meet guidelines and WUL standards. Furthermore, total suspended solids (TSS) concentration was greater than guideline levels and total phosphorus was at concentrations greater than the WUL standard (Table 3.1). Concentrations of phosphorus and iron were higher than WUL standards at the reference area, upper McGinty Creek. Since phosphorus concentration was greater than guidelines at both reference and exposure areas it appears to be naturally elevated. The analytes noted above also tend to be positively correlated with TSS (Minnow 2012b). Concentrations of TSS were greater than guideline levels at both lower Minto Creek and lower Wolverine Creek but levels at lower Minto Creek were considerably elevated above guidelines (Table 3.1). Of the analytes greater than water quality guidelines, only concentrations of cadmium and copper were also greater than reference (lower Wolverine Creek. Conversely, fluoride was the only analyte with concentrations greater than guidelines in reference areas and not at the exposure areas, indicating natural elevation due to differences in source geology. Interestingly, the water quality of upper Minto Creek was better than the water quality of lower Minto Creek, indicating that the Minto Mine had a limited influence on water quality at the time of sampling.

Comparisons of analyte concentrations that were higher than WUL standards and/or guidelines in the receiving environment in 2012 against 2011 data (Minnow 2012) indicate that mean TSS, aluminum, chromium and iron concentrations were higher in lower Minto Creek in 2012 than in 2011 (Appendix Table B.6). Concentrations of aluminum, chromium and iron were likely relatively elevated in 2012 because of the elevated levels of TSS in lower Minto Creek. Copper and cadmium concentrations were greater than guidelines in 2012 in lower Minto Creek but were not in 2011 and this could be due to the fact TSS

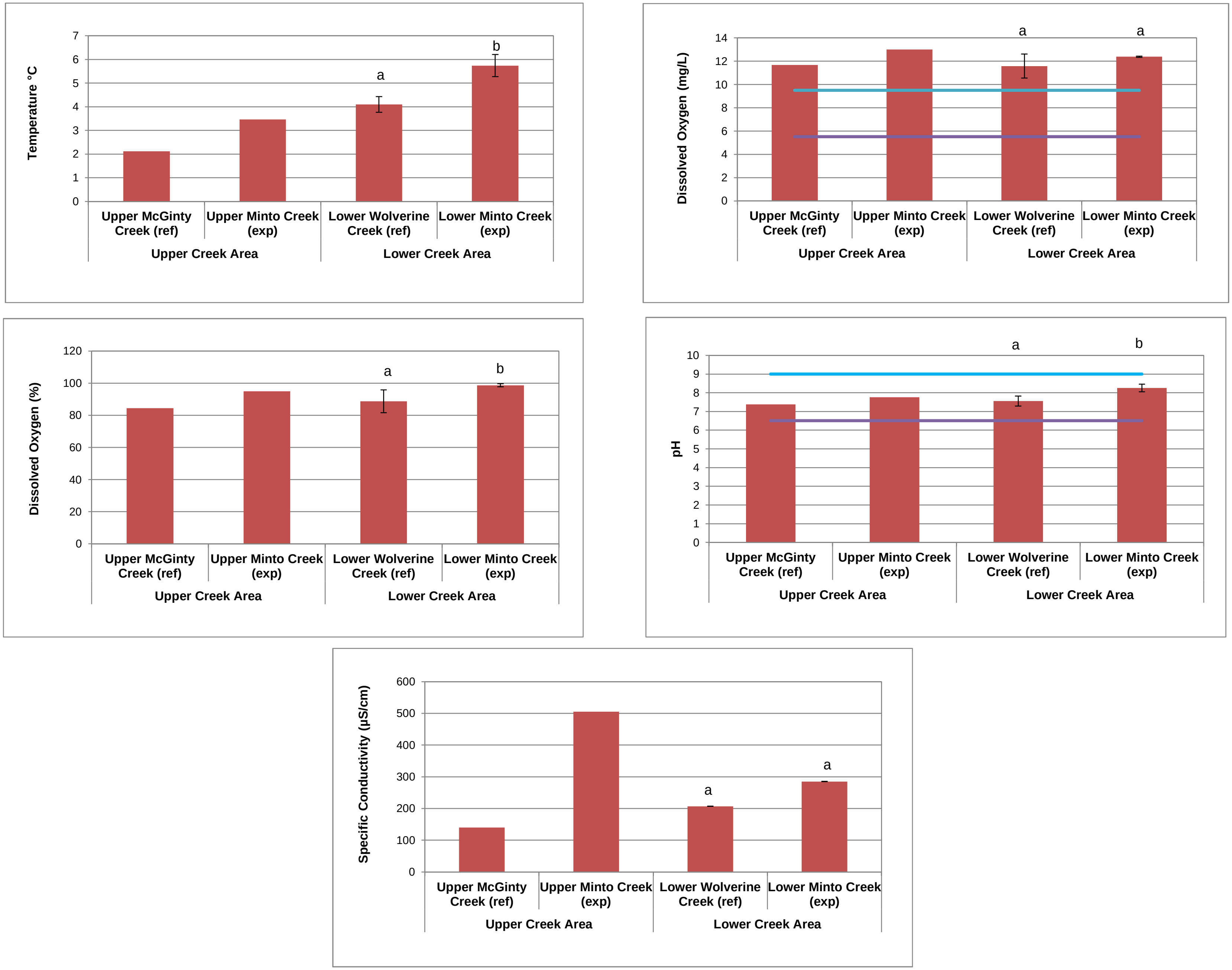


Figure 3.1: Physico-chemical measurements in depositional areas of upper and lower Minto Creek relative to reference areas. Data presented as mean ± standard deviation. Sample sizes were n = 5 in lower areas and n = 1 in upper areas.

Table 3.1: Water quality results at exposure and reference, Minto Mine WUL, September 2012.

	Analyte	Units	CCME Water Quality[a]		WUL Limits at W2	Lower Minto Creek (exposure)	Lower Wolverine Creek (reference)	Upper Minto Creek (exposure)	Upper McGinty Creek (reference)	Lower Big Creek (reference)
			30	Max						
Physical Tests	Conductivity	µS/cm	-	-	-	275	197	482	139	191
	Hardness (as $CaCO_3$)	mg/L	-	-	-	146	104	239	78	92
	pH	ph Units	-	-	6.0 - 9.0	8.25	8.00	7.97	7.93	8.14
	Total Suspended Solids	mg/L	17.7	-	-	425.0	22.0	< 3.0	4.7	12.7
	Total Dissolved Solids	mg/L	-	-	-	158	123	253	92	116
	Turbidity	NTU	6.85	-	-	-	6.11	-	3.58	-
Anions and Nutrients	Anion Sum	meq/L	-	-	-	2.82	2.06	4.72	1.44	2.06
	Cation Sum	meq/L	-	-	-	3.29	2.40	5.65	1.80	2.21
	Cation - Anion Balance	%	-	-	-	7.8	7.6	9.0	11.2	3.5
	Alkalinity, Total	mg/L	-	-		140	87	223	64	91
	Ammonia, Total (as N)	mg/L	0.5		0.35	0.036	0.010	< 0.005	0.007	< 0.005
	Chloride (Cl)	mg/L	120	640	-	< 0.5	< 0.5	< 0.5	< 0.5	0.8
	Fluoride (F)	mg/L	0.12	-	-	< 0.02	0.13	0.06	0.23	0.15
	Nitrate (as N)	mg/L	13	550	2.9	< 0.005	< 0.005	0.097	< 0.005	0.079
	Nitrite (as N)	mg/L	0.197	-	0.06	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Phosphorus (P)-Total dissolved	mg/L	-	-	-	-	0.021	-	0.033	-
	Phosphorus (P)-Total	mg/L	-	-	0.02	0.298	0.032	0.005	0.031	0.014
	Sulfate (SO4)	mg/L	-	-	-	0.7	15.6	12.2	7.1	10.4
Other	Cyanide, Total	mg/L	-	-	-	-	< 0.005	-	< 0.005	-
	Cyanide, Free	mg/L	0.005	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Dissolved Organic Carbon	mg/L	-	-	-	11.3	13.1	6.2	11.6	9.3
	Total Organic Carbon	mg/L	-	-	-	13.2	13.8	5.9	13.3	9.8
Total Metals	Total Aluminum (Al)	mg/L	0.1	-	0.62	6.76	0.56	0.01	0.11	0.30
	Total Antimony (Sb)	mg/L	-	-	-	0.0003	0.0002	< 0.0001	0.0002	0.0002
	Total Arsenic (As)	mg/L	0.005	-	0.005	0.0045	0.0009	0.0003	0.0012	0.0014
	Total Barium (Ba)	mg/L	-	-	-	0.242	0.053	0.083	0.048	0.071
	Total Beryllium (Be)	mg/L	-	-	-	0.0003	< 0.0001	< 0.0001	< 0.0001	< 0.0001
	Total Bismuth (Bi)	mg/L	-	-	-	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
	Total Boron (B)	mg/L	1.5	2.9	-	0.01	0.01	0.03	< 0.01	0.01
	Total Cadmium (Cd)	mg/L	0.00004	-	0.00004	0.00012	0.00002	< 0.00001	< 0.00001	0.00001
	Total Calcium (Ca)	mg/L	-	-	-	45.3	22.2	55.7	20.3	23.6
	Total Chromium (Cr)	mg/L	0.001 Cr(VI)	-	0.002	0.0126	0.0020	0.0002	0.0013	0.0008
	Total Cobalt (Co)	mg/L	-	-	-	0.0050	0.0005	< 0.0001	0.0005	0.0002
	Total Copper (Cu)	mg/L	0.003	-	0.013	0.017	0.003	0.002	0.002	0.003
	Total Iron (Fe)	mg/L	0.3	-	1.1	11.80	0.97	0.02	1.46	0.49
	Total Lead (Pb)	mg/L	0.005	-	0.004	0.00314	0.00021	< 0.00005	0.00006	0.00018
	Total Lithium (Li)	mg/L	-	-	-	0.0051	0.0019	0.0025	< 0.0005	0.0013
	Total Magnesium (Mg)	mg/L	-	-	-	14.4	11.5	25.1	5.9	9.5
	Total Manganese (Mn)	mg/L	-	-	-	0.42	0.05	0.05	0.14	0.03
	Total Mercury (Hg)	mg/L	-	-	-	0.00002	< 0.00001	< 0.00001	< 0.00001	< 0.00001
	Total Molybdenum (Mo)	mg/L	0.073	-	0.073	0.0013	0.0007	0.0049	0.0011	0.0011
	Total Nickel (Ni)	mg/L	0.12	-	0.11	0.014	0.003	0.001	0.002	0.002
	Total Phosphorus (P)	mg/L	-	-	-	0.41	< 0.05	< 0.05	< 0.05	< 0.05
	Total Potassium (K)	mg/L	-	-	-	1.67	0.90	2.19	0.48	0.84
	Total Selenium (Se)	mg/L	0.001	-	0.001	0.0003	0.0002	0.0004	0.0003	< 0.0001
	Total Silicon (Si)	mg/L	-	-	-	19.20	6.77	5.71	6.93	7.49
	Total Silver (Ag)	mg/L	0.0001	-	-	0.00006	0.00017	< 0.00001	0.00001	< 0.00001
	Total Sodium (Na)	mg/L	-	-	-	7.59	6.98	18.70	3.94	7.48
	Total Strontium (Sr)	mg/L	-	-	-	0.351	0.187	0.611	0.120	0.250
	Total Thallium (Tl)	mg/L	0.0008	-	-	0.00006	< 0.00001	< 0.00001	< 0.00001	< 0.00001
	Total Tin (Sn)	mg/L	-	-	-	0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
	Total Titanium (Ti)	mg/L	-	-	-	0.22	0.02	< 0.01	< 0.01	0.01
	Total Uranium (U)	mg/L	0.015	0.033	-	0.0015	0.0007	0.0028	0.0003	0.0019
	Total Vanadium (V)	mg/L	-	-	-	0.023	0.003	< 0.001	0.002	0.002
	Total Zinc (Zn)	mg/L	0.03	-	0.03	0.026	0.003	< 0.003	< 0.003	< 0.003

Water use licence standard not met

Water quality guideline not met

[a] CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.5 for explanatory notes on selected water quality guidelines.

concentrations were much greater in 2012 than in 2011 and/or because there was discharge from the WSP in 2012 but not in 2011 (Appendix Table B.6). Total phosphorus was above WUL standards in both 2011 and 2012 at both exposure and reference areas.

In 2012, chlorophyll *a* concentration was measured in periphyton whereas in previous years it was measured in water. Concentration of chlorophyll *a* was lower at lower Minto Creek than at lower Wolverine Creek but the difference was not statistically significant (Figure 3.2). The observed difference was likely due to greater light penetration to the substrate at lower Wolverine Creek than with water quality. Chlorophyll *a* concentrations at both areas were well below the British Columbia Water Quality Guideline of 100 mg/m^2 for the protection of aquatic life (BCMOE 1985). The production of both creeks could be considered low (oligotrophic) based on the classification by Dodds et al. (1998) which sets the oligotrophic-mesotrophic boundary for benthic chlorophyll at 20 mg/m^2. This differs from the classification based on only total phosphorus which would define both areas as mesotrophic (Dodds et al. 1998). The lower concentrations of chlorophyll *a* despite relatively high phosphorus may be due to environmental factors associated with a northern system such as low water temperatures and a short growing season.

3.3 Summary

Temperature and specific conductivity were higher at the exposure areas (upper and lower Minto Creek) than at the reference areas (upper McGinty Creek and lower Wolverine Creek). Other field water quality measures (dissolved oxygen and pH) were similar at the exposure and reference areas. Conditions observed in 2012 were generally consistent with those observed in 2011.

Overall, water quality results demonstrated that seven analytes (phosphorus, TSS, aluminum, cadmium, chromium, copper, and iron) did not meet WUL standards and/or water quality guidelines in at least one exposure area. Phosphorus was higher than the WUL standard in lower Minto Creek and reference areas suggesting naturally elevated concentrations and indicating that the WUL standard is not appropriate. Total suspended solids at lower Minto Creek in 2012 were much higher than in any other sampling year and could explain why aluminum, chromium and iron were elevated in 2012 at lower Minto Creek (Minnow 2010c; Minnow 2012a). A key finding was that, in lower Minto Creek, only cadmium and copper were greater than both guidelines/standards and reference concentrations. Furthermore, at the time of sampling in 2012, the water quality of upper Minto Creek was better than the water quality of lower Minto Creek, indicating that the Minto Mine had a limited influence on water quality at that time. Differences in chlorophyll

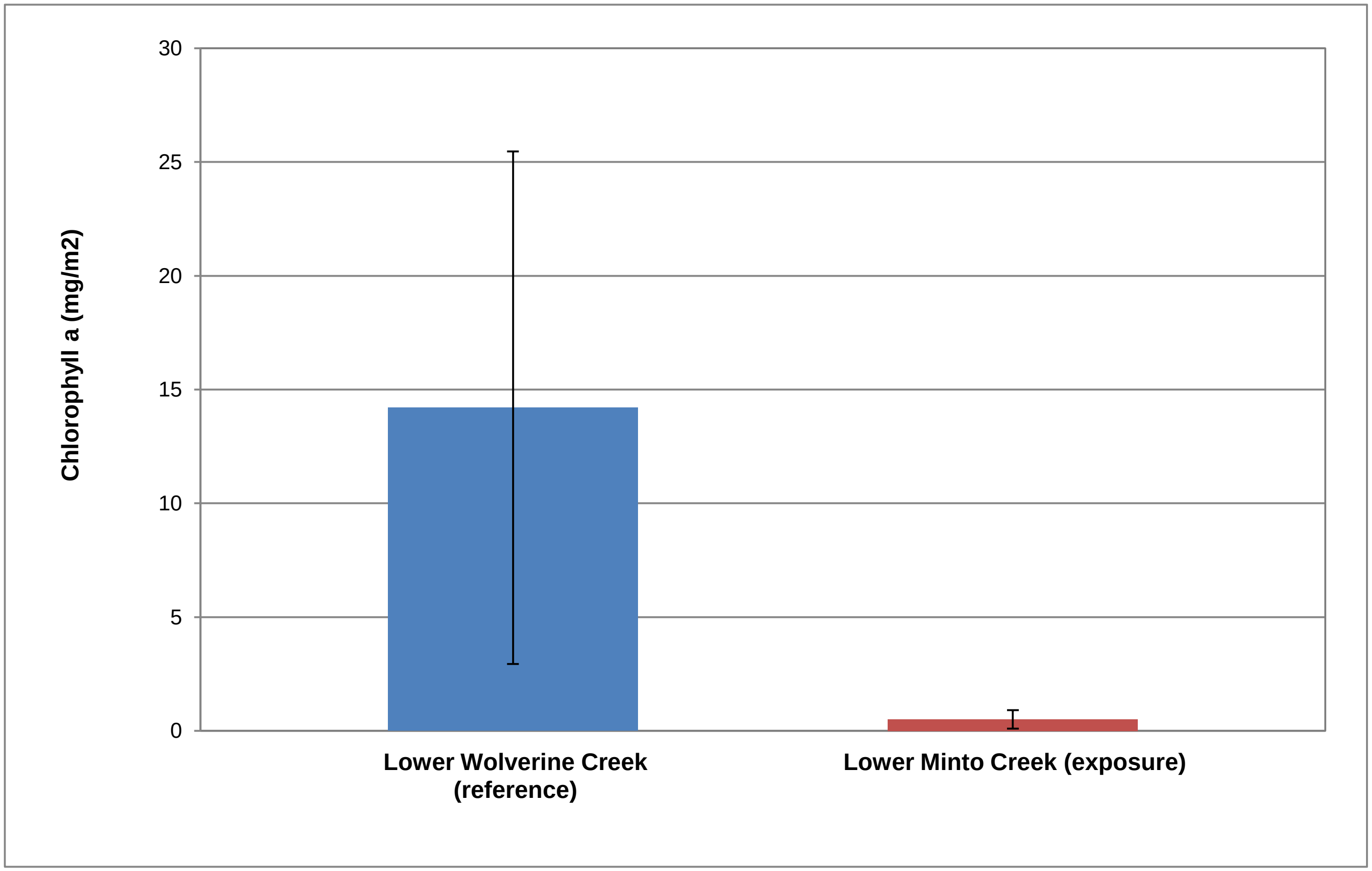


Figure 3.2: Concentrations of chlorophyll *a* in periphyton measured at five benthic stations in lower Wolverine and lower Minto Creeks, Minto Mine WUL, 2012. Data presented as mean ± standard deviation.

a between areas were likely not related to water quality but rather to natural differences. Regardless, the concentrations of chlorophyll a found at both areas were well below the guideline of 100 mg/m^2 for the protection of aquatic life and both indicate low productivity (oligotrophic) based on the classification system of Dodds et al. (1998).

4.0 SEDIMENT QUALITY

4.1 Sediment Particle Size and Chemistry

Sediments collected in 2012 were largely composed of fine particles in the silt/clay and sand size categories (Figure 4.1; Appendix Table C.1). Mean total organic carbon content of sediment collected from lower Minto Creek was approximately three times greater than in lower Wolverine Creek (Table 4.1). Arsenic and copper were the only analytes with mean concentrations greater than the Interim Sediment Quality Guideline (ISQG; CCME 1999) in an exposure area (upper and lower Minto Creek; Table 4.1; Appendix Table C.1). However, arsenic was also greater than ISQG at reference areas indicating that levels might be natural. Therefore, only mean copper concentrations at upper Minto Creek were greater than ISQG and reference, indicating a mine related influence on sediment quality at a concentration with the potential to adversely affect aquatic life. Mean chromium concentration was higher than the applicable ISQG, but only in the reference area of lower Wolverine Creek.

Due to the predominantly erosional habitat in upper Minto Creek, there are relatively few areas where sediment is deposited and this only in small quantities that likely wash away each year during freshet. Therefore, elevated sediment copper in fine sediment in the upper reaches of Minto Creek may be of limited importance in terms of exposure and potential toxicity to biota. In lower Minto Creek where fine sediment deposits were more common, sediment metal concentrations were below sediment quality guidelines and/or reference concentrations.

4.2 Temporal Comparisons

Sediment particle size distribution in 2012 was similar to 2010 and 2011 but was notably different from earlier sample year data (Figure 4.1). The disparity between 2010-2012 and 1994-2009 data reflects the change in sediment sampling methodology initiated in 2010 (Minnow 2011). Mean analyte concentrations higher than guideline in Minto Creek were compared to earlier data to detect any increasing or decreasing trends in sediment quality. In 2011, arsenic was elevated above guideline at all areas whereas in 2012 it was elevated at all areas except for upper Minto Creek (Figure 4.2). Chromium was again elevated at the reference area, lower Wolverine Creek, but not at other areas. Copper was greater than the guideline in 1994 and continued to be elevated above the guideline in 2012 in upper Minto Creek but not at lower Minto Creek (Figure 4.3; Table 4.1; Appendix Table C.1). Lower concentrations of copper at lower Minto Creek relative to

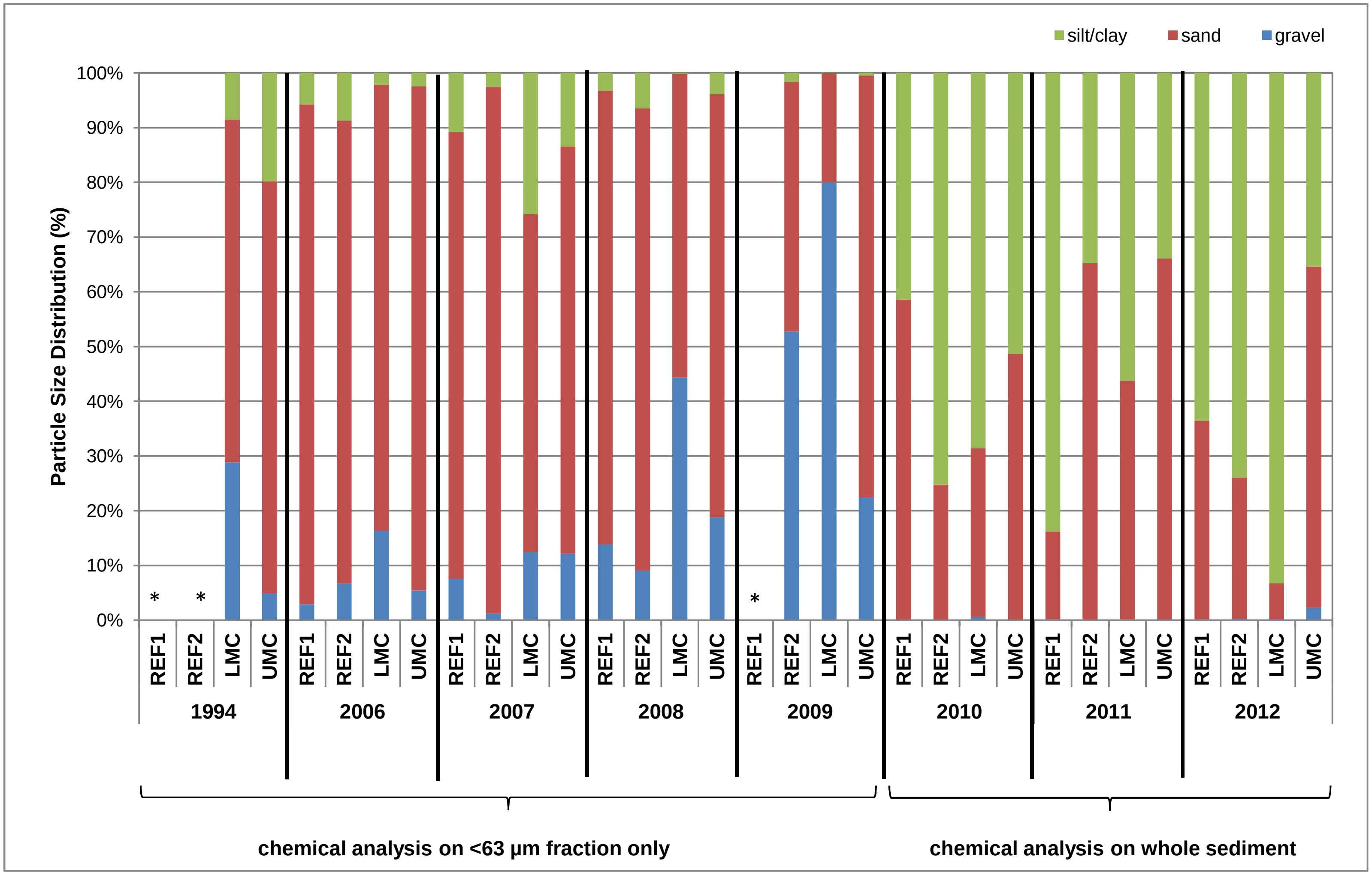


Figure 4.1: Particle size distribution of sediment collected in Minto Creek and reference locations, 1994 - 2012[1]

[1] UMC = Upper Minto Creek; LMC = Lower Minto Creek; REF1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2012; REF2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2012; * - no data

Table 4.1: Sediment chemistry data collected at exposed and reference areas, Minto Mine WUL, 2012.

	Analytes	Units	CSQG [a]		Upper McGinty Creek (Reference)				Lower Wolverine Creek (Reference)				Upper Minto Creek (Exposure)				Lower Minto Creek (Exposure)			
			ISQG	PEL	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
Particle size, TKN, carbon analytes and pH	Loss on Ignition	%			-	-	-	-	21	4	14	24	-	-	-	-	8	3	5	12
	pH (1:2 soil:water)	pH units			7.04	0.20	6.83	7.29	7.27	0.33	6.93	7.71	7.98	0.21	7.72	8.19	8.08	0.08	7.99	8.19
	% Gravel (>2mm)	%			-	-	-	-	0.15	0.18	0.01	0.46	-	-	-	-	< 0.1	0.0	< 0.1	< 0.1
	% Sand (2.0mm - 0.063mm)	%			-	-	-	-	14.86	16.99	0.97	42.40	-	-	-	-	3.41	2.21	0.95	5.91
	% Silt (0.063mm - 4um)	%			-	-	-	-	74.1	14.7	50.9	85.8	-	-	-	-	86.6	2.1	85.2	90.2
	% Clay (<4um)	%			-	-	-	-	10.9	2.5	6.7	13.4	-	-	-	-	10.02	2.34	8.13	13.9
	Total Kjeldahl Nitrogen	%			0.48	0.13	0.31	0.67	0.50	0.13	0.32	0.65	0.09	0.03	0.07	0.13	0.17	0.06	0.10	0.25
	Total Organic Carbon	%			-	-	-	-	9.6	2.1	6.1	11.3	-	-	-	-	3.41	1.54	1.71	5.71
Total Metals	Aluminum (Al)	mg/kg			14,960	1,222	13,400	16,700	17,780	2,091	14,800	20,700	11,206	1,274	9,830	13,000	10,758	1,082	9,290	12,100
	Antimony (Sb)	mg/kg			0.54	0.05	0.45	0.57	0.56	0.03	0.53	0.59	0.36	0.08	0.27	0.47	0.47	0.07	0.40	0.56
	Arsenic (As)	mg/kg	5.9	17	9.78	1.72	7.77	12.2	6.43	0.48	6.1	7.27	5.65	0.41	5.25	6.31	6.11	1.12	4.85	7.44
	Barium (Ba)	mg/kg			348	40	287	399	300	28	260	335	194	26	175	238	195	36	151	240
	Beryllium (Be)	mg/kg			0.49	0.05	0.41	0.52	0.86	0.06	0.80	0.94	0.42	0.08	0.32	0.54	0.40	0.07	0.32	0.49
	Bismuth (Bi)	mg/kg			< 0.2	0	< 0.2	< 0.2	< 0.2	0	< 0.2	< 0.2	< 0.2	0.0	< 0.2	< 0.2	< 0.2	0	< 0.2	< 0.2
	Cadmium (Cd)	mg/kg	0.6	3.5	0.24	0.05	0.17	0.31	0.34	0.03	0.30	0.37	0.17	0.03	0.15	0.22	0.14	0.04	0.10	0.20
	Calcium (Ca)	mg/kg			12,000	1,808	9,500	14,300	12,340	940	11,600	13,900	6,676	1,373	5,200	8,870	9,542	1,835	7,810	12,200
	Chromium (Cr)	mg/kg	37.3	90	31.4	2.3	28.6	34.4	53.9	5.7	44.8	60.4	26.3	2.8	23.8	30.7	21.7	2.7	18.2	24.9
	Cobalt (Co)	mg/kg			13.8	1.5	12.5	16.3	14.8	0.9	13.3	15.9	10.7	0.9	10.0	12.3	7.9	1.2	6.5	9.5
	Copper (Cu)	mg/kg	35.7	197	33.3	4.4	25.9	37.8	38.2	3.1	33.6	42.1	**113.8**	14.3	**96.8**	**133.0**	20.1	3.9	15.8	25.4
	Iron (Fe)	mg/kg			31,140	3,230	27,300	35,500	29,520	1,836	26,500	31,300	23,180	1,128	22,500	25,100	19,200	2,508	16,100	22,100
	Lead (Pb)	mg/kg	35	91.3	6.11	0.29	5.77	6.52	8.10	1.35	6.88	10.4	5.26	0.82	4.22	6.49	5.28	0.61	4.42	5.91
	Lithium (Li)	mg/kg			9.1	0.9	7.9	10.3	11.9	1.2	10.3	13.7	7.4	1.2	5.9	9.2	8.0	0.9	6.8	9.0
	Magnesium (Mg)	mg/kg			5,178	294	4,900	5,640	9,606	700	8,560	10,300	7,918	866	7,360	9,430	4,930	570	4,220	5,630
	Manganese (Mn)	mg/kg			1,616	537	1,090	2,430	768	49	716	827	1,612	370	1,050	2,010	457	132	320	631
	Mercury (Hg)	mg/kg	0.17	0.49	0.071	0.018	0.050	0.099	0.060	0.003	0.056	0.063	0.019	0.004	0.015	0.024	0.033	0.008	0.025	0.044
	Molybdenum (Mo)	mg/kg			0.73	0.23	0.53	1.13	0.52	0.01	0.52	0.53	1.23	0.26	0.92	1.59	0.55	0.07	0.50	0.66
	Nickel (Ni)	mg/kg			22.4	1.5	20.0	23.6	41.5	2.7	37.4	45.0	36.4	5.8	31.9	46.5	18.6	2.4	15.8	21.7
	Phosphorus (P)	mg/kg			971	74	877	1,050	981	26	941	1,010	994	30	958	1,040	792	41	758	860
	Potassium (K)	mg/kg			708	55	630	780	856	80	730	950	1,254	118	1,120	1,350	800	121	620	940
	Selenium (Se)	mg/kg			0.65	0.14	0.47	0.8	0.60	0.04	0.54	0.64	0.35	0.09	0.28	0.49	0.25	0.07	0.20	0.36
	Silver (Ag)	mg/kg			0.13	0.01	0.12	0.14	0.14	0.01	0.13	0.15	< 0.1	0	< 0.1	< 0.1	< 0.1	0	< 0.1	< 0.1
	Sodium (Na)	mg/kg			202	8	190	210	310	12	300	330	378	54	310	450	244	27	210	280
	Strontium (Sr)	mg/kg			98	16	78	119	123	10	114	139	67.9	16.6	48.3	94.0	75.6	17.6	58.8	101
	Thallium (Tl)	mg/kg			0.081	0.003	0.076	0.084	0.097	0.012	0.078	0.108	0.066	0.012	0.052	0.082	0.073	0.015	0.055	0.094
	Tin (Sn)	mg/kg			< 2.0	0	< 2.0	< 2.0	< 2.0	0	< 2.0	< 2.0	< 2.0	0	< 2.0	< 2.0	< 2.0	0	< 2.0	< 2.0
	Titanium (Ti)	mg/kg			655	78	537	738	695	52	611	749	653	59	578	738	564	63	476	644
	Uranium (U)	mg/kg			1.57	0.27	1.28	1.97	2.72	0.07	2.66	2.83	0.63	0.17	0.53	0.93	0.83	0.18	0.65	1.06
	Vanadium (V)	mg/kg			59.8	3.6	54.0	62.9	70.7	4.3	63.9	76.0	52.2	2.8	50.2	56.9	41.8	4.7	35.5	46.6
	Zinc (Zn)	mg/kg	123	315	52.6	2.8	49.3	56.4	62.6	4.0	56.5	67.4	65.8	4.1	61.3	71.4	43.8	5.0	37.7	49.1

[a] Canadian Sediment Quality Guidelines - ISQG = interim sediment quality guideline; PEL = probable effect level (CCME 1999).

(blue box) Indicates sediment concentration exceeding CSQG ISQG.

(green box) Indicates sediment concentration exceeding CSQG PEL.

bold Indicates sediment concentration exceeding the higher reference mean by more than 2 times

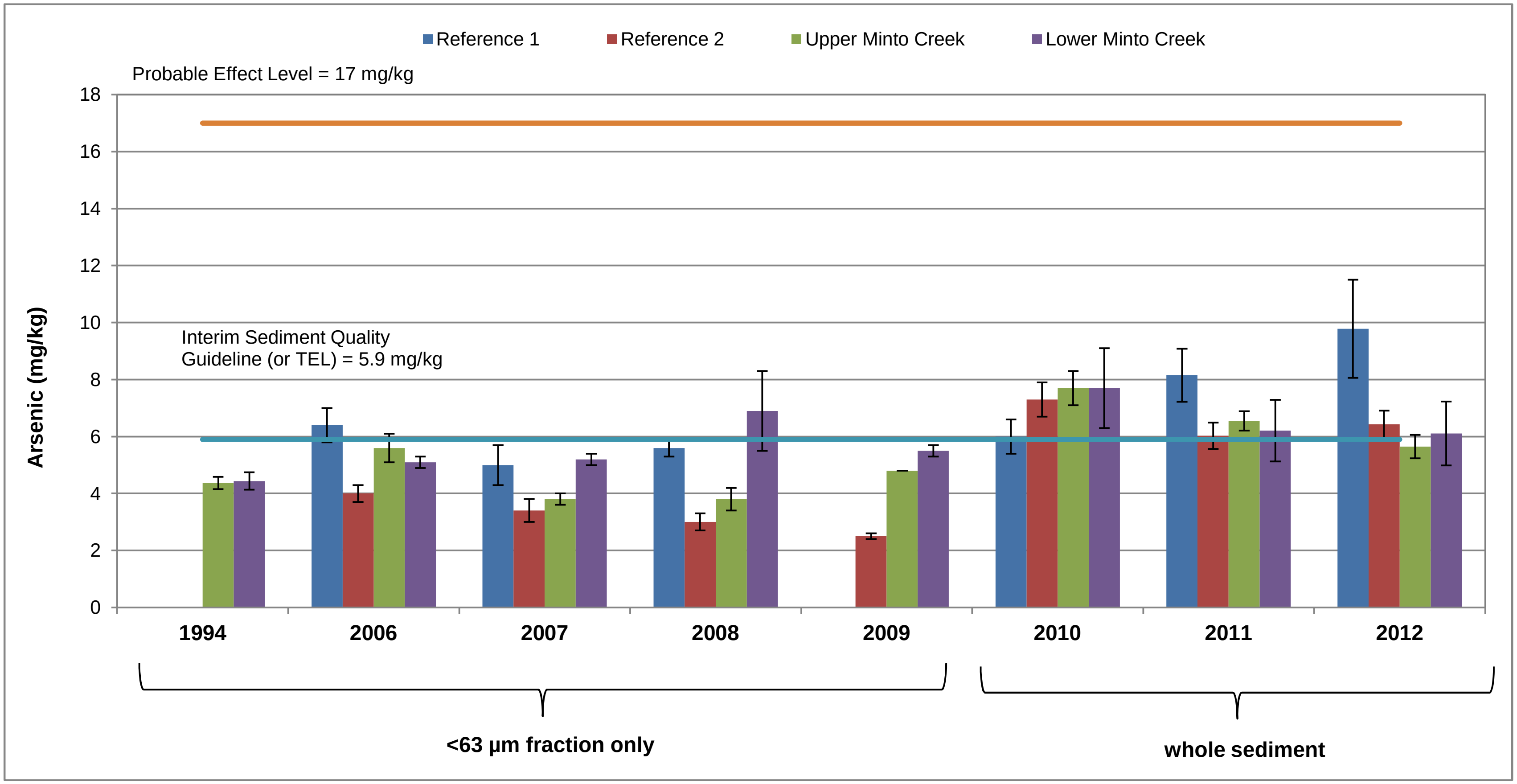


Figure 4.2: Mean arsenic concentrations in sediment collected in Minto Creek and reference locations, 1994-2012 (mean ± standard deviation)

Note: Reference 1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2012; Reference 2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2012; * = no data. TEL: Threshold Effect Levels

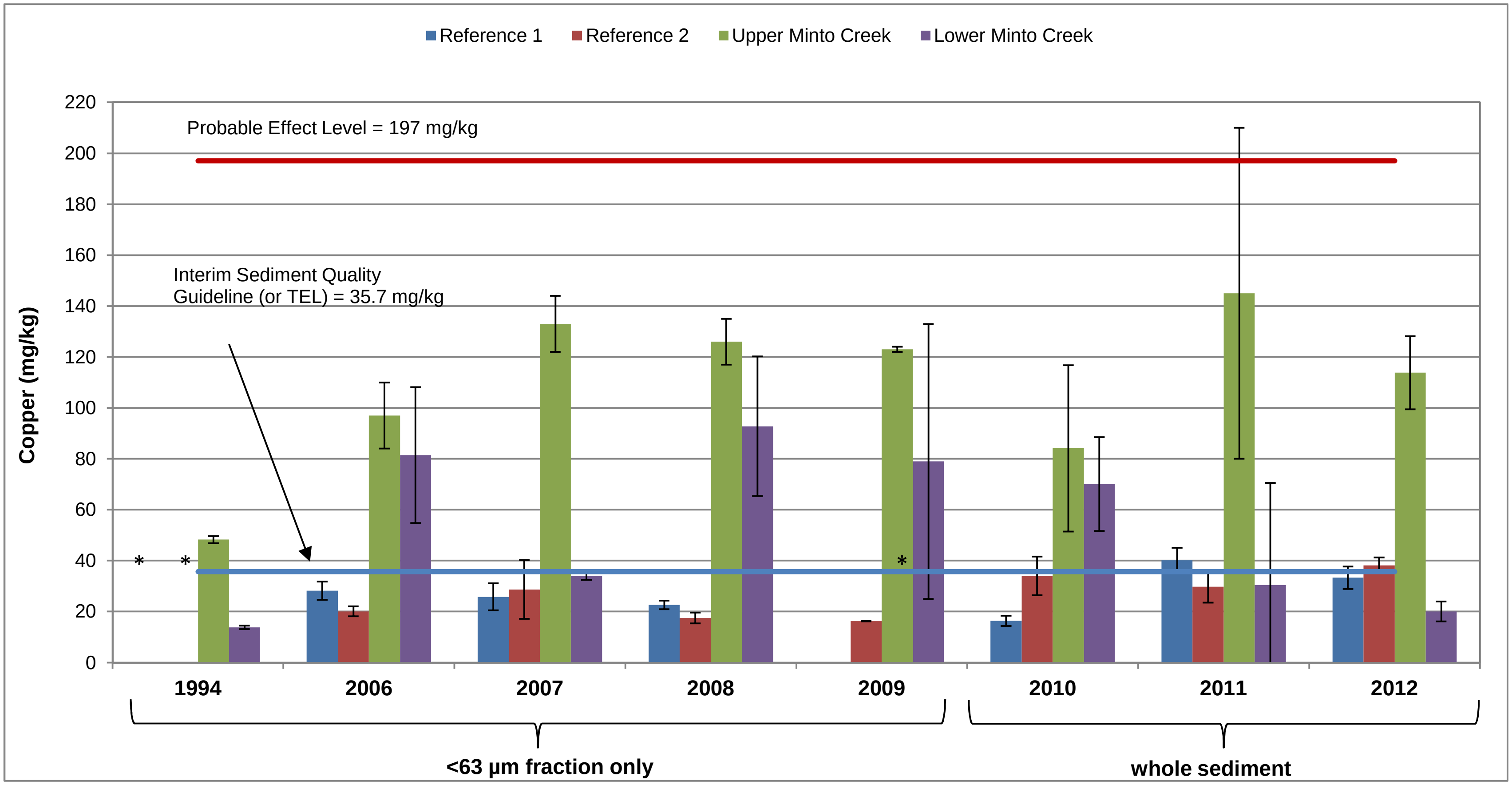


Figure 4.3: Mean copper concentrations in sediment collected in Minto Creek and reference locations, 1994-2012 (mean ± standard deviation)[1]

[1]Reference 1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2012; Reference 2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2012; * = no data. TEL: Threshold Effect Levels

reference differs from the observations of previous sampling years and could be due to inputs from non-mineralized areas within the catchment (e.g. bank instability in several tributaries).

4.3 Summary

Overall, concentrations of metals in receiving environment sediments were lower than reference and/or sediment quality guidelines with the exception of copper at upper Minto Creek. Arsenic concentration was greater than the sediment quality guideline at both exposure and reference areas (as it was in previous sampling years), indicating naturally elevated arsenic concentrations. In lower Minto Creek, where sediment is less sparsely distributed and some depositional habitat is supported, sediment metal concentrations were below reference and/or sediment quality guidelines. In 2012, concentrations of many analytes in lower Minto Creek were lower than in 2010 and 2011 possibly due to contribution of sediment from bank erosion in several tributaries.

5.0 BENTHIC INVERTEBRATE COMMUNITY

Benthic invertebrate community samples were processed separately using 250 µm and 500 µm sieve sizes. In comparisons of lower Minto Creek to lower Wolverine Creek, the same trends were evident for both 250 µm and 500 µm sieve sizes (Appendix D). Due to the similarity in results associated with the two mesh sizes, the 500 µm fraction results (Appendix Tables D.1-D.6) are discussed herein. Results for 250 µm mesh size are provided in Appendix D (Appendix Tables D.7-D.13).

5.1 Primary Metrics and Community Composition

Lower Minto Creek had significantly lower density (individuals/m^2; 856 versus 7,579; Figure 5.1a; Table 5.1) and significantly higher mean number of benthic invertebrate taxa than at lower Wolverine Creek (20.4 versus 12.6; Figure 5.1b; Table 5.1). Consistent with the greater number of taxa in lower Minto Creek, Simpson's Diversity was also significantly greater; whereas there was no difference in Simpson's Evenness (Figure 5.1c; Table 5.1). Bray-Curtis index (distance from the reference median) was significantly higher at lower Minto Creek than at lower Wolverine Creek (Figure 5.1d; Table 5.1), indicating a difference in community composition.

Dominant taxonomic groups in lower Minto and Wolverine creeks included EPT taxa (Ephemeroptera, Plecoptera and Trichoptera or mayflies, stoneflies and caddisflies, respectively), chironomids (non-biting midges), oligochaetes (worms) and nematodes (roundworms). There were no significant differences between areas in the relative abundance of oligochaetes, nematodes or organisms from the pollution and enrichment intolerant EPT order (Figure 5.2a,c,d; Table 5.1, Appendix Table D.5). However, percent chironomids was significantly lower at lower Minto Creek than at lower Wolverine Creek (Figure 5.2b; Table 5.1, Appendix Table D.5).

Correspondence Analysis (CA) summarized 64.4 percent of the community variance in the first three axes (Appendix Table D.4). The first CA axis explained 38.2 percent of the variation and significantly separated lower Minto Creek from the reference area, lower Wolverine Creek. There were no area differences for subsequent axes (Appendix Table D.5). The exposure area had extreme negative scores on CA Axis-1, in contrast to the extreme positive scores for the reference area (Figure 5.3; Appendix Table D.4). Low CA axis scores were associated with higher relative abundance of negative scoring taxa such as naidid worms, *Sphaeromias* No-See-Ums, cyclopoid copepods, *Psectrocladius* chironomids, and flatworms (Appendix Table D.4). The large positive scores for the reference stations indicated peak abundances of *Taenioma* and perlodid stoneflies, the

Table 5.1: Summary of benthic invertebrate community metrics and statistical comparisons, Minto Mine WUL, 2012.

Metric	Area Means		Statistical Contrasts		
	Lower Wolverine Creek (Reference)	Lower Minto Creek (Exposed)	Significant Difference between areas?	Direction	p-value
Density (organisms/m^2)	7,579	856	Yes	Minto < Wolverine	0.001
Number of Taxa	12.6	20.4	Yes	Minto > Wolverine	0.000
Simpson's Diversity [1]	0.51	0.74	Yes	Minto > Wolverine	0.050
Simpson's Evenness [1]	0.20	0.20	No	-	0.981
Bray-Curtis Distance	0.25	0.91	Yes	Minto > Wolverine	0.000
EPT (%) [2]	11.4	23.5	No	-	0.103
Chironomidae (%)	75.1	51.5	Yes	Minto < Wolverine	0.014
Oligochaetae (%)	11.1	7.8	No	-	0.558
Nemata (%)	0.7	4.9	No	-	0.272
CA Axis-1 (38.2%)	0.60	-0.87	Yes	non-directional	0.000
CA Axis-2 (14.1%)	0.01	-0.09	No	-	0.749
CA Axis-3 (12.1%)	0.07	0.02	No	-	0.885

(yellow highlight) indicates a statistically significant difference between exposed and reference areas

[1] Calculated as recommended by Environment Canada 2012

[2] Percent Ephemeroptera, Plecoptera, Trichoptera

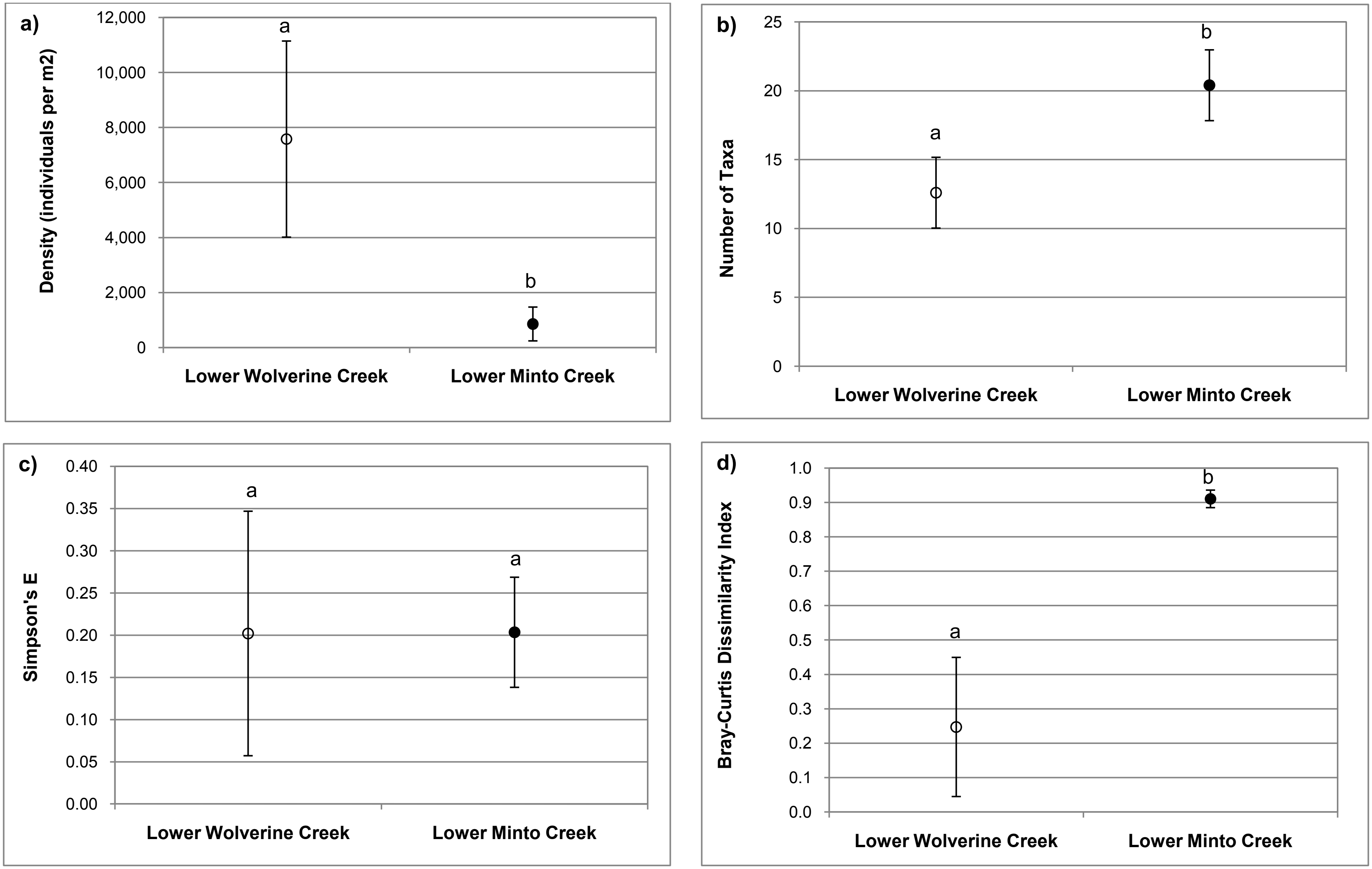


Figure 5.1: Comparison of a) benthic invertebrate density, b) number of taxa, c) Simpson's Eveness and d) Bray-Curtis Dissimilarity at the lower Minto Creek exposure area compared to the lower Wolverine Creek reference area (500 µm mesh). Data represents area means and 95% confidence intervals (n=5 in all areas). Different letters above data points indicate areas that were significantly different ($p < 0.1$).

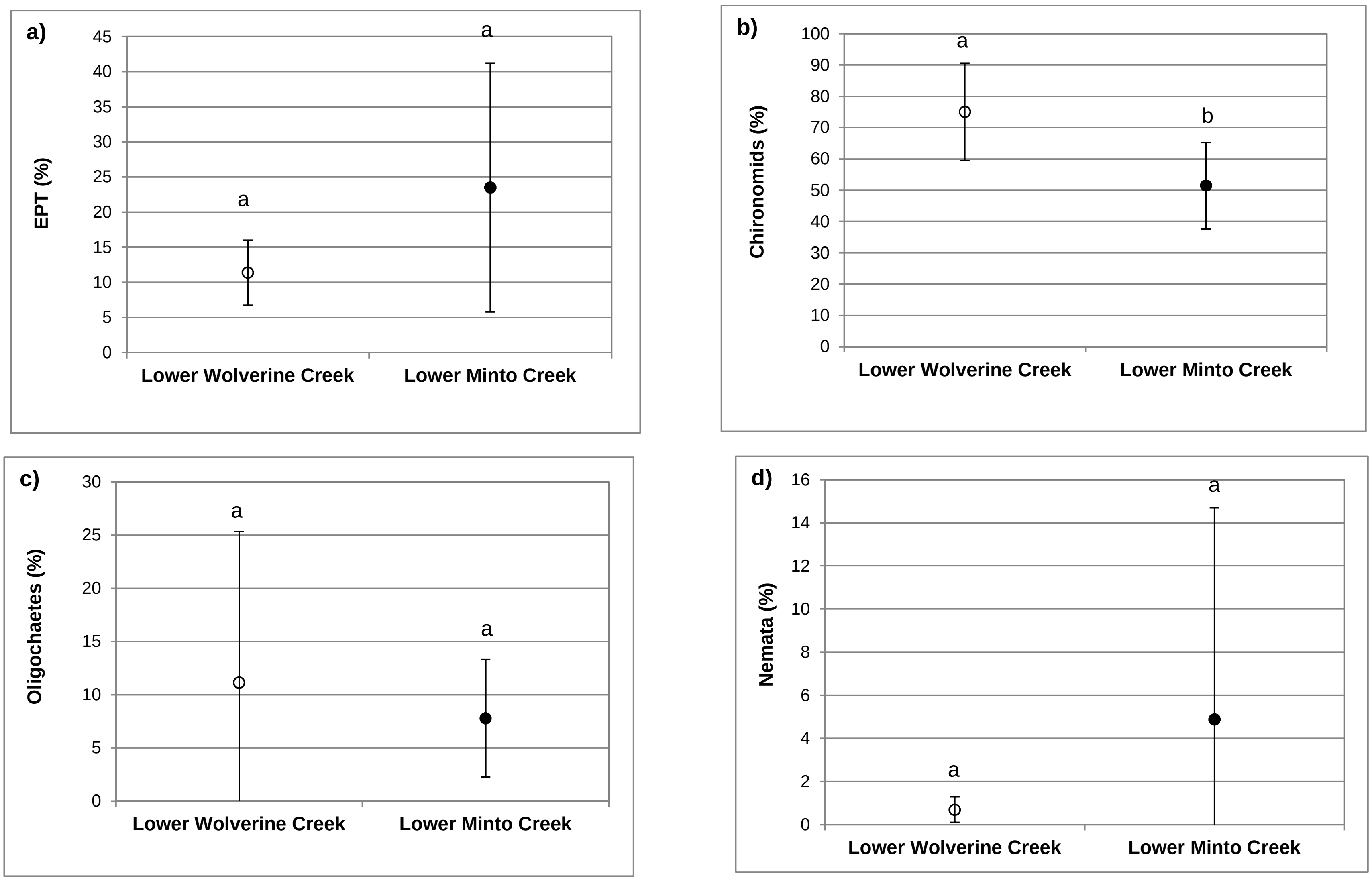


Figure 5.2: The relative abundance as percent of total organisms in an area for a) EPT, b) Chironomids, c) Oligochaetes and d) Nemata (500 µm mesh). Data represents area means and 95% confidence intervals (n=5 in all areas). Different letters above 95% confidence interval bars indicate areas that were significantly different (p<0.1).

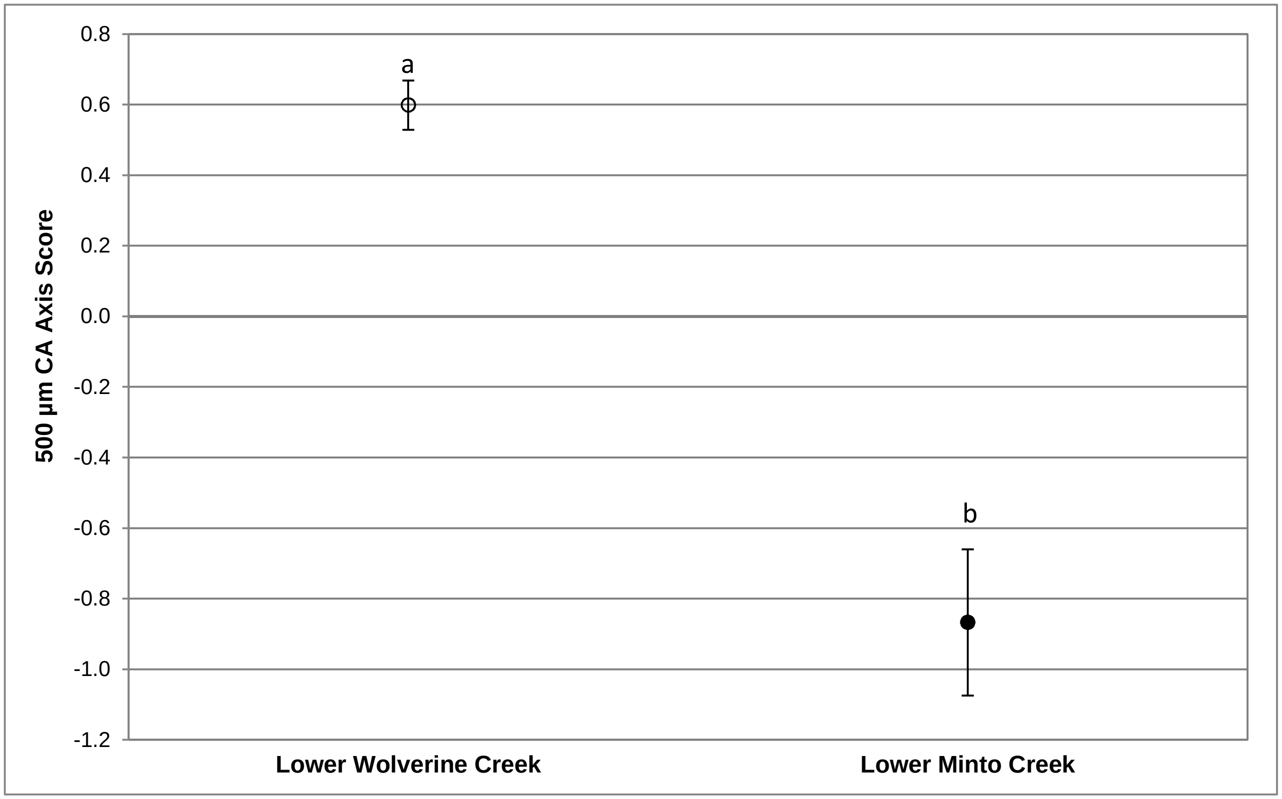


Figure 5.3: Comparison of CA Axis-1 at lower Minto Creek to lower Wolverine Creek

mayfly *Drunella spinifera*, and chironomids of the genus *Orthocladius*. The taxa listed above occurred in most cases at only exposure stations (-ve scoring taxa) or reference stations (+ve scoring taxa).

The absence of *Orthocladius* chironomids and of some stonefly taxa (Family Perlodidae, and *Taenioma*) at exposure stations identified key, extreme-scoring taxa that led to significant reference-exposure differences on the first CA axis. Stoneflies are, in general, associated with unpolluted, clear water with alkaline-to-neutral pH (Burdick and Gaufin 1978). Specific taxa in the order do vary somewhat in tolerance, but the presence of nemourid stoneflies at the slightly more alkaline exposure area suggest that water quality differences are minor, and that habitat differences may play a role in determining which stonefly families are present. *Orthocladius* is a genus of chironomids represented by more than 20 different species, some of which are variously reported to be acidophilous or tolerant of eutrophication (Beck 1977). The absence of *Orthocladius* at exposure stations cannot clearly be ascribed to the slightly more basic pH in this area without knowing more about the tolerances of the species of *Orthocladius* found at reference stations.

5.2 Correlation Analysis

Most significant correlations between benthic invertebrate community metrics and physical-chemical conditions were related to temperature and specific conductivity (Table 5.2). With higher temperature and specific conductivity at lower Minto Creek relative to reference, there were lower density, more taxa/diversity, greater Bray-Curtis distance and lower CA Axis-1 score (Table 5.2, Figure 5.4). However, the relationships were highly leveraged rather than a continuously distributed. These correlations suggest that lower density, higher taxon richness and greater Bray-Curtis dissimilarity could be mine related as higher temperatures and specific conductivity are related to mine discharges. However, correlation is not causation and inference of cause is not strong due to the observed leveraging. Other significant correlations are presented in Appendix D (Appendix Figures D.2-D.4).

5.3 Temporal Comparisons

Temporal comparisons of the benthic invertebrate community condition of lower Minto Creek were made in order to augment data interpretation, but their power is tempered by temporal changes in sampling location, sampling methodology, level of replication and analytical processing techniques. For example, 1994 baseline data were collected near the mouth of Minto Creek as three single grab samples, 2006 data were collected at Station W2 in the same manner, 2008 and 2010 data were collected at Station W2 as

Table 5.2: Correlations between benthic metrics and environmental supporting measurements at Minto Mine WUL Stations, 2012.

		Median Intermediate Axis Length (cm)	Median Embeddedness (%)	Water Velocity (m/s)	Depth (m)	Temperature (°C)	DO (%)	Specific Conductivity (µS/cm)	pH	% cobble	% gravel	% sand and finer
Density (organisms/m^2)	Pearson Correlation	-0.32	-0.53	0.24	-0.25	-0.79	-0.82	-0.86	-0.88	-0.17	-0.04	0.22
	Sig. (2-tailed)	0.375	0.145	0.508	0.510	0.007	0.004	0.002	0.001	0.635	0.915	0.536
	N	10	9	10	9	10	10	10	10	10	10	10
Number of Taxa	Pearson Correlation	0.10	0.31	-0.22	0.53	0.82	0.72	0.87	0.73	-0.28	0.07	-0.12
	Sig. (2-tailed)	0.776	0.416	0.547	0.140	0.003	0.019	0.001	0.016	0.441	0.840	0.750
	N	10	9	10	9	10	10	10	10	10	10	10
Simpson's Diversity	Pearson Correlation	0.06	0.54	-0.01	0.12	0.67	0.44	0.61	0.52	-0.31	0.17	0.00
	Sig. (2-tailed)	0.860	0.132	0.985	0.754	0.032	0.203	0.061	0.122	0.382	0.632	1.000
	N	10	9	10	9	10	10	10	10	10	10	10
Simpson's Evenness	Pearson Correlation	-0.13	0.72	0.26	-0.32	0.20	-0.26	0.01	-0.12	-0.45	0.10	0.22
	Sig. (2-tailed)	0.730	0.028	0.473	0.398	0.583	0.470	0.986	0.748	0.193	0.776	0.537
	N	10	9	10	9	10	10	10	10	10	10	10
Bray-Curtis Distance	Pearson Correlation	-0.21	0.40	-0.17	0.22	0.91	0.56	0.95	0.70	-0.38	0.20	-0.32
	Sig. (2-tailed)	0.568	0.289	0.645	0.572	0.000	0.094	0.000	0.024	0.278	0.581	0.374
	N	10	9	10	9	10	10	10	10	10	10	10
EPT (%) [1]	Pearson Correlation	0.14	0.40	0.12	0.27	0.59	0.40	0.54	0.45	-0.54	0.00	0.32
	Sig. (2-tailed)	0.697	0.283	0.735	0.481	0.070	0.251	0.108	0.190	0.104	0.996	0.361
	N	10	9	10	9	10	10	10	10	10	10	10
Chironomidae (%)	Pearson Correlation	-0.26	-0.63	-0.04	-0.28	-0.72	-0.65	-0.72	-0.70	0.30	-0.21	-0.02
	Sig. (2-tailed)	0.473	0.071	0.914	0.463	0.020	0.042	0.019	0.025	0.399	0.561	0.958
	N	10	9	10	9	10	10	10	10	10	10	10
Oligochaetae (%)	Pearson Correlation	0.20	0.30	0.03	-0.31	-0.11	0.07	-0.20	0.10	0.25	0.35	0.30
	Sig. (2-tailed)	0.571	0.425	0.930	0.415	0.770	0.840	0.586	0.792	0.483	0.314	0.408
	N	10	9	10	9	10	10	10	10	10	10	10
Nemata (%)	Pearson Correlation	0.09	0.36	0.39	0.08	0.13	0.21	0.36	0.17	0.03	-0.15	-0.99
	Sig. (2-tailed)	0.812	0.335	0.268	0.832	0.716	0.561	0.310	0.637	0.945	0.681	0.000
	N	10	9	10	9	10	10	10	10	10	10	10
CA Axis-1 (38.2%)	Pearson Correlation	-0.08	-0.49	0.13	-0.37	-0.86	-0.75	-0.97	-0.82	0.17	-0.15	0.39
	Sig. (2-tailed)	0.819	0.184	0.724	0.332	0.001	0.012	0.000	0.004	0.641	0.679	0.261
	N	10	9	10	9	10	10	10	10	10	10	10
CA Axis-2 (14.1%)	Pearson Correlation	0.07	-0.03	0.20	-0.01	-0.32	-0.17	-0.16	-0.27	0.33	0.00	-0.79
	Sig. (2-tailed)	0.854	0.930	0.583	0.982	0.369	0.643	0.662	0.450	0.356	0.992	0.006
	N	10	9	10	9	10	10	10	10	10	10	10
CA Axis-3 (12.1%)	Pearson Correlation	0.17	0.03	-0.10	-0.31	-0.01	0.01	-0.02	0.10	0.44	-0.68	-0.01
	Sig. (2-tailed)	0.644	0.935	0.774	0.414	0.977	0.975	0.946	0.776	0.198	0.032	0.974
	N	10	9	10	9	10	10	10	10	10	10	10

(grey) correlation scatterplot inspected: $p < 0.0100$

(yellow) significant after Bonferroni correction; $p < 0.00035$ ($p = 0.05$ adjusted for 143 comparisons)

[1] Percent Ephemeroptera, Plecoptera, Trichoptera

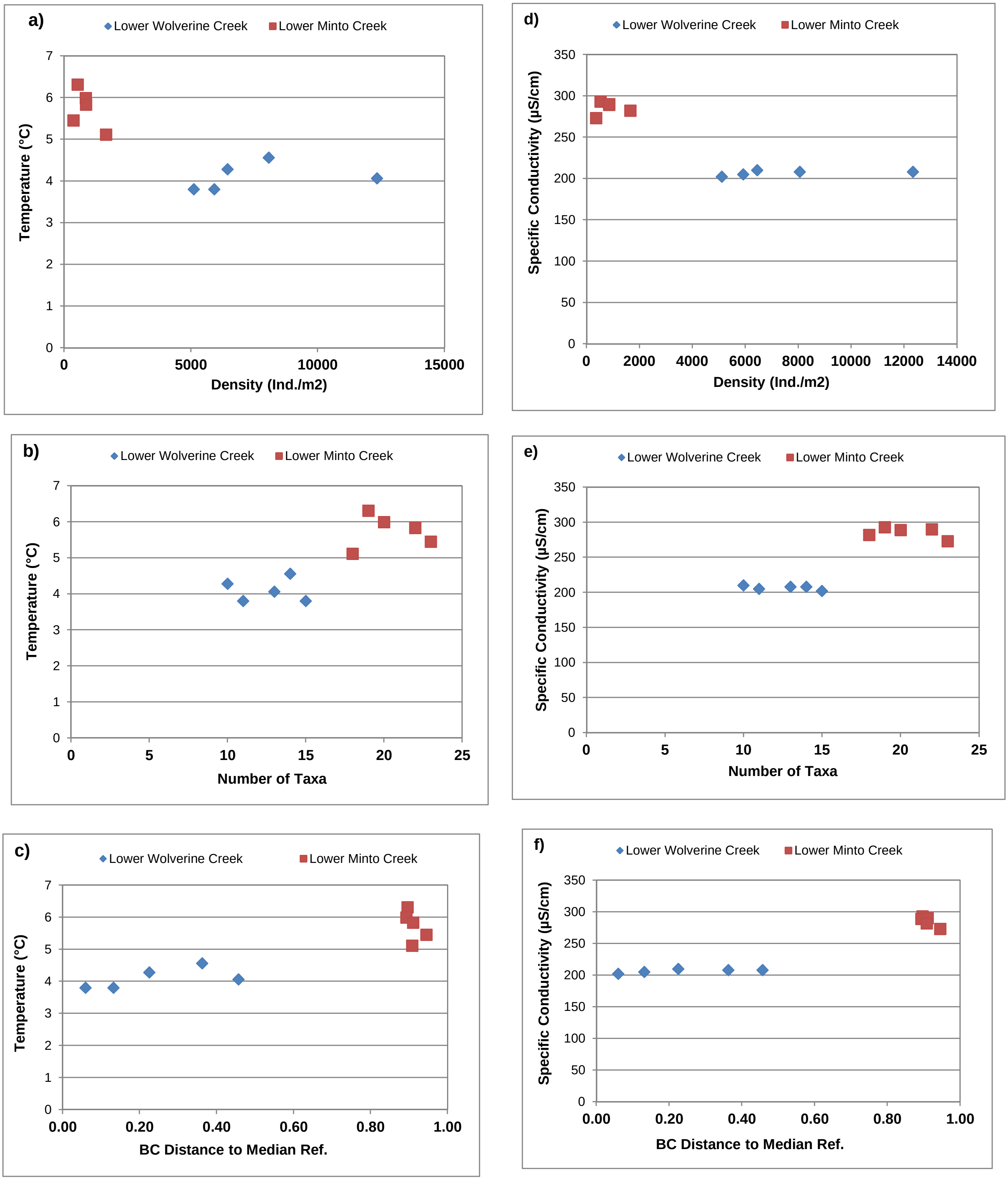


Figure 5.4: Scatterplots of significant relationships between selected benthic invertebrate community metrics and temperature and conductivity

three-grab composites whereas 2011 and 2012 data were collected as five replicate three-grab samples from a large area upstream of Station W2. Only in the later years (2011 and 2012) do data represent an area (i.e., lower Minto Creek) rather than a station.

Benthic invertebrate density in 2012 was lower than in all previous collections (Figure 5.5). This could be due to the unusually high sediment loads associated with erosion in non-mine impacted tributaries. Mean number of taxa in lower Minto Creek in 2012 (20.4 taxa) was lower than the 1994 baseline (HPK 1994) but similar to collections in 2008 and 2010, when the mine was discharging effluent (Figure 5.5). In comparisons of lower Minto Creek to the lower Wolverine Creek reference, differences in density and number of taxa/diversity observed in 2012 were opposite from those observed in 2011. As in 2011, evenness was lower at the exposure area compared to other sampling years; however, in 2012, the difference was not statistically significant (Table 5.1; Figure 5.1c; Figure 5.5; Appendix Tables D.3-D.6). Changes in density and evenness over time likely reflected high temporal variability of benthic invertebrate communities in the region, also evident at reference areas (Minnow 2009b; 2011). High inter-annual variability in environmental conditions such as flow, deep freezing, and occasional pulses of very high sediment loads can, in turn, influence benthic invertebrate community composition features among years.

5.4 Summary

Based on control-impact comparison of benthic invertebrate community data collected by Hess sampling, the benthic invertebrate community of lower Minto Creek differed from that of lower Wolverine Creek on the basis of density (lower), taxon richness (higher), Simpson’s Diversity (higher), Bray-Curtis dissimilarity (greater), percent chironomids (lower), as well as for the first axis of Correspondence Analysis. Greater taxon richness/diversity and lower dominance by chironomids are typically considered indicative of a healthy erosional benthic invertebrate community, whereas lower density can be equivocal. The lower density, higher number of taxa and greater Bray-Curtis dissimilarity at the lower Minto Creek was correlated with higher temperature and specific conductivity, but the relationships were highly leveraged and therefore do not strongly infer cause. Percent chironomids was significantly lower and percent EPT taxa was higher (but not significantly so) at lower Minto Creek than at lower Wolverine Creek. Given that chironomids are generally considered to be tolerant of pollutants and EPT taxa are generally considered to be sensitive to pollutants, this pattern suggests limited influence of the mine on the benthic invertebrate community of lower Minto Creek. High temporal variability has been observed at the exposure and reference area (Minnow 2009b; 2011, 2012a), presumably due to inter-annual variability in environmental conditions (e.g., flow,

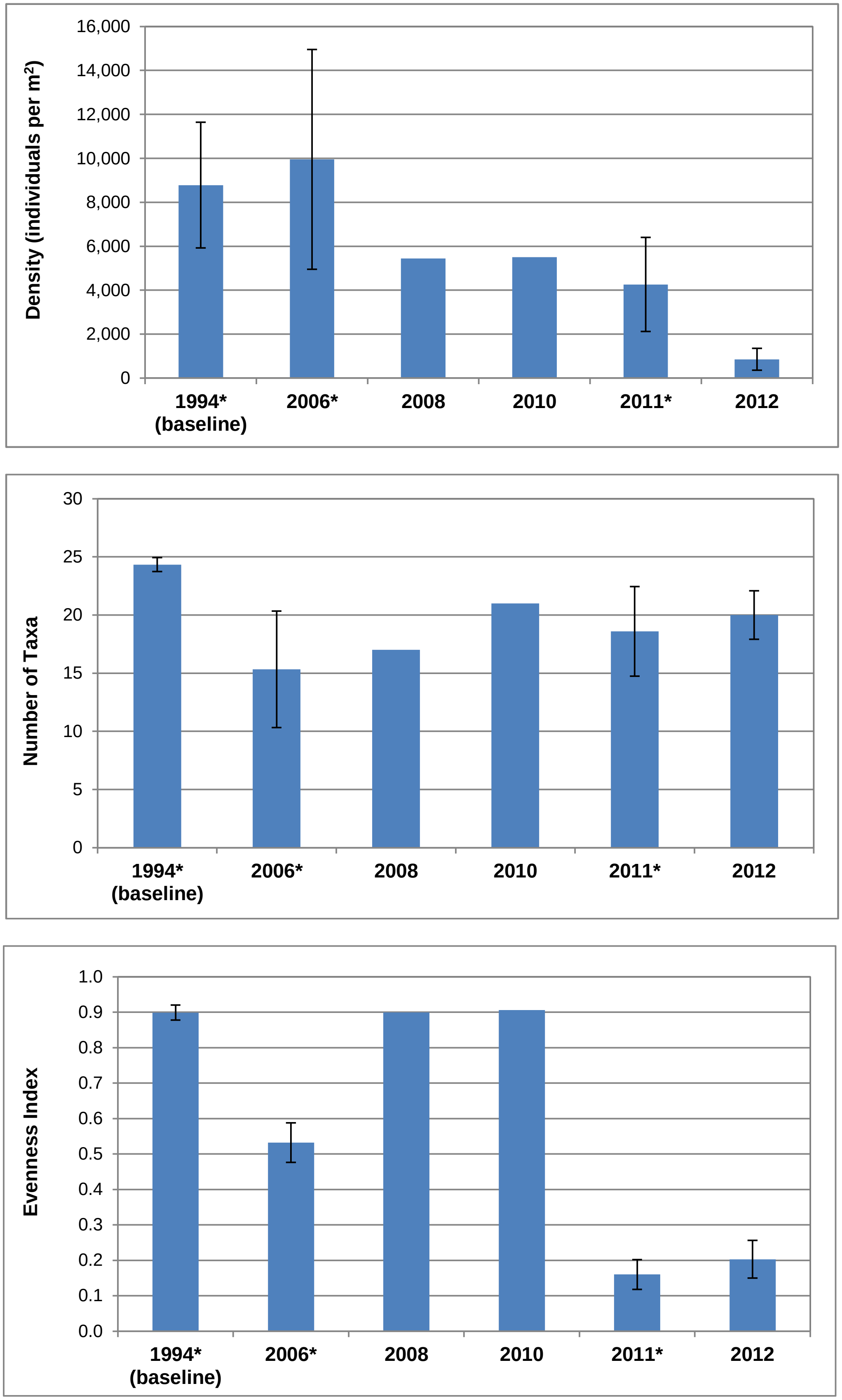


Figure 5.5: Primary benthic invertebrate community metrics at lower Minto Creek, 1994 - 2012. Data presented as mean ± standard deviation where replicated. Asterisk (*) indicates a year the mine was not discharging.

ice scour). This variability may also be related to changes in sampling method/replication, making it difficult to distinguish any mine-related influences.

6.0 TISSUE CHEMISTRY

As indicated in Section 2.5, tissue chemistry data are provided here simply to report the ancillary data that were collected along with the selenium data reported under separate cover (Minnow 2013). Data interpretation is therefore limited to basic comparisons of metal concentrations in tissue collected at the exposure area (lower Minto Creek) to those collected at reference creeks.

6.1 Periphyton Tissue

Metal concentrations in periphyton tissue collected from lower Minto Creek were lower than in periphyton tissue collected from lower Wolverine Creek and similar to lower Bog Creek (Table 6.1; Appendix Table C.2). In the absence of the periphyton community data (pending), it is unclear whether the differences may be related to differences in community composition.

6.2 Benthic Invertebrate Tissue

Metal concentrations in benthic invertebrate tissue collected from lower Minto Creek were generally similar to concentrations in samples collected from lower Wolverine Creek and lower Big Creek, with no evidence of consistently greater concentrations in lower Minto Creek than in reference. However, at least one mine-related metal (copper) was present at a greater concentration in benthic invertebrate samples from lower Minto Creek than reference (Appendix Table C.3).

6.3 Fish Tissue

Selenium and sodium were the only analytes present at significantly greater concentrations in slimy sculpin collected from Minto Creek relative to those collected from lower Big Creek (Table 6.1; Appendix Table C.4). Conversely, concentrations of six metals (arsenic, beryllium, bismuth, boron, silver and strontium) were significantly lower in slimy sculpin collected from Minto Creek than in those collected from lower Big Creek (Table 6.1; Appendix Table C.4). Of the analytes observed to differ among areas, selenium is noteworthy, and comparison of selenium concentrations in other fish tissues and to additional areas is planned for 2013 (Minnow 2013).

Table 6.1: Tissue chemistry results, Minto Mine WUL, September 2012.

Analyte	Units	Periphyton				Benthic Invertebrates			Slimy Sculpin			
		Lower Wolverine Creek (Reference)		Lower Big Creek (Reference)	Lower Minto Creek (Exposed)	Lower Wolverine Creek (Reference)	Lower Big Creek (Reference)	Lower Minto Creek (Exposed)	Lower Big Creek (Reference)		Lower Minto Creek (Exposed)	
		n = 5		n=1	n=1	n = 1	n=1	n = 1	n = 8		n = 7	
		Mean	Standard Deviation	Mean	Mean	Mean	Mean	Mean	Mean	Standard Deviation	Mean	Standard Deviation
Moisture	%	82.1	4.5	59.3	51.9	80.1	85.4	90.7	-	-	-	-
Aluminum (Al)	mg/kg dw	31,440	2,207	21,500	21,100	4,890	2,440	8,720	91.8	81.9	61.8	63.4
Antimony (Sb)	mg/kg dw	0.04	0.00	0.03	0.02	< 0.01	0.05	0.08	0.027	0.014	0.019	0.012
Arsenic (As)	mg/kg dw	8.20	1.21	13.90	4.24	2.05	2.86	5.32	0.435	0.084	0.308	0.130
Barium (Ba)	mg/kg dw	361	26	260	284	71	48	196	15.3	2.2	13.5	6.1
Beryllium (Be)	mg/kg dw	1.23	0.09	0.692	0.664	0.23	0.09	0.35	0.142	0.017	0.095	0.005
Bismuth (Bi)	mg/kg dw	0.143	0.008	0.451	0.125	0.03	0.07	0.07	0.142	0.017	0.095	0.005
Boron (B)	mg/kg dw	17.5	20.3	5.6	4.9	< 2.0	< 3.0	20.3	2.84	0.35	1.90	0.10
Cadmium (Cd)	mg/kg dw	0.38	0.05	0.24	0.18	0.27	0.37	0.31	0.197	0.117	0.171	0.109
Calcium (Ca)	mg/kg dw	15,400	997	11,500	16,200	3,040	3,630	9,450	30,886	4,632	32,509	4,497
Chromium (Cr)	mg/kg dw	81.7	5.5	43.6	51.4	12.4	17.2	16.9	0.388	0.144	0.266	0.128
Cobalt (Co)	mg/kg dw	19.5	1.6	10.6	10.3	3.94	2.44	5.38	0.154	0.094	0.178	0.109
Copper (Cu)	mg/kg dw	44.4	3.5	30.9	26.3	17.3	18.5	33.2	4.468	0.912	4.555	1.096
Iron (Fe)	mg/kg dw	37,400	3,102	26,000	28,000	7,640	5,400	13,500	222	138	190	136
Lead (Pb)	mg/kg dw	8.30	0.47	7.32	6.72	1.32	1.30	3.34	0.249	0.124	0.178	0.059
Magnesium (Mg)	mg/kg dw	13,540	1,361	8,460	7,230	3,120	2,160	3,440	1,847	264	1,704	234
Manganese (Mn)	mg/kg dw	1,526	373	653	1,130	360	256	782	27	8	49	32
Mercury (Hg)	mg/kg dw	0.09	0.05	0.07	0.06	0.07	0.06	0.08	0.198	0.045	0.176	0.065
Molybdenum (Mo)	mg/kg dw	0.49	0.04	0.68	0.43	0.72	1.64	3.21	0.109	0.023	0.138	0.040
Nickel (Ni)	mg/kg dw	50.2	3.9	25.1	23.9	8.88	5.19	11.3	0.539	0.242	0.302	0.185
Phosphorus (P)	mg/kg dw	1,390	203	1,190	1,060	5,750	5,030	4,250	24,404	3,394	25,953	2,202
Potassium (K)	mg/kg dw	3,340	740	2,600	2,400	6,200	7,300	5,400	15,874	3,651	14,612	2,226
Selenium (Se)	mg/kg dw	0.87	0.12	0.3	0.21	1.01	0.83	1.14	3.4	0.7	5.2	1.1
Silver (Ag)	mg/kg dw	-	-	-	-	-	-	-	0.028	0.003	0.019	0.001
Sodium (Na)	mg/kg dw	< 1,000	-	< 1,000	< 1,000	4,300	6,100	3,000	4,265	812	6,101	764
Strontium (Sr)	mg/kg dw	133	8	91	104	26.0	34.3	74.3	87	24	62	9
Thallium (Tl)	mg/kg dw	0.21	0.02	0.15	0.14	0.04	0.02	0.07	0.019	0.003	0.015	0.008
Tin (Sn)	mg/kg dw	0.23	0.04	0.04	< 0.02	< 0.02	0.03	0.35	0.142	0.017	0.237	0.127
Titanium (Ti)	mg/kg dw	1,472	73	1,000	1,020	28	102	404	7.8	4.2	7.1	4.3
Uranium (U)	mg/kg dw	2.52	0.22	1.08	1.32	0.60	1.28	1.29	0.043	0.017	0.032	0.018
Vanadium (V)	mg/kg dw	105	8	75	81	21.5	14.7	37.5	-	-	-	-
Yttrium (Y)	mg/kg dw	15.7	0.7	13.3	17.1	2.70	1.76	7.37	0.777	0.241	0.869	0.302
Zinc (Zn)	mg/kg dw	97	7	79	73	93.0	74.0	96.1	111	18	112	11

(green) indicates a mean concentration in lower Minto Creek that is significantly lower than the mean concentration in lower Big Creek (t-test; p=0.05)

(orange) indicates a mean concentration in lower Minto Creek that is significantly greater than the mean concentration in lower Big Creek (t-test; p=0.05)

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The Minto Mine sediment, periphyton and benthic assessment undertaken from September 5th to 8th, 2012 served to quantitatively compare water quality (field measures and chemistry), sediment quality and benthic invertebrate community condition of Minto Creek relative to reference creeks and also drew on previous data for interpretation.

Temperature and specific conductivity were higher at the exposure areas (upper and lower Minto Creek) than at the reference areas (upper McGinty Creek and lower Wolverine Creek). At the time of water sampling (September 5th to 8th, 2012), a total of seven analytes (phosphorus, TSS, aluminum, cadmium, chromium, copper, and iron) did not meet WUL standards and/or water quality guidelines in at least one exposure area. Phosphorus was higher than the WUL standard in lower Minto Creek and reference areas suggesting naturally elevated concentrations and indicating that the WUL standard is not appropriate. Total suspended solids at lower Minto Creek in 2012 were much higher than in any other sampling year and could explain why aluminum, chromium and iron were elevated in 2012 at lower Minto Creek (Minnow 2010c; Minnow 2012a). A key finding was that, in lower Minto Creek, only cadmium and copper were greater than both guidelines/standards and reference concentrations. Furthermore, at the time of sampling in 2012, the water quality of upper Minto Creek was better than the water quality of lower Minto Creek, indicating that the Minto Mine had a limited influence on water quality at that time. Differences in chlorophyll *a* between areas were likely not related to water quality but rather to natural differences. Regardless, the concentrations of chlorophyll a found at both areas were well below the guideline of 100 mg/m^2 for the protection of aquatic life and both indicate low productivity (oligotrophic) based on the classification system of Dodds et al. (1998).

Sediment metal concentrations in the exposure area were lower than reference and/or sediment quality guidelines with the exception of copper at upper Minto Creek. Arsenic concentration was greater than the sediment quality guideline at exposure and reference areas (as it was in previous sampling years), indicating naturally elevated arsenic concentrations. In lower Minto Creek, where sediment is less sparsely distributed and some depositional habitat is supported, sediment metal concentrations were below reference and/or sediment quality guidelines. In 2012, concentrations of many analytes in lower Minto Creek were lower than in 2010 and 2011 possibly due to contribution of sediment from bank erosion in several tributaries.

Based on control-impact comparison of benthic invertebrate community data collected by Hess sampling, the benthic invertebrate community of lower Minto Creek differed from that of lower Wolverine Creek on the basis of density (lower), taxon richness (higher), Simpson's Diversity (higher), Bray-Curtis dissimilarity (greater), percent chironomids (lower), as well as for the first axis of Correspondence Analysis. Greater taxon richness/diversity and lower dominance by chironomids are typically considered indicative of a healthy erosional benthic invertebrate community, whereas lower density can be equivocal. The lower density, higher number of taxa and greater Bray-Curtis dissimilarity at the lower Minto Creek was correlated with higher temperature and specific conductivity, but the relationships were highly leveraged and therefore do not strongly infer cause. Percent chironomids was significantly lower and percent EPT taxa was higher (but not significantly so) at lower Minto Creek than at lower Wolverine Creek. Given that chironomids are generally considered to be tolerant of pollutants and EPT taxa are generally considered to be sensitive to pollutants, this pattern suggests limited influence of the mine on the benthic invertebrate community of lower Minto Creek. High temporal variability has been observed at the exposure and reference area (Minnow 2009b; 2011, 2012a), presumably due to inter-annual variability in environmental conditions (e.g., flow, ice scour).

The chemical quality of biological tissues (periphyton, benthic invertebrates and slimy sculpin) collected at mine-exposed lower Minto Creek and reference areas was reported. Simple comparisons did not indicate any consistent exposed area-reference area differences indicative of a mine-related influence.

7.2 Recommendations

Based on the results and conclusions of the 2012 Minto Mine sediment, periphyton and benthic assessment, it is recommended that the program is repeated in 2013 with the sole modification being that only >500 μm sampling is used for benthic invertebrate community monitoring. The use of the 500 μm cutoff for benthic invertebrate community sampling and analysis is the industry standard (e.g., Environment Canada 2012) and reduces the collection of small organisms/life stages that are difficult to identify precisely. This is now also supported by the 2012 comparison of 250 μm and 500 μm fraction results, which yielded similar findings.

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APPENDIX A

DATA QUALITY ASSESSMENT

APPENDIX A: DATA QUALITY ASSESSMENT

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A1.0 INTRODUCTION

Data Quality Assessment (DQA) was conducted on data collected as part of the 2012 Minto Creek Periphyton and Benthic Invertebrate Community Assessment Report. The objective of DQA is to define the overall quality of the data presented in the report, and, by extension, the confidence with which the data can be used to derive conclusions.

A1.1 Background

A variety of factors can influence the chemical and biological measurements made in an environmental study and thus affect the accuracy and/or precision of the data. Inconsistencies in sampling or laboratory methods, use of instruments that are inadequately calibrated or which cannot measure to the desired level of accuracy or precision, and contamination of samples in the field or laboratory are just some of the potential factors that can lead to the reporting of data that do not accurately reflect actual environmental conditions. Depending on the magnitude of the problem, inaccuracy or imprecision have the potential to affect the reliability of any conclusions made from the data. Therefore, it is important to ensure that monitoring programs incorporate appropriate steps to control the non-natural sources of data variability (i.e., minimize the variability that does not reflect natural spatial and temporal variability in the environment) and thus assure the quality of the data.

Data quality as a concept is meaningful only when it relates to the intended use of the data. That is, one must know the context in which the data will be interpreted in order to establish a relevant basis for judging whether or not the data set is adequate. DQA involves comparison of actual field and laboratory measurement performance to data quality objectives (DQOs) established for a particular study, such as evaluation of method detection limits, blank sample data, data precision (based on field and laboratory duplicate samples), and data accuracy (based on matrix spike recoveries and/or analysis of standards or certified reference materials).

DQOs were established at the outset of the field program that reflect reasonable and achievable performance expectations (Table A.1). Programs involving a large amount of samples and analytes usually result in some results that exceed the DQOs. This is particularly so for multi-element scans (e.g., ICP scans for metals) since the analytical conditions are not necessarily optimal for every element included in the scan. Generally, scan results may be considered acceptable if no more than 20% of the parameters fail to meet the DQOs. Overall, the intent of comparing data to DQOs was

Table A.1: Data quality objectives for environmental samples.

Quality Control Measure	Quality Control Sample Type	Study Component: Water Quality	Study Component: Sediment Quality	Study Component: Benthic Invertebrate Community	Study Component: Tissue Chemistry
Method Detection Limits (MDL)	Comparison actual MDL versus target MDL	MDL for each parameter should be at least as low as applicable guidelines, ideally ≤1/10th guideline value[a]	MDL for each parameter should be at least as low as applicable guidelines, ideally ≤1/10th guideline value[a]	n/a	MDL as requested based on laboratory's stated performance
Blank Analysis	Laboratory Blank	≤two-times the laboratory MDL	≤two-times the laboratory MDL	n/a	≤two-times the laboratory MDL
Field Precision	Field Duplicates	n/a	n/a	n/a	n/a
Laboratory Precision	Laboratory Duplicates	≤25% RPD	≤35% RPD	n/a	≤35% RPD
	Sub-Sampling Error	n/a	n/a	20% difference between sub-samples	n/a
Accuracy	Recovery of Blank Spikes	80-120%	n/a	n/a	n/a
	Recovery of Matrix Spikes	75-125%	n/a	n/a	n/a
	Recovery of Certified Reference Materials (CRMs)	85-115%	70-130%	n/a	70-130%
	Organism Recovery	n/a	n/a	≥ 90%	n/a

[a] or below predictions, if applicable and no guideline exists for the substance.

[b] RPD - Relative Percent Difference

n/a - not applicable

not to reject any measurement that did not meet the DQO, but to ensure that any questionable data received more scrutiny to determine what effect, if any, this had on interpretation of results within the context of this project.

A1.2 Types of Quality Control Samples

Several types of quality control (QC) samples were assessed based on samples collected (or prepared) in the field and laboratory. These samples, and a description of each, include the following:

- **Blanks** are samples of de-ionized water and/or appropriate reagent(s) that are handled and analyzed the same way as regular samples. These samples will reflect any contamination of samples occurring in the field (in the case of field or travel blanks) or the laboratory (in the case of laboratory or method blanks). Analyte concentrations should be non-detectable although a data quality objective of twice the method detection limit allows for slight "noise" around the detection limit.

- **Laboratory Duplicates** are replicate sub-samples created in the laboratory from randomly selected field samples which are sub-sampled and then analyzed independently using identical analytical methods. The laboratory duplicate sample results reflect any variability introduced during laboratory sample handling and analysis and thus provide a measure of laboratory precision.

- **Spike Recovery Samples** are created in the laboratory by adding a known amount/concentration of a given analyte (or mixture of analytes) to a randomly selected test sample previously divided to create two sub-samples. The spiked and regular sub-samples are then analyzed in an identical manner. The spike recovery represents the difference between the measured spike amount (total amount in spiked sample minus amount in original sample) relative to the known spike amount (as a percentage). Two types of spike recovery samples are commonly analyzed. Spiked blanks (or blank spikes) are created using laboratory control materials whereas matrix spikes are created using field-collected samples. The analysis of spiked samples provides an indication of the accuracy of analytical results.

- **Certified Reference Materials** are samples containing known chemical concentrations that are processed and analyzed along with batches of environmental samples. The sample results are then compared to target results to provide a measure of analytical accuracy. The results are reported as the percent of the known amount that was recovered in the analysis.

The following QC was applied to benthic invertebrate community samples as follows:

- **Organism Recovery Checks** for benthic invertebrate community samples involve the re-processing of previously sorted material from a randomly selected sample to determine the number of invertebrates that were not recovered during the original sample processing. The reprocessing is conducted by an analyst not involved during the original processing to reduce any bias. This check allows the determination of accuracy through assessment of recovery efficiency.

A2.0 WATER SAMPLES

A2.1 Method Detection Limits

Most reported MDLs were at or below the target concentrations with the exception of five analytes: cadmium, copper, mercury, vanadium and fluoride (Table A.2). Even though these MDLs were higher than requested, they were all lower than guideline levels except for fluoride. Therefore, data for this project can be reliably interpreted relative to the guidelines.

A2.2 Laboratory Blank Sample Analysis

All blank samples contained non-detectable analyte concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Table A.3).

A2.3 Data Precision

Close agreement was generally achieved between laboratory duplicate samples indicating that reported sample results were associated with good analytical precision (Table A.4).

A2.4 Data Accuracy

A2.4.1 Blank Spike Recovery Samples

Analyte recoveries for spiked blanks all met the data quality objectives indicating excellent analytical accuracy for the water sample analyses (Table A.3).

A2.4.2 Matrix Spike Recovery Samples

All analytes measured met the data quality objective of 75 - 125% recovery, but recovery of some analytes could not be calculated (Table A.3). The laboratory reported a qualifier (MS-B) for matrix spike results for phosphorus, dissolved organic carbon, total organic carbon, barium, manganese, sodium, strontium and uranium. For sodium and strontium, over 50% of the samples had the qualifier MS-B. The qualifier MS-B indicated analyses for which recoveries could not be calculated as the spike used had concentrations much lower than the concentration in the sample.

A2.4.3 Certified Reference Materials

Most analyte recoveries from certified reference materials met the data quality objectives (Tables A.3) except for many of the dissolved metal samples. The following samples did not meet the data quality objective of 85 - 115% recovery: aluminum,

Table A.2: Laboratory method detection limits (MDLs) relative to targets and water quality guidelines, Minto Mine, 2012.

Analyte		Units	CCME Water Quality[a]		Method Detection Limit	
			30 Day	Max	Target	Achieved
Physical Tests	Conductivity	µS/cm	-	-	-	2.0
	Hardness (as CaCO3)	mg/L	-	-	-	0.5
	pH	pH units	-	-	-	0.1
	Total Suspended Solids	mg/L	12.7	-	1.27	3.0
	Total Dissolved Solids	mg/L	-	-	-	1.0
	Turbidity	NTU	4.85	-	0.485	0.1
Anions and nutrients	Alkalinity, Total	mg/L	-	-	-	2.0
	Ammonia, Total (as N)	mg/L	0.5[b]		0.05	0.005
	Chloride (Cl)	mg/L	120	640	12	0.5
	Fluoride (F)	mg/L	0.12	-	0.012	0.02
	Nitrate (as N)	mg/L	13	550	1.3	0.01
	Nitrite (as N)	mg/L	0.197	-	0.0197	0.001
	Phosphorus (P)-Total dissolved	mg/L	-	-	-	0.02
	Phosphorus (P)-Total	mg/L	-	-	-	0.02
	Sulfate (SO4)	mg/L	-	-	-	0.5
Cyanides	Cyanide, Total	mg/L	-	-	-	0.005
	Cyanide, Free	mg/L	0.005	-	0.0005	0.001
Organic / inorganic carbon	Dissolved Organic Carbon	mg/L	-	-	-	0.5 - 1.0
	Total Organic Carbon	mg/L	-	-	-	0.5 - 1.0
Total Metals	Total Aluminum (Al)	mg/L	0.1[c]	-	0.01	0.003
	Total Antimony (Sb)	mg/L	-	-	-	0.0001
	Total Arsenic (As)	mg/L	0.005	-	0.0005	0.0001
	Total Barium (Ba)	mg/L	-	-	-	0.00005
	Total Beryllium (Be)	mg/L	-	-	-	0.0001
	Total Bismuth (Bi)	mg/L	-	-	-	0.0005
	Total Boron (B)	mg/L	1.5	2.9	0.15	0.01
	Total Cadmium (Cd)	mg/L	0.00004d	-	0.000004	0.00001
	Total Calcium (Ca)	mg/L	-	-	-	0.05
	Total Chromium (Cr)	mg/L	0.001 Cr(VI)	-	0.0001	0.0001
	Total Cobalt (Co)	mg/L	-	-	-	0.0001
	Total Copper (Cu)	mg/L	0.003[d]	-	0.0003	0.0005
	Total Iron (Fe)	mg/L	0.3	-	0.03	0.01
	Total Lead (Pb)	mg/L	0.005[d]	-	0.0005	0.00005
	Total Lithium (Li)	mg/L	-	-	-	0.0005
	Total Magnesium (Mg)	mg/L	-	-	-	0.1
	Total Manganese (Mn)	mg/L	-	-	-	0.00005
	Total Mercury (Hg)	mg/L	0.00003	-	0.000003	0.00001
	Total Molybdenum (Mo)	mg/L	0.07	-	0.007	0.00005
	Total Nickel (Ni)	mg/L	0.12[d]	-	0.0126	0.0005
	Total Phosphorus (P)	mg/L	-	-	-	0.05
	Total Potassium (K)	mg/L	-	-		0.1
	Total Selenium (Se)	mg/L	0.001	-	0.0001	0.0001
	Total Silicon (Si)	mg/L	-	-	-	0.05
	Total Silver (Ag)	mg/L	0.0001		0.00001	0.00001
	Total Sodium (Na)	mg/L	-	-	-	0.05
	Total Strontium (Sr)	mg/L	-	-	-	0.0002
	Total Thallium (Tl)	mg/L	0.0008	-	0.00008	0.00001
	Total Tin (Sn)	mg/L	-	-	-	0.0001
	Total Titanium (Ti)	mg/L	-	-	-	0.01
	Total Uranium (U)	mg/L	0.015	0.033	0.0015	0.00001
	Total Vanadium (V)	mg/L	-	-	-	0.001
	Total Zinc (Zn)	mg/L	0.03	-	0.003	0.003

* Working guideline

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

[b] Based on lowest guideline using highest temperature and pH

[c] Based on lowest guideline using highest pH

[d] Based on lowest guideline using lowest hardness

(shaded) value greater than DQO

Table A.3: Laboratory QAQC for water quality, Minto Mine, 2012.

Analyte		Units	Method Blank		Spiked Blank			Matrix Spike			Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Material
Physical tests	Conductivity	µS/cm	< 2.0	< 2.0	-	-	-	-	-	-	147	143	97%	VA-EC-PCT-CONTROL
		µS/cm	< 2.0	< 2.0	-	-	-	-	-	-	147	160	109%	VA-EC-PCT-CONTROL
		µS/cm	< 2.0	< 2.0	-	-	-	-	-	-	147	142	97%	VA-EC-PCT-CONTROL
		µS/cm	< 2.0	< 2.0	-	-	-	-	-	-	147	145	99%	VA-EC-PCT-CONTROL
		µS/cm	< 2.0	< 2.0	-	-	-	-	-	-	147	144	98%	VA-EC-PCT-CONTROL
		µS/cm	< 2.0	< 2.0	-	-	-	-	-	-	147	143	97%	VA-EC-PCT-CONTROL
		µS/cm	< 2.0	< 2.0	-	-	-	-	-	-	147	160	109%	VA-EC-PCT-CONTROL
		µS/cm	< 2.0	< 2.0	-	-	-	-	-	-	147	142	97%	VA-EC-PCT-CONTROL
		µS/cm	< 2.0	< 2.0	-	-	-	-	-	-	147	145	99%	VA-EC-PCT-CONTROL
		µS/cm	< 2.0	< 2.0	-	-	-	-	-	-	147	144	98%	VA-EC-PCT-CONTROL
	pH	pH units	-	-	7.00	6.98	100%	-	-	-	7.00	7.05	101%	VA-PH7-BUF
		pH units	-	-	-	-	-	-	-	-	7.00	6.99	100%	VA-PH7-BUF
		pH units	-	-	-	-	-	-	-	-	7.00	6.97	100%	VA-PH7-BUF
		pH units	-	-	-	-	-	-	-	-	7.00	6.95	99%	VA-PH7-BUF
		pH units	-	-	-	-	-	-	-	-	7.00	6.96	99%	VA-PH7-BUF
		pH units	-	-	-	-	-	-	-	-	7.00	6.95	99%	VA-PH7-BUF
		pH units	-	-	-	-	-	-	-	-	7.00	6.94	99%	VA-PH7-BUF
		pH units	-	-	-	-	-	-	-	-	7.00	6.94	99%	VA-PH7-BUF
	Total Suspended Solids	mg/L	< 3.0	< 3.0	75.0	68.7	92%	-	-	-	-	-	-	-
		mg/L	< 3.0	< 3.0	75.0	81.3	108%	-	-	-	-	-	-	-
		mg/L	< 3.0	< 3.0	75.0	74.3	99%	-	-	-	-	-	-	-
		mg/L	< 3.0	< 3.0	75.0	70.3	94%	-	-	-	-	-	-	-
		mg/L	< 3.0	< 3.0	75.0	68.7	92%	-	-	-	-	-	-	-
	Turbidity	NTU	< 0.1	< 0.1	-	-	-	-	-	-	8.00	8.07	101%	VA-TURB-SPK-8
		NTU	< 0.1	< 0.1	-	-	-	-	-	-	8.00	8.00	100%	VA-TURB-SPK-8
Anions and nutrients	Alkalinity (as $CaCO_3$)	mg/L	< 2.0	< 2.0	50.0	50.3	101%	-	-	-	50.0	48.6	97%	VA-ALK-L-MAN
		mg/L	< 2.5	< 2.5	50.0	50.3	101%	-	-	-	-	-	-	-
		mg/L	< 2.0	< 2.0	-	-	-	-	-	-	-	-	-	-
	Ammonia (as N)	mg/L	< 0.005	< 0.005	-	-	-	0.20	0.21	103%	0.12	0.12	103%	VA-NH3-F
		mg/L	< 0.005	< 0.005	-	-	-	0.21	0.21	99%	0.12	0.11	95%	VA-NH3-F
		mg/L	< 0.005	< 0.005	-	-	-	-	-	-	0.12	0.12	97%	VA-NH3-F
		mg/L	< 0.005	< 0.005	-	-	-	-	-	-	0.12	0.12	98%	VA-NH3-F
		mg/L	< 0.005	< 0.005	-	-	-	-	-	-	0.12	0.12	100%	VA-NH3-F
		mg/L	< 0.005	< 0.005	-	-	-	-	-	-	0.12	0.11	93%	VA-NH3-F
		mg/L	< 0.005	< 0.005	-	-	-	-	-	-	0.12	0.12	98%	VA-NH3-F
		mg/L	< 0.005	< 0.005	-	-	-	-	-	-	0.12	0.12	100%	VA-NH3-F
		mg/L	< 0.005	< 0.005	-	-	-	-	-	-	0.12	0.12	100%	VA-NH3-F
	Chloride (Cl)	mg/L	< 0.5	< 0.5	100	102	102%	64.7	65.2	101%	-	-	-	-
		mg/L	< 0.5	< 0.5	100	99	99%	100	101	101%	-	-	-	-
		mg/L	< 0.5	< 0.5	100	98	98%	-	-	-	-	-	-	-

Table A.3: Laboratory QAQC for water quality, Minto Mine, 2012.

Analyte		Units	Method Blank		Spiked Blank			Matrix Spike			Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Material
Anions and nutrients	Fluoride (F)	mg/L	< 0.02	< 0.02	1.00	0.97	97%	0.56	0.54	95%	-	-	-	-
		mg/L	< 0.02	< 0.02	1.00	1.04	104%	1.23	1.30	106%	-	-	-	-
		mg/L	< 0.02	< 0.02	1.00	1.04	104%	-	-	-	-	-	-	-
	Nitrate (as N)	mg/L	< 0.005	< 0.005	2.50	2.59	104%	1.25	1.30	104%	-	-	-	-
		mg/L	< 0.005	< 0.005	2.50	2.59	104%	1.53	1.56	102%	-	-	-	-
		mg/L	-	-	-	-	-	1.25	1.30	104%	-	-	-	-
		mg/L	-	-	-	-	-	1.53	1.56	102%	-	-	-	-
	Nitrite (as N)	mg/L	< 0.001	< 0.001	0.50	0.52	104%	0.25	0.26	102%	-	-	-	-
		mg/L	< 0.001	< 0.001	0.50	0.52	104%	0.25	0.26	104%	-	-	-	-
		mg/L	-	-	-	-	-	0.25	0.26	102%	-	-	-	-
		mg/L	-	-	-	-	-	0.25	0.26	104%	-	-	-	-
	Phosphorus (P)-Total Dissolved	mg/L	< 0.002	< 0.002	-	-	-	0.06	0.06	98%	3.99	3.93	98%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	-	-	-	3.99	3.87	97%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	-	-	-	3.99	4.11	103%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	-	-	-	3.99	4.15	104%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	-	-	-	3.99	4.24	106%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	-	-	-	3.99	4.27	107%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	-	-	-	3.99	4.04	101%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	-	-	-	3.99	4.22	106%	VA-ERA-PO4
	Phosphorus (P)-Total	mg/L	< 0.002	< 0.002	-	-	-	0.05	0.05	101%	3.99	4.02	101%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	0.14	0.13	MS-B	3.99	3.98	100%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	0.05	0.05	99%	3.99	4.04	101%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	0.06	0.06	99%	3.99	4.13	104%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	0.08	0.08	99%	3.99	4.09	103%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	0.06	0.05	94%	3.99	4.19	105%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	0.06	0.06	100%	3.99	3.96	99%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	0.09	0.09	98%	3.99	3.98	100%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	0.05	0.05	98%	3.99	4.03	101%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	-	-	-	3.99	4.04	101%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	-	-	-	3.99	4.18	105%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	-	-	-	3.99	4.03	101%	VA-ERA-PO4
		mg/L	< 0.002	< 0.002	-	-	-	-	-	-	3.99	4.03	101%	VA-ERA-PO4
	Sulfate (SO_4)	mg/L	< 0.5	< 0.5	100	104	104%	75.0	75.2	100%	-	-	-	-
		mg/L	< 0.5	< 0.5	100	102	102%	107	110	103%	-	-	-	-
		mg/L	< 0.5	< 0.5	100	101	101%	-	-	-	-	-	-	-

Table A.3: Laboratory QAQC for water quality, Minto Mine, 2012.

Analyte		Units	Method Blank		Spiked Blank			Matrix Spike			Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Material
Cyanides	Cyanide, Total	mg/L	< 0.005	< 0.005	0.25	0.24	94%	0.25	0.26	103%	-	-	-	-
		mg/L	< 0.005	< 0.005	0.25	0.23	94%	0.32	0.34	104%	-	-	-	-
		mg/L	< 0.005	< 0.005	0.25	0.24	96%	0.25	0.25	102%	-	-	-	-
		mg/L	< 0.005	< 0.005	0.25	0.24	96%	0.25	0.25	102%	-	-	-	-
		mg/L	< 0.005	< 0.005	0.25	0.23	94%	-	-	-	-	-	-	-
		mg/L	< 0.005	< 0.005	0.25	0.24	96%	-	-	-	-	-	-	-
		mg/L	< 0.005	< 0.005	0.25	0.24	96%	-	-	-	-	-	-	-
	Cyanide, Free	mg/L	< 0.001	< 0.001	0.25	0.26	104%	-	-	-	-	-	-	-
		mg/L	< 0.001	< 0.001	0.25	0.26	104%	-	-	-	-	-	-	-
		mg/L	< 0.001	< 0.001	0.25	0.26	104%	-	-	-	-	-	-	-
		mg/L	< 0.001	< 0.001	0.25	0.26	104%	-	-	-	-	-	-	-
		mg/L	< 0.001	< 0.001	0.25	0.26	103%	-	-	-	-	-	-	-
		mg/L	< 0.001	< 0.001	0.25	0.26	104%	-	-	-	-	-	-	-
		mg/L	< 0.001	< 0.001	0.25	0.26	106%	-	-	-	-	-	-	-
		mg/L	< 0.001	< 0.001	0.25	0.26	104%	-	-	-	-	-	-	-
		mg/L	< 0.001	< 0.001	0.25	0.26	104%	-	-	-	-	-	-	-
		mg/L	< 0.001	< 0.001	0.25	0.26	104%	-	-	-	-	-	-	-
		mg/L	< 0.001	< 0.001	0.25	0.26	104%	-	-	-	-	-	-	-
		mg/L	< 0.001	< 0.001	0.25	0.26	103%	-	-	-	-	-	-	-
		mg/L	< 0.001	< 0.001	0.25	0.26	104%	-	-	-	-	-	-	-
		mg/L	< 0.001	< 0.001	0.25	0.26	106%	-	-	-	-	-	-	-
Organic/ inorganic carbon	Dissolved Organic Carbon	mg/L	< 0.5	< 0.5	-	-	-	42.8	42.6	MS-B	8.57	9.34	109%	VA-DOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	6.70	6.56	98%	8.57	9.03	105%	VA-DOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	6.97	6.98	100%	8.57	8.69	101%	VA-DOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	9.35	109%	VA-DOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.42	98%	VA-DOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.59	100%	VA-DOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	9.34	109%	VA-DOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	9.03	105%	VA-DOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.69	101%	VA-DOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.39	98%	VA-DOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.25	96%	VA-DOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.22	96%	VA-DOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.19	96%	VA-DOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.27	96%	VA-DOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.85	103%	VA-DOC-C-CAFFEINE

Table A.3: Laboratory QAQC for water quality, Minto Mine, 2012.

Analyte		Units	Method Blank		Spiked Blank			Matrix Spike			Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Material
Organic/ inorganic carbon	Total Organic Carbon	mg/L	< 0.5	< 0.5	-	-	-	5.00	5.57	111%	8.57	8.55	100%	VA-TOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	11.7	11.5	MS-B	8.57	8.63	101%	VA-TOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	5.00	5.21	104%	8.57	8.69	101%	VA-TOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	10.0	9.68	MS-B	8.57	8.60	100%	VA-TOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	6.22	6.32	102%	8.57	8.83	103%	VA-TOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	5.00	5.57	111%	8.57	8.75	102%	VA-TOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.66	101%	VA-TOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.72	102%	VA-TOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.55	100%	VA-TOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.63	101%	VA-TOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.69	101%	VA-TOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.60	100%	VA-TOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.29	97%	VA-TOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.53	100%	VA-TOC-C-CAFFEINE
		mg/L	< 0.5	< 0.5	-	-	-	-	-	-	8.57	8.45	99%	VA-TOC-C-CAFFEINE
		mg/L	-	-	-	-	-	-	-	-	8.57	8.31	97%	VA-TOC-C-CAFFEINE
		mg/L	-	-	-	-	-	-	-	-	8.57	8.40	98%	VA-TOC-C-CAFFEINE
		mg/L	-	-	-	-	-	-	-	-	8.57	8.41	98%	VA-TOC-C-CAFFEINE
		mg/L	-	-	-	-	-	-	-	-	8.57	8.51	99%	VA-TOC-C-CAFFEINE
Total metals	Aluminum (Al)-Total	mg/L	< 0.003	< 0.003	-	-	-	-	-	-	2.00	2.05	103%	VA-HIGH-WATRM
		mg/L	< 0.003	< 0.003	-	-	-	-	-	-	2.00	2.17	109%	VA-HIGH-WATRM
	Antimony (Sb)-Total	mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	1.00	1.07	107%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	1.00	1.06	106%	VA-HIGH-WATRM
	Arsenic (As)-Total	mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	1.00	0.99	99%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	1.00	1.04	104%	VA-HIGH-WATRM
	Barium (Ba)-Total	mg/L	< 0.00005	< 0.00005	-	-	-	-	-	-	0.25	0.26	103%	VA-HIGH-WATRM
		mg/L	< 0.00005	< 0.00005	-	-	-	-	-	-	0.25	0.26	105%	VA-HIGH-WATRM
	Beryllium (Be)-Total	mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	0.10	0.11	106%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	0.10	0.10	102%	VA-HIGH-WATRM
	Bismuth (Bi)-Total	mg/L	< 0.0005	< 0.0005	-	-	-	-	-	-	1.00	0.99	99%	VA-HIGH-WATRM
		mg/L	< 0.0005	< 0.0005	-	-	-	-	-	-	1.00	1.00	100%	VA-HIGH-WATRM
	Boron (B)-Total	mg/L	< 0.01	< 0.01	-	-	-	-	-	-	1.00	1.00	100%	VA-HIGH-WATRM
		mg/L	< 0.01	< 0.01	-	-	-	-	-	-	1.00	1.00	100%	VA-HIGH-WATRM
	Cadmium (Cd)-Total	mg/L	< 0.00001	< 0.00001	-	-	-	-	-	-	0.10	0.11	105%	VA-HIGH-WATRM
		mg/L	< 0.00001	< 0.00001	-	-	-	-	-	-	0.10	0.11	105%	VA-HIGH-WATRM
	Calcium (Ca)-Total	mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	49.6	99%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	51.7	103%	VA-HIGH-WATRM
	Chromium (Cr)-Total	mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	0.25	0.26	102%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	0.25	0.26	104%	VA-HIGH-WATRM
	Cobalt (Co)-Total	mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	0.25	0.25	99%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	0.25	0.26	104%	VA-HIGH-WATRM

Table A.3: Laboratory QAQC for water quality, Minto Mine, 2012.

Analyte		Units	Method Blank		Spiked Blank			Matrix Spike			Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Material
Total metals	Copper (Cu)-Total	mg/L	< 0.0005	< 0.0005	-	-	-	-	-	-	0.25	0.24	97%	VA-HIGH-WATRM
		mg/L	< 0.0005	< 0.0005	-	-	-	-	-	-	0.25	0.26	103%	VA-HIGH-WATRM
	Iron (Fe)-Total	mg/L	< 0.01	< 0.01	-	-	-	-	-	-	1.00	0.99	99%	VA-HIGH-WATRM
		mg/L	< 0.01	< 0.01	-	-	-	-	-	-	1.00	1.00	100%	VA-HIGH-WATRM
	Lead (Pb)-Total	mg/L	< 0.00005	< 0.00005	-	-	-	-	-	-	0.50	0.50	99%	VA-HIGH-WATRM
		mg/L	< 0.00005	< 0.00005	-	-	-	-	-	-	0.50	0.51	103%	VA-HIGH-WATRM
	Lithium (Li)-Total	mg/L	< 0.0005	< 0.0005	-	-	-	-	-	-	0.25	0.28	113%	VA-HIGH-WATRM
		mg/L	< 0.0005	< 0.0005	-	-	-	-	-	-	0.25	0.26	104%	VA-HIGH-WATRM
	Magnesium (Mg)-Total	mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	51.0	102%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	52.5	105%	VA-HIGH-WATRM
	Manganese (Mn)-Total	mg/L	< 0.00005	< 0.00005	-	-	-	-	-	-	0.25	0.26	102%	VA-HIGH-WATRM
		mg/L	< 0.00005	< 0.00005	-	-	-	-	-	-	0.25	0.26	105%	VA-HIGH-WATRM
	Mercury (Hg) - Total	mg/L	< 0.00001	< 0.00001	0.0001	0.0001	97%	0.0001	0.0001	96%	-	-	-	-
		mg/L	< 0.00001	< 0.00001	0.0001	0.0001	96%	0.0001	0.0001	98%	-	-	-	-
		mg/L	< 0.00001	< 0.00001	0.0001	0.0001	93%	0.0001	0.0001	101%	-	-	-	-
		mg/L	< 0.00001	< 0.00001	0.0001	0.0001	90%	0.0001	0.0001	98%	-	-	-	-
		mg/L	< 0.00001	< 0.00001	0.0001	0.0001	91%	0.0001	0.0001	95%	-	-	-	-
		mg/L	-	-	0.0001	0.0001	90%	0.0002	0.0001	95%	-	-	-	-
		mg/L	-	-	0.0001	0.0001	100%	0.0001	0.0001	97%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	98%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	96%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	87%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	97%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	93%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	97%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	97%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	97%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	99%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	98%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	91%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	87%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	91%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	91%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	88%	-	-	-	-
	Molybdenum (Mo)-Total	mg/L	< 0.00005	< 0.00005	-	-	-	-	-	-	0.25	0.26	102%	VA-HIGH-WATRM
		mg/L	< 0.00005	< 0.00005	-	-	-	-	-	-	0.25	0.26	103%	VA-HIGH-WATRM
	Nickel (Ni)-Total	mg/L	< 0.0005	< 0.0005	-	-	-	-	-	-	0.50	0.50	101%	VA-HIGH-WATRM
		mg/L	< 0.0005	< 0.0005	-	-	-	-	-	-	0.50	0.52	104%	VA-HIGH-WATRM
	Phosphorus (P)-Total	mg/L	< 0.05	< 0.05	-	-	-	-	-	-	2.50	2.55	102%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	-	-	-	2.50	2.57	103%	VA-HIGH-WATRM
	Potassium (K)-Total	mg/L	< 0.1	< 0.1	-	-	-	-	-	-	50.0	51.9	104%	VA-HIGH-WATRM
		mg/L	< 0.1	< 0.1	-	-	-	-	-	-	50.0	51.3	103%	VA-HIGH-WATRM

Table A.3: Laboratory QAQC for water quality, Minto Mine, 2012.

Analyte		Units	Method Blank		Spiked Blank			Matrix Spike			Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Material
Total metals	Selenium (Se)-Total	mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	1.00	1.00	100%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	1.00	1.02	102%	VA-HIGH-WATRM
	Silicon (Si)-Total	mg/L	< 0.05	< 0.05	-	-	-	-	-	-	1.00	1.07	107%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	-	-	-	1.00	1.08	108%	VA-HIGH-WATRM
	Silver (Ag)-Total	mg/L	< 0.00001	< 0.00001	-	-	-	-	-	-	0.100	0.102	102%	VA-HIGH-WATRM
		mg/L	< 0.00001	< 0.00001	-	-	-	-	-	-	0.100	0.106	106%	VA-HIGH-WATRM
	Sodium (Na)-Total	mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	52.3	105%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	53.7	107%	VA-HIGH-WATRM
	Strontium (Sr)-Total	mg/L	< 0.0002	< 0.0002	-	-	-	-	-	-	0.250	0.256	102%	VA-HIGH-WATRM
		mg/L	< 0.0002	< 0.0002	-	-	-	-	-	-	0.250	0.253	101%	VA-HIGH-WATRM
	Thallium (Tl)-Total	mg/L	< 0.00001	< 0.00001	-	-	-	-	-	-	1.00	0.98	98%	VA-HIGH-WATRM
		mg/L	< 0.00001	< 0.00001	-	-	-	-	-	-	1.00	1.02	102%	VA-HIGH-WATRM
	Tin (Sn)-Total	mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	0.500	0.511	102%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	-	-	-	0.500	0.520	104%	VA-HIGH-WATRM
	Titanium (Ti)-Total	mg/L	< 0.01	< 0.01	-	-	-	-	-	-	0.25	0.25	100%	VA-HIGH-WATRM
		mg/L	< 0.01	< 0.01	-	-	-	-	-	-	0.25	0.27	108%	VA-HIGH-WATRM
	Uranium (U)-Total	mg/L	< 0.00001	< 0.00001	-	-	-	-	-	-	0.005	0.005	100%	VA-HIGH-WATRM
		mg/L	< 0.00001	< 0.00001	-	-	-	-	-	-	0.005	0.005	103%	VA-HIGH-WATRM
	Vanadium (V)-Total	mg/L	< 0.001	< 0.001	-	-	-	-	-	-	0.50	0.51	102%	VA-HIGH-WATRM
		mg/L	< 0.001	< 0.001	-	-	-	-	-	-	0.50	0.52	105%	VA-HIGH-WATRM
	Zinc (Zn)-Total	mg/L	< 0.003	< 0.003	-	-	-	-	-	-	0.50	0.48	96%	VA-HIGH-WATRM
		mg/L	< 0.003	< 0.003	-	-	-	-	-	-	0.50	0.47	94%	VA-HIGH-WATRM
Dissovled metals	Aluminum (Al)-Dissolved	mg/L	< 0.001	< 0.001	-	-	-	0.20	0.19	95%	2.00	2.35	118%	VA-HIGH-WATRM
		mg/L	< 0.001	< 0.001	-	-	-	0.20	0.20	99%	2.00	2.35	118%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.23	0.23	103%	-	-	-	-
		mg/L	-	-	-	-	-	0.20	0.19	95%	-	-	-	-
		mg/L	-	-	-	-	-	0.20	0.20	99%	-	-	-	-
		mg/L	-	-	-	-	-	0.23	0.23	103%	-	-	-	-
	Antimony (Sb)-Dissolved	mg/L	< 0.0001	< 0.0001	-	-	-	0.02	0.02	103%	1.00	1.19	119%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	0.02	0.02	104%	1.00	1.19	119%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.02	0.02	104%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	103%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	104%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	104%	-	-	-	-
	Arsenic (As)-Dissolved	mg/L	< 0.0001	< 0.0001	-	-	-	0.02	0.02	108%	1.00	1.13	113%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	0.02	0.02	108%	1.00	1.13	113%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.02	0.02	113%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	108%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	108%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	113%	-	-	-	-

Table A.3: Laboratory QAQC for water quality, Minto Mine, 2012.

Analyte		Units	Method Blank		Spiked Blank			Matrix Spike			Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Material
Dissovled metals	Barium (Ba)-Dissolved	mg/L	< 0.00005	< 0.00005	-	-	-	0.28	0.27	MS-B	0.25	0.29	118%	VA-HIGH-WATRM
		mg/L	< 0.00005	< 0.00005	-	-	-	0.02	0.02	104%	0.25	0.29	118%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.03	0.04	103%	-	-	-	-
		mg/L	-	-	-	-	-	0.28	0.27	MS-B	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	104%	-	-	-	-
		mg/L	-	-	-	-	-	0.03	0.04	103%	-	-	-	-
	Beryllium (Be)-Dissolved	mg/L	< 0.0001	< 0.0001	-	-	-	0.04	0.04	100%	0.10	0.12	116%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	0.04	0.04	105%	0.10	0.12	116%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.04	0.04	105%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	100%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	105%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	105%	-	-	-	-
	Bismuth (Bi)-Dissolved	mg/L	< 0.0005	< 0.0005	-	-	-	0.01	0.01	88%	1.00	1.13	113%	VA-HIGH-WATRM
		mg/L	< 0.0005	< 0.0005	-	-	-	0.01	0.01	99%	1.00	1.13	113%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.01	0.01	87%	-	-	-	-
		mg/L	-	-	-	-	-	0.01	0.01	88%	-	-	-	-
		mg/L	-	-	-	-	-	0.01	0.01	99%	-	-	-	-
		mg/L	-	-	-	-	-	0.01	0.01	87%	-	-	-	-
	Boron (B)-Dissolved	mg/L	< 0.01	< 0.01	-	-	-	0.10	0.10	103%	1.0	1.1	110%	VA-HIGH-WATRM
		mg/L	< 0.01	< 0.01	-	-	-	0.10	0.10	100%	1.0	1.1	110%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.11	0.11	98%	-	-	-	-
		mg/L	-	-	-	-	-	0.10	0.10	103%	-	-	-	-
		mg/L	-	-	-	-	-	0.10	0.10	100%	-	-	-	-
		mg/L	-	-	-	-	-	0.11	0.11	98%	-	-	-	-
	Cadmium (Cd)-Dissolved	mg/L	< 0.00001	< 0.00001	-	-	-	0.004	0.004	103%	0.10	0.12	120%	VA-HIGH-WATRM
		mg/L	< 0.00001	< 0.00001	-	-	-	0.004	0.004	105%	0.10	0.12	120%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.004	0.004	103%	-	-	-	-
		mg/L	-	-	-	-	-	0.004	0.004	103%	-	-	-	-
		mg/L	-	-	-	-	-	0.004	0.004	105%	-	-	-	-
		mg/L	-	-	-	-	-	0.004	0.004	103%	-	-	-	-
	Calcium (Ca)-Dissolved	mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	51.2	102%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	51.2	102%	VA-HIGH-WATRM
	Chromium (Cr)-Dissolved	mg/L	< 0.0001	< 0.0001	-	-	-	0.04	0.04	98%	0.25	0.29	117%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	0.04	0.04	98%	0.25	0.29	117%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.04	0.04	98%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	98%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	98%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	98%	-	-	-	-

Table A.3: Laboratory QAQC for water quality, Minto Mine, 2012.

Analyte		Units	Method Blank		Spiked Blank			Matrix Spike			Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Material
Dissovled metals	Cobalt (Co)-Dissolved	mg/L	< 0.0001	< 0.0001	-	-	-	0.02	0.02	97%	0.25	0.29	114%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	0.02	0.02	100%	0.25	0.29	114%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.02	0.02	98%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	97%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	100%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	98%	-	-	-	-
	Copper (Cu)-Dissolved	mg/L	< 0.0002	< 0.0002	-	-	-	0.02	0.02	95%	0.25	0.28	112%	VA-HIGH-WATRM
		mg/L	< 0.0002	< 0.0002	-	-	-	0.02	0.02	100%	0.25	0.28	112%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.02	0.02	95%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	95%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	100%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	95%	-	-	-	-
	Iron (Fe)-Dissolved	mg/L	< 0.01	< 0.01	-	-	-	-	-	-	1.00	1.00	100%	VA-HIGH-WATRM
		mg/L	< 0.01	< 0.01	-	-	-	-	-	-	1.00	1.00	100%	VA-HIGH-WATRM
	Lead (Pb)-Dissolved	mg/L	< 0.00005	< 0.00005	-	-	-	0.02	0.02	96%	0.50	0.57	113%	VA-HIGH-WATRM
		mg/L	< 0.00005	< 0.00005	-	-	-	0.02	0.02	102%	0.50	0.57	113%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.02	0.02	94%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	96%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	102%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	94%	-	-	-	-
	Lithium (Li)-Dissolved	mg/L	< 0.0005	< 0.0005	-	-	-	0.11	0.11	100%	0.25	0.30	118%	VA-HIGH-WATRM
		mg/L	< 0.0005	< 0.0005	-	-	-	0.10	0.10	101%	0.25	0.30	118%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.13	0.13	100%	-	-	-	-
		mg/L	-	-	-	-	-	0.11	0.11	100%	-	-	-	-
		mg/L	-	-	-	-	-	0.10	0.10	101%	-	-	-	-
		mg/L	-	-	-	-	-	0.13	0.13	100%	-	-	-	-
	Magnesium (Mg)-Dissolved	mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	51.1	102%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	-	-	-	50.0	51.1	102%	VA-HIGH-WATRM
	Manganese (Mn)-Dissolved	mg/L	< 0.00005	< 0.00005	-	-	-	0.03	0.03	95%	0.25	0.30	118%	VA-HIGH-WATRM
		mg/L	< 0.00005	< 0.00005	-	-	-	0.02	0.02	100%	0.25	0.30	118%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.10	0.10	MS-B	-	-	-	-
		mg/L	-	-	-	-	-	0.03	0.03	95%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	100%	-	-	-	-
		mg/L	-	-	-	-	-	0.10	0.10	MS-B	-	-	-	-
	Mercury (Hg) - Dissolved	mg/L	-	-	0.0001	0.0001	96%	0.0001	0.0001	95%	-	-	-	-
		mg/L	-	-	0.0001	0.0001	96%	0.0001	0.0001	92%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	97%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	86%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	92%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	95%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	95%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	92%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	97%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	86%	-	-	-	-
		mg/L	-	-	-	-	-	0.0001	0.0001	92%	-	-	-	-

Table A.3: Laboratory QAQC for water quality, Minto Mine, 2012.

Analyte		Units	Method Blank		Spiked Blank			Matrix Spike			Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Material
Dissovled metals	Molybdenum (Mo)-Dissolved	mg/L	< 0.00005	< 0.00005	-	-	-	0.02	0.02	101%	0.25	0.29	114%	VA-HIGH-WATRM
		mg/L	< 0.00005	< 0.00005	-	-	-	0.02	0.02	100%	0.25	0.29	114%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.02	0.02	99%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	101%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	100%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	99%	-	-	-	-
	Nickel (Ni)-Dissolved	mg/L	< 0.0005	< 0.0005	-	-	-	0.04	0.04	94%	0.50	0.58	116%	VA-HIGH-WATRM
		mg/L	< 0.0005	< 0.0005	-	-	-	0.04	0.04	101%	0.50	0.58	116%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.04	0.04	95%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	94%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	101%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	95%	-	-	-	-
	Phosphorus (P)-Dissolved	mg/L	< 0.05	< 0.05	-	-	-	-	-	-	2.50	2.55	102%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	-	-	-	2.50	2.55	102%	VA-HIGH-WATRM
	Potassium (K)-Dissolved	mg/L	< 0.1	< 0.1	-	-	-	-	-	-	50.0	50.8	102%	VA-HIGH-WATRM
		mg/L	< 0.1	< 0.1	-	-	-	-	-	-	50.0	50.8	102%	VA-HIGH-WATRM
	Selenium (Se)-Dissolved	mg/L	< 0.0001	< 0.0001	-	-	-	0.04	0.04	101%	1.00	1.13	113%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	0.04	0.04	108%	1.00	1.13	113%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.04	0.04	105%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	101%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	108%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	105%	-	-	-	-
	Silicon (Si)-Dissolved	mg/L	< 0.05	< 0.05	-	-	-	-	-	-	1.00	1.05	105%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	-	-	-	1.00	1.05	105%	VA-HIGH-WATRM
	Silver (Ag)-Dissolved	mg/L	< 0.00001	< 0.00001	-	-	-	0.004	0.004	101%	0.10	0.12	115%	VA-HIGH-WATRM
		mg/L	< 0.00001	< 0.00001	-	-	-	0.004	0.004	105%	0.10	0.12	115%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.004	0.004	101%	-	-	-	-
		mg/L	-	-	-	-	-	0.004	0.004	105%	-	-	-	-
	Sodium (Na)-Dissolved	mg/L	< 0.05	< 0.05	-	-	-	6.69	6.46	MS-B	50.0	59.7	119%	VA-HIGH-WATRM
		mg/L	< 0.05	< 0.05	-	-	-	2.00	2.03	102%	50.0	59.7	119%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	161	157	MS-B	-	-	-	-
		mg/L	-	-	-	-	-	6.69	6.46	MS-B	-	-	-	-
		mg/L	-	-	-	-	-	2.00	2.03	102%	-	-	-	-
		mg/L	-	-	-	-	-	161	157	MS-B	-	-	-	-
	Strontium (Sr)-Dissolved	mg/L	< 0.0002	< 0.0002	-	-	-	0.16	0.15	MS-B	0.25	0.29	116%	VA-HIGH-WATRM
		mg/L	< 0.0002	< 0.0002	-	-	-	0.02	0.02	100%	0.25	0.29	116%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.14	0.14	MS-B	-	-	-	-
		mg/L	-	-	-	-	-	0.16	0.15	MS-B	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	100%	-	-	-	-
		mg/L	-	-	-	-	-	0.14	0.14	MS-B	-	-	-	-
	Thallium (Tl)-Dissolved	mg/L	< 0.00001	< 0.00001	-	-	-	0.004	0.004	98%	1.00	1.11	111%	VA-HIGH-WATRM
		mg/L	< 0.00001	< 0.00001	-	-	-	0.004	0.004	101%	1.00	1.11	111%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.004	0.004	94%	-	-	-	-
		mg/L	-	-	-	-	-	0.004	0.004	98%	-	-	-	-
		mg/L	-	-	-	-	-	0.004	0.004	101%	-	-	-	-
		mg/L	-	-	-	-	-	0.004	0.004	94%	-	-	-	-

Table A.3: Laboratory QAQC for water quality, Minto Mine, 2012.

Analyte		Units	Method Blank		Spiked Blank			Matrix Spike			Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Target	Achieved	% Recovery	Material
Dissovled metals	Tin (Sn)-Dissolved	mg/L	< 0.0001	< 0.0001	-	-	-	0.02	0.02	102%	0.50	0.59	117%	VA-HIGH-WATRM
		mg/L	< 0.0001	< 0.0001	-	-	-	0.02	0.02	100%	0.50	0.59	117%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.02	0.02	101%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	102%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	100%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	101%	-	-	-	-
	Titanium (Ti)-Dissolved	mg/L	< 0.01	< 0.01	-	-	-	0.04	0.04	97%	0.25	0.30	120%	VA-HIGH-WATRM
		mg/L	< 0.01	< 0.01	-	-	-	0.04	0.04	105%	0.25	0.30	120%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.04	0.04	106%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	97%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	105%	-	-	-	-
		mg/L	-	-	-	-	-	0.04	0.04	106%	-	-	-	-
	Uranium (U)-Dissolved	mg/L	< 0.00001	< 0.00001	-	-	-	0.004	0.004	100%	0.01	0.01	114%	VA-HIGH-WATRM
		mg/L	< 0.00001	< 0.00001	-	-	-	0.004	0.004	102%	0.01	0.01	114%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.02	0.02	MS-B	-	-	-	-
		mg/L	-	-	-	-	-	0.004	0.004	100%	-	-	-	-
		mg/L	-	-	-	-	-	0.004	0.004	102%	-	-	-	-
		mg/L	-	-	-	-	-	0.02	0.02	MS-B	-	-	-	-
	Vanadium (V)-Dissolved	mg/L	< 0.001	< 0.001	-	-	-	0.10	0.10	101%	0.50	0.59	118%	VA-HIGH-WATRM
		mg/L	< 0.001	< 0.001	-	-	-	0.10	0.10	99%	0.50	0.59	118%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.10	0.10	103%	-	-	-	-
		mg/L	-	-	-	-	-	0.10	0.10	101%	-	-	-	-
		mg/L	-	-	-	-	-	0.10	0.10	99%	-	-	-	-
		mg/L	-	-	-	-	-	0.10	0.10	103%	-	-	-	-
	Zinc (Zn)-Dissolved	mg/L	< 0.001	< 0.001	-	-	-	0.40	0.37	93%	0.50	0.54	109%	VA-HIGH-WATRM
		mg/L	< 0.001	< 0.001	-	-	-	0.40	0.38	95%	0.50	0.54	109%	VA-HIGH-WATRM
		mg/L	-	-	-	-	-	0.41	0.37	90%	-	-	-	-
		mg/L	-	-	-	-	-	0.40	0.37	93%	-	-	-	-
		mg/L	-	-	-	-	-	0.40	0.38	95%	-	-	-	-
		mg/L	-	-	-	-	-	0.41	0.37	90%	-	-	-	-

(grey shading) value greater than DQO

Table A.4: Laboratory duplicate results for water quality, Minto Mine, 2012.

Analyte		Units	Lab Dup		
			Replicate 1	Replicate 2	RPD (%)
Physical Tests	pH	pH units	8.1	8.1	0%
	Total Suspended Solids	mg/L	4.7	5.3	12%
		mg/L	< 3.0	< 3.0	0%
Anions and nutrients	Alkalinity, Total	mg/L	90.5	90.5	0%
	Chloride (Cl)	mg/L	< 0.50	< 0.50	0%
	Fluoride (F)	mg/L	0.23	0.23	0%
	Nitrate (as N)	mg/L	< 0.005	< 0.005	0%
	Nitrite (as N)	mg/L	< 0.001	< 0.001	0%
	Phosphorus (P)-Total	mg/L	0.03	0.03	10%
	Sulfate (SO_4)	mg/L	7.1	7.1	0%
Organic / inorganic carbon	Dissolved Organic Carbon	mg/L	13.1	14.0	7%
	Total Organic Carbon	mg/L	13.8	14.2	3%

value greater than DQO

antimony, barium, beryllium, cadmium, chromium, lithium, manganese, nickel, sodium, strontium, tin, titanium and vanadium. These analytes were over-recovered (they had recoveries greater than 115%). The recovery of reference material indicates good analytical accuracy.

A3.0 SEDIMENT SAMPLES

A3.1 Method Detection Limits

All analytes, except silver, had reported MDLs that were at or below the target MDLs (Table A.5). The MDL achieved for silver was still below guideline levels. Therefore, all data can be reliably interpreted relative to the guidelines.

A3.2 Laboratory Blank Sample Analysis

All blank samples contained non-detectable analyte concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Table A.6).

A3.3 Data Precision

The laboratory duplicate sediment samples showed very good agreement in analyte concentrations (Tables A.7) indicating very good precision.

A3.4 Data Accuracy

Recoveries of all analytes in certified reference materials met the data quality objective (Table A.6). These data indicated excellent analytical accuracy associated with the analysis of sediment samples.

Table A.5: Laboratory method detection limits (MDLs) relative to targets and to sediment quality guidelines, Minto Mine, 2012.

Analyte		Units	CCME Water Quality Guidelines[a]		Method Detection Limit	
			ISQG[b]	PEL[c]	Target	Achieved
Physical Tests	Loss on Ignition @ 550 C	%	-	-	-	1.0
	pH (1:2 soil:water)	pH units	-	-	-	0.1
Partical Size	% Gravel (> 2 mm)	%	-	-	-	0.1
	% Sand (2.0 mm - 0.063 mm)	%	-	-	-	0.1
	% Silt (0.063 mm - 4 µm)	%	-	-	-	0.1
	% Clay (< 4 µm)	%	-	-	-	0.1
Anions and nutrients	Total Kjeldahl Nitrogen (TKN)	%	-	-	-	0.02
Organic / inorganic carbon	Total Organic Carbon	%	-	-	-	0.1
Metals	Total Aluminum (Al)	mg/kg	-	-	-	50
	Total Antimony (Sb)	mg/kg	-	-	-	0.1
	Total Arsenic (As)	mg/kg	5.9	17	0.59	0.05
	Total Barium (Ba)	mg/kg	-	-	-	0.5
	Total Beryllium (Be)	mg/kg	-	-	-	0.2
	Total Bismuth (Bi)	mg/kg	-	-	-	0.2
	Total Cadmium (Cd)	mg/kg	0.6	3.5	0.06	0.05
	Total Calcium (Ca)	mg/kg	-	-	-	50
	Total Chromium (Cr)	mg/kg	37.3	90	3.73	0.5
	Total Cobalt (Co)	mg/kg	-	-	-	0.1
	Total Copper (Cu)	mg/kg	35.7	197	3.57	0.5
	Total Iron (Fe)	mg/kg	-	-	-	50
	Total Lead (Pb)	mg/kg	35	91.3	3.5	0.5
	Total Lithium (Li)	mg/kg	-	-	-	5
	Total Magnesium (Mg)	mg/kg	-	-	-	20
	Total Manganese (Mn)	mg/kg	-	-	-	1.0
	Total Mercury (Hg)	mg/kg	0.17	0.486	0.017	0.005
	Total Molybdenum (Mo)	mg/kg	-	-	-	0.5
	Total Nickel (Ni)	mg/kg	-	-	-	0.5
	Total Phosphorus (P)	mg/kg	-	-	-	50
	Total Potassium (K)	mg/kg	-	-	-	100
	Total Selenium (Se)	mg/kg	-	-	-	0.2
	Total Silver (Ag)	mg/kg	-	-	-	0.1
	Total Sodium (Na)	mg/kg	-	-	-	100
	Total Strontium (Sr)	mg/kg	-	-	-	0.5
	Total Thallium (Tl)	mg/kg	-	-	-	0.05
	Total Tin (Sn)	mg/kg	-	-	-	2
	Total Titanium (Ti)	mg/kg	-	-	-	1
	Total Uranium (U)	mg/kg	-	-	-	0.05
	Total Vanadium (V)	mg/kg	-	-	-	0.2
	Total Zinc (Zn)	mg/kg	123	315	12.3	1

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

[b] Interim sediment quality guideline (ISQG)/probable effect level (PEL)

[c] Probable effect level (PEL)

value greater than DQO

Table A.6: Laboratory QAQC for sediment quality, Minto Mine, 2012.

Analyte		Units	Method Blank		Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Material
Physical tests [a]	Loss of Ignition @ 550 C	%	< 1	< 1	7	7	100%	FARM2009
Partical Size [a]	% Sand (2.0 mm - 0.063 mm)	%	-	-	45.0	45.5	101%	FARM2009
	% Silt (0.063 mm - 4 µm)	%	-	-	35.0	36.9	105%	FARM2009
	% Clay (< 4 µm)	%	-	-	18.0	17.7	98%	FARM2009
Anions and nutrients [a]	Total Kjeldahl Nitrogen (TKN)	mg/L	< 0.02	< 0.02	0.08	0.07	84%	07-114_SOIL
		mg/L	< 0.02	< 0.02	0.08	0.06	76%	07-114_SOIL
Organic/ inorganic carbon [a]	Total Organic Carbon	mg/L	< 0.1	< 0.1	1.10	1.04	95%	08-109_SOIL
Total metals	Aluminum (Al)-Total	mg/L	< 50	< 50	18,200	16,600	91%	VA-CANMET-TILL1
		mg/L	< 50	< 50	18,200	15,800	87%	VA-CANMET-TILL1
		mg/L	< 50	< 50	17,500	15,900	91%	VA-NRC-PACS2
		mg/L	-	-	17,500	15,700	90%	VA-NRC-PACS2
	Antimony (Sb)-Total	mg/L	< 0.1	< 0.1	6.27	6.20	99%	VA-CANMET-TILL1
		mg/L	< 0.1	< 0.1	6.27	6.47	103%	VA-CANMET-TILL1
		mg/L	< 0.1	< 0.1	9.79	9.01	92%	VA-NRC-PACS2
		mg/L	-	-	9.79	9.67	99%	VA-NRC-PACS2
	Arsenic (As)-Total	mg/L	< 0.05	< 0.05	15.4	15.3	99%	VA-CANMET-TILL1
		mg/L	< 0.05	< 0.05	15.4	15.3	99%	VA-CANMET-TILL1
		mg/L	< 0.05	< 0.05	23.3	23.6	101%	VA-NRC-PACS2
		mg/L	-	-	23.3	24.1	103%	VA-NRC-PACS2
	Barium (Ba)-Total	mg/L	< 0.5	< 0.5	80.6	76.2	95%	VA-CANMET-TILL1
		mg/L	< 0.5	< 0.5	80.6	77.6	96%	VA-CANMET-TILL1
		mg/L	< 0.5	< 0.5	294	287	98%	VA-NRC-PACS2
		mg/L	-	-	294	302	103%	VA-NRC-PACS2
	Beryllium (Be)-Total	mg/L	< 0.2	< 0.2	0.54	0.48	89%	VA-CANMET-TILL1
		mg/L	< 0.2	< 0.2	0.54	0.47	87%	VA-CANMET-TILL1
		mg/L	< 0.2	< 0.2	0.41	0.36	88%	VA-NRC-PACS2
		mg/L	-	-	0.41	0.35	85%	VA-NRC-PACS2
	Bismuth (Bi)-Total	mg/L	< 0.2	< 0.2	0.35	0.33	94%	VA-NRC-PACS2
		mg/L	< 0.2	< 0.2	0.35	0.31	89%	VA-NRC-PACS2
		mg/L	< 0.2	< 0.2	-	-	-	-
	Cadmium (Cd)-Total	mg/L	< 0.05	< 0.05	0.23	0.22	94%	VA-CANMET-TILL1
		mg/L	< 0.05	< 0.05	0.23	0.22	94%	VA-CANMET-TILL1
		mg/L	< 0.05	< 0.05	1.98	2.11	107%	VA-NRC-PACS2
		mg/L	-	-	1.98	2.17	110%	VA-NRC-PACS2
	Calcium (Ca)-Total	mg/L	< 50	< 50	3,320	3,180	96%	VA-CANMET-TILL1
		mg/L	< 50	< 50	3,320	3,070	92%	VA-CANMET-TILL1
		mg/L	< 50	< 50	7,790	7,410	95%	VA-NRC-PACS2
		mg/L	-	-	7,790	7,460	96%	VA-NRC-PACS2
	Chromium (Cr)-Total	mg/L	< 0.5	< 0.5	27.2	26.7	98%	VA-CANMET-TILL1
		mg/L	< 0.5	< 0.5	27.2	26.0	96%	VA-CANMET-TILL1
		mg/L	< 0.5	< 0.5	48.1	46.2	96%	VA-NRC-PACS2
		mg/L	-	-	48.1	47.7	99%	VA-NRC-PACS2
	Cobalt (Co)-Total	mg/L	< 0.1	< 0.1	12.5	11.9	95%	VA-CANMET-TILL1
		mg/L	< 0.1	< 0.1	12.5	11.8	94%	VA-CANMET-TILL1
		mg/L	< 0.1	< 0.1	8.75	8.06	92%	VA-NRC-PACS2
		mg/L	-	-	8.75	8.43	96%	VA-NRC-PACS2
	Copper (Cu)-Total	mg/L	< 0.5	< 0.5	44.9	42.2	94%	VA-CANMET-TILL1
		mg/L	< 0.5	< 0.5	44.9	41.6	93%	VA-CANMET-TILL1
		mg/L	< 0.5	< 0.5	297	275	93%	VA-NRC-PACS2
		mg/L	-	-	297	285	96%	VA-NRC-PACS2
	Iron (Fe)-Total	mg/L	< 50	< 50	33,300	30,700	92%	VA-CANMET-TILL1
		mg/L	< 50	< 50	33,300	30,000	90%	VA-CANMET-TILL1
		mg/L	< 50	< 50	31,200	29,000	93%	VA-NRC-PACS2
		mg/L	-	-	31,200	29,800	96%	VA-NRC-PACS2
	Lead (Pb)-Total	mg/L	< 0.5	< 0.5	14.4	12.3	85%	VA-CANMET-TILL1
		mg/L	< 0.5	< 0.5	14.4	13.5	94%	VA-CANMET-TILL1
		mg/L	< 0.5	< 0.5	167	163	98%	VA-NRC-PACS2
		mg/L	-	-	167	166	99%	VA-NRC-PACS2
	Lithium (Li)-Total	mg/L	< 5.0	< 5.0	9.8	9.5	97%	VA-CANMET-TILL1
		mg/L	< 5.0	< 5.0	9.8	9.6	98%	VA-CANMET-TILL1
		mg/L	< 5.0	< 5.0	25.8	21.3	83%	VA-NRC-PACS2
		mg/L	-	-	25.8	22.5	87%	VA-NRC-PACS2
	Magnesium (Mg)-Total	mg/L	< 20	< 20	5,830	5,440	93%	VA-CANMET-TILL1
		mg/L	< 20	< 20	5,830	5,370	92%	VA-CANMET-TILL1
		mg/L	< 20	< 20	9,900	9,380	95%	VA-NRC-PACS2
		mg/L	-	-	9,900	9,490	96%	VA-NRC-PACS2

Table A.6: Laboratory QAQC for sediment quality, Minto Mine, 2012.

Analyte		Units	Method Blank		Reference Material			
			Target	Achieved	Target	Achieved	% Recovery	Material
Total metals	Manganese (Mn)-Total	mg/L	< 1.0	< 1.0	1,100	1,080	98%	VA-CANMET-TILL1
		mg/L	< 1.0	< 1.0	1,100	1,040	95%	VA-CANMET-TILL1
		mg/L	< 1.0	< 1.0	253	238	94%	VA-NRC-PACS2
		mg/L	-	-	253	247	98%	VA-NRC-PACS2
	Mercury (Hg) - Total	mg/L	< 0.005	< 0.005	0.10	0.09	94%	VA-CANMET-TILL1
		mg/L	< 0.005	< 0.005	0.10	0.09	92%	VA-CANMET-TILL1
		mg/L	< 0.005	< 0.005	2.88	2.89	100%	VA-NRC-PACS2
		mg/L	-	-	2.88	3.13	109%	VA-NRC-PACS2
	Molybdenum (Mo)-Total	mg/L	< 0.5	< 0.5	0.74	0.65	88%	VA-CANMET-TILL1
		mg/L	< 0.5	< 0.5	0.74	0.62	84%	VA-CANMET-TILL1
		mg/L	< 0.5	< 0.5	4.57	4.56	100%	VA-NRC-PACS2
		mg/L	-	-	4.57	4.63	101%	VA-NRC-PACS2
	Nickel (Ni)-Total	mg/L	< 0.5	< 0.5	17.4	16.7	96%	VA-CANMET-TILL1
		mg/L	< 0.5	< 0.5	17.4	16.5	95%	VA-CANMET-TILL1
		mg/L	< 0.5	< 0.5	31.6	29.6	94%	VA-NRC-PACS2
		mg/L	-	-	31.6	30.2	96%	VA-NRC-PACS2
	Phosphorus (P)-Total	mg/L	< 50	< 50	796	856	108%	VA-CANMET-TILL1
		mg/L	< 50	< 50	796	733	92%	VA-CANMET-TILL1
		mg/L	< 50	< 50	838	804	96%	VA-NRC-PACS2
		mg/L	-	-	838	801	96%	VA-NRC-PACS2
	Potassium (K)-Total	mg/L	< 100	< 100	620	650	105%	VA-CANMET-TILL1
		mg/L	< 100	< 100	620	530	85%	VA-CANMET-TILL1
		mg/L	< 100	< 100	3,230	2,810	87%	VA-NRC-PACS2
		mg/L	-	-	3,230	2,890	89%	VA-NRC-PACS2
	Selenium (Se)-Total	mg/L	< 0.2	< 0.2	0.32	0.32	100%	VA-CANMET-TILL1
		mg/L	< 0.2	< 0.2	0.32	0.30	94%	VA-CANMET-TILL1
		mg/L	< 0.2	< 0.2	0.92	0.91	99%	VA-NRC-PACS2
		mg/L	-	-	0.92	0.93	101%	VA-NRC-PACS2
	Silver (Ag)-Total	mg/L	< 0.1	< 0.1	0.22	0.21	95%	VA-CANMET-TILL1
		mg/L	< 0.1	< 0.1	0.22	0.21	95%	VA-CANMET-TILL1
		mg/L	< 0.1	< 0.1	1.12	1.09	97%	VA-NRC-PACS2
		mg/L	-	-	1.12	1.08	96%	VA-NRC-PACS2
	Sodium (Na)-Total	mg/L	< 100	< 100	340	320	94%	VA-CANMET-TILL1
		mg/L	< 100	< 100	340	300	88%	VA-CANMET-TILL1
		mg/L	< 100	< 100	18,600	16,600	89%	VA-NRC-PACS2
		mg/L	-	-	18,600	16,800	90%	VA-NRC-PACS2
	Strontium (Sr)-Total	mg/L	< 0.5	< 0.5	11.6	10.7	92%	VA-CANMET-TILL1
		mg/L	< 0.5	< 0.5	11.6	10.4	90%	VA-CANMET-TILL1
		mg/L	< 0.5	< 0.5	68.0	62.5	92%	VA-NRC-PACS2
		mg/L	-	-	68.0	67.6	99%	VA-NRC-PACS2
	Thallium (Tl)-Total	mg/L	< 0.05	< 0.05	0.13	0.11	90%	VA-CANMET-TILL1
		mg/L	< 0.05	< 0.05	0.13	0.11	85%	VA-CANMET-TILL1
		mg/L	< 0.05	< 0.05	0.41	0.38	93%	VA-NRC-PACS2
		mg/L	-	-	0.41	0.38	92%	VA-NRC-PACS2
	Tin (Sn)-Total	mg/L	< 2.0	< 2.0	19.1	19.1	100%	VA-NRC-PACS2
		mg/L	< 2.0	< 2.0	19.1	18.4	96%	VA-NRC-PACS2
		mg/L	< 2.0	< 2.0	-	-	-	-
	Titanium (Ti)-Total	mg/L	< 1.0	< 1.0	764	847	111%	VA-CANMET-TILL1
		mg/L	< 1.0	< 1.0	764	743	97%	VA-CANMET-TILL1
		mg/L	< 1.0	< 1.0	900	1,010	112%	VA-NRC-PACS2
		mg/L	-	-	900	939	104%	VA-NRC-PACS2
	Uranium (U)-Total	mg/L	< 0.05	< 0.05	0.80	0.75	94%	VA-CANMET-TILL1
		mg/L	< 0.05	< 0.05	0.80	0.79	99%	VA-CANMET-TILL1
		mg/L	< 0.05	< 0.05	1.64	1.43	87%	VA-NRC-PACS2
		mg/L	-	-	1.64	1.47	90%	VA-NRC-PACS2
	Vanadium (V)-Total	mg/L	< 0.2	< 0.2	54.9	54.0	98%	VA-CANMET-TILL1
		mg/L	< 0.2	< 0.2	54.9	52.3	95%	VA-CANMET-TILL1
		mg/L	< 0.2	< 0.2	74.4	72.2	97%	VA-NRC-PACS2
		mg/L	-	-	74.4	74.0	99%	VA-NRC-PACS2
	Zinc (Zn)-Total	mg/L	< 1.0	< 1.0	67.5	61.6	91%	VA-CANMET-TILL1
		mg/L	< 1.0	< 1.0	67.5	59.8	89%	VA-CANMET-TILL1
		mg/L	< 1.0	< 1.0	337	320	95%	VA-NRC-PACS2
		mg/L	-	-	337	326	97%	VA-NRC-PACS2

[a] Results reported by the lab as IRM (Internal Reference Material) which is a reference material developed by the lab and is similar to commercially available CRMs.

value greater than DQO

Table A.7: Laboratory duplicate results for sediment quality, Minto Mine, 2012.

Analyte		Units	Lab Dup		
			Replicate 1	Replicate 2	RPD (%)
Physical tests	Loss of Ignition @ 550 C	%	6	6	0%
	pH	pH units	8.19	8.24	1%
		pH units	8.08	8.04	0%
Partical Size	% Gravel (> 2 mm)	%	< 0.10	< 0.10	0%
	% Sand (2.0 mm - 0.063 mm)	%	0.97	1.00	3%
	% Silt (0.063 mm - 4 µm)	%	85.7	85.9	0%
	% Clay (< 4 µm)	%	13.4	13.1	2%
Metals	Total Aluminum (Al)	mg/L	10,800	10,300	5%
		mg/L	9,290	9,060	3%
	Total Antimony (Sb)	mg/L	0.41	0.41	0%
		mg/L	0.40	0.42	5%
	Total Arsenic (As)	mg/L	5.16	4.48	14%
		mg/L	4.85	5.45	12%
	Total Barium (Ba)	mg/L	167	150	11%
		mg/L	151	172	13%
	Total Beryllium (Be)	mg/L	0.35	0.31	12%
		mg/L	0.32	0.37	14%
	Total Bismuth (Bi)	mg/L	< 0.20	< 0.20	0%
		mg/L	< 0.20	< 0.20	0%
	Total Cadmium (Cd)	mg/L	0.10	0.10	2%
		mg/L	0.11	0.13	17%
	Total Calcium (Ca)	mg/L	7,860	7,400	6%
		mg/L	7,810	9,090	15%
	Total Chromium (Cr)	mg/L	21.4	20.4	5%
		mg/L	18.2	18.8	3%
	Total Cobalt (Co)	mg/L	6.90	6.35	8%
		mg/L	6.52	7.11	9%
	Total Copper (Cu)	mg/L	16.6	15.1	9%
		mg/L	15.8	18.8	17%
	Total Iron (Fe)	mg/L	17,200	16,300	5%
		mg/L	16,100	17,300	7%
	Total Lead (Pb)	mg/L	5.02	4.77	5%
		mg/L	4.42	4.75	7%
	Total Lithium (Li)	mg/L	7.6	7.5	1%
		mg/L	6.8	7.4	8%
	Total Magnesium (Mg)	mg/L	4,620	4,360	6%
		mg/L	4,220	4,380	4%
	Total Manganese (Mn)	mg/L	320	281	13%
		mg/L	345	408	17%
	Total Mercury (Hg)	mg/L	0.02	0.02	5%
		mg/L	0.03	0.03	13%
	Total Molybdenum (Mo)	mg/L	< 0.5	< 0.5	0%
		mg/L	< 0.5	< 0.5	0%
	Total Nickel (Ni)	mg/L	16.5	15.6	6%
		mg/L	15.8	16.9	7%

Table A.7: Laboratory duplicate results for sediment quality, Minto Mine, 2012.

Analyte		Units	Lab Dup		
			Replicate 1	Replicate 2	RPD (%)
Metals	Total Phosphorus (P)	mg/L	796	713	11%
		mg/L	758	838	10%
	Total Potassium (K)	mg/L	760	710	7%
		mg/L	620	610	2%
	Total Selenium (Se)	mg/L	< 0.2	< 0.2	0%
		mg/L	< 0.2	0.2	18%
	Total Silver (Ag)	mg/L	< 0.1	< 0.1	0%
		mg/L	< 0.1	< 0.1	0%
	Total Sodium (Na)	mg/L	260	260	0%
		mg/L	210	190	10%
	Total Strontium (Sr)	mg/L	59.5	54.7	8%
		mg/L	58.8	68.2	15%
	Total Thallium (Tl)	mg/L	0.07	0.07	0%
		mg/L	0.06	0.06	4%
	Total Tin (Sn)	mg/L	< 2.0	< 2.0	0%
		mg/L	< 2.0	< 2.0	0%
	Total Titanium (Ti)	mg/L	594	585	2%
		mg/L	476	423	12%
	Total Uranium (U)	mg/L	0.65	0.59	9%
		mg/L	0.66	0.75	12%
	Total Vanadium (V)	mg/L	38.7	37.0	4%
		mg/L	35.5	36.0	1%
	Total Zinc (Zn)	mg/L	41.4	39.2	5%
		mg/L	37.7	39.5	5%

value greater than DQO

A4.0 BENTHIC MACROINVERTEBRATE SAMPLES

The objective for percent organism recovery was met for each of the four re-sorted samples, with an average percent recovery of approximately 95% at 250 µm and 99% at 500 µm (Table A.8). Records of sub-sampling were maintained (Table A.9). There was no evaluation of sub-sampling error.

Table A.8: Percent recovery of benthic invertebrates, Minto Mine, 2012.

Site	Initial Sort	Re-sort	Percent sorting efficiency[a]
LMC-1, 250 µm	306	15	95%
LWC-4, 250 µm	240	12	95%
LWC-4, 500 µm	213	2	99%
LWC-3, 500 µm	231	3	99%

[a] percent sorting efficiency = [1-((# in QA/AC re-sort / (# sorted originally + # in QA/QC resort))]* 100

value less than 90%

Table A.9: Percent of benthic sample analyzed for each station.

Area	Station				
	1	2	3	4	5
LMC, 250 µm	38%	100%	100%	100%	100%
LWC, 250 µm	38%	63%	100%	44%	50%
LMC, 500 µm	100%	100%	100%	100%	53%
LWC, 500 µm	10%	14%	13%	11%	6%

A5.0 TISSUE SAMPLES

A5.1 Method Detection Limits

All analytes had reported MDLs that were at or below the target concentrations (Table A.10). Therefore, data are reported reliably.

A5.2 Laboratory Blank Sample Analysis

All blank samples contained non-detectable analyte concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Table A.10).

A5.3 Data Precision

The laboratory duplicate sediment samples showed very good agreement in analyte concentrations (Tables A.10) indicating very good precision. High variability was reported for concentrations of cadmium, mercury and tin; only for mercury was it excessively high, indicating a potential issue with precision associated with tissue mercury concentrations.

A5.4 Data Accuracy

Recoveries of all analytes in certified reference materials, except for selenium, met the data quality objective (Table A.11). Selenium was slightly over-recovered and reported concentrations could be slightly high. Overall, these data indicated excellent analytical accuracy associated with the analysis of tissue samples.

Table A.10: Laboratory method detection limits and precision for tissue analyses, Minto Mine, 2012.

Analyte	dry or wet weight	Method Detection Limits		Method Blank Results	Laboratory Duplicate Results		
		Target	Achieved		Duplicate 1	Duplicate 2	RPD%
Physical Tests							
% Moisture		0.10	0.10		75.8	73.9	2.6
Metals							
Aluminum (Al)-Total	dw	2.0	2.0	<2	28100	28300	0.9
Aluminum (Al)-Total	ww	0.40	0.40	<0.4	6790	6850	0.9
Antimony (Sb)-Total	dw	0.010	0.010	<0.01	0.038	0.043	14
Antimony (Sb)-Total	ww	0.0020	0.0020	<0.002	0.0091	0.0105	14
Arsenic (As)-Total	dw	0.020	0.020	<0.02	6.18	7.06	13
Arsenic (As)-Total	ww	0.0040	0.0040	<0.004	1.49	1.70	13
Barium (Ba)-Total	dw	0.050	0.050	<0.05	315	339	7.3
Barium (Ba)-Total	ww	0.010	0.010	<0.01	76.2	82.0	7.3
Beryllium (Be)-Total	dw	0.010	0.010	<0.01	1.10	1.20	9.1
Beryllium (Be)-Total	ww	0.0020	0.0020	<0.002	0.265	0.290	9.1
Bismuth (Bi)-Total	dw	0.010	0.010	<0.01	0.132	0.137	3.3
Bismuth (Bi)-Total	ww	0.0020	0.0020	<0.002	0.0320	0.0331	3.3
Boron (B)-Total	dw	1.0	1.0	<1	5.6	6.2	10
Boron (B)-Total	ww	0.20	0.20	<0.2	1.36	1.51	10
Cadmium (Cd)-Total	dw	0.010	0.010	<0.01	0.300	0.439	38
Cadmium (Cd)-Total	ww	0.0020	0.0020	<0.002	0.0725	0.106	38
Calcium (Ca)-Total	dw	30	30	<30	13900	15900	14
Calcium (Ca)-Total	ww	5.0	5.0	<5	3360	3850	14
Cesium (Cs)-Total	dw	0.0050	0.0050	<0.005	3.36	3.45	2.8
Cesium (Cs)-Total	ww	0.0010	0.0010	<0.001	0.811	0.833	2.8
Chromium (Cr)-Total	dw	0.050	0.050	<0.05	73.8	74.6	1.1
Chromium (Cr)-Total	ww	0.010	0.010	<0.01	17.8	18.0	1.1
Cobalt (Co)-Total	dw	0.020	0.020	<0.02	16.8	17.6	4.6
Cobalt (Co)-Total	ww	0.0040	0.0040	<0.004	4.05	4.24	4.6
Copper (Cu)-Total	dw	0.050	0.050	<0.05	38.2	44.0	14
Copper (Cu)-Total	ww	0.010	0.010	<0.01	9.22	10.6	14
Gallium (Ga)-Total	dw	0.020	0.020	<0.02	8.13	8.26	1.6
Gallium (Ga)-Total	ww	0.0040	0.0040	<0.004	1.96	1.99	1.6
Iron (Fe)-Total	dw	1.0	1.0	<1	32200	33700	4.5
Iron (Fe)-Total	ww	0.20	0.20	<0.2	7790	8150	4.5
Lead (Pb)-Total	dw	0.020	0.020	<0.02	7.69	7.81	1.6
Lead (Pb)-Total	ww	0.0040	0.0040	<0.004	1.86	1.89	1.6
Lithium (Li)-Total	dw	0.10	0.10	<0.1	17.6	18.0	2.2
Lithium (Li)-Total	ww	0.020	0.020	<0.02	4.24	4.34	2.2
Magnesium (Mg)-Total	dw	50	50	<50	11900	12700	5.9
Magnesium (Mg)-Total	ww	10	10	<10	2880	3060	5.9
Manganese (Mn)-Total	dw	0.020	0.020	<0.02	900	1070	17
Manganese (Mn)-Total	ww	0.0040	0.0040	<0.004	217	259	17
Mercury (Hg)-Total	dw	0.0050	0.0050	<0.005	0.0101	0.0844	157
Mercury (Hg)-Total	ww	0.0010	0.0010	<0.001	0.0024	0.0204	157
Molybdenum (Mo)-Total	dw	0.020	0.020	<0.02	0.420	0.452	7.4
Molybdenum (Mo)-Total	ww	0.0040	0.0040	<0.004	0.101	0.109	7.4
Nickel (Ni)-Total	dw	0.050	0.050	<0.05	44.1	45.2	2.4
Nickel (Ni)-Total	ww	0.010	0.010	<0.01	10.7	10.9	2.4
Phosphorus (P)-Total	dw	200	200	<200	1090	1240	14
Phosphorus (P)-Total	ww	50	50	<50	262	300	13
Potassium (K)-Total	dw	1000	1000	<1000	2500	2800	8.3
Potassium (K)-Total	ww	200	200	<200	610	670	8.3
Rhenium (Re)-Total	dw	0.010	0.010	<0.01	<0.010	<0.010	N/A
Rhenium (Re)-Total	ww	0.0020	0.0020	<0.002	<0.0020	<0.0020	N/A
Rubidium (Rb)-Total	dw	0.050	0.050	<0.05	26.3	27.2	3.1
Rubidium (Rb)-Total	ww	0.010	0.010	<0.01	6.36	6.56	3.1
Selenium (Se)-Total	dw	0.10	0.10	<0.1	0.67	0.80	18
Selenium (Se)-Total	ww	0.020	0.020	<0.02	0.161	0.193	18
Sodium (Na)-Total	dw	1000	1000	<1000	<1000	<1000	N/A
Sodium (Na)-Total	ww	200	200	<200	<200	<200	N/A
Strontium (Sr)-Total	dw	0.050	0.050	<0.05	122	132	8.4
Strontium (Sr)-Total	ww	0.010	0.010	<0.01	29.4	32.0	8.4
Tellurium (Te)-Total	dw	0.020	0.020	<0.02	0.022	0.027	18
Tellurium (Te)-Total	ww	0.0040	0.0040	<0.004	0.0054	0.0065	18
Thallium (Tl)-Total	dw	0.0020	0.0020	<0.002	0.185	0.193	4.0
Thallium (Tl)-Total	ww	0.00040	0.00040	<0.0004	0.0447	0.0465	4.0
Thorium (Th)-Total	dw	0.010	0.010	<0.01	5.21	5.39	3.4
Thorium (Th)-Total	ww	0.0020	0.0020	<0.002	1.26	1.30	3.4
Tin (Sn)-Total	dw	0.020	0.020	<0.02	0.181	0.270	40
Tin (Sn)-Total	ww	0.0040	0.0040	<0.004	0.0437	0.0653	40
Titanium (Ti)-Total	dw	0.050	0.050	<0.05	1420	1370	4.0
Titanium (Ti)-Total	ww	0.010	0.010	<0.01	344	330	4.0
Uranium (U)-Total	dw	0.0020	0.0020	<0.002	2.21	2.67	19
Uranium (U)-Total	ww	0.00040	0.00040	<0.0004	0.533	0.645	19
Vanadium (V)-Total	dw	0.020	0.020	<0.02	92.1	100	8.6
Vanadium (V)-Total	ww	0.0040	0.0040	<0.004	22.3	24.3	8.6
Yttrium (Y)-Total	dw	0.010	0.010	<0.01	14.6	15.7	7.5
Yttrium (Y)-Total	ww	0.0020	0.0020	<0.002	3.52	3.79	7.5
Zinc (Zn)-Total	dw	0.50	0.50	<0.5	85.8	88.0	2.5
Zinc (Zn)-Total	ww	0.10	0.10	<0.1	20.7	21.3	2.5
Zirconium (Zr)-Total	dw	0.20	0.20	<0.2	19.7	20.6	4.6
Zirconium (Zr)-Total	ww	0.040	0.040	<0.04	4.76	4.98	4.6

(grey shading) indicates an instance when the DQO was not achieved

Table A.11: Laboratory accuracy for tissue analyses, Minto Mine, 2012.

	Certified Reference Material	dry weight concentrations (mg/kg dw)		
		Achieved Value	Certified Value	% Recovery
Aluminum (Al)-Total	VA-NIST-1547	248	199	124.5
Antimony (Sb)-Total	VA-NIST-1547	0.018	0.020	90.0
Arsenic (As)-Total	VA-NRC-DOLT4	10.0	9.66	104.0
Barium (Ba)-Total	VA-NIST-1547	119	124	95.8
Cadmium (Cd)-Total	VA-NIST-1547	0.024	0.026	92.3
Cadmium (Cd)-Total	VA-NRC-DOLT4	26.9	24.3	110.6
Calcium (Ca)-Total	VA-NIST-1547	17500	15600	112.4
Calcium (Ca)-Total	VA-NRC-DOLT4	665	680	97.8
Chromium (Cr)-Total	VA-NIST-1547	0.845	1.00	84.5
Chromium (Cr)-Total	VA-NRC-DOLT4	1.28	1.40	91.2
Cobalt (Co)-Total	VA-NIST-1547	0.062	0.060	103.3
Cobalt (Co)-Total	VA-NRC-DOLT4	0.227	0.250	90.9
Copper (Cu)-Total	VA-NIST-1547	4.02	3.70	108.7
Copper (Cu)-Total	VA-NRC-DOLT4	34.5	31.2	110.4
Iron (Fe)-Total	VA-NIST-1547	196	218	90.1
Iron (Fe)-Total	VA-NRC-DOLT4	1740	1830	95.1
Lead (Pb)-Total	VA-NIST-1547	0.752	0.870	86.5
Lead (Pb)-Total	VA-NRC-DOLT4	0.114	0.160	71.5
Magnesium (Mg)-Total	VA-NIST-1547	4720	4320	109.2
Magnesium (Mg)-Total	VA-NRC-DOLT4	1460	1500	97.1
Manganese (Mn)-Total	VA-NIST-1547	103	98.0	104.8
Mercury (Hg)-Total	VA-NIST-1547	0.0342	0.0310	110.4
Mercury (Hg)-Total	VA-NRC-DOLT4	2.40	2.58	93.2
Molybdenum (Mo)-Total	VA-NRC-DOLT4	1.06	1.00	105.6
Nickel (Ni)-Total	VA-NRC-DOLT4	0.883	0.970	91.0
Phosphorus (P)-Total	VA-NIST-1547	1490	1370	109.0
Potassium (K)-Total	VA-NIST-1547	27800	24300	114.3
Potassium (K)-Total	VA-NRC-DOLT4	10100	9800	103.5
Rubidium (Rb)-Total	VA-NIST-1547	19.3	19.7	97.8
Selenium (Se)-Total	VA-NIST-1547	0.16	0.12	133.3
Selenium (Se)-Total	VA-NRC-DOLT4	9.33	8.30	112.4
Sodium (Na)-Total	VA-NRC-DOLT4	7200	6800	105.9
Strontium (Sr)-Total	VA-NIST-1547	52.4	53.0	98.9
Strontium (Sr)-Total	VA-NRC-DOLT4	4.95	5.50	90.0
Thorium (Th)-Total	VA-NIST-1547	0.032	0.045	72.2
Tin (Sn)-Total	VA-NRC-DOLT4	0.127	0.170	74.9
Vanadium (V)-Total	VA-NIST-1547	0.307	0.370	83.1
Vanadium (V)-Total	VA-NRC-DOLT4	0.536	0.600	89.3
Zinc (Zn)-Total	VA-NIST-1547	20.4	17.9	113.8
Zinc (Zn)-Total	VA-NRC-DOLT4	137	116	118.4

(shaded) indicates an instance when the DQO (70% - 130% recovery) was not achieved

A6.0 DATA QUALITY STATEMENT

The overall quality of data for this project was adequate to serve the project objectives.

APPENDIX B

SUPPORTING INFORMATION AND DATA

Table B.1: Habitat characteristics for benthic invertebrate areas, Minto Mine, September 2012.

Characteristics		Lower Wolverine Creek (Reference)	Lower Minto Creek (Exposure)
Latitude (dd mm ss.s)		62° 42' 27.2"	62° 38' 49.9"
Longitude (ddd mm ss.s)		137° 17' 46.5"	137° 06' 08.1"
Approximate Length of Reach Assessed (m)		-	40
Gradient (%)		1.5	1 (low gradient but plunge below)
Depth (m)	Mean	0.18	0.18
	Maximum	-	0.26
Width (m)	Wetted	6	1.8
	Bankfull	13	2.8
General Morphology	% pool	0	0
	% riffle	80	0
	% run	20	100
Bank Condition		Moderate	Stable - no Bank Erosion
Substrate Coverage	% bedrock	0	0
	% boulder	0	0
	% cobble	60	70
	% gravel	35	30
	% sand and finer	5	0
Instream Cover (% total Surface)	undercut banks	0	2
	boulder	0	0
	woody debris	2 - 5	5
	deep pool	0	0
	macrophytes	0	0
	other	0	0
Overhead Canopy (%Surface)	Dense	-	0
	Partially Open	20	100
	Open	80	0
Aquatic Vegetation (% areal coverage)	Emergent	0	0
	Submergent	0	0
	Floating	0	0
	Attached Algae	22 (green)	0
Riparian vegetation		willow, alder, spruce	willow, alder, spruce
Surrounding Land Use		forested	forested
Evidence of Anthropogenic Disturbance		-	Mine upstream
General Comments/Notes		overcast, log jam	overcast, calm, small log jams

Table B.2: Erosional benthic invertebrate grab sample collections, Minto Mine, September 2012.

Characteristics		Lower Wolverine Creek (Reference)				
		LWC-1	LWC-2	LWC-3	LWC-4	LWC-5
Latitude (dd mm ss.s)		62° 42' 30.5"	62° 42' 15.4"	62° 42' 17.9"	62° 42' 25.2"	62° 42' 27.2"
Longitude (ddd mm ss.s)		137° 17' 45.1"	137° 17' 54.1"	137° 17' 51.4"	137° 17' 14.6"	137° 17' 46.5"
Sampling Device		Hess	Hess	Hess	Hess	Hess
Sampler Size (m^2)		0.1	0.1	0.1	0.1	0.1
Mesh Size (µm)		250	250	250	250	250
Grabs in Comosite		3	3	3	3	3
Water Velocity (m/s)		0.58	0.48	0.55	0.54	0.51
Depth (m)		0.16	0.19	-	0.16	0.18
Number of Jars		1	1	1	1	1
Average Depth (Sampler pushed into substrate)		10	10	10	10	10
Average Depth (substrate is sampled/cleaned)		10	10	10	10	10
Average Sampling Time per Grab (min)		8	8	8	6 - 8	7
Macrophytes (in sample)		none	none	none	none	none
Algae (in sample)		sparse (skim of green algae)	none	sparse (green)	sparse (green)	sparse (some green)
Sample Texture	% cobble	60	80	75	70	60
	% gravel	35	15	50	25	35
	% sand and finer	5	5	5	5	5
	% organic	0	0	0	0	0

Table B.2: Erosional benthic invertebrate grab sample collections, Minto Mine, September 2012.

Characteristics		Lower Minto Creek (Exposure)				
		LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
Latitude (dd mm ss.s)		62° 38' 50.1"	62° 38' 49.9"	62° 38' 48.9"	62° 38' 49.3"	62° 38' 49.9" (08V 0392246)
Longitude (ddd mm ss.s)		137° 06' 18.1"	137° 06' 16.4"	137° 06' 10.1"	137° 06' 09.1"	137° 06' 08.1" (6948037)
Sampling Device		Hess	Hess	Hess	Hess	Hess
Sampler Size (m^2)		0.1	0.1	0.1	0.1	0.1
Mesh Size (µm)		250	250	250	250	250
Grabs in Comosite		3	3	3	3	3
Water Velocity (m/s)		0.45	0.39	0.59	0.51	0.58
Depth (m)		0.16	0.18	0.18	0.20	0.18
Number of Jars		1	1	1	1	1
Average Depth (Sampler pushed into substrate)		10	10	10	10	10
Average Depth (substrate is sampled/cleaned)		10	10	10	10	10
Average Sampling Time per Grab (min)		8	8	8	7	7
Macrophytes (in sample)		none	none	none	none	none
Algae (in sample)		none	none	none	none	none
Sample Texture	% cobble	70	75	60	60	70
	% gravel	25	50	35	35	30
	% sand and finer	5	5	5	5	trace
	% organic	0	0	0	0	0

Table B.3: *In situ* measures at benthic invertebrate stations, Minto Mine WUL, September 2012. Shade indicates value does not meet WUL standard or water quality guideline.

Area	Variable	Temperature	Specific Conductance	Dissolved Oxygen	Dissolved Oxygen	pH	Mean Depth	Mean Velocity
	Unit	°C	µS/cm	mg/L	%	pH units	m	m/s
	Water Quality Guidelines	-	-	7	54	6.5-9.0[a]	-	-
Upper McGinty Creek (Reference)	URC	2.12	140	11.68	84.4	7.38	-	-
Upper Minto Creek (Exposure)	UMC	3.46	505	13	95	7.76	-	-
Lower Wolverine Creek (Reference)	LWC-1	4.56	208	10.39	81.1	7.26	0.16	0.58
	LWC-2	3.80	202	12.75	96.8	7.78	0.19	0.48
	LWC-3	3.80	205	12.56	95.5	7.91	-	0.55
	LWC-4	4.28	210	10.92	83.8	7.46	0.16	0.54
	LWC-5	4.06	208	11.28	86.2	7.39	0.18	0.51
	Mean	4.10	207	11.58	88.7	7.56	0.17	0.53
	Standard Deviation	0.33	3	1.03	7.1	0.27	0.015	0.038
Lower Minto Creek (Exposure)	LMC-1	6.31	293	12.37	99.0	8.56	0.16	0.45
	LMC-2	5.99	289	12.35	99.3	8.32	0.18	0.39
	LMC-3	5.83	290	12.38	99.1	8.28	0.18	0.59
	LMC-4	5.45	273	12.47	99.0	8.08	0.20	0.51
	LMC-5	5.11	282	12.37	97.2	8.06	0.18	0.58
	Mean	5.74	285	12.39	98.7	8.26	0.18	0.50
	Standard Deviation	0.47	8	0.05	0.9	0.204	0.014	0.085

[a] Range for the Water Use Licence is 6.0 - 9.0

[c] see Appendix Table B.4 for explanatory notes on selected water quality guidelines.

Note: data for dissolved oxygen at upper Minto Creek was accidentally lost; however, observed percent saturation at the time of the survey was >80% at each station.

Table B.4: Water quality results at reference and exposure areas, Minto Mine WUL, September 5th to 8th, 2012.

	Analyte	Units	LWC (reference)	URC (reference)	LBC (reference)	LMC (exposure)	UMC (exposure)
	Sampling Dates:		7-Sep-12	8-Sep-12	6-Sep-12	5-Sep-12	6-Sep-12
Physical Tests	Conductivity	µS/cm	197	139	191	275	482
	Hardness (as $CaCO_3$)	mg/L	104	77.5	92.1	146	239
	pH	ph Units	8.00	7.93	8.14	8.25	7.97
	Total Suspended Solids	mg/L	22.0	4.7	12.7	425	< 3.0
	Total Dissolved Solids	mg/L	123	91.6	116	158	253
	Turbidity	NTU	6.11	3.58	-	-	-
Leachable Anions & Nutrients	Anion Sum	meq/L	2.06	1.44	2.06	2.82	4.72
	Cation Sum	meq/L	2.40	1.80	2.21	3.29	5.65
	Cation - Anion Balance	%	7.6	11.2	3.5	7.8	9.0
Anions and Nutrients	Alkalinity, Total	mg/L	86.7	63.9	90.5	140	223
	Ammonia, Total (as N)	mg/L	0.010	0.007	< 0.005	0.036	< 0.005
	Chloride (Cl)	mg/L	< 0.5	< 0.5	0.8	< 0.5	< 0.5
	Fluoride (F)	mg/L	0.13	0.23	0.15	< 0.02	0.06
	Nitrate (as N)	mg/L	< 0.005	< 0.005	0.079	< 0.005	0.097
	Nitrite (as N)	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Phosphorus (P)-Total dissolved	mg/L	0.02	0.03	-	-	-
	Phosphorus (P)-Total	mg/L	0.032	0.031	0.014	0.298	0.005
	Sulfate (SO4)	mg/L	15.6	7.06	10.4	0.74	12.2
Cyanides	Cyanide, Total	mg/L	< 0.005	< 0.005	-	-	-
	Cyanide, Free	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Organic/ inorganic carbon	Dissolved Organic Carbon	mg/L	13.1	11.6	9.3	11.3	6.2
	Total Organic Carbon	mg/L	13.8	13.3	9.8	13.2	5.9
Total Metals	Total Aluminum (Al)	mg/L	0.56	0.11	0.30	6.76	0.01
	Total Antimony (Sb)	mg/L	0.0002	0.0002	0.0002	0.0003	< 0.0001
	Total Arsenic (As)	mg/L	0.0009	0.0012	0.0014	0.0045	0.0003
	Total Barium (Ba)	mg/L	0.05	0.05	0.07	0.24	0.08
	Total Beryllium (Be)	mg/L	< 0.0001	< 0.0001	< 0.0001	0.0003	< 0.0001
	Total Bismuth (Bi)	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
	Total Boron (B)	mg/L	0.01	< 0.01	0.01	0.01	0.03
	Total Cadmium (Cd)	mg/L	0.00002	< 0.00001	0.00001	0.00012	< 0.00001
	Total Calcium (Ca)	mg/L	22.2	20.3	23.6	45.3	55.7
	Total Chromium (Cr)	mg/L	0.0020	0.0013	0.0008	0.0126	0.0002
	Total Cobalt (Co)	mg/L	0.0005	0.0005	0.0002	0.0050	< 0.0001
	Total Copper (Cu)	mg/L	0.003	0.002	0.003	0.017	0.002
	Total Iron (Fe)	mg/L	0.97	1.46	0.49	11.80	0.02
	Total Lead (Pb)	mg/L	0.00021	0.00006	0.00018	0.00314	< 0.00005
	Total Lithium (Li)	mg/L	0.0019	< 0.0005	0.0013	0.0051	0.0025
	Total Magnesium (Mg)	mg/L	11.5	5.9	9.5	14.4	25.1
	Total Manganese (Mn)	mg/L	0.05	0.14	0.03	0.42	0.05
	Total Mercury (Hg)	mg/L	< 0.00001	< 0.00001	< 0.00001	0.00002	< 0.00001
	Total Molybdenum (Mo)	mg/L	0.0007	0.0011	0.0011	0.0013	0.0049
	Total Nickel (Ni)	mg/L	0.003	0.002	0.002	0.014	0.001
	Total Phosphorus (P)	mg/L	< 0.05	< 0.05	< 0.05	0.408	< 0.05
	Total Potassium (K)	mg/L	0.90	0.48	0.84	1.67	2.19
	Total Selenium (Se)	mg/L	0.0002	0.00029	< 0.0001	0.00027	0.00044
	Total Silicon (Si)	mg/L	6.77	6.93	7.49	19.20	5.71
	Total Silver (Ag)	mg/L	0.00017	0.00001	< 0.00001	0.00006	< 0.00001
	Total Sodium (Na)	mg/L	6.98	3.94	7.48	7.59	18.7

Table B.4: Water quality results at reference and exposure areas, Minto Mine WUL, September 5th to 8th, 2012.

	Analyte	Units	LWC (reference)	URC (reference)	LBC (reference)	LMC (exposure)	UMC (exposure)
Sampling Dates:			7-Sep-12	8-Sep-12	6-Sep-12	5-Sep-12	6-Sep-12
Total Metals	Total Strontium (Sr)	mg/L	0.19	0.12	0.25	0.35	0.61
	Total Thallium (Tl)	mg/L	< 0.00001	< 0.00001	< 0.00001	0.000057	< 0.00001
	Total Tin (Sn)	mg/L	< 0.0001	< 0.0001	< 0.0001	0.0001	< 0.0001
	Total Titanium (Ti)	mg/L	0.02	< 0.01	0.01	0.22	< 0.01
	Total Uranium (U)	mg/L	0.0007	0.0003	0.0019	0.0015	0.0028
	Total Vanadium (V)	mg/L	0.0032	0.0015	0.0019	0.0226	< 0.001
	Total Zinc (Zn)	mg/L	0.003	< 0.003	< 0.003	0.0264	< 0.003
Dissolved Metals	Dissolved Aluminum (Al)	mg/L	0.0293	0.0491	0.0347	0.0384	0.0027
	Dissolved Antimony (Sb)	mg/L	< 0.0001	< 0.0001	0.0001	0.0001	< 0.0001
	Dissolved Arsenic (As)	mg/L	0.0006	0.0010	0.0009	0.0010	0.0003
	Dissolved Barium (Ba)	mg/L	0.04	0.04	0.07	0.07	0.08
	Dissolved Beryllium (Be)	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
	Dissolved Bismuth (Bi)	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
	Dissolved Boron (B)	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	0.021
	Dissolved Cadmium (Cd)	mg/L	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
	Dissolved Calcium (Ca)	mg/L	22.5	21.1	22.2	39.4	55.0
	Dissolved Chromium (Cr)	mg/L	0.0005	0.0005	0.0004	0.0005	< 0.0001
	Dissolved Cobalt (Co)	mg/L	0.0002	0.0005	< 0.0001	0.0003	< 0.0001
	Dissolved Copper (Cu)	mg/L	0.002	0.002	0.002	0.002	0.002
	Dissolved Iron (Fe)	mg/L	0.23	1.19	0.11	0.56	0.02
	Dissolved Lead (Pb)	mg/L	< 0.00005	< 0.00005	< 0.00005	0.00014	< 0.00005
	Dissolved Lithium (Li)	mg/L	0.0014	< 0.0005	0.0013	0.0010	0.0027
	Dissolved Magnesium (Mg)	mg/L	11.6	6.1	8.9	11.5	24.8
	Dissolved Manganese (Mn)	mg/L	0.03	0.13	0.02	0.08	0.05
	Dissolved Mercury (Hg)	mg/L	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
	Dissolved Molybdenum (Mo)	mg/L	0.0005	0.0009	0.0010	0.0011	0.0047
	Dissolved Nickel (Ni)	mg/L	0.002	0.002	0.001	0.002	0.001
	Dissolved Phosphorus (P)	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
	Dissolved Potassium (K)	mg/L	0.82	0.51	0.76	0.92	2.19
	Dissolved Selenium (Se)	mg/L	0.0001	0.0003	< 0.0001	0.0001	0.0004
	Dissolved Silicon (Si)	mg/L	5.70	6.96	6.70	6.86	5.73
	Dissolved Silver (Ag)	mg/L	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
	Dissolved Sodium (Na)	mg/L	6.7	3.7	7.8	7.4	18.6
	Dissolved Strontium (Sr)	mg/L	0.17	0.12	0.24	0.28	0.61
	Dissolved Thallium (Tl)	mg/L	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
	Dissolved Tin (Sn)	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
	Dissolved Titanium (Ti)	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	Dissolved Uranium (U)	mg/L	0.0006	0.0003	0.0017	0.0010	0.0027
	Dissolved Vanadium (V)	mg/L	0.001	0.001	0.001	0.002	< 0.001
	Dissolved Zinc (Zn)	mg/L	< 0.001	0.002	0.001	0.002	< 0.001

Table B.5: Explanatory notes for selected water quality guidelines, Minto Mine WUL, 2012.

Analyte		Water Quality Guidelines	Unit	CCME[a]
Physical, anion and nutrient analytes	**Ammonia (Total)**	**0.502**	mg/L	Ammonia guideline is based on highest field pH of 8.56 and highest temperature of 6.6°C
	Fluoride	**0.12**	mg/L	Guideline is an interm level
	Total Suspended Solids	**17.7**	mg/L	Guideline is based on the median of background of 12.7 mg/L plus 5 mg/L
	Turbidity	**6.85**	NTU	Guideline is based on the median of background of 4.85 NTU plus 2 NTU
Total Metals	**Aluminum**	**0.1**	mg/L	Guideline is baded on pH of > 6.5
	Cadmium	**0.000044**	mg/L	Guideline is based on lowest hardness of 139 mg/L.
	Chromium	**0.001**	mg/L	Guideline is based hexavalent chromium (Cr VI).
	Copper	**0.00313**	mg/L	Guideline is based on lowest hardness of 139 mg/L.
	Lead	**0.00484**	mg/L	Guideline is based on lowest hardness of 139 mg/L.
	Nickel	**0.12276**	mg/L	Guideline is based on lowest hardness of 139 mg/L.

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

Table B.6: Comparing water quality results at reference and exposure areas in 2011 and 2012, Minto Mine WUL.

Analyte		Units	CCME Water Quality[a]		WUL Limits at W2	2011				2012				
			30	Max		Upper McGinty Creek (reference)	Upper Minto Creek (exposure)	Lower Wolverine Creek (reference)	Lower Minto Creek (exposure)	Upper McGinty Creek (reference)	Upper Minto Creek (exposure)	Lower Wolverine Creek (reference)	Lower Minto Creek (exposure)	Little Big Creek (reference)
Physical Tests	Total Suspended Solids	mg/L	12.7	-	-	7.7	<3.0	24.5	24.5	4.7	< 3.0	22.0	425.0	12.7
Total Metals	Total Aluminum (Al)	mg/L	0.1[c]	-	0.62	0.284	0.0103	0.818	0.717	0.11	0.01	0.56	6.76	0.30
	Total Antimony (Sb)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	0.0002	< 0.0001	0.0002	0.0003	0.0002
	Total Arsenic (As)	mg/L	0.005	-	0.005	0.00076	0.00028	0.00077	0.00128	0.0012	0.0003	0.0009	0.0045	0.0014
	Total Barium (Ba)	mg/L	-	-	-	0.0467	0.0833	0.0520	0.0747	0.048	0.083	0.053	0.242	0.071
	Total Beryllium (Be)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	< 0.0001	< 0.0001	< 0.0001	0.0003	< 0.0001
	Total Bismuth (Bi)	mg/L	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
	Total Boron (B)	mg/L	1.5	2.9	-	<0.010	0.022	0.010	<0.010	< 0.01	0.03	0.01	0.01	0.01
	Total Cadmium (Cd)	mg/L	0.00004d	-	0.00004	<0.000010	<0.000010	0.000017	0.000014	< 0.00001	< 0.00001	0.00002	0.00012	0.00001
	Total Calcium (Ca)	mg/L	-	-	-	17.5	59.6	21.3	37.0	20.3	55.7	22.2	45.3	23.6
	Total Chromium (Cr)	mg/L	0.001 Cr(VI)	-	0.002	0.00109	0.00048	0.00236	0.00167	0.0013	0.0002	0.0020	0.0126	0.0008
	Total Cobalt (Co)	mg/L	-	-	-	0.00052	<0.00010	0.00067	0.00073	0.0005	< 0.0001	0.0005	0.0050	0.0002
	Total Copper (Cu)	mg/L	0.003[d]	-	0.013	0.00254	0.00192	0.00363	0.00278	0.002	0.002	0.003	0.017	0.003
	Total Iron (Fe)	mg/L	0.3	-	1.1	1.16	<0.030	1.39	1.95	1.46	0.02	0.97	11.80	0.49
	Total Lead (Pb)	mg/L	0.005[d]	-	0.004	0.000110	<0.000050	0.000330	0.000303	0.00006	< 0.00005	0.00021	0.00314	0.00018
	Total Lithium (Li)	mg/L	-	-	-	0.00073	0.00224	0.00158	0.00128	< 0.0005	0.0025	0.0019	0.0051	0.0013
	Total Magnesium (Mg)	mg/L	-	-	-	5.20	23.8	11.1	10.7	5.9	25.1	11.5	14.4	9.5
	Total Manganese (Mn)	mg/L	-	-	-	0.0910	0.0174	0.0591	0.163	0.14	0.05	0.05	0.42	0.03
	Total Mercury (Hg)	mg/L	-	-	-	<0.000010	<0.000010	-	-	< 0.00001	< 0.00001	< 0.00001	0.00002	< 0.00001
	Total Molybdenum (Mo)	mg/L	0.073	-	0.073	0.000789	0.00340	0.000558	0.00113	0.0011	0.0049	0.0007	0.0013	0.0011
	Total Nickel (Ni)	mg/L	0.12[d]	-	0.11	0.00188	0.00075	0.00353	0.00276	0.002	0.001	0.003	0.014	0.002
	Total Phosphorus (P)	mg/L	-	-	-	-	-	-	-	< 0.05	< 0.05	< 0.05	0.41	< 0.05
	Total Potassium (K)	mg/L	-	-	-	0.404	2.13	0.637	0.936	0.48	2.19	0.90	1.67	0.84
	Total Selenium (Se)	mg/L	0.001	-	0.001	0.00021	0.00034	0.00020	0.00013	0.0003	0.0004	0.0002	0.0003	< 0.0001
	Total Silicon (Si)	mg/L	-	-	-	7.61	5.58	7.82	8.66	6.93	5.71	6.77	19.20	7.49
	Total Silver (Ag)	mg/L	0.0001	-	-	<0.000010	<0.000010	<0.000010	<0.000010	0.00001	< 0.00001	0.00017	0.00006	< 0.00001
	Total Sodium (Na)	mg/L	-	-	-	3.57	16.5	6.48	6.25	3.94	18.70	6.98	7.59	7.48
	Total Strontium (Sr)	mg/L	-	-	-	0.109	0.636	0.199	0.269	0.120	0.611	0.187	0.351	0.250
	Total Thallium (Tl)	mg/L	0.0008	-	-	<0.000010	<0.000010	<0.000010	<0.000010	< 0.00001	< 0.00001	< 0.00001	0.00006	< 0.00001
	Total Tin (Sn)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	< 0.0001	< 0.0001	< 0.0001	0.0001	< 0.0001
	Total Titanium (Ti)	mg/L	-	-	-	0.017	0.011	0.040	0.032	< 0.01	< 0.01	0.02	0.22	0.01
	Total Uranium (U)	mg/L	0.015	0.033	-	0.000258	0.00292	0.000912	0.000785	0.0003	0.0028	0.0007	0.0015	0.0019
	Total Vanadium (V)	mg/L	-	-	-	0.0020	<0.0010	0.0042	0.0032	0.002	< 0.001	0.003	0.023	0.002
	Total Zinc (Zn)	mg/L	0.03	-	0.03	<0.0030	<0.0030	0.0035	0.0035	< 0.003	< 0.003	0.003	0.026	< 0.003

[Bold box] Water use licence standard not met

[Grey shading] Water quality guideline not met

[a] CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.4 for explanatory notes on selected water quality guidelines.

[b] Based on lowest guideline using highest temperature and pH

[c] Based on lowest guideline using highest pH

[d] Based on lowest guideline using lowest hardness

Table B.7: Concentration of chlorophyll *a* measured at five benthic stations in lower Wolverine and lower Minto Creeks, Minto Mine WUL, 2012.

Lower Wolverine Creek (reference)		**Lower Minto Creek (exposure)**	
Station	mg/m^2	Station	mg/m^2
LWC-1	11.6	LMC-1	0.25
LWC-2	6.7	LMC-2	1.21
LWC-3	1.1	LMC-3	0.39
LWC-4	27.0	LMC-4	0.28
LWC-5	24.6	LMC-5	0.39
Mean	14.2	Mean	0.51
Standard Deviation	11.3	Standard Deviation	0.40

APPENDIX C

SEDIMENT, PERIPHYTON AND BENTHIC INVERTEBRATE QUALITY DATA

Table C.1: Sediment chemistry data collected at exposed and reference areas, Minto Mine WUL, 2012.

	Analytes	Units	CSQG [a]		Upper McGinty Creek (Reference)					Lower Wolverine Creek (Reference)				
					URC-1	URC-2	URC-3	URC-4	URC-5	LWC-1	LWC-2	LWC-3	LWC-4	LWC-5
			ISQG	PEL	8-Sep-12	8-Sep-12	8-Sep-12	8-Sep-12	8-Sep-12	8-Sep-12	8-Sep-12	8-Sep-12	8-Sep-12	8-Sep-12
Particle size, TKN, carbon analytes and pH	Loss on Ignition @ 550 C	%			-	-	-	-	-	24	14	21	20	24
	pH (1:2 soil:water)	pH units			7.19	7.29	6.86	7.03	6.83	7.71	6.93	7.27	6.99	7.46
	% Gravel (>2mm)	%			-	-	-	-	-	< 0.1	< 0.1	< 0.1	0.5	< 0.1
	% Sand (2.0mm - 0.063mm)	%			-	-	-	-	-	1.0	42.4	10.1	18.8	2.0
	% Silt (0.063mm - 4um)	%			-	-	-	-	-	85.7	50.9	79.1	69.2	85.8
	% Clay (<4um)	%			-	-	-	-	-	13.4	6.74	10.8	11.5	12.2
	Total Kjeldahl Nitrogen (TKN)	%			0.67	0.50	0.48	0.31	0.47	0.60	0.32	0.52	0.43	0.65
	Total Organic Carbon	%			-	-	-	-	-	11.30	6.10	9.91	9.58	10.90
Total Metals	Aluminum (Al)	mg/kg			13,400	15,400	16,700	14,400	14,900	20,700	17,600	17,800	14,800	18,000
	Antimony (Sb)	mg/kg			0.57	0.53	0.57	0.45	0.57	0.59	0.58	0.56	0.54	0.53
	Arsenic (As)	mg/kg	5.9	17	8.81	12.2	9.41	7.77	10.7	6.21	7.27	6.10	6.21	6.38
	Barium (Ba)	mg/kg			359	399	355	287	340	335	309	307	260	290
	Beryllium (Be)	mg/kg			0.52	0.52	0.51	0.41	0.50	0.94	0.88	0.87	0.81	0.80
	Bismuth (Bi)	mg/kg			< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Cadmium (Cd)	mg/kg	0.6	3.5	0.31	0.26	0.24	0.17	0.25	0.37	0.37	0.34	0.30	0.34
	Calcium (Ca)	mg/kg			14,300	12,800	11,100	9,500	12,300	13,900	12,000	12,500	11,700	11,600
	Chromium (Cr)	mg/kg	37.3	90	29.8	32.4	34.4	28.6	31.9	60.4	54.7	55.7	44.8	53.8
	Cobalt (Co)	mg/kg			14.0	16.3	13.8	12.6	12.5	15.9	14.9	14.9	13.3	15.0
	Copper (Cu)	mg/kg	35.7	197	38	34	34	26	35	42	39	39	34	38
	Iron (Fe)	mg/kg			28,800	35,500	32,700	27,300	31,400	31,300	30,600	29,700	26,500	29,500
	Lead (Pb)	mg/kg	35	91.3	5.92	6.18	6.52	5.77	6.15	8.01	7.62	7.57	10.4	6.88
	Lithium (Li)	mg/kg			7.9	9.3	10.3	8.8	9.0	13.7	12.1	12.1	10.3	11.3
	Magnesium (Mg)	mg/kg			4,900	5,280	5,640	5,080	4,990	10,300	9,280	9,790	8,560	10,100
	Manganese (Mn)	mg/kg			1,870	2,430	1,320	1,370	1,090	792	827	718	716	785
	Mercury (Hg)	mg/kg	0.17	0.49	0.099	0.068	0.064	0.050	0.073	0.061	0.063	0.059	0.056	0.059
	Molybdenum (Mo)	mg/kg			1.13	0.71	0.63	0.53	0.66	0.52	0.52	0.53	0.53	< 0.50
	Nickel (Ni)	mg/kg			23	24	24	20	22	45	41	42	37	42
	Phosphorus (P)	mg/kg			916	1,030	982	877	1,050	977	1,010	982	941	995
	Potassium (K)	mg/kg			630	730	780	710	690	950	850	860	730	890
	Selenium (Se)	mg/kg			0.77	0.80	0.64	0.47	0.57	0.64	0.59	0.63	0.54	0.60
	Silver (Ag)	mg/kg			0.14	0.12	0.12	< 0.1	0.13	0.15	0.14	0.13	0.14	0.13
	Sodium (Na)	mg/kg			190	200	210	210	200	310	300	300	310	330
	Strontium (Sr)	mg/kg			119	107	89	78	96	139	124	123	114	116
	Thallium (Tl)	mg/kg			0.076	0.082	0.084	0.080	0.082	0.108	0.097	0.107	0.078	0.095
	Tin (Sn)	mg/kg			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
	Titanium (Ti)	mg/kg			537	658	709	738	631	749	696	696	611	725
	Uranium (U)	mg/kg			1.97	1.71	1.39	1.28	1.50	2.69	2.66	2.68	2.83	2.72
	Vanadium (V)	mg/kg			60	63	63	54	60	76	72	71	64	71
	Zinc (Zn)	mg/kg	123	315	49	54	56	52	51	67	62	63	57	64

[a] Canadian Sediment Quality Guidelines - ISQG = interim sediment quality guideline;
PEL = probable effect level (CCME 1999).

(blue box) Indicates sediment concentration exceeding CSQG ISQG.

(green box) Indicates sediment concentration exceeding CSQG PEL.

Table C.1: Sediment chemistry data collected at exposed and reference areas, Minto Mine WUL, 2012.

Analytes		Units	CSQG [a]		Upper Minto Creek (Exposure)					Lower Minto Creek (Exposure)				
					UMC-1	UMC-2	UMC-3	UMC-4	UMC-5	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5
			ISQG	PEL	13-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	6-Sep-12	6-Sep-12	6-Sep-12	6-Sep-12	6-Sep-12
Particle size, TKN, carbon analytes and pH	Loss on Ignition @ 550 C	%			-	-	-	-	-	7	5	10	12	6
	pH (1:2 soil:water)	pH units			7.72	8.18	8.00	7.83	8.19	8.13	8.19	8.01	7.99	8.08
	% Gravel (>2mm)	%			-	-	-	-	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	% Sand (2.0mm - 0.063mm)	%			-	-	-	-	-	1.0	1.2	5.9	4.2	4.8
	% Silt (0.063mm - 4um)	%			-	-	-	-	-	85.2	90.2	86.0	85.4	86.2
	% Clay (<4um)	%			-	-	-	-	-	13.9	8.59	8.13	10.5	8.98
	Total Kjeldahl Nitrogen (TKN)	%			0.10	0.07	0.08	0.13	0.07	0.17	0.10	0.20	0.25	0.14
	Total Organic Carbon	%			-	-	-	-	-	2.98	1.71	4.07	5.71	2.60
Total Metals	Aluminum (Al)	mg/kg			10,500	9,830	12,000	13,000	10,700	12,100	10,800	10,200	11,400	9,290
	Antimony (Sb)	mg/kg			0.27	0.32	0.34	0.47	0.39	0.52	0.41	0.48	0.56	0.40
	Arsenic (As)	mg/kg	5.9	17	5.25	5.40	5.59	6.31	5.68	6.09	5.16	6.99	7.44	4.85
	Barium (Ba)	mg/kg			181	175	180	238	196	216	167	199	240	151
	Beryllium (Be)	mg/kg			0.32	0.44	0.37	0.54	0.43	0.40	0.35	0.43	0.49	0.32
	Bismuth (Bi)	mg/kg			< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Cadmium (Cd)	mg/kg	0.6	3.5	0.18	0.15	0.15	0.22	0.17	0.14	0.10	0.16	0.20	0.11
	Calcium (Ca)	mg/kg			5,200	6,400	6,020	8,870	6,890	9,540	7,860	10,300	12,200	7,810
	Chromium (Cr)	mg/kg	37.3	90	24.6	23.8	27.4	30.7	25.1	24.9	21.4	20.1	23.8	18.2
	Cobalt (Co)	mg/kg			10.0	10.1	10.5	12.3	10.5	8.4	6.9	8.1	9.5	6.5
	Copper (Cu)	mg/kg	35.7	197	133	97	103	120	116	21	17	21	25	16
	Iron (Fe)	mg/kg			22,500	22,500	23,300	25,100	22,500	20,900	17,200	19,700	22,100	16,100
	Lead (Pb)	mg/kg	35	91.3	4.22	5.27	4.99	6.49	5.32	5.83	5.02	5.24	5.91	4.42
	Lithium (Li)	mg/kg			5.9	7.2	7.1	9.2	7.4	8.7	7.6	7.8	9.0	6.8
	Magnesium (Mg)	mg/kg			7,420	7,530	7,850	9,430	7,360	5,370	4,620	4,810	5,630	4,220
	Manganese (Mn)	mg/kg			1,470	1,710	1,050	2,010	1,820	445	320	545	631	345
	Mercury (Hg)	mg/kg	0.17	0.49	0.018	0.015	0.023	0.024	0.016	0.032	0.025	0.037	0.044	0.027
	Molybdenum (Mo)	mg/kg			1.05	1.28	0.92	1.59	1.31	0.51	< 0.5	0.57	0.66	< 0.5
	Nickel (Ni)	mg/kg			32	35	34	47	35	20	17	19	22	16
	Phosphorus (P)	mg/kg			1,040	958	1,000	985	985	761	796	860	787	758
	Potassium (K)	mg/kg			1,120	1,130	1,340	1,350	1,330	940	760	810	870	620
	Selenium (Se)	mg/kg			0.36	0.28	0.28	0.49	0.32	0.24	< 0.20	0.27	0.36	< 0.20
	Silver (Ag)	mg/kg			< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Sodium (Na)	mg/kg			310	370	350	450	410	280	260	230	240	210
	Strontium (Sr)	mg/kg			48	63	64	94	70	76	60	83	101	59
	Thallium (Tl)	mg/kg			0.052	0.056	0.067	0.082	0.071	0.094	0.066	0.069	0.079	0.055
	Tin (Sn)	mg/kg			< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
	Titanium (Ti)	mg/kg			578	623	661	738	667	644	594	536	568	476
	Uranium (U)	mg/kg			0.53	0.55	0.57	0.93	0.60	0.81	0.65	0.95	1.06	0.66
	Vanadium (V)	mg/kg			50	51	53	57	50	46	39	42	47	36
	Zinc (Zn)	mg/kg	123	315	66	61	63	71	68	49	41	42	49	38

[a] Canadian Sediment Quality Guidelines - ISQG = interim sediment quality guideline;
PEL = probable effect level (CCME 1999).

Indicates sediment concentration exceeding CSQG ISQG.

Indicates sediment concentration exceeding CSQG PEL.

Table C.2: Periphyton tissue quality results at reference and exposure areas, Minto Mine WUL, 2012

Analyte		Units	LWC-1 (reference)	LWC-2 (reference)	LWC-3 (reference)	LWC-4 (reference)	LWC-5 (reference)	LWC Mean	LWC Standard Deviation	LBC (reference)	LMC (exposure)
Physical Tests	Moisture	%	85.7	79.8	75.8	86.9	82.5	82.1	4.5	59.3	51.9
Total Metals	Total Aluminum (Al)	mg/kg dw	32,800	31,600	28,100	33,900	30,800	31,440	2,207	21,500	21,100
	Total Antimony (Sb)	mg/kg dw	0.04	0.04	0.04	0.04	0.04	0.04	0.00	0.03	0.02
	Total Arsenic (As)	mg/kg dw	8.14	8.88	6.18	9.28	8.51	8.20	1.21	13.90	4.24
	Total Barium (Ba)	mg/kg dw	375	371	315	379	363	361	26	260	284
	Total Beryllium (Be)	mg/kg dw	1.33	1.21	1.10	1.29	1.22	1.23	0.09	0.692	0.664
	Total Bismuth (Bi)	mg/kg dw	0.146	0.141	0.132	0.154	0.144	0.143	0.008	0.451	0.125
	Total Boron (B)	mg/kg dw	< 7.0	12.6	5.6	7.5	< 7.0	17.5	20.3	5.6	4.9
	Total Cadmium (Cd)	mg/kg dw	0.40	0.42	0.30	0.36	0.40	0.38	0.05	0.24	0.18
	Total Calcium (Ca)	mg/kg dw	15,400	15,400	13,900	16,700	15,600	15,400	997	11,500	16,200
	Total Cesium (Cs)	mg/kg dw	4.00	3.91	3.36	4.24	3.79	3.86	0.32	2.38	1.65
	Total Chromium (Cr)	mg/kg dw	84.7	81.6	73.8	88.6	79.8	81.7	5.5	43.6	51.4
	Total Cobalt (Co)	mg/kg dw	19.9	20.3	16.8	21.0	19.7	19.5	1.6	10.6	10.3
	Total Copper (Cu)	mg/kg dw	46.2	46.3	38.2	45.9	45.4	44.4	3.5	30.9	26.3
	Total Gallium (Ga)	mg/kg dw	9.32	9.19	8.13	9.98	9.05	9.13	0.66	6.71	6.80
	Total Iron (Fe)	mg/kg dw	38,600	37,800	32,200	40,500	37,900	37,400	3,102	26,000	28,000
	Total Lead (Pb)	mg/kg dw	8.43	8.26	7.69	8.97	8.13	8.30	0.47	7.32	6.72
	Total Lithium (Li)	mg/kg dw	20.4	19.4	17.6	21.2	19.3	19.6	1.4	12.3	12.9
	Total Magnesium (Mg)	mg/kg dw	13,000	13,300	11,900	15,600	13,900	13,540	1,361	8,460	7,230
	Total Manganese (Mn)	mg/kg dw	1,490	1,710	900	1,850	1,680	1,526	373	653	1,130
	Total Mercury (Hg)	mg/kg dw	0.11	0.14	0.01	0.12	0.08	0.09	0.05	0.07	0.06
	Total Molybdenum (Mo)	mg/kg dw	0.49	0.52	0.42	0.49	0.52	0.49	0.04	0.68	0.43
	Total Nickel (Ni)	mg/kg dw	51.8	49.6	44.1	54.6	50.9	50.2	3.9	25.1	23.9
	Total Phosphorus (P)	mg/kg dw	1,310	1,420	1,090	1,510	1,620	1,390	203	1,190	1,060
	Total Potassium (K)	mg/kg dw	3,100	3,100	2,500	4,500	3,500	3,340	740	2,600	2,400
	Total Rhenium (Re)	mg/kg dw	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0	< 0.01	< 0.01
	Total Rubidium (Rb)	mg/kg dw	31.6	30.6	26.3	35.4	30.4	30.9	3.2	19.3	16.5
	Total Selenium (Se)	mg/kg dw	0.97	0.92	0.67	0.95	0.85	0.87	0.12	0.3	0.21
	Total Sodium (Na)	mg/kg dw	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	0	< 1,000	< 1,000
	Total Strontium (Sr)	mg/kg dw	143	134	122	137	131	133	8	91	104
	Total Tellurium (Te)	mg/kg dw	0.03	0.03	0.02	0.03	0.03	0.03	0.00	0.05	< 0.02
	Total Thallium (Tl)	mg/kg dw	0.21	0.21	0.19	0.24	0.22	0.21	0.02	0.15	0.14
	Total Thorium (Th)	mg/kg dw	5.98	5.58	5.21	6.40	5.51	5.74	0.46	5.50	7.56
	Total Tin (Sn)	mg/kg dw	0.20	0.29	0.18	0.25	0.24	0.23	0.04	0.04	< 0.02
	Total Titanium (Ti)	mg/kg dw	1,480	1,490	1,420	1,580	1,390	1,472	73	1,000	1,020
	Total Uranium (U)	mg/kg dw	2.76	2.69	2.21	2.41	2.52	2.52	0.22	1.08	1.32
	Total Vanadium (V)	mg/kg dw	109	110	92	111	105	105	8	75	81
	Total Yttrium (Y)	mg/kg dw	16.3	16.1	14.6	16.2	15.4	15.7	0.7	13.3	17.1
	Total Zinc (Zn)	mg/kg dw	101	97	86	104	98	97	7	79	73
	Total Zirconium (Zr)	mg/kg dw	23.2	22.4	19.7	24.6	22.4	22.5	1.8	10.6	12.4

bold Indicates periphyton tissue concentration exceeding the higher reference mean by more than 2 times

Table C.3: Benthic tissue quality results at reference and exposure areas, Minto Mine WUL, 2012.

Analyte		Units	LWC (reference)	LBC (reference)	LMC (exposure)
Physical Tests	Moisture	%	80.1	85.4	90.7
Total Metals	Total Aluminum (Al)	mg/kg dw	4,890	2,440	8,720
	Total Antimony (Sb)	mg/kg dw	< 0.01	0.05	0.08
	Total Arsenic (As)	mg/kg dw	2.05	2.86	5.32
	Total Barium (Ba)	mg/kg dw	71	48	**196**
	Total Beryllium (Be)	mg/kg dw	0.23	0.09	0.35
	Total Bismuth (Bi)	mg/kg dw	0.03	0.07	0.07
	Total Boron (B)	mg/kg dw	< 2.0	< 3.0	**20.3**
	Total Cadmium (Cd)	mg/kg dw	0.27	0.37	0.31
	Total Calcium (Ca)	mg/kg dw	3,040	3,630	**9,450**
	Total Cesium (Cs)	mg/kg dw	0.54	0.25	0.82
	Total Chromium (Cr)	mg/kg dw	12.4	17.2	16.9
	Total Cobalt (Co)	mg/kg dw	3.94	2.44	5.38
	Total Copper (Cu)	mg/kg dw	17.3	18.5	33.2
	Total Gallium (Ga)	mg/kg dw	1.57	0.85	2.70
	Total Iron (Fe)	mg/kg dw	7,640	5,400	13,500
	Total Lead (Pb)	mg/kg dw	1.32	1.30	**3.34**
	Total Lithium (Li)	mg/kg dw	2.96	1.87	5.03
	Total Magnesium (Mg)	mg/kg dw	3,120	2,160	3,440
	Total Manganese (Mn)	mg/kg dw	360	256	**782**
	Total Mercury (Hg)	mg/kg dw	0.07	0.06	0.08
	Total Molybdenum (Mo)	mg/kg dw	0.72	1.64	3.21
	Total Nickel (Ni)	mg/kg dw	8.88	5.19	11.3
	Total Phosphorus (P)	mg/kg dw	5,750	5,030	4,250
	Total Potassium (K)	mg/kg dw	6,200	7,300	5,400
	Total Rhenium (Re)	mg/kg dw	< 0.01	< 0.01	< 0.01
	Total Rubidium (Rb)	mg/kg dw	5.93	2.65	9.51
	Total Selenium (Se)	mg/kg dw	1.01	0.83	1.14
	Total Sodium (Na)	mg/kg dw	4,300	6,100	3,000
	Total Strontium (Sr)	mg/kg dw	26.0	34.3	**74.3**
	Total Tellurium (Te)	mg/kg dw	< 0.02	< 0.02	< 0.02
	Total Thallium (Tl)	mg/kg dw	0.04	0.02	0.07
	Total Thorium (Th)	mg/kg dw	1.02	0.66	**2.39**
	Total Tin (Sn)	mg/kg dw	< 0.02	0.03	**0.35**
	Total Titanium (Ti)	mg/kg dw	28	102	**404**
	Total Uranium (U)	mg/kg dw	0.60	1.28	1.29
	Total Vanadium (V)	mg/kg dw	21.5	14.7	37.5
	Total Yttrium (Y)	mg/kg dw	2.70	1.76	**7.37**
	Total Zinc (Zn)	mg/kg dw	93.0	74.0	96.1
	Total Zirconium (Zr)	mg/kg dw	2.89	1.42	**5.80**

bold Indicates periphyton tissue concentration exceeding the higher reference mean by more than 2 times

Table C.4: Slimy sculpin tissue quality results at reference and exposure areas, Minto Mine WUL, 2012.

	Analyte	Units	Lower Big Creek (reference)										Lower Minto Creek (exposure)								
			REF-01	REF-02	REF-03	REF-04	REF-05	REF-06	REF-07	REF-08	Mean	Standard Deviation	EXP-01	EXP-02	EXP-03	EXP-04	EXP-05	EXP-06	EXP-07	Mean	Standard Deviation
Meristics	Weight	g	1.34	1.94	1.40	3.22	1.45	1.54	1.53	1.79	1.78	0.62	8.49	2.36	8.82	5.55	1.59	8.95	7.77	6.22	3.12
	Total Length	mm	54.76	60.06	53.95	72.12	57.05	57.07	54.81	60.01	58.73	5.88	109	66	101	86	59	106	95	88.9	19.6
	Headless Weight	g	0.72	1.09	0.72	1.73	0.82	0.86	0.88	1.01	0.98	0.33	5.03	1.31	5.07	3.22	0.92	4.97	3.65	3.45	1.76
Physical Tests	Moisture	%	-	-	-	86	-	-	-	-	-	-	78	-	77	80	-	79	79	-	-
Total Metals	Total Aluminum (Al)	mg/kg dw	5.9	110.6	20.9	35.1	237.5	35.6	167.1	122.0	91.8	81.9	40.4	81.3	40.3	190.0	69.4	6.5	4.7	61.8	63.4
	Total Antimony (Sb)	mg/kg dw	0.013	0.021	0.021	0.022	0.059	0.019	0.036	0.027	0.027	0.014	0.011	0.024	0.015	0.042	0.022	0.011	0.007	0.019	0.012
	Total Arsenic (As)	mg/kg dw	0.317	0.431	0.531	0.407	0.580	0.387	0.441	0.387	0.435	0.084	0.200	0.342	0.257	0.410	0.540	0.219	0.190	0.308	0.130
	Total Barium (Ba)	mg/kg dw	10.9	15.9	16.2	16.3	16.2	17.6	16.5	13.0	15.3	2.2	9.4	17.0	12.8	24.8	14.3	9.5	6.7	13.5	6.1
	Total Beryllium (Be)	mg/kg dw	0.149	0.099	0.149	0.143	0.149	0.149	0.149	0.149	0.142	0.017	0.091	0.099	0.087	0.100	0.099	0.095	0.095	0.095	0.005
	Total Bismuth (Bi)	mg/kg dw	0.149	0.099	0.149	0.143	0.149	0.149	0.149	0.149	0.142	0.017	0.091	0.099	0.087	0.100	0.099	0.095	0.095	0.095	0.005
	Total Boron (B)	mg/kg dw	2.98	1.98	2.98	2.86	2.98	2.98	2.98	2.98	2.84	0.35	1.82	1.98	1.74	2.00	1.98	1.90	1.90	1.90	0.10
	Total Cadmium (Cd)	mg/kg dw	0.227	0.409	0.095	0.155	0.336	0.132	0.099	0.124	0.197	0.117	0.133	0.158	0.272	0.095	0.366	0.104	0.068	0.171	0.109
	Total Calcium (Ca)	mg/kg dw	31,190	37,091	31,041	30,143	29,107	35,554	31,339	21,620	30,886	4,632	32,727	33,769	38,826	25,950	31,388	36,667	28,238	32,509	4,497
	Total Chromium (Cr)	mg/kg dw	0.298	0.342	0.298	0.286	0.679	0.298	0.540	0.367	0.388	0.144	0.182	0.293	0.204	0.540	0.263	0.190	0.190	0.266	0.128
	Total Cobalt (Co)	mg/kg dw	0.060	0.343	0.074	0.117	0.220	0.087	0.186	0.147	0.154	0.094	0.076	0.206	0.162	0.369	0.258	0.095	0.079	0.178	0.109
	Total Copper (Cu)	mg/kg dw	3.669	6.099	3.679	4.914	5.355	3.575	4.180	4.274	4.468	0.912	3.209	4.463	4.913	5.300	6.397	4.105	3.500	4.555	1.096
	Total Iron (Fe)	mg/kg dw	64	260	89	142	454	133	360	274	222	138	138	238	136	469	196	81	74	190	136
	Total Lead (Pb)	mg/kg dw	0.176	0.142	0.213	0.244	0.540	0.206	0.266	0.201	0.249	0.124	0.130	0.224	0.146	0.264	0.208	0.185	0.092	0.178	0.059
	Total Magnesium (Mg)	mg/kg dw	1,567	1,607	2,008	2,193	2,023	1,899	2,013	1,468	1,847	264	1,541	1,850	1,674	1,875	2,043	1,595	1,352	1,704	234
	Total Manganese (Mn)	mg/kg dw	21	42	28	22	23	30	30	18	27	8	23	78	37	109	42	31	23	49	32
	Total Mercury (Hg)	mg/kg dw	0.156	0.263	0.180	0.265	0.195	0.193	0.193	0.138	0.198	0.045	0.301	0.170	0.211	0.111	0.115	0.171	0.153	0.176	0.065
	Total Molybdenum (Mo)	mg/kg dw	0.079	0.119	0.119	0.107	0.154	0.104	0.099	0.089	0.109	0.023	0.150	0.114	0.113	0.155	0.218	0.110	0.110	0.138	0.040
	Total Nickel (Ni)	mg/kg dw	0.203	0.397	0.565	0.900	0.714	0.238	0.615	0.679	0.539	0.242	0.164	0.397	0.278	0.645	0.362	0.138	0.133	0.302	0.185
	Total Phosphorus (P)	mg/kg dw	21,868	24,545	24,744	29,214	25,785	26,727	24,545	17,802	24,404	3,394	25,045	26,926	29,043	24,850	26,331	27,333	22,143	25,953	2,202
	Total Potassium (K)	mg/kg dw	12,050	11,157	17,455	21,071	19,438	16,364	17,107	12,347	15,874	3,651	12,455	14,628	13,913	16,900	18,248	13,905	12,238	14,612	2,226
	Total Selenium (Se)	mg/kg dw	3.8	4.2	2.7	4.5	3.4	3.2	2.6	2.6	3.4	0.7	4.5	5.3	5.4	5.4	7.4	4.8	4.0	5.2	1.1
	Total Silver (Ag)	mg/kg dw	0.030	0.020	0.030	0.029	0.030	0.030	0.030	0.030	0.028	0.003	0.018	0.020	0.017	0.020	0.020	0.019	0.019	0.019	0.001
	Total Sodium (Na)	mg/kg dw	3,694	3,352	4,359	5,600	4,909	4,726	4,235	3,248	4,265	812	4,955	5,901	6,348	6,700	7,140	6,333	5,333	6,101	764
	Total Strontium (Sr)	mg/kg dw	54	66	97	100	94	126	92	64	87	24	69	63	73	55	50	70	51	62	9
	Total Thallium (Tl)	mg/kg dw	0.017	0.021	0.018	0.026	0.020	0.018	0.017	0.015	0.019	0.003	0.009	0.017	0.018	0.012	0.030	0.010	0.009	0.015	0.008
	Total Tin (Sn)	mg/kg dw	0.149	0.099	0.149	0.143	0.149	0.149	0.149	0.149	0.142	0.017	0.209	0.099	0.243	0.200	0.119	0.471	0.314	0.237	0.127
	Total Titanium (Ti)	mg/kg dw	3.0	8.3	3.9	5.7	14.8	4.6	12.1	9.7	7.8	4.2	5.7	9.0	5.8	15.8	6.4	3.5	3.2	7.1	4.3
	Total Uranium (U)	mg/kg dw	0.018	0.071	0.040	0.032	0.058	0.031	0.042	0.050	0.043	0.017	0.027	0.033	0.035	0.068	0.035	0.017	0.012	0.032	0.018
	Total Vanadium (V)	mg/kg dw	0.511	0.779	0.521	0.986	1.145	0.516	0.893	0.863	0.777	0.241	0.582	1.230	0.683	1.325	0.927	0.729	0.610	0.869	0.302
	Total Zinc (Zn)	mg/kg dw	120	113	109	142	96	116	111	81	111	18	96	114	107	117	121	127	103	112	11

indicates a mean concentration in lower Minto Creek that is significantly lower than the mean concentration in lower Big Creek (t-test; p=0.05)

indicates a mean concentration in lower Minto Creek that is significantly greater than the mean concentration in lower Big Creek (t-test; p=0.05)

APPENDIX D

BENTHIC INVERTEBRATE COMMUNITY DATA

Table D.1: Benthic Invertebrates collected by Hess sampler and screened through a 500 µM sieve. Values reported as number of organisms per m^2, Minto Mine WUL, 2012.

Invertebrate	Reference					Exopsure				
	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5	LWC-1	LWC-2	LWC-3	LWC-4	LWC-5
Phylum: Arthropoda										
Subphylum: Hexapoda										
Class: Insecta										
Order: Ephemeroptera										
Family: Ameletidae										
Ameletus sp.			7							
Family: Baetidae										
Baetis sp.	3	3		3		233	167	127	90	500
Baetis tricaudatus group						100	47			
Family: Ephemerellidae										
Drunella spinifera						67				57
Ephemerella sp.							23			
Serratella sp.			3							
Family: Heptageniidae			3			33	23	27		57
Epeorus sp.									30	
Order: Plecoptera						33	23			
Family: Capniidae		3		17		567	333	283	333	333
Family: Chloroperlidae										
Suwallia sp.			3			67				
Sweltsa sp.									30	
Family: Nemouridae	40	23	130	23	20					
Nemoura	17	13	20							
Ostrocerca sp.	7	57	67	10	7					
Podmosta sp.	43	13	133	53	83					
Zapada sp.										57
Family: Perlodidae						267	23	50		223
Family: Taeniopterygidae										
Taenionema sp.							23		30	
Order: Trichoptera										
Family: Brachycentridae										
Family: Limnephilidae	10	7	3	7						
Ecclisomyia sp.				3						110
Order: Coleoptera				3						
Family: Hydraenidae										
Order: Diptera	10	13	13	13	20					57
Family: Ceratopogonidae										
Atrichopogon sp.		3								
Culicoides sp.										
Sphaeromias sp.				7	13					
Family: Chironomidae										
Subfamily: Chironominae										
Tribe: Tanytarsini										
Micropsectra/Tanytarsus							23		90	
Paratanytarsus sp.		20			20					
Tanytarsus sp.	20									
Subfamily: Diamesinae										
Tribe: Diamesini										
Diamesa sp.		20			37	433			90	
Pagastia sp.		3				867		27		610
Pseudodiamesa sp.	3				13					
Subfamily: Orthocladiinae						800				
Cardiocladius sp.	13									
Cricotopus sp.	17									
Diplocladius cultriger										
Eukiefferiella sp.	207	450	317	117	937	733	263		243	223
Hydrobaenus sp.		17	13	10	30					
Limnophyes sp.		10	7	10						
Metriocnemus sp.		7		13	27					
Orthocladius complex						2,133	3,453	3,820	5,393	9,723
Parakiefferiella sp.										
Parorthocladius sp.	7									
Psectrocladius sp.			3	7						
Family: Empididae							23			
Chelifera/ Metachela	10		23	10	7	0	23	27		
Clinocera sp.	7		3							
Family: Simuliidae	3				27					
Simulium sp.	3				13					
Family: Tipulidae										
Antocha sp.							23			
Dicranota sp.	3	3		3		67	47		120	223
Tipula sp.			7							
Order: Lepidoptera				3						
Class: Entognatha										
Order: Collembola										
Family: Poduridae	3	103		3				27		

Table D.1: Benthic Invertebrates collected by Hess sampler and screened through a 500 μM sieve. Values reported as number of organisms per m^2, Minto Mine WUL, 2012.

Invertebrate	Reference					Exopsure				
	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5	LWC-1	LWC-2	LWC-3	LWC-4	LWC-5
Subphylum: Crustacea										
Class: Ostracoda			3							
Class: Copepoda		3								
Order: Cyclopoida				13	7					
Order: Harpacticoida				3						
Class: Malacostraca										
Order: Amphipoda										
Family: Hyalellidae										
Hyalella sp.			3							
Subphylum: Chelicerata										
Class: Arachnida										
Order: Trombidiformes	3	3	3	7						
Family: Aturidae										
Aturus sp.										
Family: Feltriidae										
Feltria sp.										
Family: Hydryphantidae										
Protzia sp.										57
Family: Lebertiidae										
Lebertia sp.	7									
Family: Sperchontidae										
Sperchon sp.	10		7	7						
Order: Oribatei										
Family: Halacaridae										
Order: Sarcoptiformes										
Family: Hydrozetidae										
Phylum: Mollusca										
Class: Gastropoda										
Order: Hypsogastropoda										
Family: Hydrobiidae					7					
Phylum: Annelida										
Subphylum: Clitellata										
Class: Oligochaeta										
Order: Lumbriculida										
Family: Lumbriculidae	77		7	3	20	1,267	333	820		
Order: Tubificida										
Family: Enchytraeidae										
Enchytraeus		77	3	3	13	300	213	693		
Family: Naididae			57	13	7					
Phylum: Nemata	10		23	3	313	100	47	27		110
Phylum: Platyhelminthes										
Class: Turbellaria					37					
Order: Tricladida										
Family: Planariidae										
Polycelis coronata		3								
Totals:	**533**	**857**	**863**	**370**	**1,657**	**8,067**	**5,113**	**5,927**	**6,450**	**12,340**

Table D.2: Benthic invertebrate community metrics by station for samples collected by Hess sampler, Minto Mine WUL, 2012.

Area	Station	Density (individuals per m^2)	Number of Taxa	BC Diss. to LWC Median	Simpson's E^a	Ephemeroptera (%)	Plecoptera (%)	Trichoptera (%)	EPT (%)
Lower Minto Creek (Exposure)	LMC-1	533	19	0.90	0.25	1	20	2	23
	LMC-2	857	20	0.89	0.16	0	13	1	14
	LMC-3	863	22	0.91	0.20	2	41	0	43
	LMC-4	370	23	0.94	0.26	1	28	3	32
	LMC-5	1,657	18	0.91	0.15	0	7	0	7
Lower Wolverine Creek (Reference)	LWC-1	8,067	14	0.36	0.40	5	12	0	17
	LWC-2	5,113	15	0.06	0.14	5	8	0	13
	LWC-3	5,927	11	0.13	0.20	3	6	0	8
	LWC-4	6,450	10	0.22	0.14	2	6	0	8
	LWC-5	12,340	13	0.46	0.12	5	5	1	11

[a] calculated as recommnended by Environment Canada 2011.

Table D.2: Benthic invertebrate community metrics by station for samples collected by Hess sampler, Minto Mine WUL, 2012.

Area	Station	Chironomids (%)	Oligochaetes (%)	Nemata (%)	CA Axis-1 (38.2%)	CA Axis-2 (14.1%)	CA Axis-3 (12.1%)
Lower Minto Creek (Exposure)	LMC-1	50	14	2	-0.63	-0.51	0.45
	LMC-2	61	9	0	-0.77	0.03	-0.21
	LMC-3	39	8	3	-1.01	-0.80	-0.04
	LMC-4	42	5	1	-0.93	-0.25	-0.14
	LMC-5	64	2	19	-1.01	1.06	0.06
Lower Wolverine Creek (Reference)	LWC-1	62	19	1	0.60	0.16	-0.40
	LWC-2	73	11	1	0.54	0.01	0.43
	LWC-3	65	26	0	0.56	0.06	-0.22
	LWC-4	90	0	0	0.68	0.05	0.93
	LWC-5	86	0	1	0.61	-0.22	-0.41

[a] calculated as recommnended by Environment Canada 2011.

Table D.3: Summary of Benthic Invertebrate Community Characteristics (500 µm mesh), and Statistical Comparisons Among Areas Minto Mine WUL, 2012.

	Comparison	2-group ANOVA for Estimation of Effect Size						
Metric	**Planned Comparison**	**Mean Square**	**F (ANOVA)**	**Significant Difference Among Areas? (p-value)[a]**		**Power**	**Magnitude of Difference (# of SDs)[b]**	**Minimum Detectable Effect Size (# of SDs)[c]**
Density (Ind./m2)	Wolverine Creek Reference vs. Minto Creek Exposure	113,008,027	26.6	YES	0.001	1.00	-2.3	~
Number of Taxa	Wolverine Creek Reference vs. Minto Creek Exposure	152	35.4	YES	0.000	1.00	3.8	~
EPT (%)	Wolverine Creek Reference vs. Minto Creek Exposure	367.5	3.4	NO	0.103	0.51	~	6.1
Chironomids (%)	Wolverine Creek Reference vs. Minto Creek Exposure	1,391.4	9.9	YES	0.014	0.89	-1.9	~
Oligochaetes (%)	Wolverine Creek Reference vs. Minto Creek Exposure	28.2	0.4	NO	0.558	0.15	~	1.6
Nemata (%)	Wolverine Creek Reference vs. Minto Creek Exposure	43.7	1.4	NO	0.272	0.29	~	25.3
BC Distance to Median Ref.	Wolverine Creek Reference vs. Minto Creek Exposure	1.1	81.6	YES	0.000	1.00	4.1	~
Simpson's D	Wolverine Creek Reference vs. Minto Creek Exposure	0.1	5.3	YES	0.050	0.68	1.1	~
Simpson's E[d]	Wolverine Creek Reference vs. Minto Creek Exposure	0.000	0.001	NO	0.981	0.10	~	1.7
CA Axis-1 (38.2%)	Wolverine Creek Reference vs. Minto Creek Exposure	5.4	347.0	YES	0.000	1.00	-26.2	~
CA Axis-2 (14.1%)	Wolverine Creek Reference vs. Minto Creek Exposure	0.03	0.11	NO	0.749	0.12	~	7.9
CA Axis-3 (12.1%)	Wolverine Creek Reference vs. Minto Creek Exposure	0.005	0.022	NO	0.885	0.10	~	1.7

[a] p-value obtained from 1-way ANOVA

[b] Magnitude calculated by comparing the difference between the reference and exposure area means to the reference area standard deviation (SD) [(exposure mean - reference mean) / standard deviation of the reference mean]

[c] Minimum effect size detectable calculated based on variance as square root of MSE from ANOVA and alpha = beta = 0.10. Minimum effect size reported as the minimum number of standard deviations detectable based on reference area standard deviation.

[d] Calculated as recommended by Environment Canada 2011

Table D.4: Benthic Taxon Scores from Correspondence Analysis of (500 µM mesh) Samples Collected at Minto MIne WUL Stations, 2012.

	CA Axis-1 (38.2%)	CA Axis-2 (14.1%)	CA Axis-3 (12.1%)	CA Axis-4 (9.5%)
Baetis sp. (incl. B. tricaudatus group)	0.65	-0.04	0.03	0.00
Drunella spinifera	0.83	-0.05	-0.98	0.67
| Family: Heptageniidae (incl. Epeorus sp.)	0.70	-0.09	0.08	0.05
| Family: Capniidae	0.63	0.00	0.09	-0.03
Suwallia sp.	0.41	-0.03	-0.81	0.09
Nemoura	-1.10	-1.04	0.20	-0.51
Ostrocerca sp.	-1.20	-0.52	-0.06	-0.35
Podmosta sp.	-1.22	-0.28	0.10	0.17
| Family: Perlodidae	0.80	0.00	-0.57	0.07
Taenionema sp.	0.84	0.08	1.68	-0.06
| Family: Limnephilidae (incl. Ecclisomyia sp.)	-0.26	-0.66	-0.38	0.47
Sphaeromias sp.	-1.34	1.17	-0.06	0.82
Micropsectra/Tanytarsus (incl. Tanytarsus sp.)	0.40	-0.25	1.61	0.08
Paratanytarsus sp.	-1.21	1.23	-0.18	-0.74
Diamesa sp.	0.12	0.65	0.17	-0.09
Pagastia sp.	0.72	-0.02	-0.88	0.18
Pseudodiamesa sp.	-1.22	1.31	0.43	0.63
Eukiefferiella sp.	-0.29	-0.02	0.14	0.08
Hydrobaenus sp.	-1.28	0.26	-0.17	-0.11
Limnophyes sp.	-1.22	-0.69	-0.33	-0.44
Metriocnemus sp.	-1.27	0.88	-0.16	0.14
Orthocladius complex	0.82	0.02	0.16	0.00
Psectrocladius sp.	-1.31	-1.04	-0.24	0.59
Chelifera/ Metachela	-0.35	-0.29	0.25	-0.14
Clinocera sp.	-1.06	-1.40	0.63	0.21
| Family: Simuliidae (incl. Simulium sp.)	-1.22	1.32	0.43	0.63
Dicranota sp.	0.58	-0.11	0.26	0.31
| Family: Poduridae	-0.49	-0.09	-0.34	-1.45
| Order: Cyclopoida	-1.32	0.63	-0.14	0.84
| Order: Trombidiformes (incl. Protzia sp., Lebertia sp., and Sperchon sp.)	-0.46	-0.83	-0.21	0.50
| Family: Lumbriculidae	0.20	0.07	-0.02	-0.27
Enchytraeus	0.17	0.24	-0.22	-0.71
| Family: Naididae	-1.35	-0.62	-0.11	0.47
Phylum: Nemata	-0.09	0.24	-0.17	0.26
| Class: Turbellaria (incl. Polycelis coronata)	-1.31	1.88	0.01	0.12

[blue] Indicates heavy positively-weighted variable on respective CA axis
[green] Indicates heavy negatively-weighted variable on respective CA axis

Table D.5: Benthic Analyses - ANOVA results (500 µM mesh), Minto Mine WUL, 2012.

Dependent Variable	Mean Square	F (ANOVA)	p-value	Observed Power
Density (Ind./m2)	113,008,026.66	26.61	0.00	1.00
Number of Taxa	152.10	35.37	0.00	1.00
EPT Pct.	367.47	3.38	0.10	0.51
Chironomids Pct.	1,391.40	9.93	0.01	0.89
Oligochaetes Pct.	28.16	0.37	0.56	0.15
Nemata Pct.	43.67	1.39	0.27	0.29
Simpson's D	0.13	5.31	0.05	0.68
Simpson's E	0.00	0.00	0.98	0.10
BC Distance to Median Ref.	1.10	81.55	0.00	1.00
Minto 500 µM CA-1 (38.2%)	5.37	347.04	0.00	1.00
Minto 500 µM CA-2 (14.1%)	0.03	0.11	0.75	0.12
Minto 500 µM CA-3 (12.1%)	0.00	0.02	0.89	0.10
Median Intermediate Axis Length (cm)	0.00	0.01	0.92	0.10
Median Embeddedness (%)	75.21	4.67	0.07	0.60
Water Velocity (m/s)	0.00	0.01	0.91	0.10
Depth (m)	0.00	0.10	0.76	0.11
Temperature (°C)	5.36	32.44	0.00	1.00
DO (mg/L)	1.02	3.24	0.12	0.48
DO (%)	179.59	10.92	0.02	0.90
Specific Conductivity (µS/cm)	11,623.01	238.94	0.00	1.00
pH	0.96	22.85	0.00	0.99
% cobble	16.88	0.27	0.62	0.14
% gravel	187.50	2.05	0.20	0.36
% sand and finer	1.88	0.56	0.48	0.17

Indicates p value < 0.1

Table D.6: Eigenvalues of Correspondence Analysis for samples collected by Hess sampler (500 µm mesh). Minto Mine WUL, 2012.

	CA Axis-1 (38.2%)	CA Axis-2 (14.1%)	CA Axis-3 (12.1%)	CA Axis-4 (9.5%)
Eigenvalue	0.53	0.20	0.17	0.13
Relative Inertia (%)	38.23	14.06	12.14	9.54
Cumulative Inertia (%)	38.23	52.29	64.43	73.97

Table D.7: Benthic Invertebrates collected by Hess sampler and screened through a 250 µm sieve. Values reported as number of organisms per m^2, Minto Mine WUL, 2012.

Invertebrate	Reference					Exopsure				
	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5	LWC-1	LWC-2	LWC-3	LWC-4	LWC-5
Phylum: Arthropoda										
Subphylum: Hexapoda										
Class: Insecta										
Order: Ephemeroptera										
Family: Ameletidae										
Ameletus sp.			7			10				
Family: Baetidae										
Baetis sp.	3	7	7	3		597	230	133	150	640
Baetis tricaudatus group						100	47			
Family: Ephemerellidae			3						7	
Drunella spinifera						67				57
Ephemerella sp.							23			
Serratella sp.			3							
Family: Heptageniidae			3			87	23	30	7	57
Epeorus sp.									30	
Order: Plecoptera	37	3	23	3	13	70	30			27
Family: Capniidae		3	3	20	3	850	353	290	423	373
Family: Chloroperlidae										
Suwallia sp.			3			67				
Sweltsa sp.									30	
Family: Nemouridae	40	23	130	27	20					
Nemoura	17	13	20							
Ostrocerca sp.	7	57	67	10	7					
Podmosta sp.	43	13	133	53	83					
Zapada sp.					3	10				57
Family: Perlodidae						277	23	50	7	230
Family: Taeniopterygidae										
Taenionema sp.							23		30	
Order: Trichoptera							0			7
Family: Brachycentridae							7			
Family: Limnephilidae	10	7	3	7						
Ecclisomyia sp.				3						110
Order: Coleoptera				3						
Family: Hydraenidae		3								
Order: Diptera	37	20	20	20	33	10		13		57
Family: Ceratopogonidae										
Atrichopogon sp.		3								
Culicoides sp.			3							
Sphaeromias sp.	10			7	13					
Family: Chironomidae										
Subfamily: Chironominae										
Tribe: Tanytarsini										
Micropsectra/Tanytarsus							113	10	190	
Paratanytarsus sp.	10	20	7	10	23	43				
Tanytarsus sp.	37	10								
Subfamily: Diamesinae										
Tribe: Diamesini										
Diamesa sp.		20			53	567			90	
Pagastia sp.		3				867		27		610
Pseudodiamesa sp.	3				13					
Subfamily: Orthocladiinae		3	30			1,067				1,267
Cardiocladius sp.	13									
Cricotopus sp.	87	13	20							
Diplocladius cultriger				7						13
Eukiefferiella sp.	793	590	597	167	1,283	1,203	323		433	223
Hydrobaenus sp.		17	23	10	43					
Limnophyes sp.		10	7	17						
Metriocnemus sp.		7		13	37					
Orthocladius complex						2,417	3,633	4,003	6,650	9,990
Parakiefferiella sp.							20			
Parorthocladius sp.	7									
Psectrocladius sp.			3	7						
Family: Empididae							30	0		
Chelifera/ Metachela	10		23	10	7	10	23	47		
Clinocera sp.	7		7							
Family: Simuliidae	3				27					
Simulium sp.	3				17			3		
Family: Tipulidae										
Antocha sp.							23			
Dicranota sp.	3	3		3		77	47		120	223
Tipula sp.			7							
Order: Lepidoptera				3						
Class: Entognatha										
Order: Collembola										
Family: Poduridae	627	177	13	7	3			33	7	

Table D.7: Benthic Invertebrates collected by Hess sampler and screened through a 250 μm sieve. Values reported as number of organisms per m^2, Minto Mine WUL, 2012.

Invertebrate	Reference					Exopsure				
	LMC-1	LMC-2	LMC-3	LMC-4	LMC-5	LWC-1	LWC-2	LWC-3	LWC-4	LWC-5
Subphylum: Crustacea										
Class: Ostracoda		7	20	83	67	17	47	10		
Class: Copepoda		3								
Order: Cyclopoida	150	53	47	57	73		17	30	23	
Order: Harpacticoida	37		3	40	27			20	7	
Class: Malacostraca										
Order: Amphipoda										
Family: Hyalellidae										
Hyalella sp.			3							
Subphylum: Chelicerata										
Class: Arachnida										
Order: Trombidiformes	13	3	7	10		53	7	10		
Family: Aturidae										
Aturus sp.								3		
Family: Feltriidae										
Feltria sp.			10	3	10		10	3	7	20
Family: Hydryphantidae										
Protzia sp.										57
Family: Lebertiidae										
Lebertia sp.	7							3		
Family: Sperchontidae										
Sperchon sp.	10		7	7						
Order: Oribatei										
Family: Halacaridae			3							
Order: Sarcoptiformes										
Family: Hydrozetidae	150		27	23	7					7
Phylum: Mollusca										
Class: Gastropoda										
Order: Hypsogastropoda										
Family: Hydrobiidae					7					
Phylum: Annelida										
Subphylum: Clitellata										
Class: Oligochaeta										
Order: Lumbriculida										
Family: Lumbriculidae	93		7	3	30	1,267	333	850	7	
Order: Tubificida										
Family: Enchytraeidae										
Enchytraeus	213	110	77	10	37	2,023	940	1,057	17	13
Family: Naididae			293	27	20	70				
Phylum: Nemata	773	223	180	100	480	143	137	57	37	157
Phylum: Platyhelminthes										
Class: Turbellaria					70					
Order: Tricladida										
Family: Planariidae										
Polycelis coronata		3			3					
Totals:	**3,253**	**1,430**	**1,850**	**773**	**2,513**	**11,967**	**6,463**	**6,683**	**8,270**	**14,193**

Table D.8: Benthic invertebrate community metrics by station for samples collected by Hess sampler and screened through a 250 µm sieve, Minto Mine WUL, 2012.

Area	Station	Density (individuals per m^2)	Number of Taxa	BC Diss. to LWC Median	Simpson's E[a]	Ephemeroptera (%)	Plecoptera (%)	Trichoptera (%)	EPT (%)
Lower Minto Creek (Exposure)	LMC-1	3,253	25	0.83	0.24	0	4	0	5
	LMC-2	1,430	26	0.85	0.17	0	8	0	9
	LMC-3	1,850	32	0.85	0.18	1	21	0	22
	LMC-4	773	27	0.90	0.35	0	15	1	16
	LMC-5	2,513	25	0.88	0.13	0	5	0	5
Lower Wolverine Creek (Reference)	LWC-1	11,967	21	0.38	0.33	7	11	0	18
	LWC-2	6,463	20	0.06	0.14	5	7	0	12
	LWC-3	6,683	17	0.11	0.15	2	5	0	8
	LWC-4	8,270	19	0.32	0.08	2	6	0	8
	LWC-5	14,193	16	0.49	0.10	5	5	1	11

[a] calculated as recommnended by Environment Canada 2011.

Table D.8: Benthic invertebrate community metrics by station for samples collected by Hess sampler and screened through a 250 µm sieve, Minto Mine WUL, 2012.

Area	Station	Chironomids (%)	Oligochaetes (%)	Nemata (%)	CA Axis-1 (40.0%)	CA Axis-2 (13.8%)	CA Axis-3 (13.0%)
Lower Minto Creek (Exposure)	LMC-1	29	9	24	0.66	-0.51	0.27
	LMC-2	48	8	16	0.64	-0.13	0.17
	LMC-3	37	20	10	0.69	0.06	0.48
	LMC-4	30	5	13	0.68	0.31	0.12
	LMC-5	58	3	19	0.76	0.39	-0.86
Lower Wolverine Creek (Reference)	LWC-1	52	28	1	-0.56	0.37	-0.01
	LWC-2	63	20	2	-0.55	-0.42	-0.19
	LWC-3	60	29	1	-0.46	-0.29	-0.15
	LWC-4	89	0	0	-0.62	-0.49	-0.25
	LWC-5	85	0	1	-0.80	0.49	0.40

[a] calculated as recommnended by Environment Canada 2011.

Table D.9: Descriptive statistics of benthic metrics by are for samples collected by Hess sampler and screened through a 250 µm sieve, Minto Mine WUL, 2012.

Variable	Area	n	Median	Mean	Standard Deviation	Standard Error	95% Confidence Interval (Mean)		Minimum	Maximum
							Lower Bound	Upper Bound		
Density (Individuals/m2)	LMC	5	8,270	9,515	3,420	1,529	5,269	13,762	6,463	14,193
	LWC	5	1,850	1,964	959	429	773	3,155	773	3,253
Number of Taxa	LMC	5	19.00	18.60	2.07	0.93	16.03	21.17	16.00	21.00
	LWC	5	26.00	27.00	2.92	1.30	23.38	30.62	25.00	32.00
EPT (%)	LMC	5	10.97	11.27	4.07	1.82	6.21	16.33	7.53	17.83
	LWC	5	8.86	11.44	7.51	3.36	2.12	20.76	4.82	21.98
Chironomids (%)	LMC	5	63.28	69.91	16.39	7.33	49.56	90.26	51.50	89.04
	LWC	5	37.12	40.47	12.44	5.56	25.03	55.92	29.20	57.82
Oligochaetes (%)	LMC	5	19.70	15.34	14.27	6.38	-2.38	33.05	0.09	28.53
	LWC	5	7.69	9.22	6.64	2.97	0.98	17.46	3.45	20.36
Nemata (%)	LMC	5	1.10	1.14	0.62	0.28	0.37	1.91	0.44	2.11
	LWC	5	15.62	16.23	5.45	2.44	9.47	22.99	9.73	23.77
BC Diss to WC Median	LMC	5	0.32	0.27	0.18	0.08	0.04	0.50	0.06	0.49
	LWC	5	0.85	0.86	0.03	0.01	0.83	0.89	0.83	0.90
Simpson's D	LMC	5	0.60	0.56	0.21	0.10	0.30	0.83	0.35	0.86
	LWC	5	0.82	0.80	0.08	0.04	0.70	0.90	0.68	0.89
Simpson's E[a]	LMC	5	0.14	0.16	0.10	0.05	0.03	0.29	0.08	0.33
	LWC	5	0.18	0.21	0.09	0.04	0.10	0.32	0.13	0.35
CA Axis-1 (40.0%)	LMC	5	-0.56	-0.60	0.13	0.06	-0.76	-0.44	-0.80	-0.46
	LWC	5	0.68	0.68	0.04	0.02	0.63	0.74	0.64	0.76
CA Axis-2 (13.8%)	LMC	5	-0.29	-0.07	0.46	0.21	-0.64	0.51	-0.49	0.49
	LWC	5	0.06	0.03	0.36	0.16	-0.42	0.47	-0.51	0.39
CA Axis-3 (13.0%)	LMC	5	-0.15	-0.04	0.26	0.12	-0.36	0.28	-0.25	0.40
	LWC	5	0.17	0.04	0.52	0.23	-0.61	0.68	-0.86	0.48

[a] Calculated as recommended by Environment Canada 2011.

Table D.10: Summary of Benthic Invertebrate Community Characteristics (250 µm mesh), and Statistical Comparisons Among Areas Minto Mine WUL, 2012.

	Comparison	2-group ANOVA for Estimation of Effect Size						
Metric	**Planned Comparison**	**Mean Square**	**F (ANOVA)**	**Significant Difference Among Areas? (p-value)[a]**		**Power**	**Magnitude of Difference (# of SDs)[b]**	**Minimum Detectable Effect Size (# of SDs)[c]**
Density (Ind./m2)	Wolverine Creek Reference vs. Minto Creek Exposure	142,556,588	22.60	YES	0.00	1.00	-2.2	~
Number of Taxa	Wolverine Creek Reference vs. Minto Creek Exposure	176	27.56	YES	0.00	1.00	4.1	~
EPT Pct.	Wolverine Creek Reference vs. Minto Creek Exposure	0.07	0.00	NO	0.97	0.10	~	3.2
Chironomids Pct.	Wolverine Creek Reference vs. Minto Creek Exposure	2,166.06	10.24	YES	0.01	0.90	-1.8	~
Oligochaetes Pct.	Wolverine Creek Reference vs. Minto Creek Exposure	93.54	0.76	NO	0.41	0.21	~	1.7
Nemata Pct.	Wolverine Creek Reference vs. Minto Creek Exposure	569.12	37.90	YES	0.00	1.00	24.4	~
BC Distance to Median Ref.	Wolverine Creek Reference vs. Minto Creek Exposure	0.87	51.05	YES	0.00	1.00	3.2	~
Simpson's D	Wolverine Creek Reference vs. Minto Creek Exposure	0.14	5.44	YES	0.05	0.69	1.1	~
Simpson's E[d]	Wolverine Creek Reference vs. Minto Creek Exposure	0.01	0.72	NO	0.42	0.20	~	2.0
Minto 250 µM CA-1 (40.0%)	Wolverine Creek Reference vs. Minto Creek Exposure	4.12	452.19	YES	0.00	1.00	10.0	~
Minto 250 µM CA-2 (13.8%)	Wolverine Creek Reference vs. Minto Creek Exposure	0.02	0.13	NO	0.73	0.12	~	1.9
Minto 250 µM CA-3 (13.0%)	Wolverine Creek Reference vs. Minto Creek Exposure	0.01	0.08	NO	0.78	0.11	~	3.5

[a] p-value obtained from 1-way ANOVA

[b] Magnitude calculated by comparing the difference between the reference and exposure area means to the reference area standard deviation (SD) [(exposure mean - reference mean) / standard deviation of the reference mean]

[c] Minimum effect size detectable calculated based on variance as square root of MSE from ANOVA and alpha = beta = 0.10. Minimum effect size reported as the minimum number of standard deviations detectable based on reference area standard deviation.

[d] Calculated as recommended by Environment Canada 2011

Table D.11: Benthic Taxon Scores from Correspondence Analysis of Samples Collected (250 µm mesh) at Minto Mine EEM Stations, 2012.

	CA Axis-1 (40.0%)	CA Axis-2 (13.8%)	CA Axis-3 (13.0%)
Ameletus sp.	-0.01	0.62	0.57
Baetis sp. (incl. B. tricaudatus group)	-0.67	-0.05	0.07
| Family: Ephemerellidae (incl. Drunella spinifera, Ephemerella sp., Serratella sp.)	-0.77	0.31	0.26
| Family: Heptageniidae (incl. Epeorus sp.)	-0.84	-0.01	0.02
| Family: Capniidae	-0.64	-0.04	-0.08
Suwallia sp.	-0.50	0.82	0.23
Nemoura	1.03	-0.52	0.87
Ostrocerca sp.	1.05	0.00	0.42
Podmosta sp.	1.07	0.12	0.10
Zapada sp.	-0.74	1.17	0.21
| Family: Perlodidae	-0.95	0.27	0.10
Taenionema sp.	-0.91	-1.20	-0.59
| Family: Limnephilidae (incl. Ecclisomyia sp.)	0.03	0.45	0.83
| Order: Coleoptera (incl. Family Hydraenidae)	1.02	0.24	0.40
Sphaeromias sp.	1.09	0.17	-0.58
Micropsectra/Tanytarsus (incl. identified Tanytarsus sp.)	-0.30	-1.09	-0.20
Paratanytarsus sp.	0.59	0.33	-0.10
Diamesa sp.	-0.18	0.23	-0.61
Pagastia sp.	-0.89	0.75	0.36
Pseudodiamesa sp.	1.12	0.31	-1.41
Cricotopus sp.	1.03	-0.67	0.83
Diplocladius cultriger	-0.32	1.10	0.77
Eukiefferiella sp.	0.18	0.03	-0.01
Hydrobaenus sp.	1.08	0.45	-0.26
Limnophyes sp.	1.03	0.28	0.63
Metriocnemus sp.	1.09	0.67	-0.91
Orthocladius complex	-0.93	-0.16	-0.08
Psectrocladius sp.	1.05	0.56	0.71
Chelifera/ Metachela	0.07	-0.24	-0.07
Clinocera sp.	1.04	-0.58	1.02
Simulium sp.	0.84	0.16	-1.28
Dicranota sp.	-0.73	0.02	0.11
| Family: Poduridae	0.64	-0.60	0.30
| Class: Ostracoda	0.35	0.22	-0.33
| Order: Cyclopoida	0.52	-0.30	-0.09
| Order: Harpacticoida	0.56	-0.16	-0.29
| Order: Trombidiformes (incl. Aturus, Feltria, Protzia, Lebertia, and Sperchon sp.)	-0.08	0.11	0.16
| Family: Hydrozetidae	0.81	-0.05	0.48
| Family: Lumbriculidae	-0.25	-0.26	-0.28
Enchytraeus	-0.07	-0.20	-0.04
| Family: Naididae	0.57	0.64	0.17
Phylum: Nemata	0.20	-0.02	0.00
Family Planariidae: Polycelis coronata	1.14	0.78	-1.84

[blue] Indicates heavy positively-weighted variable on respective CA axis
[green] Indicates heavy negatively-weighted variable on respective CA axis

Table D.12: Benthic Analyses (250 µm mesh) - ANOVA results, Minto Mine WUL 2012.

Dependent Variable	Mean Square	F (ANOVA)	p-value	Observed Power
Density (Ind./m2)	142,556,588	22.60	0.00	1.00
Number of Taxa	176.40	27.56	0.00	1.00
EPT Pct.	0.07	0.00	0.97	0.10
Chironomids Pct.	2,166.06	10.24	0.01	0.90
Oligochaetes Pct.	93.54	0.76	0.41	0.21
Nemata Pct.	569.12	37.90	0.00	1.00
Simpson's D	0.14	5.44	0.05	0.69
Simpson's E	0.01	0.72	0.42	0.20
BC Distance to Median Ref.	0.87	51.05	0.00	1.00
Minto 250 µM CA-1 (40.0%)	4.12	452.19	0.00	1.00
Minto 250 µM CA-2 (13.8%)	0.02	0.13	0.73	0.12
Minto 250 µM CA-3 (13.0%)	0.01	0.08	0.78	0.11
Median Intermediate Axis Length (cm)	0.00	0.01	0.92	0.10
Median Embeddedness (%)	75.21	4.67	0.07	0.60
Water Velocity (m/s)	0.00	0.01	0.91	0.10
Depth (m)	0.00	0.10	0.76	0.11
Temperature (°C)	5.36	32.44	0.00	1.00
DO (mg/L)	1.02	3.24	0.12	0.48
DO (%)	179.59	10.92	0.02	0.90
Specific Conductivity (µS/cm)	11,623.01	238.94	0.00	1.00
pH	0.96	22.85	0.00	0.99
% cobble	16.88	0.27	0.62	0.14
% gravel	187.50	2.05	0.20	0.36
% sand and finer	1.88	0.56	0.48	0.17
% organic	0.00	-	-	-

Indicates p value < 0.1

Table D.13: Eigenvalues of Correspondence Analysis for samples collected by Hess sampler (250 μm mesh). Minto Mine WUL, 2012.

	CA Axis-1 (40.0%)	CA Axis-2 (13.8%)	CA Axis-3 (13.0%)	CA Axis-4
Eigenvalue	0.419	0.144	0.136	0.097
Relative Inertia (%)	39.990	13.750	12.960	9.310
Cumulative Inertia (%)	39.990	53.740	66.700	76.000

Table D.14: Intermediate axis length and embededdness of 100 cobble washed during Hess sampling at benthic invertebrate stations, Minto Mine WUL, 2012.

Cobble Number	LWC-1		LWC-2		LWC-3		LWC-4	
	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)
1	3.2		7.4		5.6		6.6	
2	5.9		5.7		5.4		7.6	
3	6.1		6.4		7.2		7.7	
4	5.2		4.1		8.1		3.7	
5	3.8		7.0		6.8		4.7	
6	4.5		6.9		10.3		3.9	
7	3.7		3.8		5.4		3.5	
8	3.9		5.2		4.9		5.5	
9	7.9		7.3		6.4		4.3	
10	5.4		9.2	20	7.0	30	4.4	20
11	3.5		4.1		5.8		5.1	
12	4.2		7.4		4.0		7.3	
13	5.3		5.4		3.8		8.3	
14	5.0		6.5		11.2		7.4	
15	3.8		4.9		5.4		3.4	
16	6.8		6.0		7.9		4.6	
17	6.8		6.9		5.7		6.0	
18	4.6		8.2		8.5		7.9	
19	5.9		5.6		5.0		3.5	
20	5.7		6.5	10	4.9	30	3.3	20
21	4.9		4.9		3.7		7.8	
22	5.2		2.9		3.1		4.4	
23	5.2		3.7		3.4		4.7	
24	4.7		3.8		5.6		5.3	
25	5.4		4.1		7.4		5.1	
26	5.9		6.9		4.1		5.4	
27	4.5		7.4		4.9		4.3	
28	4.6		3.5		6.7		4.6	
29	4.6		10.2		8.7		5.4	
30	3.0		6.2	20	4.4	20	2.9	30
31	6.0		2.7		4.2		4.7	
32	3.1		3.7		6.6		5.6	
33	3.3		3.9		3.9		3.4	
34	3.9		5.3		3.4		4.8	
35	3.5		4.4		5.5		5.1	
36	8.1		6.9		11.5		3.6	
37	4.6		4.6		5.4		4.4	
38	3.6		3.9		7.6		3.8	
39	3.1		3.7		10.9		6.6	
40	5.0		4.8	30	6.5	30	6.4	30
41	4.1		4.6		6.6		4.7	
42	4.7		8.9		6.4		4.4	
43	5.7		8.1		2.1		6.6	
44	4.2		5.5		3.4		4.1	
45	5.1		7.5		7.9		4.5	
46	3.1		6.2		2.6		4.7	
47	3.0		3.9		4.0		4.4	
48	5.1		4.3		4.3		4.1	
49	4.4		5.8		3.2		3.5	
50	5.2		6.9	20	3.9	10	7.4	20
51	5.6		3.4		5.6		7.3	
52	4.9		5.2		3.6		5.5	
53	3.2		3.8		4.2		5.2	
54	3.8		3.4		2.6		6.3	
55	2.7		3.4		2.9		8.2	
56	3.9		3.6		4.3		3.1	
57	4.4		3.6		8.3		4.9	
58	4.1		4.2		5.9		2.9	
59	6.3		8.4		6.7		3.6	
60	5.4		6.1	10	6.2	20	5.8	20
61	3.5		4.9		6.6		3.5	
62	4.0		8.7		4.9		4.0	
63	6.2		6.4		2.9		3.9	
64	5.8		6.9		2.7		6.2	
65	6.1		4.4		5.8		4.1	
66	2.9		5.6		5.2		7.4	
67	4.0		7.9		10.4		3.9	
68	4.9		5.3		6.9		4.4	
69	3.0		4.9		9.0		9.1	
70	9.6		5.1	20	7.5	30	3.4	30
71	5.3		6.7		5.2		3.3	
72	3.8		8.1		3.9		3.4	
73	3.1		3.5		3.7		4.3	
74	3.6		5.5		4.3		3.2	
75	3.8		3.5		8.0		8.1	
76	4.7		3.5		4.6		8.3	
77	2.8		6.0		4.7		5.2	
78	3.1		7.9		3.8		5.1	
79	3.5		5.4		10.4		3.6	
80	6.7		11.0	20	5.0	30	5.7	20
81	6.7		8.0		4.7		6.7	
82	7.6		7.0		7.9		5.3	
83	7.0		5.4		8.2		4.9	
84	5.4		9.0		10.1		4.4	
85	4.3		3.2		4.5		6.1	
86	6.9		9.8		2.5		2.4	
87	4.4		5.7		2.7		7.9	
88	5.6		6.0		6.8		5.6	
89	5.0		3.1		9.0		6.9	
90	4.3		11.5	20	5.8	20	8.6	30
91	3.6		8.8		3.4		7.1	
92	3.4		5.1		7.6		8.8	
93	6.4		3.6		3.8		3.2	
94	4.0		8.2		6.7		3.9	
95	7.4		4.3		5.8		6.8	
96	4.9		8.2		5.9		5.4	
97	5.1		6.2		8.1		3.3	
98	4.8		14.6		7.5		7.2	
99	4.5		4.5		4.1		9.8	
100	4.1		5.1	30	4.7		10.1	30
Minimum	**2.7**		**2.7**		**2.1**		**2.4**	
Maximum	**9.6**		**14.6**		**11.5**		**10.1**	
Mean	**4.8**		**5.9**		**5.8**		**5.3**	
Geometric mean	**4.6**		**5.5**		**5.4**		**5.1**	
Median	**4.6**		**5.5**	**20**	**5.5**	**30**	**4.9**	**25**
Description of Surrounding material								

Note: intermediate axis length is the second longest axis on a cobble. Embeddedness refers to how deeply the cobble is surrounded or buried by other substrate.

Table D.14: Intermediate axis length and embededdness of 100 cobble washed during Hess sampling at benthic invertebrate stations, Minto Mine WUL, 2012.

Cobble Number	LWC-5		LMC-1		LMC-2		LMC-3	
	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)
1	9.5		6.0		4.9		7.5	
2	6.0		5.8		6.4		3.9	
3	8.0		4.9		4.9		10.6	
4	10.0		5.0		4.1		9.6	
5	7.0		4.0		3.5		7.5	
6	6.0		3.4		4.3		4.5	
7	7.2		2.7		6.4		4.7	
8	3.3		3.8		6.3		6.9	
9	5.4		2.9		7.4		4.4	
10	5.7	20	7.3	40	3.6	30	4.2	20
11	5.3		10.6		8.0		6.7	
12	6.7		5.1		5.5		3.5	
13	3.5		8.3		9.0		3.0	
14	3.9		6.1		9.3		5.2	
15	3.7		5.7		6.0		5.8	
16	3.5		5.8		8.0		6.7	
17	6.8		3.6		6.7		4.1	
18	3.6		3.8		5.1		4.6	
19	6.3		5.7		3.1		2.1	
20	3.6	30	5.1	30	5.2	10	2.4	40
21	4.2		4.6		4.3		2.4	
22	4.3		4.3		4.3		3.2	
23	5.4		5.9		7.8		3.5	
24	5.4		4.2		7.4		3.1	
25	4.5		4.4		5.2		8.0	
26	7.4		5.3		3.3		6.4	
27	9.5		4.0		2.7		5.8	
28	4.6		5.2		3.3		7.1	
29	5.8		4.6		3.8		3.7	
30	4.9	10	5.0	20	3.2	15	4.3	30
31	5.9		4.8		13.6		2.5	
32	9.7		4.2		6.9		3.3	
33	5.1		4.5		6.4		5.1	
34	5.4		3.6		4.6		2.7	
35	5.9		4.0		4.9		5.0	
36	5.5		4.3		3.8		7.6	
37	4.6		11.1		2.9		11.7	
38	4.0		11.4		3.3		11.0	
39	3.9		8.0		3.6		4.4	
40	8.2	10	6.1	30	4.6	5	2.7	70
41	4.4		4.3		3.9		6.2	
42	6.3		3.5		5.7		6.7	
43	4.4		3.1		4.9		6.3	
44	4.3		5.0		4.4		2.3	
45	4.0		6.9		5.6		9.5	
46	3.7		4.2		3.6		5.3	
47	3.9		6.8		5.5		4.9	
48	6.8		2.9		5.4		3.0	
49	4.6		4.1		4.6		3.8	
50	3.4	30	5.4	40	4.0	10	4.2	
51	4.4		4.0		10.5		3.2	
52	2.5		2.4		4.0		6.2	
53	2.7		8.5		5.5		3.1	
54	6.5		6.4		4.3		3.4	
55	4.3		3.8		2.7		2.4	
56	4.3		5.0		4.1		2.6	
57	6.5		5.1		3.6		2.3	
58	4.1		5.9		4.1		2.9	
59	2.8		4.3		3.7		2.6	
60	2.4	10	2.9	30	5.2	20	2.4	40
61	4.7		8.3		4.6		2.7	
62	2.8		3.9		5.7		3.7	
63	3.7		5.1		4.6		15.6	
64	4.6		3.4		3.5		11.6	
65	2.8		3.6		3.9		4.7	
66	3.3		4.2		4.0		4.6	
67	3.4		3.3		4.6		16.1	
68	4.5		3.4		3.7		6.2	
69	3.8		3.8		5.3		4.1	
70	2.8	20	9.0	20	4.2	30	7.2	30
71	2.7		5.5		3.3		7.1	
72	3.2		8.6		3.0		5.4	
73	2.9		5.5		4.7		9.8	
74	2.4		6.2		3.9		5.8	
75	3.5		4.4		3.8		5.4	
76	4.1		4.7		3.0		5.6	
77	2.9		4.7		3.7		7.1	
78	2.7		5.5		3.3		6.4	
79	2.8		4.3		3.7		11.9	
80	3.3	10	3.8	30	3.6	20	6.8	30
81	7.5		4.4		7.5		4.3	
82	7.9		4.1		7.0		8.7	
83	8.5		5.6		3.0		11.4	
84	8.2		5.8		5.0		11.2	
85	9.2		3.5		4.1		7.5	
86	4.0		3.6		7.2		7.0	
87	6.9		5.8		6.2		2.8	
88	3.2		5.4		6.4		9.5	
89	3.6		4.8		3.4		7.2	
90	5.0	30	3.3	20	10.5	60	4.2	40
91	5.6		5.2		8.1		5.5	
92	4.2		3.7		8.7		8.3	
93	2.6		4.3		10.2		3.5	
94	5.7		4.6		4.2		3.6	
95	8.4		4.7		3.9		2.9	
96	6.3		3.8		8.2		12.3	
97	5.0		4.5		4.3		7.1	
98	2.8		3.7		4.5		10.0	
99	8.7		4.7		5.6		3.7	
100	5.4	20	6.3	20	3.9	25	4.5	30
Minimum	**2.4**		**2.4**		**2.7**		**2.1**	
Maximum	**10.0**		**11.4**		**13.6**		**16.1**	
Mean	**5.0**		**5.0**		**5.1**		**5.8**	
Geometric mean	**4.7**		**4.8**		**4.8**		**5.1**	
Median	**4.5**	**20**	**4.7**	**30**	**4.6**	**20**	**5.1**	**30**
Description of Surrounding material							fine, some sediment (turbidity)	

Note: intermediate axis length is the second longest axis on a cobble. Embeddedness refers to how deeply the cobble is surrounded or buried by other substrate.

Table D.14: Intermediate axis length and embededdness of 100 cobble washed during Hess sampling at benthic invertebrate stations, Minto Mine WUL, 2012.

Cobble Number	LMC-4		LMC-5	
	Intermediate Axis Length (cm)	Embeddedness (%)	Intermediate Axis Length (cm)	Embeddedness (%)
1	5.8		10.4	
2	8.0		9.4	
3	6.6		6.0	
4	7.5		9.1	
5	5.4		7.4	
6	5.3		6.5	
7	4.0		6.4	
8	7.6		4.7	
9	5.3		4.4	
10	6.1	40	5.6	30
11	11.8		10.7	
12	8.8		8.2	
13	7.7		5.1	
14	4.8		5.1	
15	4.4		5.2	
16	3.7		3.8	
17	5.3		4.8	
18	4.3		7.0	
19	4.1		8.3	
20	5.3	20	8.0	25
21	6.3		4.5	
22	5.5		3.9	
23	5.8		6.3	
24	5.7		3.9	
25	5.8		3.5	
26	6.2		7.4	
27	4.6		8.0	
28	4.0		11.6	
29	3.9		7.1	
30	5.4	40	8.5	40
31	6.5		8.5	
32	4.1		6.5	
33	4.4		5.1	
34	4.3		7.2	
35	5.5		5.0	
36	5.0		5.4	
37	4.2		5.7	
38	2.9		7.5	
39	5.5		4.3	
40	9.7	15	3.9	25
41	5.5		4.5	
42	6.0		5.4	
43	3.8		4.3	
44	9.5		4.7	
45	3.2		5.8	
46	6.0		4.4	
47	4.9		4.4	
48	4.2		4.3	
49	3.8		4.6	
50	3.9	30	5.5	30
51	3.6		4.8	
52	2.3		5.1	
53	3.2		3.4	
54	4.3		5.0	
55	9.3		6.0	
56	5.0		5.3	
57	7.9		3.7	
58	4.4		3.4	
59	8.7		4.4	
60	5.2	30	4.2	
61	9.9		4.0	
62	4.7		4.1	
63	8.5		4.2	
64	6.2		4.8	
65	14.7		3.9	
66	8.2		3.8	
67	7.7		3.7	
68	7.8		4.0	
69	8.5		3.6	
70	3.1	45	3.1	
71	3.9		4.5	
72	4.7		3.9	
73	4.7		3.4	
74	10.9		3.6	
75	8.1		6.4	
76	8.8		6.5	
77	5.6		7.3	
78	7.6		14.2	
79	6.3		6.6	
80	7.6	10	4.6	50
81	7.6		4.9	
82	8.7		4.7	
83	7.2		3.2	
84	6.4		4.1	
85	6.2		7.8	
86	5.1		3.2	
87	5.2		6.7	
88	5.9		4.4	
89	3.4		4.4	
90	6.5	90	5.1	35
91	6.0		5.6	
92	9.7		6.8	
93	6.0		4.7	
94	4.4		8.5	
95	3.6		3.5	
96	3.9		6.3	
97	3.2		7.3	
98	4.8		7.5	
99	3.7		9.3	
100	2.9		4.9	30
Minimum	**2.3**		**3.1**	
Maximum	**14.7**		**14.2**	
Mean	**5.9**		**5.7**	
Geometric mean	**5.5**		**5.4**	
Median	**5.5**	**30**	**5.1**	**30**
Description of Surrounding material	fines			

Note: intermediate axis length is the second longest axis on a cobble. Embeddedness refers to how deeply the cobble is surrounded or buried by other substrate.

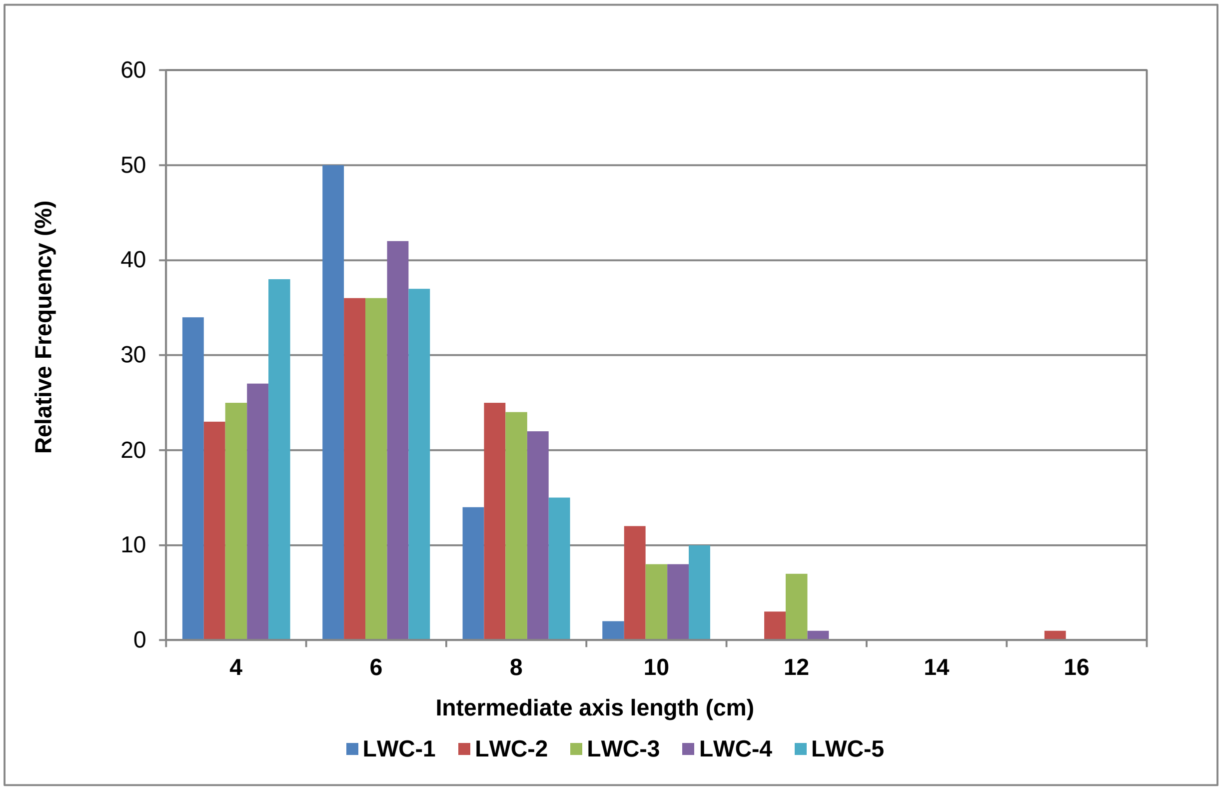


Figure D.1a: Intermediate axis length of 100 rocks measured at five benthic stations in Lower Wolverine Creek.

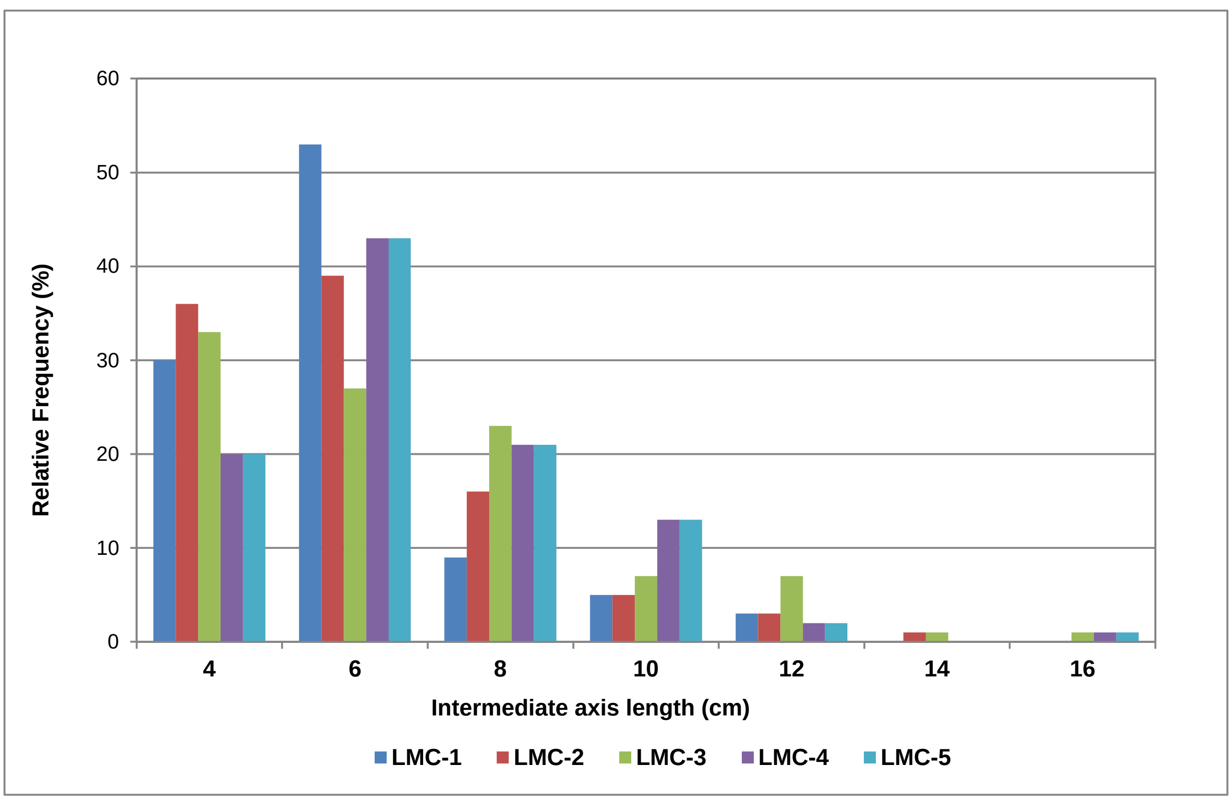


Figure D.1b: Intermediate axis length of 100 rocks measured at five benthic stations in Lower Minto Creek.

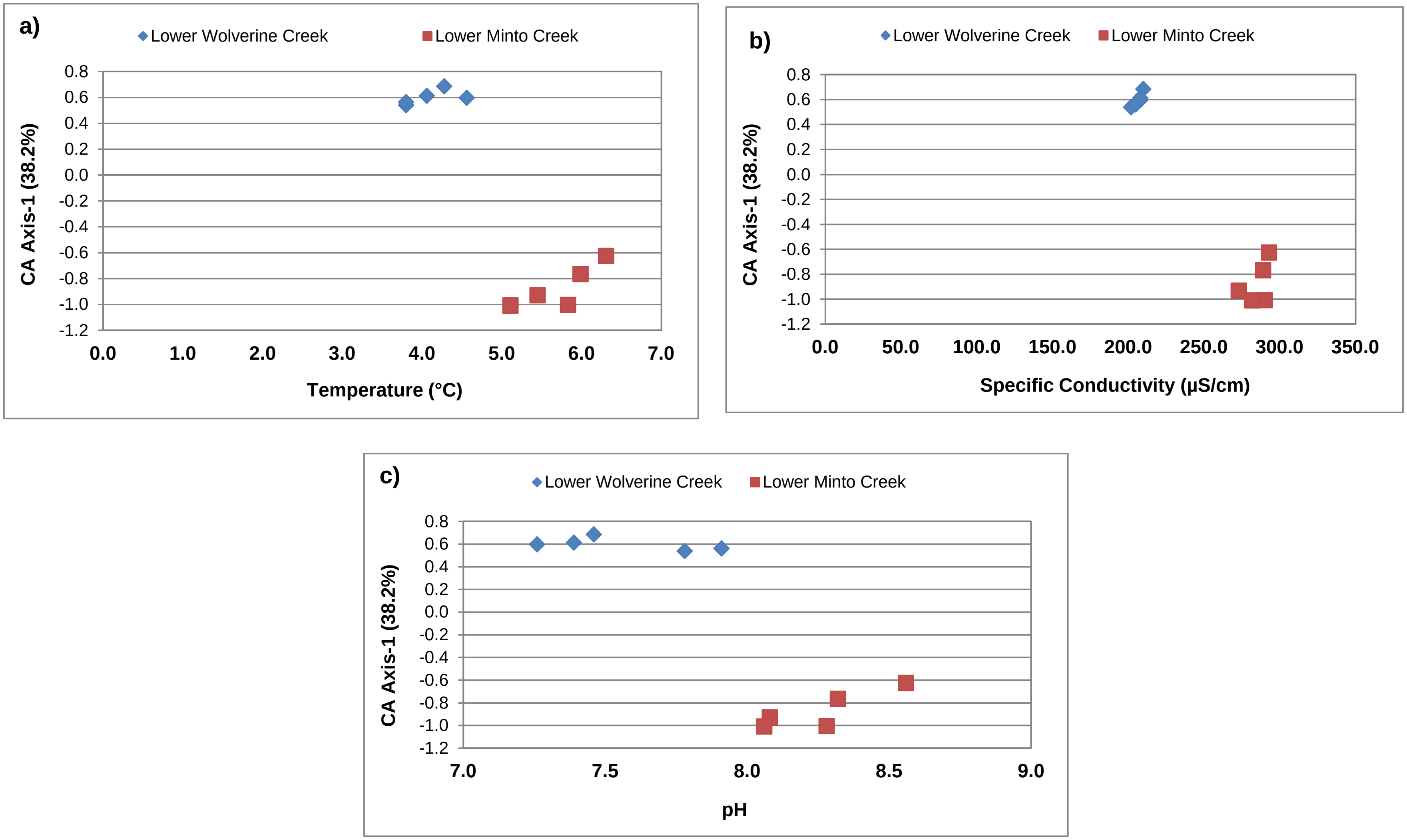
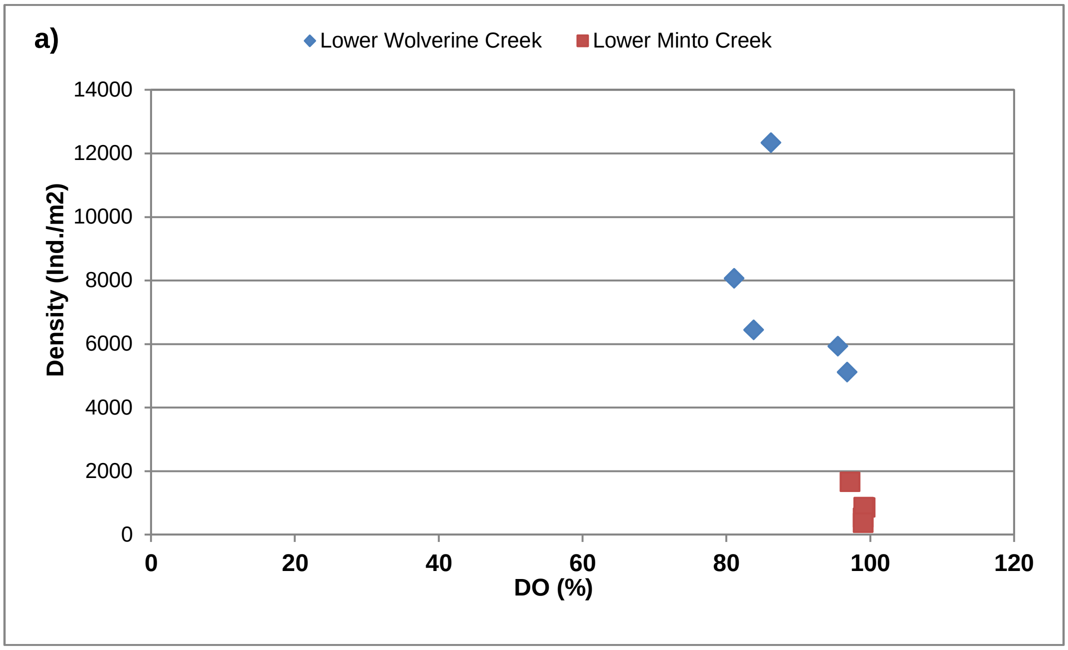


Figure D.2: Scatterplot of benthic invertebrate community compared to CA Axis-1 a) Temperature, b) Specific Conductivity and c) pH



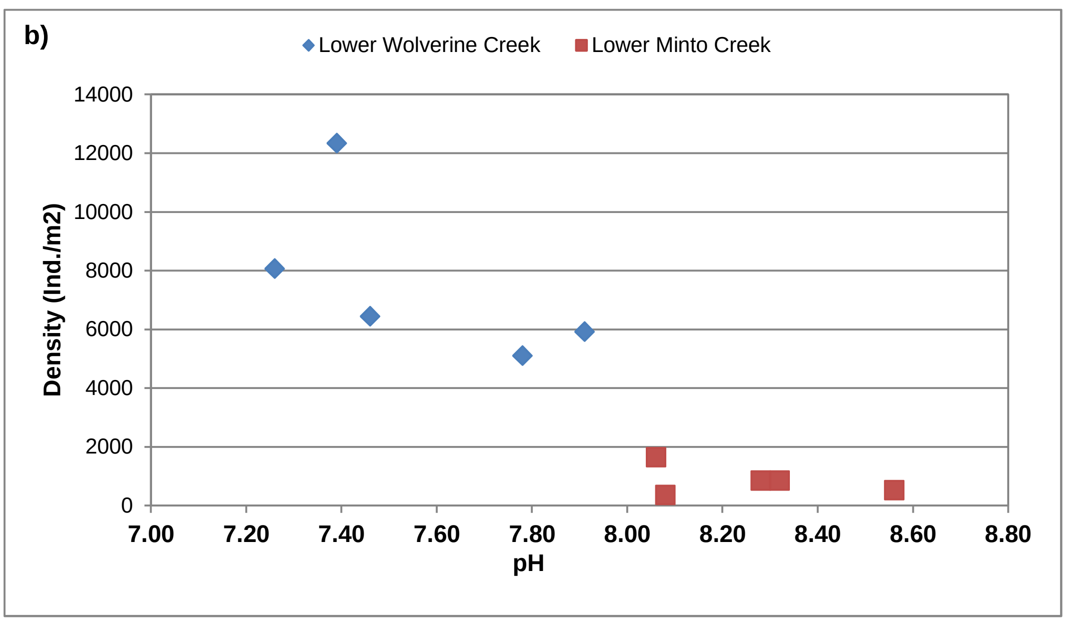


Figure D.3: Scatterplot of benthic invertebrate community compared to Density a) Dissolved Oxygen (%), b) pH

Appendix E: 2012 Fisheries Study Update for Minto Mine

FISHERIES MONITORING PROGRAM, MINTO CREEK

2012 SUMMARY REPORT

February 2013

Prepared for:

MINTO EXPLORATIONS LTD

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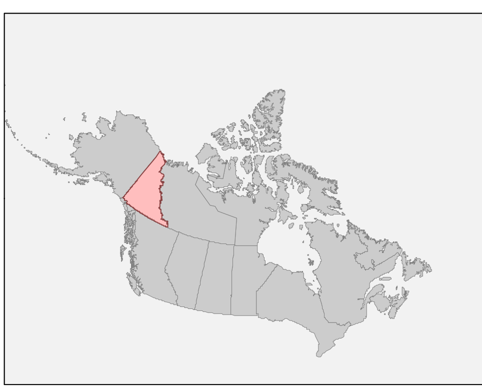
1 INTRODUCTION

Minto Explorations Ltd. (MintoEx), a wholly owned subsidiary of Capstone Mining Corp. (Capstone), owns and operates the Minto Mine, a high-grade copper mine, located approximately 240 km northwest of Whitehorse, Yukon Territory (Figure 1-1). The project is located within Selkirk First Nation (Selkirk) Category A Settlement Land Parcel R6A, and is centered at approximately 62°37'N latitude and 137°15'W longitude. The Minto Mine commenced commercial operation in October 2007 and is permitted to conduct mining and milling operations at a rate of 3,600 tonnes of ore per day (tpd). The Minto orebody (copper/gold/silver) currently being mined 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). MintoEx is required, under the terms of its water use license #QZ96-006 (amendment 7), to conduct an annual biological monitoring program, of which this fisheries monitoring program in Minto Creek is a component.



MINTO MINE

MINTO EXPLORATIONS LTD.

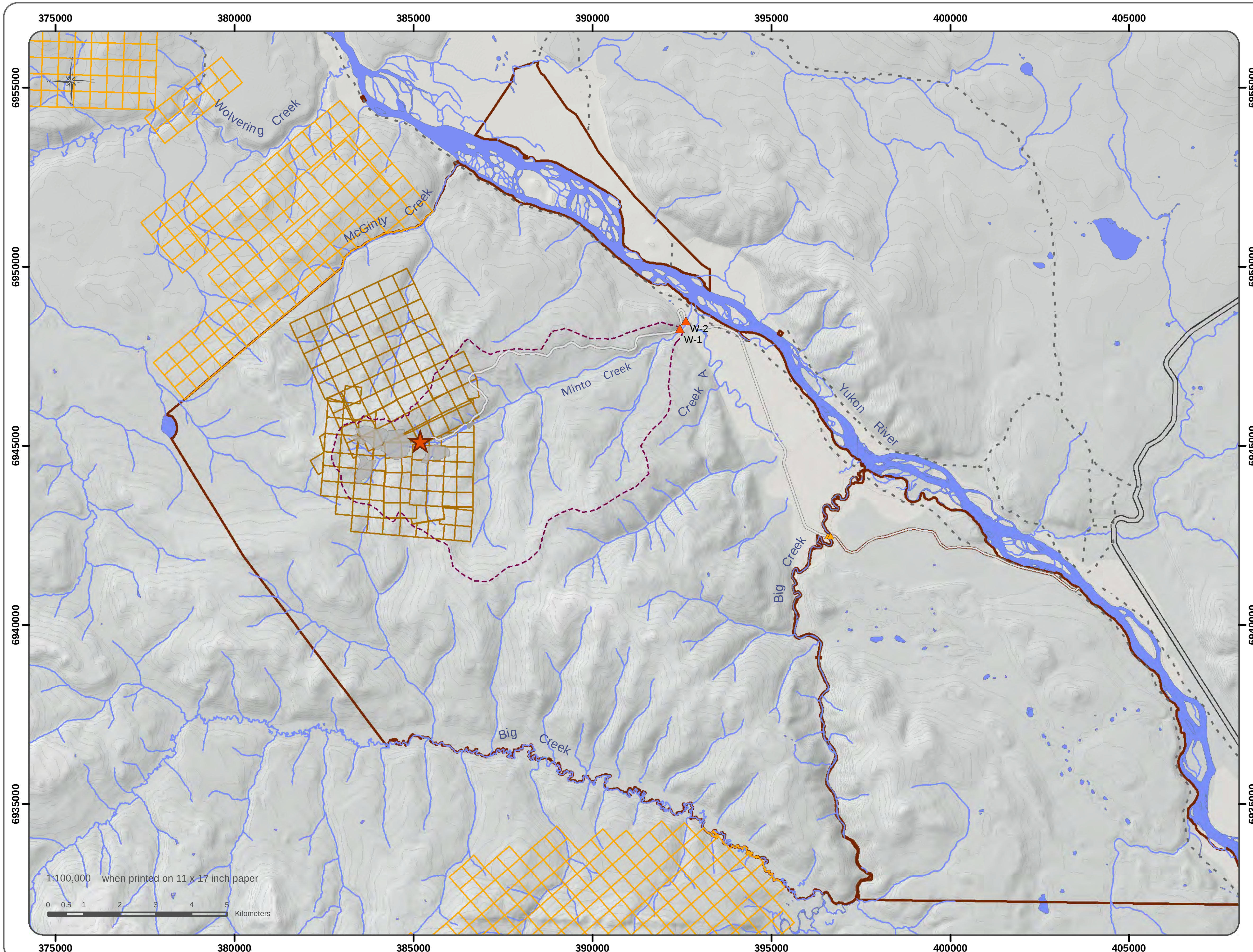
A Subsidiary of Capstone Mining Corp.

FISHERIES MONITORING PROGRAM, MINTO CREEK - 2011 SUMMARY REPORT

FIGURE 1-1

PROJECT LOCATION

ACCESS



MINTO MINE

FISHERIES MONITORING PROGRAM, MINTO CREEK - 2012 SUMMARY REPORT

FIGURE 1-2
AREA OVERVIEW

- Minto Mine Site
- Fish Monitoring Station
- Water Quality Station
- Mine Access Road
- Road
- Trail
- Watercourse
- Waterbody
- Existing Minto Mine Footprints
- Minto Creek Catchment
- Other Quartz Claims
- Minto Explorations Ltd. Quartz Claims
- First Nation Settlement Land

Quartz claims data obtained from Energy, Mines and Ressources, YTG. Data currrent as of August 1st 2011.

NAD 83 UTM Zone 8N

MINTO EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

ACCESS

D:\Project\AllProjects\Minto\gis\mxd\Reports\Fisheries-2012\Area_Overview_20130214.mxd
(*Last edited by: jlindeman;14/02/2013/15:54 PM*)

2 Previous Studies

Attempts to collect fish in lower Minto Creek while conducting the Phase 1 Metal Mining Effluent Regulation, Environmental Effects Monitoring (EEM) study in 2008 resulted in the capture of no fish during the month of June and very few fish during the month of September. This is consistent with the findings of previous fish investigations conducted in the creek (HKP 1994; R&D 2006, 2007). Fish use of Minto Creek is transient and likely short-lived as has been found in other non-natal Chinook rearing creeks (Walker 1976; Scrivener et al. 1994). Minto Creek does not provide preferred spawning habitat for fish and the fact that it completely freezes during winter months, with no winter flow in lower Minto Creek, negates its suitability for spawning by Chinook salmon. Accordingly, there is no evidence of spawning in Minto Creek (HKP 1994; R&D 2006, 2007), nor is there traditional knowledge indicating spawning occurring in the system (HKP 1994).

Although water flows are adequate to support fish during the spring it appears that fish do not enter Minto Creek until early summer (late June to early July), once water temperatures in the creek rise and equilibrate with that of the Yukon River. Lower Minto Creek is also subject to low or zero flow conditions during periods in the summer when a portion (or all) of the flow sometimes infiltrates the ground following passage through a canyon located approximately 2.0 km upstream of the Yukon River.

In the past, when fish have been captured in the creek, the majority of them tended to be juvenile Chinook salmon (*Onchoryhnchus tshawytscha*). Other species that have been found in the creek in low numbers include round whitefish (*Prosopium cylindraceum*), Arctic grayling (*Thymallus arcticus*), slimy sculpin (*Cottus cognatus*) and burbot (*Lota lota*). Fish sampling events conducted in 1994, 2006, 2007 (summarized in the Phase 1 EEM study design; Minnow/Access 2007) and as part of the Phase II EEM study design in 2008 (Minnow/Access 2009; Table 2.6) yielded both low numbers of fish and catch-per-unit-effort (CPUE).

During the summer of 2009, the Minto Mine was given authorization to discharge effluent from the site under an amendment to its Water Use License. This resulted in a substantial increase in water flow-rate in Minto Creek for a sustained period from June 26th through October 30th. Fish sampling conducted during this discharge period indicated that fish (juvenile Chinook salmon in particular), were possibly being attracted by the higher flow in Minto Creek and/or the temperature differential between Minto Creek and the Yukon River resulting from the discharge. This was apparent in a marked increase in CPUE using minnow traps. The numbers of fish entering Minto Creek as a result of the discharge were substantial enough for Fisheries and Oceans Canada (DFO), Whitehorse Office, to direct the company to undertake a fish re-location program on lower Minto Creek and establish a fish barrier near the Yukon River confluence in order to prevent additional fish from moving into Minto Creek. DFO was concerned that the fish could become stranded in Minto Creek following cessation of the discharge. The fish re-location project was undertaken from late September through early October and resulted in the capture of 987 juvenile Chinook salmon. At the beginning of the relocation, some minnow traps were yielding catches as high as 80 individuals per minnow trap in an overnight set. Prior to this, the most salmon captured in a sampling event (excluding those captured at the Yukon River confluence), including the application of both electrofishing and multiple minnow trapping effort was 17 (Minnow/Access 2009).

In 2010, a mark-recapture study was undertaken to better understand the dynamics of the juvenile Chinook salmon (JCS) population using Minto Creek. The study was developed to determine how use of the system by

JCS changes throughout the open-water season and to determine how long individual fish may stay in the creek system (i.e. residency time). No juvenile Chinook salmon or other species were encountered in Minto Creek during a late June sampling event. This is consistent with previous studies in that few fish if any have been encountered in the creek prior to July. During this study fish were still present in the system in early November. Numbers of JCS increased on subsequent events from July 14 until August 11 when the peak number were captured. The estimated population of JCS in the creek at this time was 1,500 after which the numbers declined. The number of fish captured in 2009 and 2010 were much higher on a "catch per unit effort" basis than in years previous to 2009. As in 2009 Minto Mine was influencing the flow regime in Minto Creek through a controlled water discharge from the mine site throughout much of the summer until early November 2010. This likely influenced an increased use of the system by juvenile Chinook salmon. Analysis of marked fish recaptured indicates that much of the population does not remain in the creek for an extended period of time and that there is a high degree of immigration and emigration of the population in the creek. The data suggests that 90% of the population may only spend up to approximately two weeks in the system. Only a few individuals (1%) spent an extended period of time (> 12 weeks) in the system. JCS growth leveled off towards the end of August, likely a reflection of cooling water temperatures. Overall, the growth of individuals in the system is consistent with JCS populations in other tributaries of the Yukon River.

In 2011, Minnow trapping was conducted at the same sites as in 2010 from July to October. In comparison to 2010 when some trapping events returned over 400 juvenile Chinook salmon, a very small number of fish were captured in 2011. The 2011 capture numbers are more consistent with fish usage numbers in the creek during the years the mine was not discharging into the creek and prior to mine operations. Very few fish (3 in total) were captured during the first sampling event in mid-July indicating as determined in previous studies that fish do not likely enter the creek until after June. No fish were captured upstream of the natural barrier identified in Minto Creek during the 2010 assessment work. No adult fish were observed spawning in the vicinity of the Minto Creek/Yukon River confluence during 2011. Bottom substrate in the confluence area consists primarily of silt and mud which is not considered suitable substrate for salmon spawning.

Table 2-1 Summary of captures in Minto Creek between 2008 and 2011.

Year	Method	Effort	Summary Statistics	Units	Juvenile Chinook Salmon	All Species
2008	Backpack Electrofishing	796 s	Catch	#	1	0
			CPUE	Fish/min	0.075	0
	Baited Gee Minnow Trapping	28.6 days	Catch	#	18	0
			CPUE	Fish/day	0.63	0
2009*	Baited Gee Minnow Trapping	28.6 days	Catch	#	136	142
			CPUE	Fish/day	4.76	4.97
2010	Baited Gee Minnow Trapping	145.9 days	Catch	#	2293	2307
			CPUE	Fish/day	15.72	15.81
2011	Baited Gee Minnow Trapping	71 days	Catch	#	12	29
			CPUE	Fish/day	0.17	0.41

**Does not include the fish relocation program*

Past observations have indicated that the area at the confluence of Minto Creek and the Yukon River is not used by spawning salmon or other species. The annual fisheries program however, continue to observe for and report on the use of the confluence zone by spawning salmon and other species.

3 OBJECTIVES

The objectives of the 2012 Fisheries Monitoring Program were to monitor, assess and characterize fish usage in Minto Creek during open water season, and to provide data allowing interpretation of the potential role and influence of the Minto Mine on the fish community. As part of the 2012 monitoring program, assessments at Big Creek were added to compare fish use in a neighbouring system relative to Minto Creek. Fish monitoring studies were conducted in support of the requirements of Water Use License QZ096-006.

4 METHODOLOGY

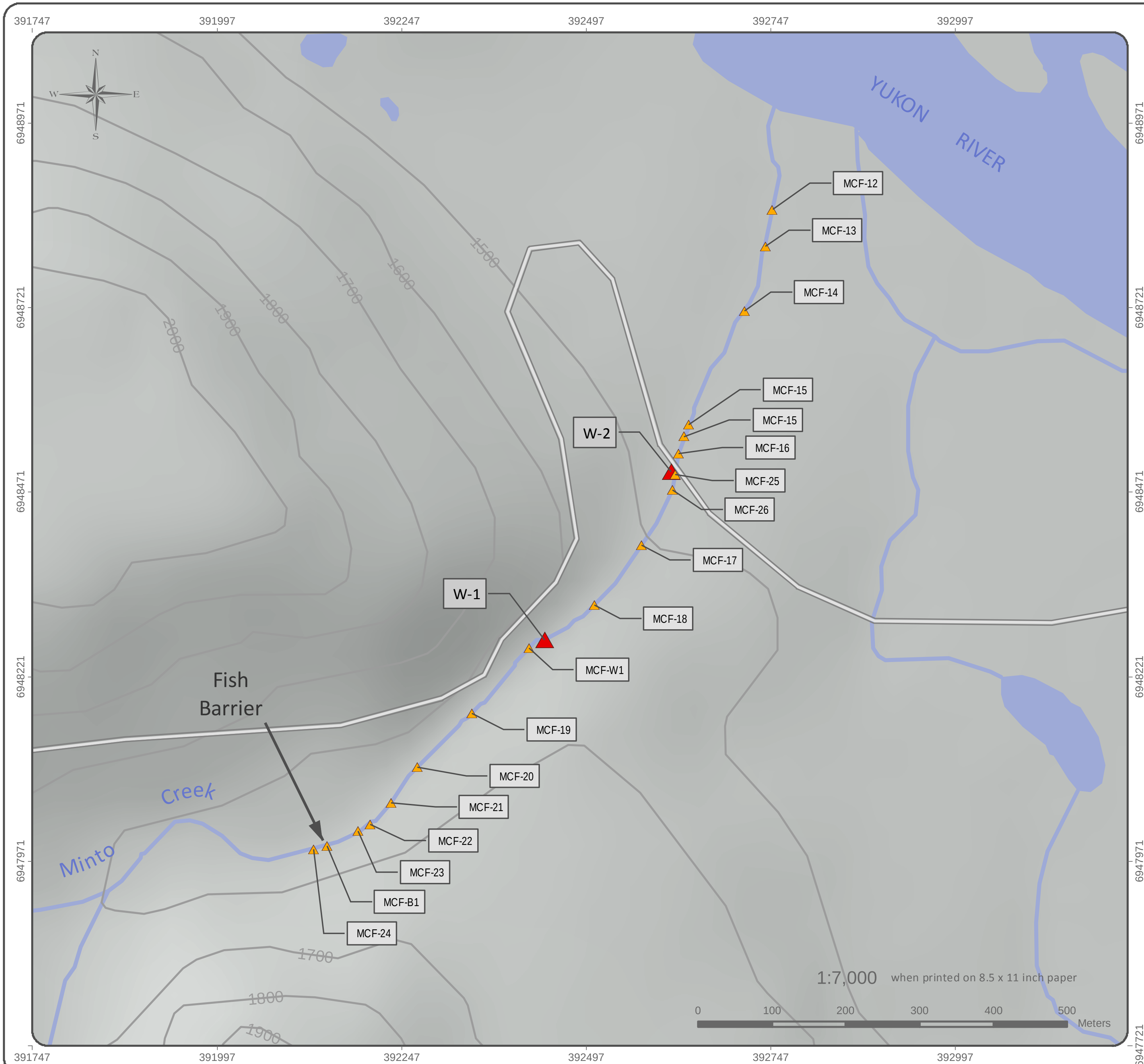
4.1 FISH MONITORING

Fish monitoring of Minto Creek and Big Creek was conducted from June to September 2012 at trapping sites consistent with the 2010 mark-recapture study and the 2011 fish monitoring (Figure 4-1). Trapping efforts included the use of Gee-type Minnow traps with 0.635 cm wire mesh size baited using Yukon River origin Chinook salmon roe or fish food pellets. Between 12 and 16 minnow traps were set in Minto Creek, depending on water levels and availability of pools and backwater.

The monthly sampling was conducted during the open water period between June and September 2012. All fish captured were identified, enumerated and measured for fork length or total length (mm± 1), weighed (g ± 0.1), inspected for abnormalities (as described below), and released at the vicinity of their trapping location.

Additional supporting information collected included photo documentation of the creek, water level reading at W1 staff gauge, in situ water parameters (temperature, dissolved oxygen, conductivity) as well as weather conditions at time of sampling. Supporting variables also included monitoring of the confirmed fish barrier (1.2 km upstream of the Yukon River confluence) and/or any new barriers that may have developed.

Aerial reconnaissance survey for potential fish spawning activity was flown by Minto personel on September 8th 2012 for approximately 24 minutes. The survey was completed using a helicopter and covered the mouth of McGinty Creek, Minto Creek, Big Creek, both banks of the barge landing as well as islands located downstream of the mine area.



MINTO MINE

FISHERIES MONITORING PROGRAM, MINTO CREEK - 2012 SUMMARY REPORT

FIGURE 4-1
CAPTURE LOCATIONS

- Minto Creek Fish Monitoring Station
- Water Quality Monitoring Station
- Mine Access Road
- Contours (ft)
- Watercourse
- Waterbody

NAD 83 UTM Zone 8N

MINTO EXPLORATIONS LTD.

ACCESS

D:\Project\AllProjects\Minto\gis\mxd\Reports\Fisheries-2012\Capture_Locations_20130214.mxd
(Last edited by: jlindeman;14/02/2013/13:06 PM)

5 RESULTS

The following sections present the fisheries statistics and effort in Minto Creek and Big Creek between June and September 2012. Trapping locations are identified on figure 4-1 for Minto Creek and figure 1-2 for Big Creek.

5.1 MINTO CREEK

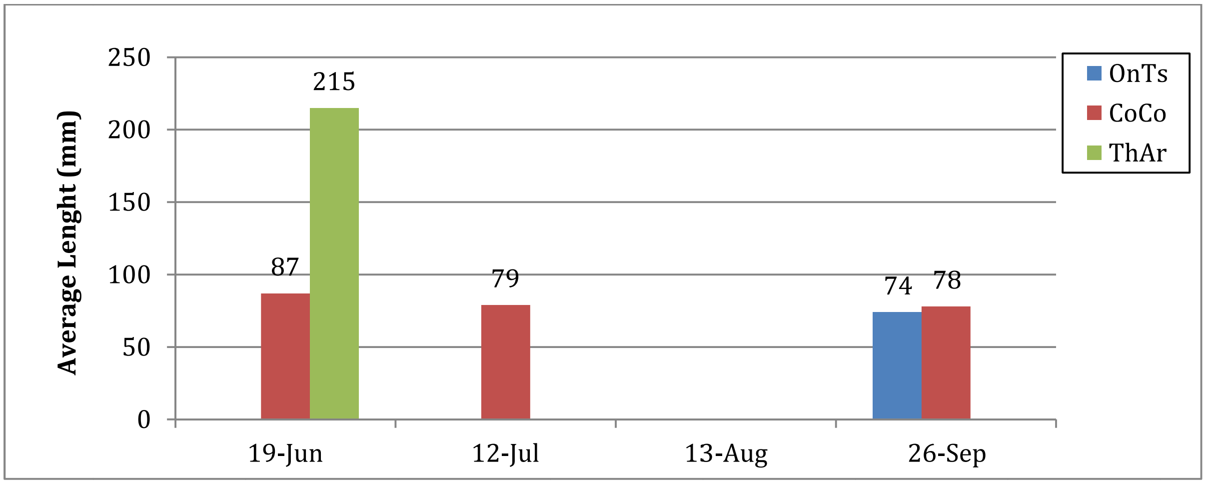
Minto Creek was assessed monthly between June and September 2012. A total of thirteen fish were captured in Minto Creek, including three juvenile Chinook salmon, which were all were captured in September, nine slimy sculpins and one Arctic grayling captured by electrofishing in June. The following table (Table 5-1) presents the effort applied and the summary of fish captures in Minto Creek in 2012.

Table 5-1 Summary statistics of Fish Monitoring Program in Minto Creek in 2012.

Period	Method	Effort	Summary Statistics	Juvenile Chinook Salmon	All Other Species
June	Minnow trapping	10.4 days	Catch*	0	4
			CPUE**	0	0.38
	Electrofishing	1051 seconds	Catch*	0	4
			CPUE**	0	0.23
July	Minnow trapping	10.5 days	Catch*	0	1
			CPUE**	0	0.095
August	Minnow trapping	7.99 days	Catch*	0	0
			CPUE**	0	0
September	Minnow trapping	11.0 days	Catch*	3	4
			CPUE**	0.27	0.36

**Number of fish, **Number of Fish per day (MT) or minute(EF)*

Figure 5-1 below presents a summary of the measurements for the thirteen fish captured in Minto Creek. Fish length refers to fork length for juvenile Chinook salmon and to total length for other species.



OnTs: Oncorhynchus tshawytscha (Chinook Salmon); CoCo: Cottus cognatus (Slimy Sculpin); ThAr: Thymallus Arcticus (Arctic Grayling)

Figure 5-1 Average length of fish captured during the Fish Monitoring Program of Minto Creek, 2012.

An average weight of 4.37 g was calculated for the three juvenile Chinook salmon (n=3) captured. Weight of other fish species was not obtained.

Minto Creek had a high level of suspended solids throughout the 2012 open water season (Appendix 3). Also, the channel configuration and the relatively low water level limited the availability of deep pools and backwaters, limiting at the same time potential trapping locations.

5.2 BIG CREEK

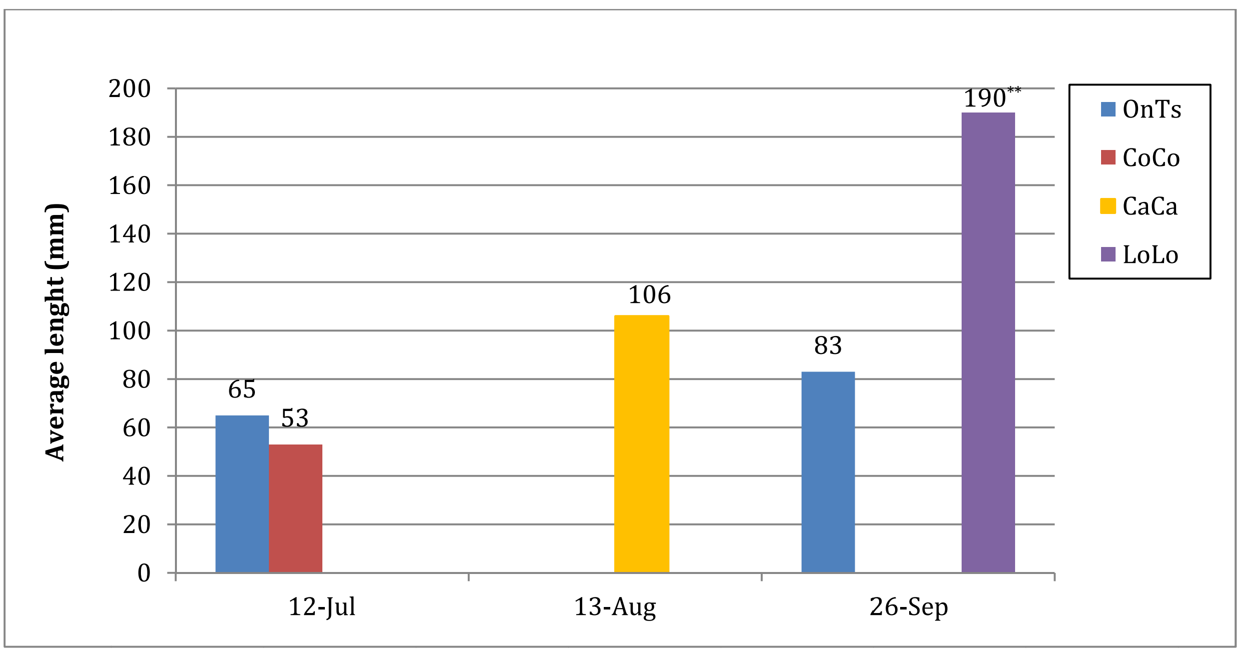
Fisheries effort in Big Creek was initiated in July resulting in a total of thirty three fish captured, of which seven were juvenile Chinook salmon. Other species found in Big Creek include longnose sucker (*Catostomus catostomus)*, and burbot (*Lota lota*). A total of 33 fish were caught during the Big Creek fisheries investigations, most of which were captured by electrofishing. The following table (Table 5-2) presents the effort undertaken and the description of fish captured in Big Creek in 2012.

Table 5-2 Fisheries data in Big creek in 2012.

Period	Method	Effort	Summary Statistics	Juvenile Chinook Salmon	All Other Species
July	Minnow trapping	3.05 days	Catch*	6	0
			CPUE**	1.97	0
	Electrofishing	273 seconds	Catch*	1	23
			CPUE***	0.22	5.05
August	Minnow trapping	4.83 days	Catch*	0	1
			CPUE**	0	0.21
September	Minnow trapping	3.87 days	Catch*	1	1
			CPUE**	0.26	0.26

**Number of fish, ** Number of fish per day, ***Number of Fish per minute*

Figure 5-2 present the measurements collected on fish captured in Big Creek, where fish length refers to fork length for juvenile Chinook salmon and to total length for other species.



*OnTs= Oncorhynchus tshawytscha (Chinook Salmon); CoCo= Cottus cognatus (Slimy Sculpin); CaCa=Catostomus catostomus (Longnose Sucker); LoLo=Lota lota (Burbot). **Length is estimated.*

Figure 5-2 Average length of fish captured in Big Creek, 2012.

The weight of juvenile Chinook salmon captured in June and September averaged 2.3 g and 8 g respectively. Weight for other species was not obtained.

5.3 IN SITU WATER PARAMETERS

In situ data was collected in Minto Creek at W2 during each site visit and results are summarized in Table 5-3. Water levels at the W1 staff gauge were also noted. Turbidity in Minto Creek was observed to be high throughout the summer. TSS records for Minto Creek are presented in Appendix 3. In situ parameters were collected with a YSI multimeter instrument near the substrate and stream discharge was obtained with a Marsh McBirney electromagnetic flow meter in June, July and a Hach electromagnetic flow meter in August and September.

Table 5-3 In situ and stream discharge data in Minto Creek 2012.

	June 20	July 13	Aug 13	Sept 27
Time	19:20	10:40	16:50	16:03
Water temperature (°C)	8.9	7.1	9.4	4.0
Dissolved Oxygen (%)*	108	115	107.2	103.4
Dissolved Oxygen (mg/L)	12.4	13.8	12.24	13.55
Specific Conductance (µS/cm)	229.7	256.8	290.6	295.5
pH	7.49	8.58	8.00	8.23
Oxidation Reduction Potential (mV)	174.2	292.5	10.2	53.2
Stream discharge at W2 (m3/sec) / (Time)	0.180 (June 20, 19:30)	0.055 (July 13, 10:00)	0.056 (Aug.13, 16:55)	0.026 (Sept.28, 9:25)
W1 Staff Gauge Level (m) / (Time)	0.218 (June 20, 16:43)	0.190 (July 12, 13:35) 0.180 (July 13, 9:30)	0.170 (Aug.13, 16:42)	0.256 (Sept.27, 16:40) 0.255 (Sept.28, 8:52)

** DO (%) values above 100% are considered suspicious*

Big Creek in situ data was collected monthly between July and September according to the methodology mentioned above. Sampling occurred at the bridge crossing with the Minto Haul road. Water levels (Table 5-4) and discharge were obtained through the Water Survey of Canada (Figure 5-3) on-line database (Water Survey Canada 2012) and are presented below.

Table 5-4 In situ and stream discharge data at Big Creek Water Survey Canada station in 2012.

	July 12	Aug 14	Sept 27
Time	16:30	9:28	15:43
Water temperature (°C)	11.3	7.2	4.7
Dissolved Oxygen (%)*	118	98.6	100.2
Dissolved Oxygen (mg/L)	12.7	11.94	12.90
Specific Conductance (µS/cm)	158.2	172.0	199.9
pH	8.5	8.24	8.55
Oxidation Reduction Potential (mV)	283.3	26.0	57.6
Stream discharge (m3/sec) / (Time)	19.614 (July 12, 16:30)	17.497 (Aug.14, 9:30)	11.415 (Sept.27, 15:45)
Water Level (m) / (Time)	6.778 (July 12, 16:30)	6.474 (Aug.14, 9:30)	6.274 (Sept.27, 15:45)

** DO (%) values above 100% are considered suspicious*

The Big Creek hydrometric station (Water Survey of Canada station ID # 09AH003) is located downstream of the Minto road bridge, near its confluence with the Yukon River, at the following coordinates: 62° 34' 07'' N; 137° 00' 58'' W. It records continuous water level and discharge. Figure 5-3 presents data from June to October 2012.

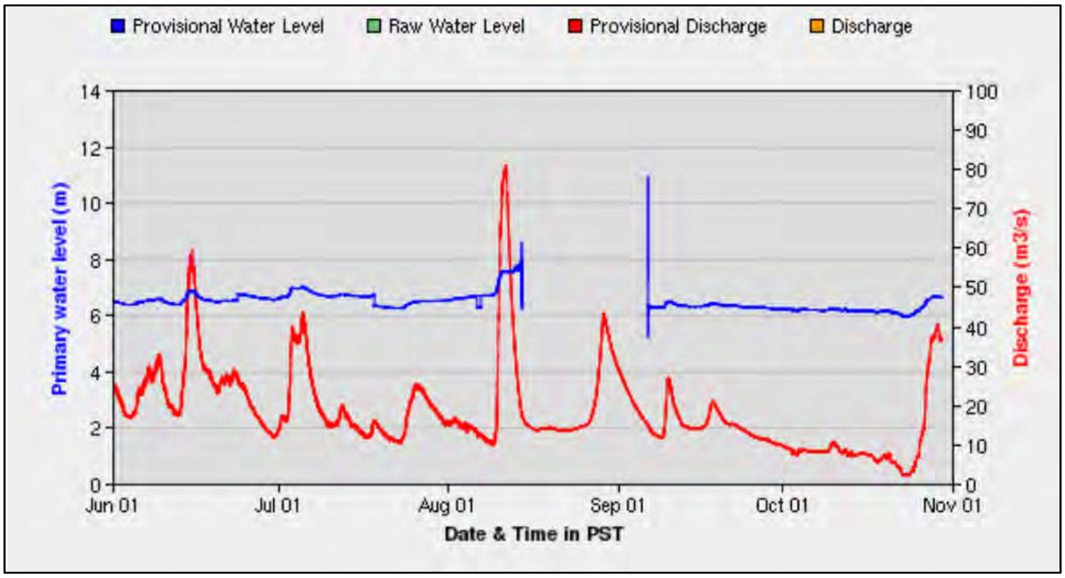


Figure 5-3 Water Level and Discharge in Big Creek 2012 *(Source: Water Survey of Canada, 2012).*

5.4 FISH BARRIER

The fish barrier located approximately 1.2 km upstream of the Yukon River (Figure 4-1), which was documented in previous years, was re-confirmed in 2012. The barrier, which consists of a log jam, was measured to be 30 cm high (above the water surface) on August 13, 2012 (Figure 5-4). Fish use upstream of the barrier was assessed by setting traps during each sampling event. No fish were captured upstream of the barrier during 2012.

Figure 5-4 Fish Barrier on August 13, 2012.

5.5 AERIAL SURVEY

An aerial survey was conducted on September 8, 2012 on the Yukon River to investigate for spawning salmon in the vicinity of the Minto Mine. The area between the barge landing to McGinty Creek was surveyed for approximately 24 minutes and no live fish or carcasses were observed. All channels and islands downstream of Minto landing were examined, and no fish were found. Table 5-5 below summarizes the results.

Table 5-5 Aerial Survey Results

Location	Observations	Number of Fish Observations
Mc Guinty Creek Confluence	Deep channel with no good shoals, water was clear with good visibility. Pilot also flew through the adjacent island channels, channels has good visibility with pebble/rocky bottoms. Investigated both above and below confluence. 5 minutes of flying.	0
Minto Creek Confluence	Sediment at mouth of Minto creek, good water visibility. Shallow channels/ islands off main Yukon river, channels were shallow and 4 eagles were in the area. Flew for approximately 3 minutes.	0
Big Creek Confluence	Plume visible in Yukon River. Water entering Yukon river as brown and transparent. Larger clear channels in the middle of the Yukon R. flew up to the Km 19 bridge and above and below confluence. Flew for 10 minutes in the area.	0
Barge Landing (West Bank)	No shoals, no islands, water is clear and open along the river's edge, becomes more turbid in the middle. Flew for 3 minutes.	0
Barge Landing (East Bank)	1 eagle, same water conditions as west bank. Flew for 3 minutes.	0

6 DISCUSSION

The number of fish captured in lower Minto Creek in 2012 is relatively consistent with numbers found when the mine was not discharging into the creek and prior to mine operations. A total of 13 fish were captured in Minto creek in 2012, only 3 of which were juvenile Chinook salmon (JCS). CPUE for minnow trapping ranged from 0.095 to 0.38 fish/day. In comparison, a total of 29 fish including 12 JCS were captured in 2011 for a similar trapping effort. In 2010 however, some trapping events returned over 400 JCS. In 2010, the mine was discharging, causing higher and more consistent flows and temperature regimes in lower Minto Creek, conditions which may have been more attractive to JCS. Also, following a forest fire in 2010, more sediment entered Minto Creek through runoff in 2011 and 2012 increasing water turbidity. A small landslide was documented by Minto personnel in an upstream tributary, possibly contributing to high TSS levels observed downstream. The increased turbidity may have deterred fish from entering Minto Creek. No adult fish were observed spawning in the vicinity of the Minto Creek/Yukon River confluence during 2012 or in the area downstream and upstream of Minto Creek. Bottom substrate in the confluence area consists primarily of silt and mud which is not suitable substrate for salmon spawning. The natural barrier identified in previous years was confirmed in 2012. Therefore the area of usable fish habitat in Minto Creek is limited to the lower 1.2 km of the creek.

Big Creek was sampled on three occasions during 2012. A total of 33 fish were captured, eight of which were JCS. CPUE for minnow trapping in Big Creek ranged from 0.21 to 1.97 fish/day, which was higher than the CPUE Minto Creek. Big Creek is a bigger system with slightly higher water temperatures, clearer water and more consistent flow regimes than Minto Creek likely creating more favourable conditions for JCS.

7 REFERENCES

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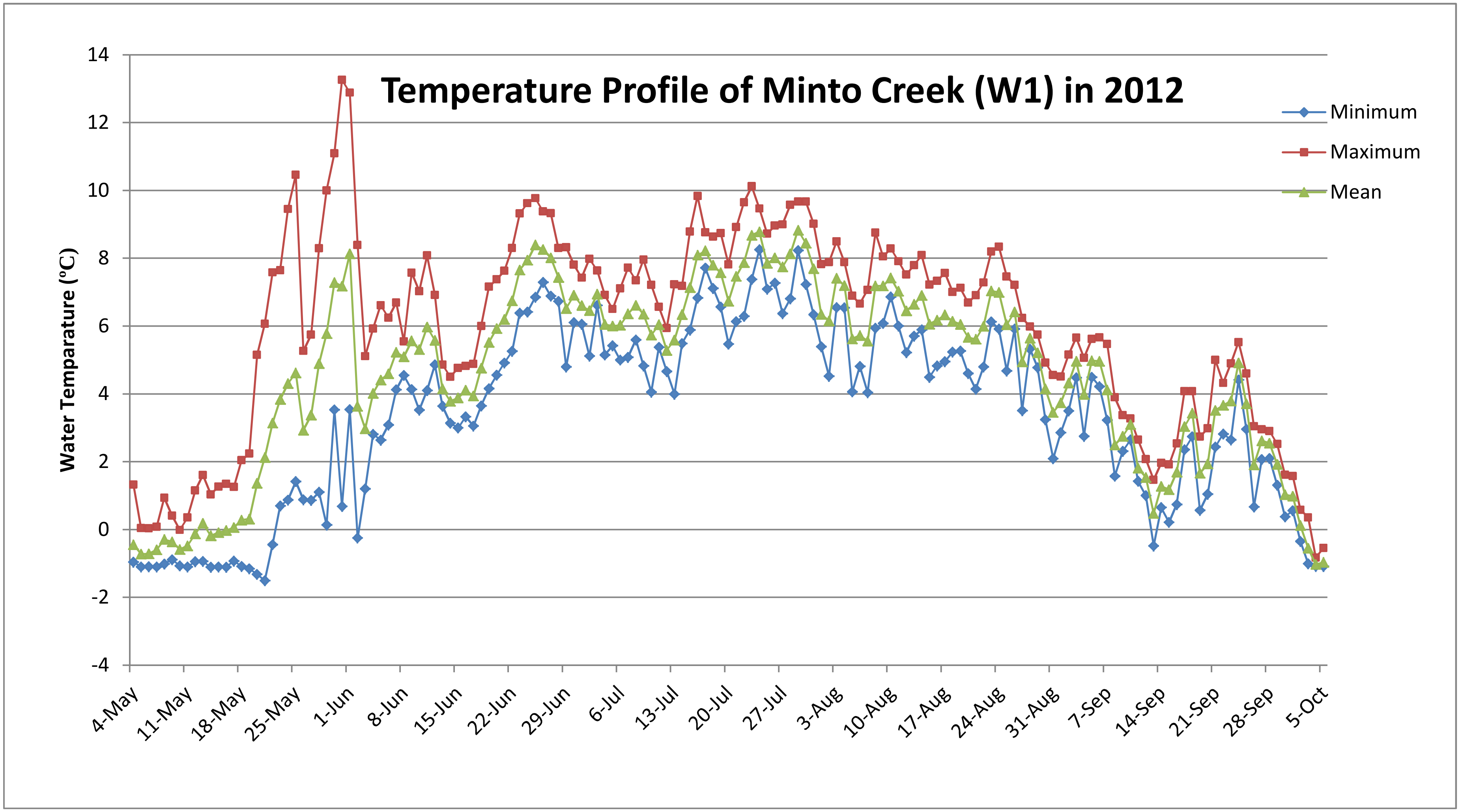
APPENDIX 1

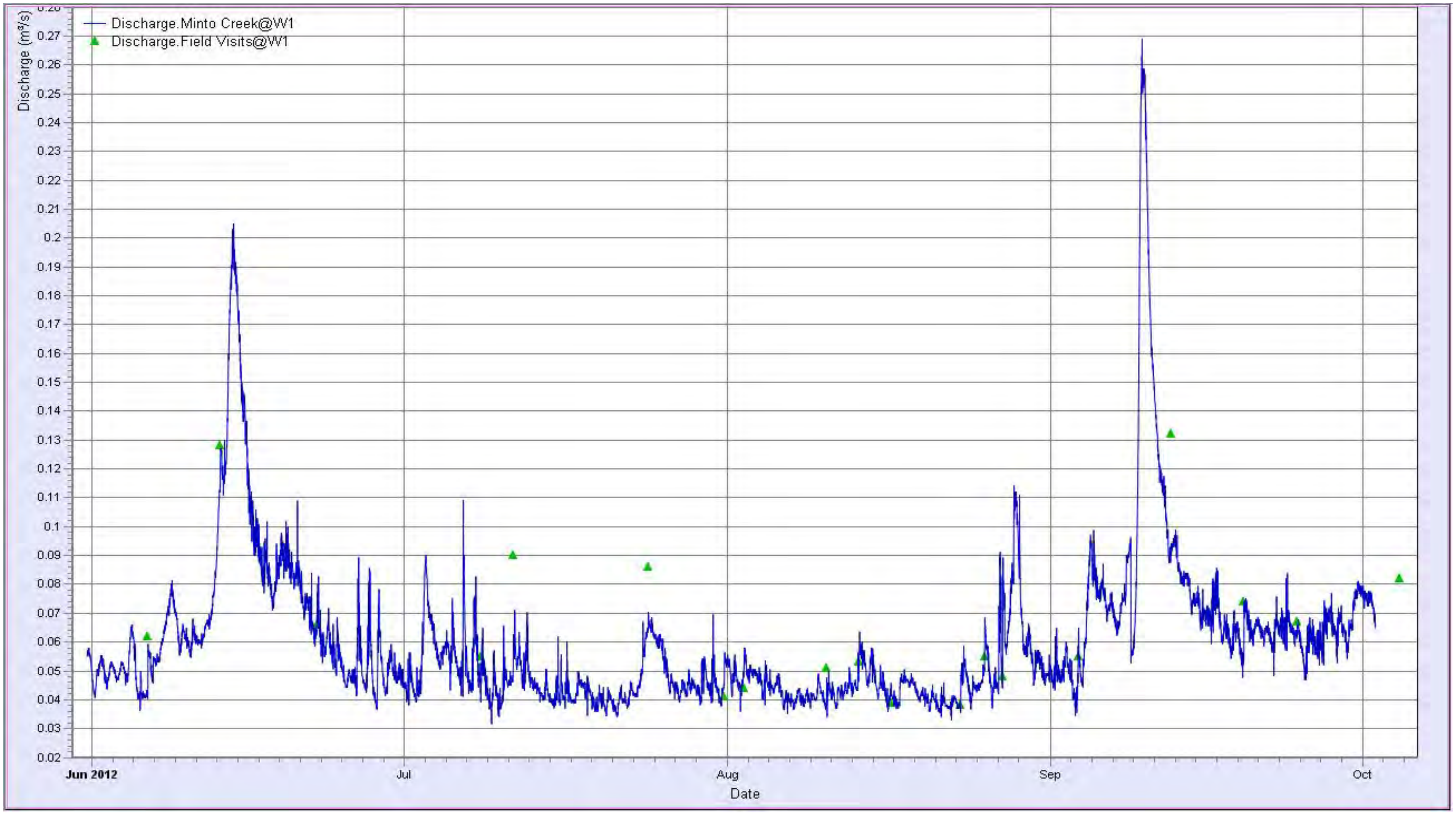
TEMPERATURE PROFILE OF MINTO CREEK IN 2012


Temperature Profile of Minto Creek (W1) in 2012
Water Temparature (°C)
14
12
10
8
6
4
2
0
-2
-4
4-May
11-May
18-May
25-May
1-Jun
8-Jun
15-Jun
22-Jun
29-Jun
6-Jul
13-Jul
20-Jul
27-Jul
3-Aug
10-Aug
17-Aug
24-Aug
31-Aug
7-Sep
14-Sep
21-Sep
28-Sep
5-Oct
Minimum
Maximum
Mean

APPENDIX 2

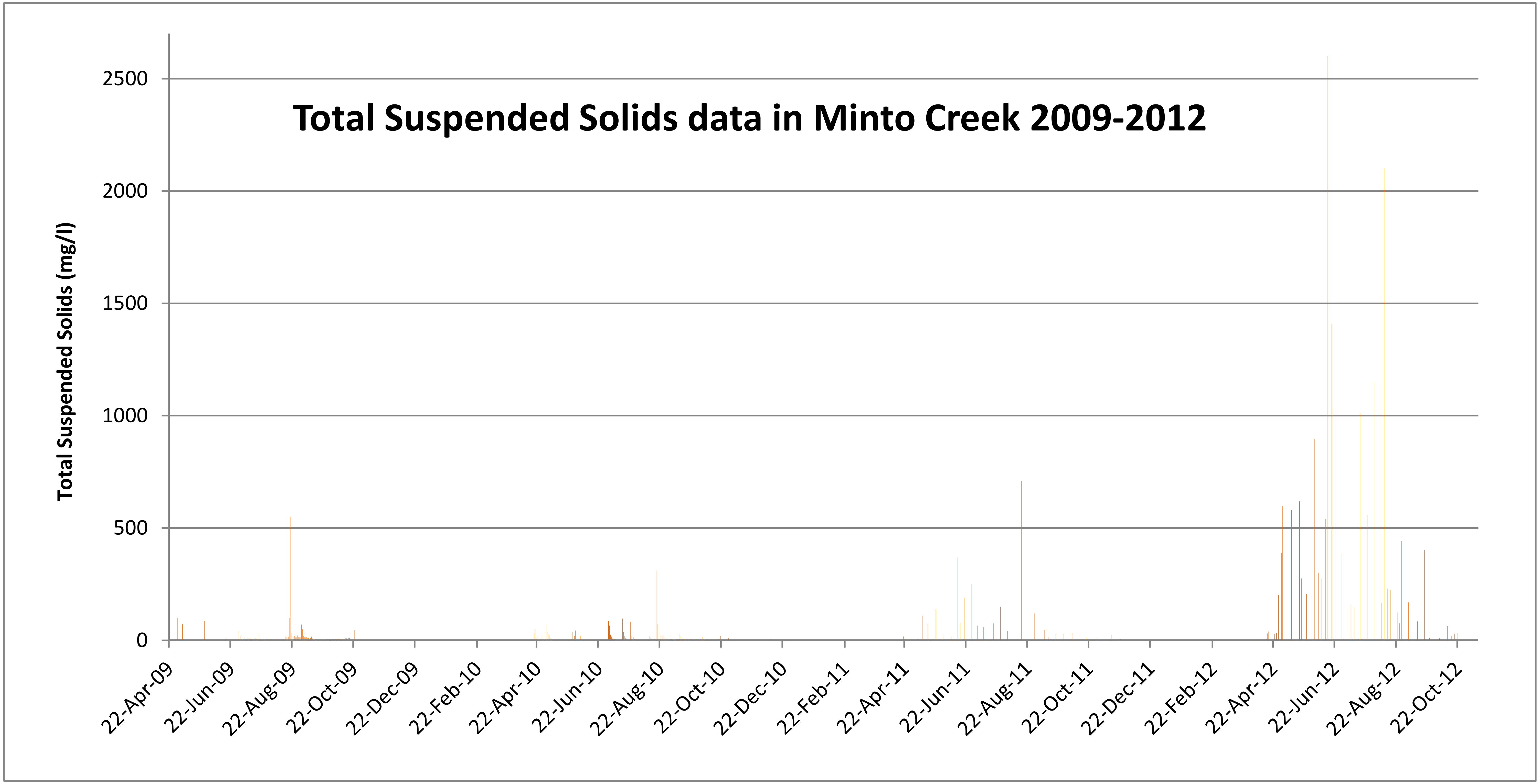
WATER FLOW PROFILE OF MINTO CREEK IN 2012

Flow data of Minto Creek between June and September 2012



APPENDIX 3

TOTAL SUSPENDED SOLIDS IN MINTO CREEK FROM 2009 TO 2012


Total Suspended Solids data in Minto Creek 2009-2012
Total Suspended Solids (mg/l)
0
500
1000
1500
2000
2500
22-Apr-09
22-Jun-09
22-Aug-09
22-Oct-09
22-Dec-09
22-Feb-10
22-Apr-10
22-Jun-10
22-Aug-10
22-Oct-10
22-Dec-10
22-Feb-11
22-Apr-11
22-Jun-11
22-Aug-11
22-Oct-11
22-Dec-11
22-Feb-12
22-Apr-12
22-Jun-12
22-Aug-12
22-Oct-12

Appendix F: 2012 Adaptive Monitoring and Management Plan (AMMP)

CAPSTONE MINING CORP.

MINTO MINE

OPERATED BY MINTO EXPLORATIONS LTD.

WATER USE LICENCE QZ96-006

ADAPTIVE MONITORING AND MANAGEMENT PLAN

MINTO MINE, YUKON TERRITORY

MARCH 2013

MINTO EXPLORATIONS LTD.

ADAPTIVE MONITORING AND MANAGEMENT PLAN

MINTO MINE, YUKON TERRITORY

MARCH 2013

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1 Copy + 3 PDF	Yukon Government, Energy Mines and Resources, Mineral Resources Division
1 Copies + 3 PDF	Selkirk First Nation
1 Copies + 3 PDF	Minto Explorations Ltd.
1 Copies + 1 PDF	Access Consulting Group

*PDF = digital version of report

PROJECT CONTACT LIST

Capstone Mining Corp. Minto Mine Suite 900 - 999 West Hastings Street Vancouver BC V6C 2W2 Telephone: (604) 684-8894 Fax: (604) 688-2180 http://www.capstonemining.com	**Ronald K Light** General Manager, Minto Mine Minto Explorations Ltd. Email: rlight@capstonemining.com **Colleen Roche** Manager, Sustainability & Environmental Affairs Minto Explorations Ltd. Email: colleenr@capstonemining.com **Jennie Gjertsen** Environment Manager Minto Explorations Ltd. Email: jennieg@mintomine.com

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1.0 INTRODUCTION AND BACKGROUND

Capstone Mining Corp. Minto Mine (Minto Mine) owns and operates a high-grade copper mine located within Selkirk First Nation (Selkirk) Category A Settlement Land Parcel R-6A, approximately 240 km northwest of Whitehorse, Yukon Territory. The Minto Mine commenced commercial operations in October 2007. Minto Mine conducts operations pursuant to various authorizations, including a Quartz Mining Licence and Type A Water Use Licence.

As per clause 93 of Water Use Licence QZ96-006 Amendment #8 issued on October 18th, 2012 Minto Mine has revised the Adaptive Management and Monitoring Plan (AMMP). The AMMP revisions are intended to better reflect the terms and conditions of the licence.

1.1 LOCATION

The Minto Mine is located on the west side of the Yukon River within Selkirk Category A Settlement Land Parcel R-6A (Figure 1-2), approximately 240 km northwest of Whitehorse, Yukon Territory and is centered at 62°37'N latitude and 137°15'W longitude (NAD 83, UTM Zone 8 coordinates 6945000N, 384000E). Highway 2 is located on the east side of the Yukon River and the mine can be accessed by summer barge crossing or winter ice bridge crossing at Minto Landing. Minto Mine is the 100% registered owner of the 164 claims which comprise the Minto Mine.

The Minto Mine site is accessible from Whitehorse, Yukon Territory, by the Klondike Highway (YG Highway No. 2) to Minto Landing. Passage across the Yukon River can be made by barge in the summer or by ice-bridge in the winter. A gravel road provides access from the west side of the Yukon River to the Minto Mine site. The highway, river crossing and gravel access road are suitable for heavy transport traffic. Storage capacity for consumables at the Minto Mine site is sufficient for 10 weeks which, historically, is sufficient for the impassable freeze-up period and thaw period of the Yukon River. When possible, operations personnel are transported to the Minto Mine by bus or light vehicle from Whitehorse and Pelly Crossing and by air when ground transport is not feasible due to river conditions.

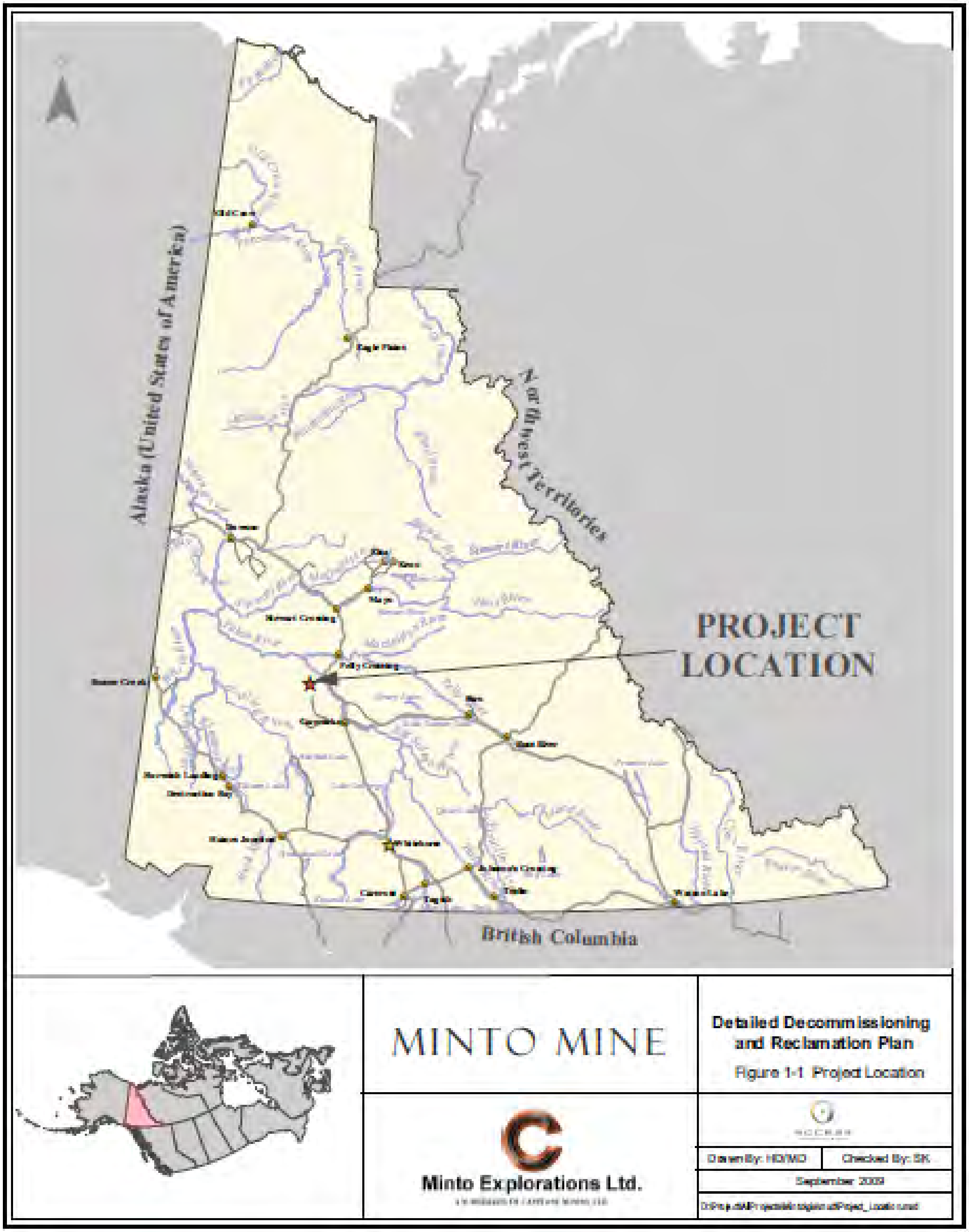

Figure 1-1 Minto Mine – General Location in Yukon

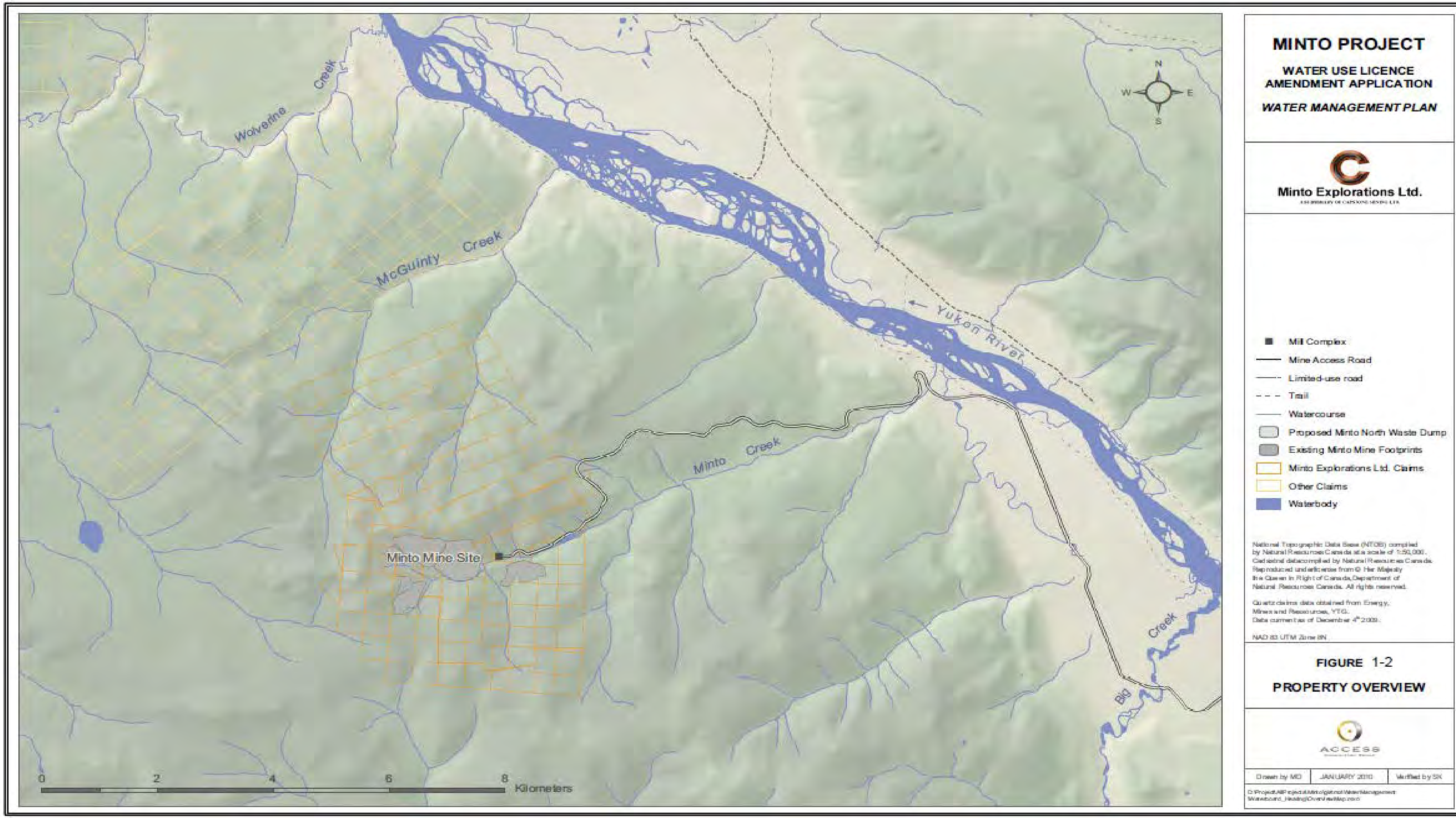

Figure 1-2 Minto Mine Area Overview

1.2 LICENSING

1.2.1 Type A Water Use Licence QZ96-006

Minto Mine holds Type A Water Use Licence QZ96-006 ("WUL QZ96-006") originally issued in April 1998 and valid until its expiry date of June 30, 2016.

Minto Mine submitted a Type A Water Use Licence application (QZ96-006), following which the Yukon Water Board (the "Board") convened a public hearing into the application in May 1997. After deliberations by the Board, the Type A Water Use Licence was subsequently issued in April 1998 pursuant to the Yukon Waters Act and Regulations for the mine and milling operations. The Type A Licence was supported by the Selkirk First Nation (SFN) and contained typical licence terms and conditions to ensure that mitigation measures identified during the environmental assessment were implemented. The original expiry date for the Water Use Licence QZ96-006 was June 30, 2006 (since amended to June 30, 2016).

Water Use Licence QZ96-006 was amended (Amendment #1) to revise the decommissioning requirements for the project, and to request the submission of an interim plan as the project was not yet constructed. The project is still subject to Water Use Licence QZ96-006.

Generally, the Type A Water Use Licence is considered more restrictive that the Federal Metal Mining Effluent Regulations (MMER) under the Fisheries Act, which apply to the Minto Mine, however, separate reporting for effluent discharge and receiving water monitoring is required by the Federal Department of Environment Canada.

As the Type A Water Use Licence (QZ96-006), Type B Water Use Licence (MS95-013), and Yukon Quartz Mining Licence (QLM-9902) were set to expire in June 2006, and in recognition of the project development delays, licence amendment applications to extend the licences to June 30, 2016 were filed with the Board and Yukon Government (YG), Department of Energy, Mines & Resources (EMR) in October 2004.

In response to the amendment applications, YG Development Assessment Branch completed a Yukon Environmental Assessment Act (YEAA) screening of the Type A Water Use Licence using the previous EARPGO screening and issued their screening report in March 2005.

YG Development Assessment Branch completed a YEAA screening of the Type A Water Use Licence and Yukon Quartz Mining Licence using the previous EARPGO screening and issued their screening report in March 2005. The Board issued the an amendment to the Type A Water Use Licence in September 2005 (Amendment #2) and YG EMR issued amendments to the Yukon Quartz Mining Licence QLM-0001, Amendment No. 05-001 in December 2005 and Amendment No. 05-002 to change the mill rate to 2,500 today in October 2006.

The Type A Water Use Licence was further amended on April 6, 2006 (Amendment #3) to address an apparent inconsistency in the original licence regarding the milling of sulphide ore.

In response to exceptional precipitation received in the site area in late August 2008 and an imminent release of water from the Water Storage Pond that did not meet licensed effluent quality standards, Minto Mine applied on August 25 to the Board for an amendment to the Water Use License QZ96-006 under section 21 (4), c.19 of the Yukon Waters Act. The application to release 350,000 m^3 of water from the WSP using the Metal Mining Effluent Regulations (MMER) effluent discharge criteria was approved and Amendment #4 to the WUL was issued on August 26, 2008.

The melting of significant snowpack accumulations in the winter of 2008-09 required the retention of freshet runoff in the open Pit and prompted concern about stability of the south Pit wall should additional summer precipitation events need to be directed there as well. As a result, Minto Mine applied twice again for amendments to the Water Use Licence under the same provision of the Yukon Waters Act in June and in August of 2009, to allow the release of water that would provide additional capacity for such an event. The Yukon Water Board approved Amendment #5 on June 26, 2009, and Amendment #6 on August 11, 2009, each on an emergency basis, which authorized the release of 300,000 m^3 and 705,000 m^3 respectively of water from the site, subject to adjusted effluent quality standards and additional monitoring requirements. Following a review of application QZ09-094 regarding water management at the site, Amendment #7 was issued on March 31, 2011. Following a review of application QZ11-031 regarding tailings management, mining and milling of Area 2 pit, Amendment #8 was issued on October 18, 2012.

1.2.2 Quartz Mining Licence QML-0001

Minto Mine holds Quartz Mining Licence QML-0001 which is valid until its expiry date of June 30, 2016.

In 1999, the Yukon Quartz Mining Act (YQMA) was amended and Section 139 of that Act required that all development and production activities related to quartz mining in the Yukon be carried out in accordance with a licence issued by the Minister. In June 1999, Minto Mine filed an application with DIAND Minerals for a Yukon Quartz Mining Production Licence, which included a cumulative effects assessment (Access Consulting Group, 1999) for the project to ensure that the provisions of CEAA were met. DIAND issued Yukon Quartz Mining Production Licence QLM-9902 in October 1999 with a licence expiry date of June 30, 2006 (since amended to June 30, 2016).

With Yukon Quartz Mining Licence (QLM-9902) set to expire in June 2006, a licence amendment application to extend the licence to June 30, 2016 was filed with the Yukon Government (YG), Department of Energy, Mines & Resources (EMR) in October 2004. YG EMR issued amendments to the Yukon Quartz Mining Licence QLM-0001, Amendment No. 05-001 in December 2005 and Amendment No. 05-002 to change the mill rate to 2,500 today in October 2006. Subsequently, Quartz Mining Licence QML-0001 was amended to increase the milling rate (and associated mining rate) to 3,200 tpd on July 24, 2008 and again on April 8, 2010 to increase the milling rate to 3,600 tpd. Following the review of the Phase IV Expansion proposal by Minto Mine to YESAB in 2010, an amendment to the QML was issued on May 19, 2011 reflecting new mining areas on the site including Area 2 and 118 by open pit and underground methods.

2.0 ADAPTIVE MONITORING AND MANAGEMENT PLAN

2.1 INTRODUCTION

The Water Management Plan submitted by Minto Mine allows the mine to manage water in such a way that allows for successful operation of the Minto Mine and protection of the receiving environment. The Adaptive Monitoring and Management Plan (AMMP) represents a starting point from which Minto Mine intends to improve its understanding and management of water at Minto Mine.

The AMMP is an important component of the Water Management Plan (WMP). The WMP was developed based on predicted water quality and quantity at the site and the AMMP must measure actual water quality and quantity and test the assumptions that underlie the WMP. This approach is necessary due to the inherent uncertainty involved in predicting conditions that affect water quality at the mine including weather, runoff and water levels in the region in any particular year and interactions between water and the ground surface. The WMP and supporting documents represented a significant effort to better understand and predict the scale and frequency of events as well as their expected impact on operations at Minto Mine. These efforts toward increased understanding will continue and the purpose of this program is to describe how Minto Mine will:

- monitor the environment;
- detect changing conditions; and
- react to them appropriately.

The AMMP also provides a framework for re-evaluating key elements of the WMP in a systematic and adaptive way. The adaptive approach will help evaluate and adjust activities in the WMP including:

- when monitoring frequency will increase;
- where monitoring will take place;
- when the mine will discharge water downstream ; and
- when the mine will stop discharging downstream.

The AMMP includes a process for changing the WMP in a systematic and adaptive way. It includes a reporting schedule and mechanisms for incorporating stakeholder input to ensure the principles on which the WMP is approved are being applied as an increased understanding of the mine’s effect on the environment is gained.

2.1.1 Background

This AMMP describes how monitoring at the site will be implemented and changed going forward to reflect the management strategies of the WMP. The basis for the AMMP is the existing Water Quality

Surveillance Program in the current Water Use Licence (WUL QZ96-006, Appendix 3, Part 2). Revisions to this program proposed in this AMMP were based on the following:

- concepts put forward in the WMP;
- stakeholder comments received during the YESAB review process of the Water Management Plan proposal;
- recommendations in the resulting Decision Document; and
- strategies for continuous improvement of water management techniques at Minto Mine.

Minto Mine has been actively improving water management strategies since the mine began construction and operation. These improvements have included retention and diversion structures and treatment initiatives, as well as surface water quality investigations, including a Site Specific Water Quality Objective (SSWQO) study. The data obtained to date during mining provides a much-improved understanding of water quality in the affected watershed. A predictive model has been developed using this water quality data and the water balance from the site (described previously). The assumptions of the WMP must be tested and the accompanying water quality model must be calibrated regularly. In doing so, Minto Mine will determine the success of the WMP by continuously asking these two key questions:

- Does the WMP protect the receiving environment; and
- Does the WMP allow the mine to operate successfully;

An improved monitoring program is described below. The monitoring program will be further improved as operational knowledge increases and with continued sharing of stakeholder views. A technical working group was established in May 2011 to facilitate the sharing of information and reporting structures have been established in WUL QZ96-006 Amendment #7 to allow for inclusion of new information. The reporting requirements also provide a framework to revisit and confirm the assumptions that underlie the monitoring program.

2.1.2 Objectives and Guiding Fundamentals

The objectives of the AMMP are as follows:

- to ensure that any water discharged from the site is compliant with both end-of-pipe and receiving environment effluent quality standards as defined in in WUL QZ96-006 Amendment #8;
- to monitor and respond adaptively to water quality conditions in the receiving environment;
- to put forward a reasonable management response to field observations including readily implemented contingency strategies;
- to put forward a management response that is as simple as possible and easily enforceable; and
- to incorporate flexibility into the plan, allowing for integration of new information as it becomes available.

The adaptive management approach for monitoring water quality parameters necessarily includes assessment and reassessment of water management decisions and their effectiveness to achieve the program's objective of meeting the receiving environment effluent standards. Monitoring program results will be continually assessed for trends in water quality and quantity, both short term and long term, to anticipate and mitigate negative impacts to the receiving environment and to guide water management responses in the field.

The main components of this revised AMMP are:

- revisions to the current monitoring program;
- use of screening instrumentation at Minto Mine to make decisions on discharging to the receiving environment, and confirmation by accredited external laboratory analysis;
- more in-depth assessment of monitoring and performance data (increased frequency and trend analysis);
- increased detail and frequency of reporting related to monitoring results and actions.
- regular calibration of the water balance and water quality models;

- continuous revisiting of WMP assumptions, monthly reporting related to AMMP commitments, and an annual review (and accompanying report) on any proposed changes with rationale based on the monitoring program results.

2.1.3 Changes to the AMMP in 2013

In addition to the principles described above, the AMMP has been modified to meet Part F – Effluent Quality and Standards and Appendix 3 as described in WUL QZ96-006 Amendment #8 issued on October 18, 2011. Since some components of the proposed AMMP were geared towards enforceable actions in the receiving environment (as opposed to effluent *standards* in the receiving environment), many of the decision making tools described have been simplified. Minto Mine will modify its approach to water management to meet the intent of the Water Quality Surveillance Program.

Minto Mine will still use the information gained through the process of the development of the WMP (water quality and quantity models) in addition to expertise gained at site through several prior discharge periods, to determine whether or not discharge from the site is appropriate. This information will allow for calibration of the models in the WMP.

As required, this revised AMMP includes the following modifications as per Clause 93 of WUL QZ96-006 Amendment #8:

- See Appendix A for 2012 discharge rational document.
- Updates to on-site lab capabilities.

2.2 AMMP FRAMEWORK AND DEFINITIONS

The AMMP is both a monitoring plan and a management plan that charts actions and changes that may be required to the Water Management Plan over the course of the mine life. Minto Mine proposes to report on adaptive measures taken at the site in monthly water quality reports submitted to the Yukon Water Board. A template for concise and clear documentation of actions and observations is provided in Appendix H1.

Figure 2-1 below outlines an annual cycle for review of the AMMP and related components of the WMP as well as interim reporting. Reporting and review time-frames are discussed in more detail below.

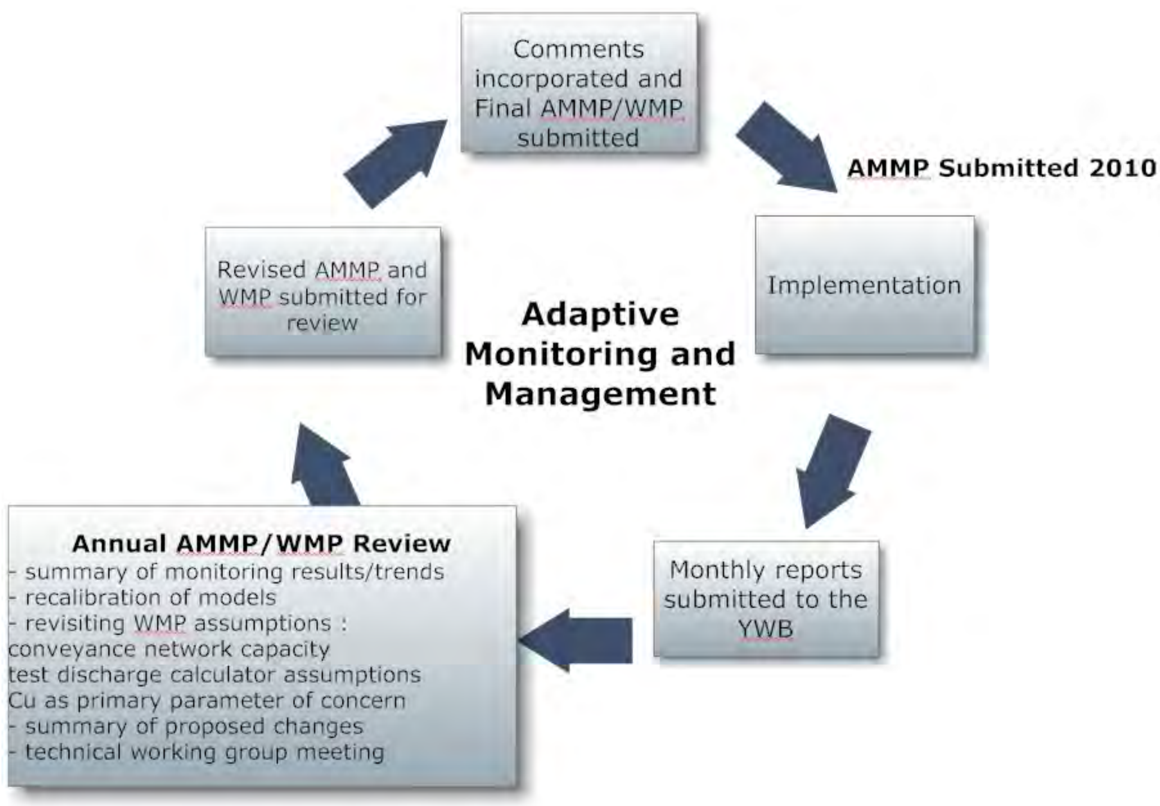

Figure 2-1 - Proposed Annual Cycle for Review of the WMP and AMMP

2.3 DEFINITIONS AND ADAPTIVE MANAGEMENT TERMINOLOGY

In developing the AMMP, clearly defining the terminology used will be important in order to allow for a consistent approach in applying adaptive responses. An understanding the adaptive management plan is essential both within Minto Mine and amongst stakeholders.

Event – this term will be used to describe an event for which there is an adaptive response outlined in the AMMP.

Possible Environmental Effect - the assignment of a possible environmental effect to an event helps characterize it in order to develop an appropriate response.

Narrative Trigger – a narrative description of the trigger that initiates an adaptive response. The input information is from the monitoring program and the narrative trigger will describe a quality or testing result recognized as triggering a response.

The first step will be verification of the results. An analysis will be made of the information and a reasonableness-check will be put in place to ensure the results are truly reflective of the current scenario or perhaps a one-off or unlikely result. This may involve re-sampling for verification purposes.

Monitoring staff will provide an analysis so that the cause of the trigger or events leading up to the trigger activation. This will formulate part of the reporting.

Monitoring requirements – monitoring parameters, locations and frequencies for sampling or investigating. Monitoring requirements may change at various stages of the AMMP.

On-site lab testing - this refers to analytical sampling that Minto Mine is equipped to perform at the mine and will include total copper (Cu-T) measurable to detectable limits aligned with Canadian Council of Ministers of the Environment (CCME) supported Canadian Water Quality Guidelines (CWQG) for the protection of aquatic life and measurement of total suspended solids (TSS) to levels of 1 mg/l.

External lab testing – this refers to third-party accredited analytical laboratory testing for the full suite of required parameters to appropriate detection limits.

The AMMP will describe a steady-state monitoring program which has been designed to detect changing conditions so that appropriate responses will be activated.

2.4 MONITORING PROGRAM

During the mine life, the scenario of discharging water will be termed an “event” (discussion below) and so monitoring water quality at the mine will typically characterize non-discharging periods. Appendix 1 of WUL QZ96-006 Amendment #8 provides details of the monitoring program and a diagram which shows the location of monitoring stations. As Minto Mine expands the project as proposed in the Phase IV expansion (YESAB Project # 2010-0198), stations may be moved or replaced. Updated monitoring station figures will be included in monthly and annual reports as modifications are required.

The aims of the monitoring program are to:

- Build on the already-existing water quality database;
- Continue to develop an understanding of water quality as it moves across the site;

- To closely monitor downstream conditions in order to support the decision making process of whether or not water should be discharged from the mine; and

- Identify water on-site meeting the proposed effluent quality standards.

2.5 MONITORING LOCATIONS

Monitoring stations are listed in Appendix 1 of QZ96-006, many of which are included in the diagram below.

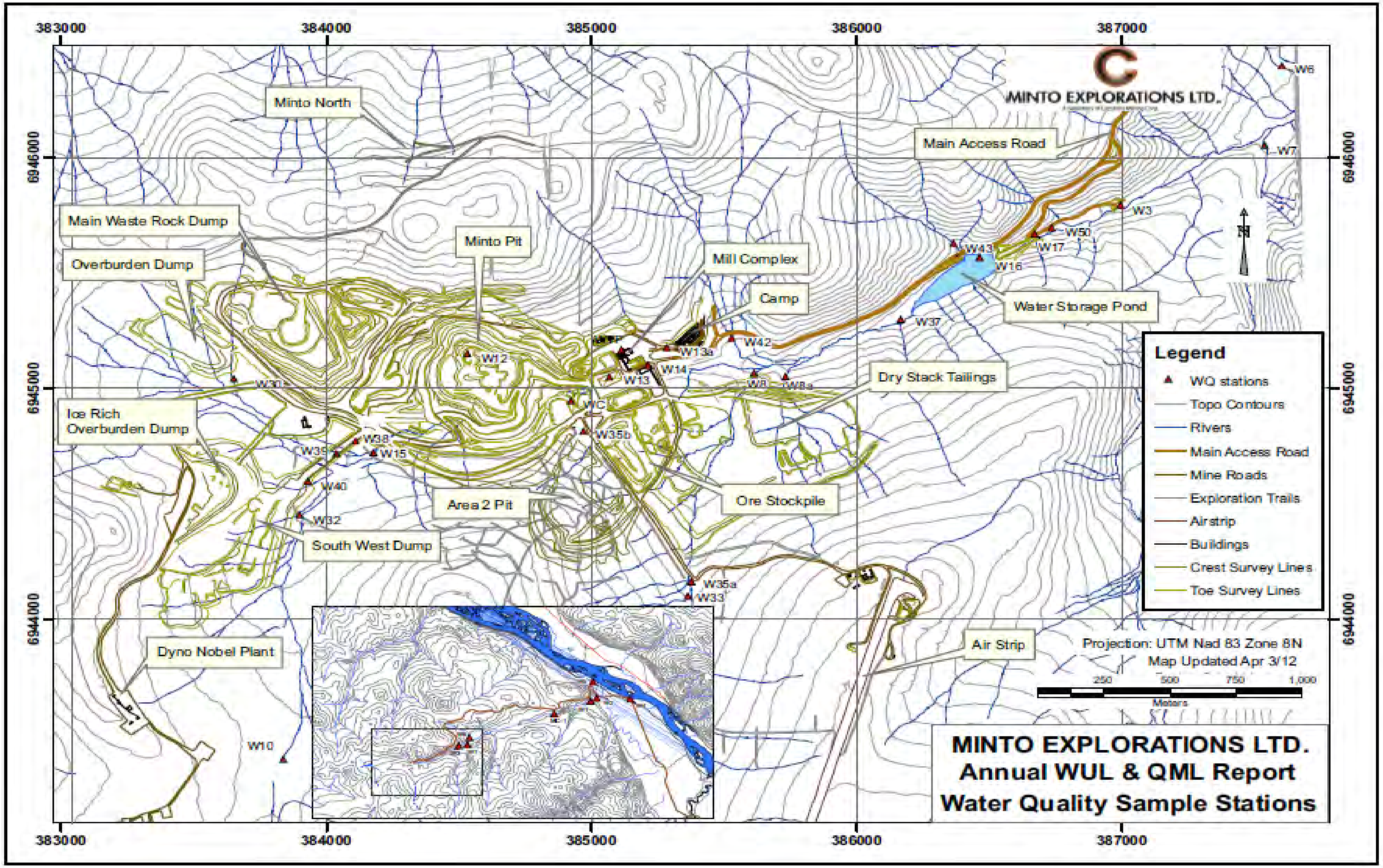

Figure 2-2 Monitoring Network Locations

2.6 MONITORING PARAMETERS

Typical parameters will be measured both in the field and at the external lab including:

- physical measurements (pH, electrical conductivity and temperature) measured in-situ;
- dissolved oxygen will be measured during AMMP events (i.e. when monitoring frequency is Level 2) using a YSI multi-meter;
- Routine parameters (TSS, alkalinity, hardness, etc.);
- Total metals;
- Dissolved metals;
- Nutrients (ammonia, nitrate, nitrite, phosphorus, etc.)
- Dissolved Organic Carbon (DOC)

2.7 MONITORING FREQUENCY

The number of samples and frequency of sampling will be conducted in accordance with Appendix 3, Part 2 of WUL QZ96-006 Amendment #8. The level of monitoring conducted when no discharge is occurring and the site is experiencing normal or expected climatic conditions will be termed Level 1 monitoring. When an AMMP Event is underway, monitoring frequency will increase to Level 2, meaning daily testing. This will be triggered when compliant water is identified on site, i.e. when water meeting the WUL effluent quality standards as per WUL QZ96-006 Amendment #8 is identified. Level 2 monitoring frequency will apply to the source waters, i.e. the collection point from which water may be discharged (W16, W12, W17, W35A, W15, WTP) and all stations downstream of that point.

2.8 ADAPTIVE RESPONSES TO DISCHARGE EVENTS

The approach to discharging water from Minto Mine will involve measuring water quality on site, deciding whether or not discharge is appropriate and continually evaluating that decision if discharge is occurring.

One of the main factors Minto Mine wished to address in proposing an adaptive monitoring and management plan was the issue of measuring water quality at site. Minto Mine will use on-site equipment to measure the parameters listed below. The onsite lab verification report was submitted as part of Minto Mine's QA/QC plan on October 31, 2012. The existence of an on-site environmental laboratory improves response-time to changing conditions and addresses the issue of a minimum delay of four days in receiving external laboratory results. The minimum detection limits for the onsite lab were submitted in the QA/QC plan.

Table 2-1 Parameters to be measured at on-site environmental laboratory, Minto Mine

Onsite Lab Parameters	**Proposed detection limit**
Total Aluminum (Al-T)	0.01 mg/L
Total Cadmium (Cd-T)	0.00006 mg/L
Total Copper (Cu-T)	0.001 mg/L
Total Selenium (Se-T)	0.0005 mg/L
TSS	<1
Nitrite	0.008 mg/L
Nitrate	0.3 mg/L
Ammonia	0.055 mg/L

2.8.1 Identification of Compliant Water: Discharge Decision Making: Can we discharge?

When water meeting the WUL QZ96-006 Amendment #8 effluent quality standards for the end-of-pipe is identified on site through Level 1 monitoring, this will trigger increased monitoring frequency for the purpose of supporting the decision making process, i.e. the decision as to whether or not water can be discharged from Minto Mine to the receiving environment. Minto Mine staff will use the on-site laboratory to determine baseline conditions throughout the property and in the receiving environment.

The sequence of events leading up to the decision to discharge water must be clearly articulated. The AMMP framework will be used to guide the decision making process as follows:

Event – Compliant water identified for discharge from the site to the receiving environment. This determination will be made using results collected throughout the site as part of the Water Quality Surveillance Program, Appendix 3, Part 2 (WUL QZ96-006 Amendment #8). These results will be issued by an external laboratory and once agreement between the external and on-site laboratories is established, the decision may be based on conditions indicated by the on-site results. Then, a decision must be made whether or not discharge should occur based on the principles of the AMMP and the ability of the discharged waters and water already flowing in Lower Minto Creek to meet the effluent standards at W2. A key feature of an 'event' will be documentation of the existing conditions and rationale for decisions related to discharging water from the mine.

Possible Environmental Effects – Discharging water from Minto Mine that does not meet the effluent standards could have negative impacts on the receiving environment. Actions taken (discharging) must align with the objective of meeting the effluent standards and protecting the receiving environment. Potential consequences of discharging water that does not meet the effluent standards to the receiving environment include:

- Avoidance of degraded area by fish – loss of habitat;
- Toxicity to early life stages of fish; and
- Acute toxicity to adult and juvenile fish;

Narrative Trigger – On-site laboratory results for all parameters tested indicate water on site at one of the water conveyance network collection areas meets the proposed effluent quality standards for the end-of-pipe ("compliant" water):

- W15 sump
- W35 SDD
- Water Treatment Plant waters
- WSP waters (W16)

The results will be verified through duplicate samples, external laboratory analysis and increased frequency sampling. If required, the decision to discharge will be based on on-site results.

The circumstances of the trigger activation will be documented and reported.

Monitoring requirements – When there is a desire to discharge water, monitoring frequency will increase to Level 2 at these locations:

- Source waters (one of the above locations)
- W3
- MC1
- W2

Minto Mine still intends to make decisions regarding discharge based on water quality results measured on site and notify appropriate agencies of the intent to discharge 24 hours in advance. As indicated above, Minto Mine will establish a reasonable agreement between the on-site and external laboratories in advance and adhere to a QA/QC program as required under WUL QZ96-006 Amendment #8 clause 27 and 28.

Since 2006 Minto Mine has observed that, at certain times of the year (typically mid to late summer), discharges in Minto Creek at station MC1 (top of canyon) are greater than those just downstream (bottom of canyon) at stations W1 and W2. This suggests that Lower Minto Creek on the floodplain of the Yukon River is an area of substantial groundwater recharge or subsurface water flow. Figure 2-3 depicts this phenomenon where stream flows can be significant at MC1 but much lower (or even zero) at W2.

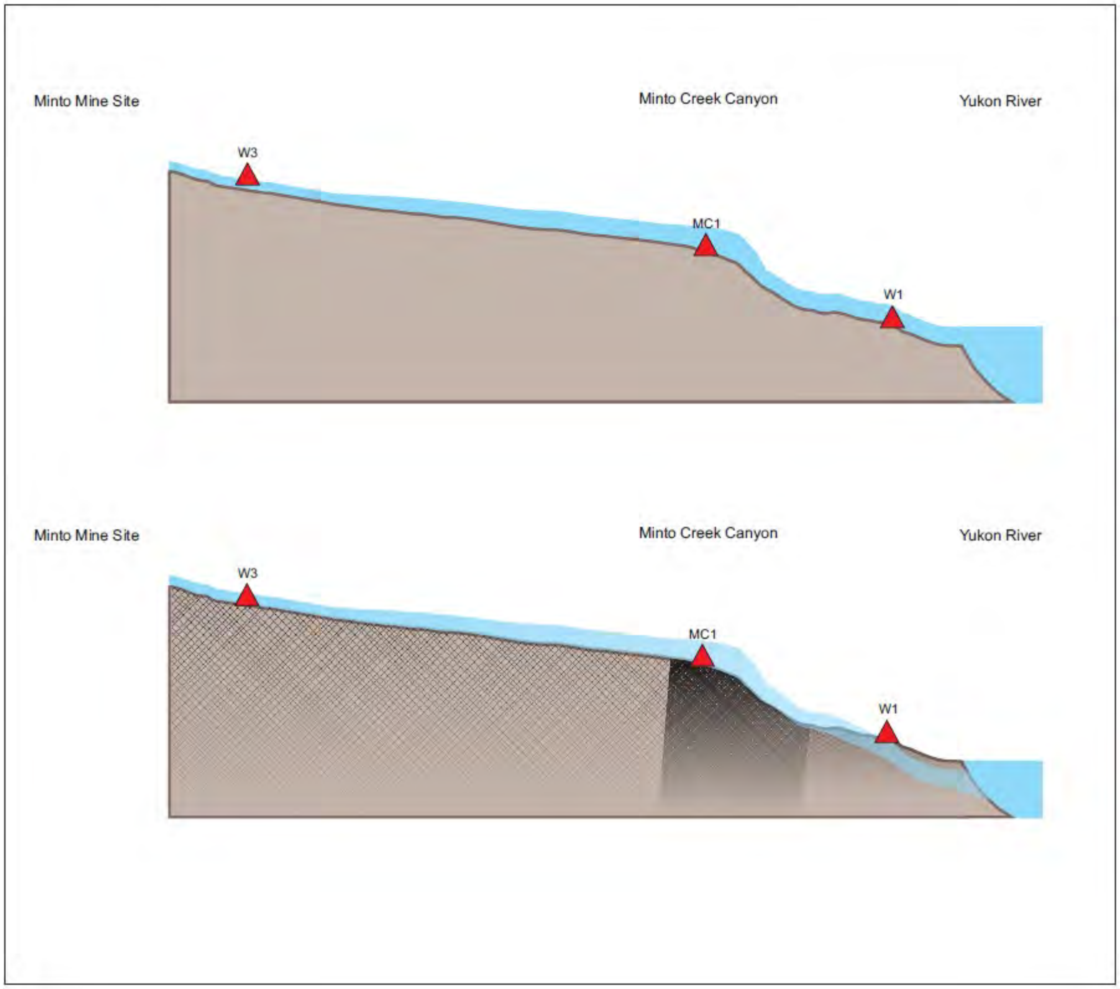

Figure 2-3 Surface and groundwater flow between MC1 and W2

For these reasons, Minto Mine, in implementing the AMMP, will review flow logs at MC1 at this juncture in the decision making process regarding discharge. Where this is impractical one of the other locations will be used and rationale provided in associated reporting.

2.8.2 Monitoring During Discharge Events: Decision Making, Can We Continue Discharging?

Event – Minto Mine is discharging compliant water downstream based on the laboratory analysis on site and observed climatic conditions.

Possible Environmental Effects – Discharging water from Minto Mine that does not meet the effluent standards could have negative impacts on the receiving environment. Actions taken (discharging) must align with the objective of meeting the effluent standards and protecting the receiving environment. Potential consequences of discharging water that does not meet the effluent standards to the receiving environment include:

- Avoidance of degraded area by fish – loss of habitat;
- Toxicity to early life stages of fish; and
- Acute toxicity to adult and juvenile fish;

Narrative Trigger – Monitoring of surface waters in Minto Creek downstream of the mine site indicates that:

- downstream water quality is starting to degrade or change from the compliant conditions that lead to the positive decision to discharge

Monitoring requirements – The monitoring stations that will be important at this stage are the downstream locations where water quantity and quality will be measured:

- W3: measure discharge volumes continuously and measure water quality daily
- MC1/W1/W2 : measure discharge volumes downstream daily
- W2: measure water quality daily

In effect, the effluent standards will guide all discharge decisions. Minto Mine will use information collected during the formation of the Water Management Plan including the water quality and quantity models and the known relationship between TSS and several metal parameters included in the site effluent standards (WUL QZ96-006 Amendment #8) to guide discharge decisions. Minto Mine will use the information gained during an investigation of the relationships between TSS and metal concentrations, combined with best management practices to prevent non-protective conditions from occurring with respect to non-conservative parameters (nutrients, temperature). Proactive thresholds will be used to identify scenarios, such as increasing TSS levels that could lead to a discharge scenario where the Potential Effects could occur. It should be noted that the receiving environment compliance point is approximately 8 km from the last point of control at the mine and precipitation events in the area have also yielded increased TSS amounts based on observed conditions in the field to date. During previous discharge events, Minto Mine has ensured water quality leaving the site met effluent standards, while water quality downstream at the same time did not meet the effluent standards with respect to TSS. As indicated, Minto Mine will manage the site in accordance with the effluent standards in WUL QZ96-006 Amendment #8 and use the information gained during previous discharge periods to inform decisions. Using the lessons learned to date at the site, in conjunction with an on-site environmental laboratory and modelling tools developed as part of the WMP review process, the company is well positioned to undertake successful discharge periods going forward.

2.8.3 Using External Laboratory Results in the Decision Making Process

Minto Mine is confident that the approach described wherein several key parameters are measured on site combined with the information gathered during the development of the site water quality and quantity models to guide discharge decisions is sound. At the same time, the receipt of external laboratory analyses will take precedence over the on-site analysis.

Event – Minto Mine is discharging compliant water downstream in accordance with the decision process described above. External laboratory results are received and must be interpreted in order to determine if continued discharge is appropriate.

Possible Environmental Effects – Discharging water from Minto Mine that does not meet the effluent standards could have negative impacts on the receiving environment. Actions taken (discharging) must align with the objective of meeting the effluent standards and protecting the receiving environment. Potential consequences of discharging water that does not meet the effluent standards to the receiving environment include:

- Avoidance of degraded area by fish – loss of habitat;
- Toxicity to early life stages of fish; and

- Acute toxicity to adult and juvenile fish;

Narrative Trigger – The external laboratory results are received and one of the effluent standards in QZ96-006 has been exceeded

Upon receipt of such results, discharge will stop immediately.

Monitoring requirements – When one of the parameters of concern is exceeded and the receiving environment water is re-sampled, the sample analysis will be requested on a "rush" basis, i.e. the results will be obtained as quickly as possible.

2.9 CONTINGENCY PLANNING

In Table 2-2 Contingency Measures Summary: Adaptive Monitoring and Management Plan below, Minto Mine has addressed some of the possible scenarios considered but not directly planned for in the decision making process described above.

Event	Monitored Item	Trigger/Threshold	Action
WATER QUANTITY			
MintoEx, in a given year, implementing proposed Water Management Plan, but in doing so is still not able to remove enough water downstream for operational flexibility due to excessive runoff	Water volumes on site heading toward freeze-up	Water is stored in pit on Nov 1 as a result of storage from the summer months	MintoEx will evaluate the need to increase treatment capacity to meet the Water Management Plan objectives.
WATER QUALITY			
MintoEx , in a given year, monitors water quality as proposed and identifies a primary parameter of concern other than copper.	Log the parameter of concern in the discharge decision making process.	More than three consecutive 'stop-discharge' decisions based on a parameter other than copper will cause an investigation	Evaluate options for optimizing treatment plant or alternative treatment technologies for primary parameter of concern.
EQUIPMENT ISSUES			
Instrumentation required for routine monitoring and/or discharge decision making malfunction.	Flow rate, water quality	Irregular reading, No readings	*Hand-held instrumentation* Purchase redundant equipment, have in stock prior to freshet. *Atomic Absorption Spectrophotometer* • Engage supplier for regular maintenance on atomic absorption. • In the case of malfunctioning, water quality samples will be sent off site for analysis on a "rush" basis.
ANALYTICAL DELAYS			
External laboratory results needed for discharge decision and unexpected delays are experienced	Water quality	Any unforeseen delay in receiving eternal laboratory results	If another laboratory can provide analyses faster, re-sample and send elsewhere. If this scenario is encountered more than twice per year, then investigate other laboratories.

Table 2-2 Contingency Measures Summary: Adaptive Monitoring and Management Plan

2.10 OTHER MONITORING PROGRAMS

In addition to the water quality management and monitoring program described above, Minto Mine is in the process of changing related monitoring activities including the implementation of a comprehensive Annual Biological Monitoring Program that has been designed based on the findings to date from the EEM test work, Benthic and Sediment Monitoring Programs (implemented under the original WUL). The nature of the test work for these programs lead to the decision to combine them.

A summary of the programs described in the original WUL and proposed changes is presented below.

2.10.1 Annual Biological Monitoring

The Annual Biological Monitoring Program serves to better understand the potential impacts of discharge from the mine site on the receiving environment in Lower Minto Creek. The program involves studies on algae (periphyton), benthic invertebrates and the fish community. In order to better understand the relationship between water quality and potential impacts on aquatic biota a more intensive stream sediment study has been undertaken. Aquatic biota sampling occurs in both upper and lower Minto creek.

2.10.2 Fisheries Program

Minto Mine has conducted fish studies in Minto Creek on an annual basis in order to characterise fish usage of the system (timing, duration and extent) by juvenile Chinook salmon and other species and to monitor possible use of lower Minto Creek by adult Chinook during their spawning period. Minto Mine also supported the continuation of an effects level study to determine what concentration of copper in Minto creek water may affect olfaction in juvenile Chinook salmon.

The first year of the program included a study to determine how long individual fish stay in the system. This was determined through a mark/recapture program (using Visible Implant Elastomer (VIE) tags) involving sampling and marking fish every 7-10 days from mid-June to early September, 2010. This also served to quantify use of the fish in the system during the current year. Year to year sampling will involve sampling throughout the open water season (i.e. June-Sept) to characterise year to year usage of the system.

2.10.3 Periphyton Program

Periphyton is a type of algae that attaches itself to stream substrate and is directly affected by physical and chemical changes that occur in a stream over time. Periphyton sampling is a requirement under the current WUL. Sampling for periphyton is conducted annually assessing relative abundance and community composition.

Sampling is relatively easy and is conducted at the same stations where benthic invertebrates will be collected. Samples are collected from suitable substrate from a variety of habitat (i.e. pools, riffles) through scraping or brushing. Samples from each respective station are combined to form one representative composite sample. Once collected samples will be placed in jars and stored in a dark cool location prior to shipping to a plant (algae) taxonomist for identification. As with the benthic program sampling will be conducted in late summer/early fall. Year to year comparisons are made with respect to community composition, reviewing between year differences and diversity as well as a review of tolerant and/or sensitive taxonomic groups.

2.10.4 Seepage Monitoring Program

The Seepage Monitoring Program has been developed based on observations by the engineer of record for the seepage infrastructure as construction began in 2010. Foundation soils were tested and a ground temperature cable (monitoring equipment) was installed. Some of the thresholds for adaptive responses will require further information, such as the foundation soil testing results and initial ground temperature cable readings. Using this information, baseline conditions will be established and considered along with engineering principles to determine reasonable thresholds for adaptive responses and actions. Note that more detail regarding monitoring of the Minto Mine seepage was submitted to the Yukon Water Board on January 15, 2013 as required under WUL QZ96-006 Amendment #8..

2.10.5 Physical Monitoring

Regular physical monitoring should be carried out daily during freshet, during and after significant rainfall events and monthly during the other times. Note that more detail regarding monitoring of the Minto Creek Detention Structure was submitted to the Yukon Water Board on January 15, 2013 as required under WUL QZ96-006 Amendment #8.

2.11 WMP AND AMMP REVIEW MECHANISMS

Minto Mine recognizes that the Water Management Plan, including the AMMP must be revisited regularly for the following reasons:

- to ensure objectives of the WMP are being met;
- to update reviewers on successes/challenges encountered in the implementation of the WMP;
- to confirm that water management plan assumptions are being verified;
- to incorporate any changes to CCME Guidelines; and
- to confirm our commitment to/strategy for protecting the receiving environment.

A key element of revisiting the WMP assumptions will be verification of the effluent quality standards as protective of the receiving environment. Conversely, if water quality model re-calibration from routine monitoring demonstrates that the proposed effluent quality standards are overly protective and overly restrictive of operational flexibility, they should be revisited and potentially increased. Minto Mine proposes to present its findings and rationale for such changes, if required, in an annual review of the WMP.

2.12 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Currently the QA/QC measures in place related to the Water Quality Surveillance Program include the items below. A QA/QC program was formalized and submitted to the Yukon Water Board on October 31st 2012 as per WUL QZ96-006 Amendment #8 clause 27 and 28:

2.13 REPORTING

In addition to the mandatory reporting required under the Metal Mining Effluent Regulations, the monthly report provided to the Yukon Water Board detailing water quality and flow data will include updates on the implementation of the AMMP and results from the expanded program in accordance with the sample frequency described in Appendix 3, Part 2, WUL QZ96-006 Amendment #8.

A template will serve as a “check-list”’ on adaptive actions taken, to be completed and submitted with each report with the aim of highlighting actions related to the AMMP for ease of review. In addition to the water quality data, the following will be identified and presented:

- Noticeable trends in changes to water quantity and quality
- Description and detail of any thresholds exceeded and the resulting response ; and
- Any proposed changes to water treatment strategy.

Any exceedence of the WUL discharge criteria will be reported by telephone or email within 24 hours to the inspectors (EMR – Client Services and Inspections and SFN Lands and Resources Department). Details of any exceedence, corrective action/mitigation undertaken and inspectors’ direction will be included in the monthly report.

In addition to the monthly reports, an Annual State of the Environment report will be submitted on March 31 of each year on the previous calendar years activities. It will summarize water management at Minto Mine and present information related to these items of concern using plain language and adhering to a narrative-style report to the extent possible:

- Storage of water at site during the calendar year (volumes, place of storage, duration of storage);
- Quantity and quality of water released from the site;
- Effectiveness of water treatment;
- Quantity and quality of water in Upper Minto Creek;
- Quantity and quality of water in Lower Minto Creek;
- Results of a sediment monitoring program;

- Results of an annual biological monitoring program including an overview of the Environmental Effects Monitoring program which is undertaken as part of Minto Mine's obligations under MMER ; and

- An overview of the effectiveness of the site water balance model in predicting site conditions after recalibration.

3.0 REFERENCES

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Appendix A: Minto Mine 2012 Discharge Rationale Document

SRK Consulting (Canada) Inc.
Suite 2200 - 1066 West Hastings Street
Vancouver, BC V6E 3X2

T: +1.604.681.4196
F: +1.604.687.5532

vancouver@srk.com
www.srk.com

Memo

To:	James Spencer, Jennie Gjertsen, Ryan Herbert	**Date:**	4 April 2012
Company:	Minto Explorations Ltd.	**From:**	Soren Jensen
Copy to:	Dylan MacGregor, Colleen Roche	**Project #:**	1CM002.005.0900
Subject:	Rationale for Discharging WSP (W16) and Dam Seepage (W17) Water to Minto Creek-		

This document is intended to serve as a record for the rationale behind proceeding with discharge of water stored in Minto's Water Storage Pond (WSP) and Dam Seepage water in April 2012.

1 Discharge Requirements

Minto's Water Use License QZ96-006 Amendment 7 (WUL) and Adaptive Management and Monitoring Plan (AMMP) specify the criteria and requirements for commencing discharge from the mine to Minto Creek. Criteria for discharging from the WSP during the freshet period (1 April to 31 May) include:

- Water discharged from the WSP (station W16a), dam seepage water (W17) and water downstream of the dam (W50) must meet quality limits listed in Section 54 of the WUL.
- All effluent discharged from the WSP (as monitored at W16a) and dam seepage reporting to Minto Creek (as monitored at W50) must meet bioassay standards as specified in Section 56 of the WUL.
- Water discharged from the Mine must meet all requirements under the federal Metal Mining Effluent Regulations (MMER).

Some AMMP requirements that need to be met include:

- Prior to discharging, the following water quality stations will be subject to increased frequency of monitoring: W16, W17, W3, MC-1 and W2.
- Monitoring must adhere to the QA/QC plan developed for monitoring activity and analysis.
- Reasonable agreement between external laboratory analyses and onsite analyses must be established before on-site analyses can be used as a basis for making operational decisions.
- Submission of notification to the Yukon Water Board 24 hours in advance.

2 Rationale for Commencing Discharge

2.1 Water Quality

Table 1 shows a compilation of external water quality analysis results (from Maxxam Analytics) for station W16 for 2011 and 2012. The table shows that all WSP samples analyzed since September 2011 have been in compliance with freshet WUL limits listed in WUL Section 54, with the exception of two outliers: nitrate-N in November 2011 and total cadmium in March 2012. Data outliers are relatively common in water quality analysis and can arise from one or more of several factors (for example, trace contamination from field or laboratory practices, improper sample handling, labeling error, instrument error). In general, data points that fall well outside a general data trend may be considered outliers and as such not representative of true water quality[1].

[1] The March 2012 total cadmium results from W16 provide a case in point: nine samples were collected at 1 m intervals from the surface of the WSP to a depth of 8 m, and 8 of 9 total cadmium concentrations were lower than the WUL standard (0.00015 mg/L) by a factor ranging from 2.5 to 7.5 (0.00002 to 0.00006 mg/L). The one total cadmium concentration that exceeded the WUL standard was higher by a factor of 1.3 (total cadmium concentration of 0.00019 mg/L). The average total cadmium concentration of the 9 samples was 0.000044 mg/L (lower than the WUL standard by more than a factor of 3).

Prior to September 2011 the WSP water regularly exceeded the WUL limit for nitrate-N, however careful operation of the pump-back system at the Minto Creek detention structure has resulted in improved water quality in the WSP. Figure 1 and 2 show trends of nitrate-N and total cadmium at W16 for 2011 and 2012.

Based on the stable water quality trends observed in the WSP over the past six months (including the results of the March 2012 stratified monitoring) it is reasonable to consider water in the WSP fit for discharge.

Table 2 shows a compilation of external water quality analysis results for W17 for 2011 and 2012. All samples analyzed since May 2011 have been in compliance with freshet WUL limits listed in WUL Section 54, with the exception of a single TSS result from November 2011.

Based on the stable water quality trends observed for water collected at W17 it is reasonable to consider the water dam seepage water fit for discharge.

2.2 Bioassay Performance

As a condition of the WUL and MMER water discharged from the site must meet non-pH adjusted 96-hour 100% LT_{50} bioassay using rainbow trout and 48-hour 100% LT_{50} bioassay using daphnia magna. Samples for rainbow trout and daphnia magna bioassays was collected at W17 on April 3, 2012 and shipped to Maxxam Analytics in Burnaby, BC.

Because bioassay verification of the acute lethality criterion may not be available prior to initial discharge, Minto's historical bioassay record was examined to determine if past lethality test results could serve as indicators for current lethality. The record show that all rainbow trout and daphnia magma bioassays completed for samples collected at W3 between 2006 and 2011 passed the acute lethality test.

The concentrations of monitored parameters at W3 have historically been higher than the parameter concentrations at W16 and W17 in recent monitoring results. Therefore, it is reasonable to presume that the potential for water at W16 and W17 to be acutely lethal is negligible. To confirm that discharge meets the MMER bioassay criteria, water samples for bioassays will be collected monthly at relevant stations specified in the WUL upon commencement and for the duration of active discharge from the WSP.

2.3 MMER Effluent Criteria

MMER include effluent criteria for arsenic, copper, cyanide, lead, nickel, zinc, TSS and radium 226. The discharge limits defined in the WUL are lower than the MMER criteria for all listed parameters. MMER also references cyanide and radium-226, neither of which are a consideration for Minto.

2.4 Monitoring Frequency

In preparation for discharge from WSP to Minto Creek, daily samples were collected from W17 and W16 beginning March 31, 2012 in accordance with the AMMP.

2.5 QA/QC Plan

All environmental monitoring will adhere to Minto's QA/QC plan. The 2012 QA/QC plan is currently in development.

2.6 External and Onsite Laboratory Analyses

Efforts to verify onsite laboratory water quality analysis results against external analysis results are on-going. Establishing reliable agreement between onsite and external analysis methods for parameter concentrations as low as 0.001 mg/L for total selenium and 0.00004 mg/L for total cadmium is a challenging task that is likely to require a large number of samples and iterative procedural modifications. As stated in the AMMP, Minto will rely on external water quality analysis for compliance monitoring until the onsite laboratory verification process is complete.

3 Requirements Following Commencement of Discharge

Once discharge has commenced the following monitoring efforts will be initiated and maintained during the freshet season:

- Daily sampling and on-site analysis of water from the following stations: W16, W17, W50, MC-1, W3 and W2.
- Weekly sampling and external analysis of water from the following stations: W16a, W17 and W50.
- Additional sampling and external analysis of water from W16a, W17 and W50, as required.
- Daily monitoring of field parameters (pH, conductivity, temperature and conductivity) at W16 and W16a.
- Daily flow monitoring at W3; continuous flow monitoring when conditions allow.
- Daily flow monitoring at MC-1 when the station can be safely accessed; continuous flow monitoring when conditions allow.
- Monthly bioassays at W2, W3, W16a and W50.
- Monthly reporting of water management and monitoring activities to the Yukon Water Board.

Table 1 Water Quality at W16, 2011 and 2012

Station Code	Collection Date/Time	Nitrite-N	Nitrate-N	Ammonia-N	Al-T	Cd-T	Cr-T	Cu-T	Fe-T	Mo-T	Ni-T	Pb-T	Se-T	TSS	Zn-T	pH
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
WUL Standard Limit for W17 and W50		**0.15**	**7.65**	**0.89**	**2.7**	**0.00015**	**0.008**	**0.08**	**3.5**	**0.4**	**0.5**	**0.02**	**0.003**	**15**	**0.15**	**6.5 to 9**
W16	24-Mar-12	0.01	4.81	0.0025	0.012	**0.00002**	0.0005	0.0237	0.033	**0.006**	**0.001**	0.0001	0.0016	**1.3**	0.0025	8.22
W16-0m	24-Mar-12	0.009	**4.52**	0.006	0.046	**0.00002**	0.0005	0.0244	0.158	**0.006**	**0.001**	0.0001	0.0015		0.0025	8.35
W16-1m	24-Mar-12	0.008	**4.51**	0.0197	0.023	**0.00003**	0.0005	0.0337	0.067	**0.006**	**0.001**	0.0003	0.0017	**0.5**	0.0025	8.23
W16-2m	24-Mar-12	0.01	4.62	0.0087	0.011	**0.00002**	0.0005	0.0258	0.045	**0.006**	**0.001**	0.0001	0.0017	**0.5**	0.005	8.21
W16-3m	24-Mar-12	0.01	4.87	0.0174	0.008	**0.00002**	0.0005	0.023	0.041	**0.006**	**0.001**	0.0001	0.0019	**0.5**	0.0025	8.19
W16-4m	24-Mar-12	0.018	**5.15**	0.0294	0.022	**0.00019**	0.0005	0.0279	0.15	**0.006**	**0.001**	0.0001	0.0018	**0.5**	0.013	8.17
W16-5m	24-Mar-12	0.01	**5.48**	0.0394	0.013	**0.00002**	0.0005	0.0274	0.067	**0.006**	**0.001**	0.0001	0.002	**0.5**	0.0025	8.16
W16-6m	24-Mar-12	0.01	5.37	0.0332	0.016	**0.00002**	0.0005	0.0272	0.077	**0.006**	**0.001**	0.0001	0.002	**0.5**	0.0025	8.17
W16-7m	24-Mar-12	0.009	5.5	0.0372	0.024	**0.00006**	0.0005	0.0756	0.085	**0.006**	**0.001**	0.0011	0.0022	**0.5**	0.008	8.13
W16-8m	24-Mar-12	0.008	**4.88**	0.0057	0.031	**0.00002**	0.0005	0.0232	0.095	**0.006**	**0.001**	0.0001	0.0015	**1.3**	0.0025	8.2
W16	13-Feb-12	0.012	**4.52**	0.0067	0.048	**0.00008**	0.0005	0.0207	0.124	**0.006**	**0.001**	0.0001	0.0012	**2**	0.0025	8.19
W16-0m	12-Feb-12	0.009	5.24	0.0169	0.028	**0.00003**	0.0005	0.0241	0.091	**0.005**	**0.001**	0.0001	0.0015	**1**	0.0025	8.03
W16-2m	12-Feb-12	0.009	5.21	0.0184	0.023	**0.00002**	0.0005	0.0233	0.08	**0.005**	**0.001**	0.0001	0.0015	**1**	0.0025	8.03
W16-4m	12-Feb-12	0.009	**5.57**	0.0296	0.013	**0.00002**	0.0005	0.0262	0.059	**0.006**	**0.001**	0.0001	0.002	**0.5**	0.0025	7.97
W16-6m	12-Feb-12	0.009	**5.92**	0.0256	0.099	**0.00003**	0.0005	0.0317	0.228	**0.005**	**0.001**	0.0001	0.0022	**2.3**	0.0025	7.98
W16	21-Nov-11	0.012	4.98	0.0359	0.118	**0.00004**	0.0005	0.0321	0.237	**0.006**	**0.002**	0.0003	0.0015	**5.1**	0.01	8.01
W16	13-Nov-11	0.032	8.77	0.0755	0.127	**0.00004**	0.0005	0.0761	0.386	**0.01**	**0.003**	0.0001	0.0028	**3.7**	0.018	8.36
W16	18-Oct-11	0.015	**5.3**	0.009	0.041	**0.00001**	0.0005	0.032	0.103	**0.005**	**0.001**	0.0001	0.0014	**7**	0.0025	8.15
W16	06-Oct-11	0.025	**5.3**	0.029	0.052	**0.00003**	0.0005	0.0325	0.135	**0.005**	**0.001**	0.0001	0.0014	**2**	0.0025	8.21
W16	30-Sep-11	0.018	4.6	0.035	0.037	**0.00002**	0.0005	0.0296	0.091	**0.005**	**0.002**	0.0001	0.0013	**2**	0.0025	8.08
W16	24-Sep-11	0.019	4.3	0.023	0.034	**0.00001**	0.0005	0.0314	0.104	**0.005**	**0.001**	0.0001	0.0015	**2**	0.0025	8.01
W16	10-Sep-11	0.024	**4.7**	0.043	0.067	**0.00002**	0.0005	0.0329	0.123	**0.005**	**0.001**	0.0001	0.0011	**3**	0.0025	8.13
W16	05-Sep-11	0.028	**4.2**	0.042	0.036	**0.00003**	0.0005	0.0316	0.105	**0.004**	**0.001**	0.0001	0.0012	**2**	0.0025	8.24
W16	30-Aug-11	0.027	3.6	0.057	0.072	**0.00002**	0.0005	0.0272	0.123	**0.004**	**0.001**	0.0001	0.0011	**3**	0.0025	8.08
W16-0m	30-Aug-11	0.032	4.6	0.031	0.044	**0.00002**	0.0005	0.0341	0.12	**0.005**	**0.001**	0.0001	0.0013	**4**	0.0025	8.16
W16-10m	30-Aug-11	0.102	**6.2**	0.429	0.062	**0.00006**	0.0005	0.0395	0.153	**0.01**	**0.002**	0.0001	0.0022	**4**	0.0025	7.94
W16-12m	30-Aug-11	0.029	**4.5**	0.046	0.022	**0.00001**	0.0005	0.0302	0.081	**0.005**	**0.001**	0.0001	0.0012	**2**	0.0025	8.08
W16-14m	30-Aug-11	0.214	8.9	0.559	0.078	**0.00005**	0.0005	0.0322	0.15	**0.013**	**0.001**	0.0001	0.0026	**3**	0.0025	7.81
W16-16m	30-Aug-11	0.6	9.6	0.812	0.106	**0.00005**	0.0005	0.0312	0.2	**0.015**	**0.001**	0.0001	0.0032	**4**	0.0025	8.02
W16-2m	30-Aug-11	0.03	**4.6**	0.047	0.02	**0.00002**	0.0005	0.0276	0.077	**0.005**	**0.001**	0.0001	0.0014	**2**	0.0025	8.13
W16-4m	30-Aug-11	0.027	**4.7**	0.034	0.038	**0.00004**	0.0005	0.0313	0.102	**0.005**	**0.001**	0.0001	0.0014	**1**	0.0025	7.88
W16-6m	30-Aug-11	0.029	4.7	0.036	0.033	**0.00001**	0.0005	0.0301	0.097	**0.005**	**0.001**	0.0001	0.0016	**0.5**	0.0025	7.98
W16-8m	30-Aug-11	0.03	5.1	0.038	0.038	**0.00002**	0.0005	0.032	0.11	**0.005**	**0.001**	0.0001	0.0016	**0.5**	0.0025	7.94
W16	28-Aug-11	0.034	**4.5**	0.012	0.065	**0.00001**	0.001	0.0333	0.129	**0.005**	**0.002**	0.0001	0.0012	**3**	0.0025	8.13
W16	11-Aug-11	0.033	**4.6**	0.026	0.154	**0.00003**	0.0005	0.04	0.353	**0.004**	**0.002**	0.0001	0.0011	**3**	0.009	8.05
W16	07-Aug-11	0.027	4.3	0.038	0.352	**0.00001**	0.0005	0.0483	0.481	**0.006**	**0.002**	0.0002	0.0012	**6**	0.0025	7.96
W16-0m	01-Aug-11	0.03	4.3	0.014	0.141	**0.00003**	0.0005	0.0359	0.289	**0.005**	**0.002**	0.0007	0.0013	**12**	0.008	7.99
W16-10m	01-Aug-11	0.029	**4.4**	0.015	0.334	**0.00003**	0.0005	0.0468	0.618	**0.006**	**0.002**	0.0007	0.0013	**2**	0.005	7.96
W16-12m	01-Aug-11	0.53	**10.9**	0.548	0.128	**0.00006**	0.0005	0.0315	0.267	**0.013**	**0.002**	0.0017	0.0032	**3**	0.006	7.62
W16-14m	01-Aug-11	0.87	11.2	0.687	2.78	**0.00009**	0.002	0.142	4.97	**0.015**	**0.003**	0.0011	0.0036	**360**	0.022	7.66
W16-2m	01-Aug-11	0.03	4.3	0.033	0.342	**0.00003**	0.0005	0.0502	0.6	**0.005**	**0.002**	0.001	0.0014	**9**	0.006	7.94
W16-4m	01-Aug-11	0.029	**4.3**	0.023	0.289	**0.00004**	0.0005	0.0533	0.522	**0.006**	**0.002**	0.0007	0.0014	**8**	0.009	7.97
W16-6m	01-Aug-11	0.2	**5.9**	0.28	0.115	**0.00004**	0.0005	0.0374	0.261	**0.008**	**0.002**	0.0006	0.0021	**4**	0.0025	7.6
W16-8m	01-Aug-11	0.336	**9.3**	0.469	0.099	**0.00007**	0.0005	0.0334	0.218	**0.012**	**0.002**	0.0011	0.0027	**6**	0.007	7.66
W16	23-Jul-11	0.02	4.2	0.029	0.162	**0.00002**	0.0005	0.0304	0.253	**0.006**	**0.001**	0.0001	0.001	**2**	0.0025	7.98
W16	16-Jul-11	0.023	**4.5**	0.036	0.126	**0.00003**	0.0005	0.0355	0.265	**0.007**	**0.002**	0.0001	0.0013	**3**	0.0025	8.05
W16	09-Jul-11	0.023	**4.2**	0.049	0.111	**0.00002**	0.0005	0.0314	0.303	**0.007**	**0.002**	0.0001	0.0011	**5**	0.0025	8.02
W16	03-Jul-11	0.022	4.4	0.056	0.101	**0.00004**	0.0005	0.0324	0.259	**0.006**	**0.002**	0.0001	0.0012	**26**	0.006	8.18
W16	27-Jun-11	0.025	4.7	0.065	0.084	**0.00005**	0.0005	0.0309	0.245	**0.007**	**0.002**	0.0025	0.0011	**6**	0.0025	8.19
W16-0m	21-Jun-11	0.026	**5.2**	0.049	0.051	**0.00004**	0.0005	0.0337	0.187	**0.007**	**0.002**	0.0001	0.0013		0.0025	7.92
W16-10m	21-Jun-11	0.317	**14.3**	0.496	0.089	**0.00005**	0.0005	0.0338	0.191	**0.017**	**0.001**	0.0001	0.0036		0.0025	7.79
W16-12m	21-Jun-11	0.66	15.2	0.655	0.061	**0.00006**	0.0005	0.0307	0.166	**0.019**	**0.002**	0.0001	0.0043		0.0025	7.83
W16-2m	21-Jun-11	0.029	5.4	0.073	0.06	**0.00008**	0.0005	0.0366	0.215	**0.007**	**0.002**	0.0001	0.0014		0.005	7.88
W16-4m	21-Jun-11	0.136	**9.3**	0.249	0.071	**0.00005**	0.0005	0.0355	0.185	**0.011**	**0.002**	0.0001	0.0024		0.008	7.67
W16-6m	21-Jun-11	0.276	**12.5**	0.424	0.048	**0.00005**	0.0005	0.0301	0.17	**0.015**	**0.001**	0.0001	0.0033		0.0025	7.76
W16-8m	21-Jun-11	0.312	12.1	0.472	0.064	**0.00005**	0.0005	0.0326	0.173	**0.017**	**0.001**	0.0001	0.0041		0.0025	7.8
W16	13-Jun-11	0.022	4.9		0.12	**0.00045**	0.0005	0.044	0.239	**0.007**	**0.002**	0.0006	0.0012	**1**	0.009	8.01
W16	04-Jun-11	0.034	**4.9**	0.051	0.087	**0.00003**	0.0005	0.0322	0.223	**0.006**	**0.002**	0.0001	0.0012	**4**	0.0025	7.97
W16-0m	01-Jun-11			0.039	0.122	**0.00005**	0.0005	0.0359	0.249	**0.007**	**0.002**	0.0002	0.0014	**4**	0.0025	8.21
W16-2m	01-Jun-11			0.055	0.125	**0.00003**	0.0005	0.0332	0.255	**0.007**	**0.002**	0.0001	0.0013	**3**	0.0025	8.02
W16-4m	01-Jun-11			0.151	0.133	**0.00004**	0.0005	0.0343	0.266	**0.007**	**0.001**	0.0001	0.0017	**2**	0.0025	7.97
W16-6m	01-Jun-11			0.446	0.151	**0.00006**	0.0005	0.0344	0.248	**0.017**	**0.001**	0.0001	0.0044	**4**	0.0025	8
W16-8m	01-Jun-11			0.459	0.156	**0.00005**	0.0005	0.0323	0.248	**0.018**	**0.001**	0.0001	0.0046	**3**	0.0025	8.07
W16	29-May-11	0.037	5.3	0.033	0.23	**0.00002**	0.0005	0.0385	0.465	**0.006**	**0.002**	0.0003	0.0014	**7**	0.0025	8.15
W16	21-May-11	0.048	5.4	0.12	0.029	**0.00004**	0.0005	0.0305	0.159	**0.006**	**0.001**	0.0001	0.0014	**1**	0.0025	8
W16	14-May-11	0.048	**5.3**	0.13	0.333	**0.00005**	0.0005	0.0429	0.572	**0.006**	**0.002**	0.0001	0.0013	**6**	0.0025	7.79
W16	07-May-11	0.03	**2.6**	0.087	0.526	**0.00004**	0.0005	0.12	0.994	**0.003**	**0.002**	0.0002	0.0009	**14**	0.006	7.47
W16	02-May-11	0.012	0.63		0.408	**0.00004**	0.0005	0.062	0.619	**0.002**	**0.002**	0.0001	0.0003	**7**	0.009	7.32
W16	25-Apr-11	0.037	1.79	0.083	0.088	**0.00003**	0.0005	0.0311	0.442	**0.002**	**0.0005**	0.0001	0.0006	**3**	0.005	7.63
W16	16-Apr-11	0.22	**16.6**	0.523	0.339	**0.00005**	0.0005	0.0408	0.501	**0.021**	**0.001**	0.0001	0.0047	**7**	0.0025	8.09
W16	09-Apr-11	0.094	**7.6**	0.22	0.657	**0.00012**	0.0005	0.268	7.76	**0.01**	**0.002**	0.0004	0.0024	**37**	0.027	7.8
W16	02-Apr-11	0.291	16.2	0.42	0.358	**0.00007**	0.0005	0.0652	0.562	**0.024**	**0.0005**	0.0001	0.0052	**8**	0.006	8.01
W16-10m	12-Mar-11	0.229	18.6	0.79	0.179	**0.00033**	0.0005	0.13	0.45	**0.056**	**0.003**	0.0001	0.0104	**2**	0.194	7.87
W16-12m	12-Mar-11	0.298	**21.9**	1	0.079	**0.00006**	0.0005	0.0421	0.156	**0.027**	**0.001**	0.0001	0.0049	**2**	0.007	7.77
W16-2m	12-Mar-11	0.116	**16.6**	0.36	0.05	**0.00004**	0.0005	0.0425	0.136	**0.02**	**0.001**	0.0001	0.0044	**2**	0.007	7.87
W16-4m	12-Mar-11	0.135	16.6	0.4	0.052	**0.00004**	0.0005	0.042	0.126	**0.019**	**0.001**	0.0001	0.0042	**8**	0.0025	7.85
W16-6m	12-Mar-11	0.168	17.5	0.51	0.112	**0.00015**	0.0005	0.0654	0.246	**0.019**	**0.002**	0.0001	0.0041	**6**	0.01	7.83
W16-8m	12-Mar-11	0.277	**20.8**	0.97	0.059	**0.00004**	0.0005	0.0338	0.119	**0.025**	**0.001**	0.0001	0.0045	**2**	0.0025	7.92
W16-2m	05-Feb-11	0.11	**15.9**	0.34	0.024	**0.00005**	0.0005	0.0408	0.07	**0.019**	**0.001**	0.0001	0.0045	**0.5**	0.0025	7.78
W16-4m	05-Feb-11	0.122	16	0.42	0.036	**0.00006**	0.0005	0.0454	0.09	**0.02**	**0.002**	0.0001	0.0048	**1**	0.0025	7.88
W16-6m	05-Feb-11	0.247	19.4	1.1	0.057	**0.00009**	0.0005	0.0418	0.107	**0.026**	**0.001**	0.0001	0.0054	**2**	0.0025	7.79
W16	04-Feb-11	0.11	**14.2**	0.39	0.045	**0.00006**	0.0005	0.0547	0.128	**0.02**	**0.001**	0.0001	0.0051	**2**	0.008	8.07
W16	08-Jan-11	0.1	**16.4**	0.23	0.06	**0.0001**	0.0005	0.0668	0.175	**0.02**	**0.003**	0.0001	0.0053	**3**	0.005	7.77

Note:

Values in bold indicate half of the value of the analytical detection limit

Highlighted values indicate exceedance of Water Use License QZ96-006 Amendment 7 Limits

Source: SRK X:\01_SITES\Minto\1CM002.005_Water_Treatment_Assessment_Short_and_Long_Term\100 Discharge Support\Memo Discharge Rationale\[MintoWQ_W16_W17_2011.xlsm]W16

Table 2 Water Quality at W17, 2011 and 2012

Station Code	Collection Date/Time	Nitrite-N	Nitrate-N	Ammonia-N	Al-T	Cd-T	Cr-T	Cu-T	Fe-T	Mo-T	Ni-T	Pb-T	Se-T	TSS	Zn-T	pH
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
WUL Standard Limit for W17 and W50		0.15	7.65	0.89	2.7	0.00015	0.008	0.08	3.5	0.4	0.5	0.02	0.003	15	0.15	6.5 to 9
W17	27-Mar-12	0.006	3.13	0.0062	0.012	0.0001	**0.0005**	0.0068	0.019	0.006	**0.0005**	**0.0001**	0.0007	**0.5**	**0.0025**	8.25
W17	24-Mar-12	0.007	3.1	**0.0025**	0.006	0.00001	**0.0005**	0.0063	0.008	0.007	**0.0005**	**0.0001**	0.0009	**0.5**	**0.0025**	8.28
W17	19-Mar-12	0.007	3.01	**0.0025**	0.011	0.00009	**0.0005**	0.0063	0.021	0.006	**0.0005**	**0.0001**	0.0009	**0.5**	**0.0025**	8.22
W17	12-Mar-12	0.006	3.29	0.008	0.006	0.00001	**0.0005**	0.0055	0.008	0.006	**0.0005**	**0.0001**	0.0009	**0.5**	**0.0025**	8.23
W17	05-Mar-12	0.008	3.22	0.0059	0.004	**0.000005**	**0.0005**	0.0057	**0.0025**	0.007	**0.0005**	**0.0001**	0.001	**0.5**	**0.0025**	8.3
W17	05-Mar-12	0.007	3.24	0.0063												
W17	25-Feb-12	0.008	3.35	**0.0025**	0.011	0.00002	**0.0005**	0.0093	0.022	0.007	**0.0005**	**0.0001**	0.0009	**2**	**0.0025**	8.21
W17	20-Feb-12	0.007	3.25	0.0102	0.005	**0.000005**	**0.0005**	0.0058	0.006	0.007	**0.0005**	**0.0001**	0.001	**2**	**0.0025**	8.06
W17	13-Feb-12	**0.0025**	3.49	**0.0025**	0.044	0.00003	**0.0005**	0.0095	0.08	0.007	0.001	**0.0001**	0.0009	**0.5**	**0.0025**	8.13
W17	07-Feb-12	0.009	3	0.0052	0.026	0.00001	**0.0005**	0.012	0.056	0.006	**0.0005**	**0.0001**	0.0007	**2**	**0.0025**	8.46
W17	31-Jan-12	0.008	3.25	**0.0025**	0.018	0.00002	**0.0005**	0.0104	0.033	0.007	**0.0005**	**0.0001**	0.0009	**2**	**0.0025**	8.16
W17	22-Jan-12	0.007	3.41	**0.0025**	0.009	**0.000005**	**0.0005**	0.006	0.014	0.006	**0.0005**	**0.0001**	0.0009	**0.5**	**0.0025**	8.25
W17	15-Jan-12	**0.0025**	4.85	0.0127	0.083	0.00004	**0.0005**	0.0144	0.135	0.006	0.001	**0.0001**	0.001	7.3	**0.0025**	8.19
W17	09-Jan-12	0.006	4.82	0.0621	0.051	0.00008	**0.0005**	0.0123	0.078	0.006	0.001	**0.0001**	0.0009	3.5	**0.0025**	8.14
W17	02-Jan-12	0.007	3.43	0.0215	0.011	**0.000005**	**0.0005**	0.0058	0.01	0.006	**0.0005**	**0.0001**	0.0009	**2**	**0.0025**	8.13
W17	27-Dec-11	0.007	3.13	0.0074	0.009	0.00001	**0.0005**	0.0061	0.014	0.007	0.001	**0.0001**	0.001	**0.5**	**0.0025**	8.17
W17	18-Dec-11	0.006	3.33	0.0371	0.011	0.00001	0.001	0.0071	0.015	0.007	0.002	**0.0001**	0.001	**0.5**	**0.0025**	8.07
W17	13-Dec-11	0.007	3.26	0.0076	0.022	0.00002	**0.0005**	0.0085	0.04	0.007	0.001	**0.0001**	0.0009	**0.5**	**0.0025**	8.19
W17	05-Dec-11	0.012	3.64	0.0147	0.015	**0.000005**	**0.0005**	0.0065	0.03	0.006	0.001	**0.0001**	0.0008	**2**	**0.0025**	7.56
W17	28-Nov-11	**0.0025**	3.39	**0.0025**	0.015	0.00002	**0.0005**	0.0099	0.042	0.007	**0.0005**	0.0003	0.0009	**0.5**	**0.0025**	8.19
W17	21-Nov-11	**0.0025**	3.68	**0.0025**	0.021	0.00015	**0.0005**	0.0108	0.051	0.007	0.001	0.0003	0.0009	**0.5**	**0.0025**	8.02
W17	13-Nov-11	0.008	3.12	0.0088	0.014	**0.000005**	**0.0005**	0.0069	0.023	0.008	**0.0005**	**0.0001**	0.0008	**0.5**	**0.0025**	8.3
W17	08-Nov-11	0.008	3.44	0.0171	0.226	0.00007	0.001	0.0221	0.333	0.008	0.003	**0.0001**	0.0009	4	**0.0025**	8.22
W17	03-Nov-11	0.006	3.14	**0.0025**	0.091	0.00009	**0.0005**	0.014	0.143	0.007	0.002	**0.0001**	0.0008	19	**0.0025**	8.23
W17	30-Oct-11	**0.0025**	3.01	**0.0025**	0.028	**0.000005**	**0.0005**	0.0098	0.053	0.008	**0.0005**	**0.0001**	0.0008	5	**0.0025**	8.21
W17	24-Oct-11	0.006	2.79	0.022	0.064	0.00005	**0.0005**	0.0128	0.103	0.009	0.001	**0.0001**	0.0008	2	**0.0025**	8.14
W17	17-Oct-11	0.007	2.85	0.006	0.007	**0.000005**	**0.0005**	0.0066	0.008	0.008	**0.0005**	**0.0001**	0.0009	**2**	**0.0025**	8.14
W17	06-Oct-11	**0.025**	2.8	0.011	0.022	**0.000005**	**0.0005**	0.0086	0.062	0.009	0.002	**0.0001**	0.0008	2	**0.0025**	8.34
W17	01-Oct-11	0.005	2.6	**0.0025**	0.017	**0.000005**	**0.0005**	0.0078	0.031	0.009	0.001	**0.0001**	0.0009	**2**	**0.0025**	8.07
W17	24-Sep-11	0.005	2.7	0.017	0.015	**0.000005**	**0.0005**	0.0077	0.027	0.008	0.001	**0.0001**	0.0008	**2**	**0.0025**	8.11
W17	17-Sep-11	0.006	1.36	0.007	0.026	0.00001	**0.0005**	0.008	0.046	0.008	0.001	**0.0001**	0.001	**0.5**	**0.0025**	8.17
W17	10-Sep-11	**0.0025**	3	0.009	0.017	0.00001	**0.0005**	0.0076	0.015	0.01	0.001	**0.0001**	0.001	**0.5**	**0.0025**	8.17
W17	05-Sep-11	0.005	2.8	0.022	0.017	0.00001	**0.0005**	0.0113	0.031	0.008	0.001	**0.0001**	0.001	5	**0.0025**	8.26
W17	30-Aug-11	**0.0025**	2.5	0.146	0.029	0.00002	**0.0005**	0.0063	0.024	0.008	**0.0005**	**0.0001**	0.0008	**0.5**	**0.0025**	8.16
W17	28-Aug-11	0.008	2.9	0.009	0.011	**0.000005**	**0.0005**	0.0077	0.011	0.008	0.003	**0.0001**	0.001	**0.5**	**0.0025**	8.04
W17	11-Aug-11	**0.0025**	2.7	0.023	0.013	0.00013	**0.0005**	0.0079	0.02	0.01	0.001	**0.0001**	0.0008	**0.5**	0.04	8.2
W17	07-Aug-11	0.007	3	0.015	0.037	0.00001	**0.0005**	0.0092	0.054	0.01	0.001	**0.0001**	0.0008	**0.5**	**0.0025**	8.1
W17	31-Jul-11	0.005	1.82	0.012	0.018	0.00004	**0.0005**	0.0086	0.028	0.009	0.001	0.0003	0.0007	**0.5**	**0.0025**	8.2
W17	23-Jul-11	0.007	2.29	0.009	0.014	0.00001	**0.0005**	0.0072	0.02	0.01	0.001	**0.0001**	0.0007	**0.5**	**0.0025**	8
W17	16-Jul-11	0.009	1.6	0.008	0.04	0.00002	**0.0005**	0.0103	0.066	0.01	0.001	**0.0001**	0.0008	**0.5**	**0.0025**	8.04
W17	09-Jul-11	0.008	2.51	0.011	0.047	0.00003	**0.0005**	0.0124	0.071	0.008	0.002	**0.0001**	0.0006	**0.5**	**0.0025**	8.06
W17	01-Jul-11	0.01	2.57	0.006	0.1	0.00004	**0.0005**	0.0086	0.164	0.003	0.003	**0.0001**	0.0004	7	0.01	8.07
W17	27-Jun-11	0.01	2.8	0.075	0.008	0.00001	**0.0005**	0.0061	0.013	0.009	0.001	**0.0001**	0.0006	1	**0.0025**	8.14
W17	16-Jun-11	0.008	3.5		0.02	0.00002	**0.0005**	0.0082	0.039	0.009	0.002	**0.0001**	0.0006	**0.5**	**0.0025**	8.05
W17	11-Jun-11	0.008	4.1	0.011	0.014	0.00003	**0.0005**	0.0079	0.023	0.009	0.001	**0.0001**	0.0006	2	**0.0025**	8.26
W17	04-Jun-11	0.009	4.7	0.008	0.012	0.00003	**0.0005**	0.0067	0.02	0.009	0.001	**0.0001**	0.0005	**0.5**	**0.0025**	8.04
W17	29-May-11	0.006	5.4	0.012	0.051	0.00002	**0.0005**	0.0136	0.092	0.009	0.001	**0.0001**	0.0007	1	**0.0025**	8.13
W17	21-May-11	0.01	6.4	0.008	0.218	0.00002	**0.0005**	0.0716	0.43	0.008	0.001	**0.0001**	0.0006	9	**0.0025**	8.32
W17	14-May-11	0.018	7.8	0.078	0.019	0.00002	**0.0005**	0.0076	0.029	0.009	0.001	**0.0001**	0.0009	**0.5**	**0.0025**	8.12
W17	08-May-11	0.012	8.8	0.009	0.048	0.00002	**0.0005**	0.0105	0.083	0.008	0.001	**0.0001**	0.001	**0.5**	**0.0025**	8.05
W17	21-Apr-11	0.009	7.3	0.007	0.014	0.00002	**0.0005**	0.0061	0.03	0.007	0.001	**0.0001**	0.0015	**0.5**	**0.0025**	8.19
W17	15-Apr-11	0.016	10.6	0.012	0.023	0.00001	**0.0005**	0.0074	0.034	0.008	0.002	**0.0001**	0.0016	5	**0.0025**	8.13
W17	09-Apr-11	0.011	11.5	0.009	0.014	**0.000005**	**0.0005**	0.0058	0.023	0.007	0.001	**0.0001**	0.0015	**0.5**	**0.0025**	8.01
W17	02-Apr-11	0.01	11.2	0.011	0.013	0.00003	**0.0005**	0.0056	0.035	0.007	0.004	**0.0001**	0.0015	**0.5**	**0.0025**	8.25
W17	31-Mar-11	0.012	11.2	0.011	1.58	0.00003	0.001	0.0402	1.78	0.007	0.002	0.0003	0.0018	19	0.006	8.16
W17	29-Mar-11	0.011	12	0.016	0.015	0.00001	**0.0005**	0.0061	0.027	0.008	0.001	**0.0001**	0.0014	**0.5**	**0.0025**	8.21
W17	26-Mar-11	0.01	11.9	0.007	0.046	0.00003	**0.0005**	0.0119	0.086	0.008	0.002	**0.0001**	0.0017	4	**0.0025**	8.3
W17	22-Mar-11	0.008	12.2	0.009	0.012	0.00003	**0.0005**	0.0069	0.024	0.008	0.001	**0.0001**	0.0017	**0.5**	**0.0025**	8.24
W17	19-Mar-11				0.012	0.00004	**0.0005**	0.0075	0.014	0.008	0.001	**0.0001**	0.0017	**0.5**	**0.0025**	8.19
W17	16-Mar-11	0.009	11.7	0.013	0.009	0.00004	**0.0005**	0.0073	0.011	0.008	0.001	**0.0001**	0.0014	**0.5**	**0.0025**	8.02
W17	13-Mar-11	0.009	12	0.029	0.529	0.00006	**0.0005**	0.267	1.1	0.008	0.001	0.0004	0.0019	1	0.006	7.97
W17	08-Mar-11	0.009	11.6	0.023	0.012	0.00004	**0.0005**	0.0062	0.06	0.008	0.002	**0.0001**	0.0019	**0.5**	**0.0025**	7.94
W17	05-Mar-11	0.008	11.8	0.014	0.02	0.00004	**0.0005**	0.007	0.035	0.009	0.001	**0.0001**	0.0021	1	**0.0025**	7.95
W17	03-Mar-11	0.008	12.4	0.023	0.005	0.00002	**0.0005**	0.0051	**0.0025**	0.007	0.001	**0.0001**	0.0018	**0.5**	**0.0025**	7.95
W17	02-Mar-11	0.009	12.3	0.018	0.012	0.00002	**0.0005**	0.0094	0.015	0.007	0.001	**0.0001**	0.0017	**0.5**	**0.0025**	7.99
W17	26-Feb-11	0.008	11.3	0.85	0.003	0.00002	**0.0005**	0.0046	**0.0025**	0.007	**0.0005**	**0.0001**	0.0019	**0.5**	**0.0025**	8
W17	15-Feb-11	0.007	12.2	0.062	**0.0015**	0.00002	**0.0005**	0.006	0.01	0.007	0.001	**0.0001**	0.0023	**0.5**	**0.0025**	7.96
W17	14-Feb-11				0.011	0.00002	**0.0005**	0.0056	0.012	0.007	0.001	**0.0001**	0.0023		**0.0025**	
W17	13-Feb-11	0.007	12.1	0.029	0.009	0.00002	**0.0005**	0.0065	0.009	0.007	0.001	**0.0001**	0.0023	**0.5**	**0.0025**	8.01
W17	12-Feb-11				0.012	0.00002	**0.0005**	0.0102	0.019	0.008	0.001	**0.0001**	0.0025		**0.0025**	
W17	11-Feb-11	0.008	12.1	0.14	0.01	0.00002	**0.0005**	0.0065	0.011	0.008	0.001	**0.0001**	0.0026	**0.5**	**0.0025**	8.03
W17	10-Feb-11				0.024	**0.000005**	**0.0005**	0.0116	0.034	0.007	0.001	**0.0001**	0.0023		**0.0025**	
W17	09-Feb-11	0.008	12.2	0.015	0.019	0.00003	**0.0005**	0.0071	0.024	0.007	0.001	**0.0001**	0.002	**0.5**	**0.0025**	7.93
W17	08-Feb-11	0.008	12.2	0.015	0.011	0.00002	**0.0005**	0.01	0.01	0.006	0.001	**0.0001**	0.0021	**0.5**	**0.005**	7.93
W17	07-Feb-11	0.008	11.8	0.015	0.01	0.00002	**0.0005**	0.006	**0.005**	0.007	0.001	**0.0001**	0.0021	1	**0.005**	7.94
W17	06-Feb-11							0.001	**0.005**						0.01	
W17	05-Feb-11	0.008	11.6	0.011	0.013	0.00002	**0.0005**	0.004	**0.005**	0.007	0.001	0.0003	0.0023	**0.5**	**0.005**	8.16
W17	04-Feb-11				0.011	**0.000005**	**0.0005**	0.003	**0.005**	0.008	0.001	**0.0001**	0.0026		**0.005**	
W17	03-Feb-11	0.008	11.9	0.025	0.019	0.00003	**0.0005**	0.003	**0.005**	0.008	0.001	**0.0001**	0.0025	1	**0.005**	8.15
W17	02-Feb-11							0.007	**0.005**						**0.005**	
W17	01-Feb-11	0.007	11.4	0.008	0.01	0.00001	**0.0005**	0.0052	0.012	0.007	0.001	**0.0001**	0.0023	**0.5**	**0.0025**	8.15
W17	30-Jan-11	0.007	12.3	0.008	0.004	0.00003	**0.0005**	0.001	**0.005**	0.006	**0.0005**	**0.0001**	0.0024	**0.5**	**0.005**	8.24
W17	28-Jan-11	0.008	12.1	0.015	0.02	0.00003	**0.0005**	0.004	**0.005**	0.006	0.001	**0.0001**	0.0024	1	**0.005**	8.35
W17	27-Jan-11	0.008	12.2	0.008	0.024	0.00006	**0.0005**	0.006	**0.005**	0.005	0.001	**0.0001**	0.0025	**0.5**	**0.005**	8.35
W17	24-Jan-11							0.005	**0.005**						**0.005**	
W17	23-Jan-11				0.018	0.00002	**0.0005**	0.008	0.035	0.006	**0.0005**	**0.0001**	0.0021		**0.0025**	
W17	22-Jan-11	0.008	12.1	**0.025**	0.024	0.00001	**0.0005**	0.0049	0.011	0.006	0.001	**0.0001**	0.0024	**0.5**	**0.0025**	7.85
W17	21-Jan-11							0.067	0.1						**0.005**	
W17	19-Jan-11							0.005	**0.005**						**0.005**	
W17	18-Jan-11				0.009	0.00001	**0.0005**	0.0045	0.014	0.006	**0.0005**	**0.0001**	0.0027		**0.0025**	
W17	17-Jan-11	0.009	12	**0.0025**	0.033	0.00003	**0.0005**	0.0127	0.06	0.006	0.001	**0.0001**	0.0026	4	**0.0025**	7.91
W17	14-Jan-11				0.042	0.00003	**0.0005**	0.014	0.079	0.008	0.001	**0.0001**	0.0029		**0.0025**	
W17	13-Jan-11				0.009	0.00003	**0.0005**	0.0059	0.012	0.007	0.001	**0.0001**	0.0029		**0.0025**	
W17	12-Jan-11	0.008	11.5	0.13	0.009	0.00005	**0.0005**	0.0057	0.01	0.007	0.001	**0.0001**	0.0027	3	**0.0025**	8.01
W17	11-Jan-11				0.008	0.00002	**0.0005**	0.0054	0.007	0.007	0.001	**0.0001**	0.0028		**0.0025**	
W17	10-Jan-11				0.006	0.00001	**0.0005**	0.0052	0.008	0.007	0.001	**0.0001**	0.0027		**0.0025**	
W17	08-Jan-11	0.01	11.5	**0.0025**	0.012	0.00001	**0.0005**	0.0061	0.02	0.008	0.001	**0.0001**	0.0027	3	**0.0025**	7.94
W17	07-Jan-11				0.011	**0.000005**	**0.0005**	0.0058	0.017	0.007	0.001	**0.0001**	0.0026		**0.0025**	
W17	06-Jan-11				0.112	0.00008	0.001	0.0402	0.231	0.008	0.002	0.0006	0.0028		0.014	
W17	05-Jan-11	0.008	11.3	**0.0025**	0.014	0.00001	**0.0005**	0.004	**0.005**	0.007	0.001	**0.0001**	0.0026	2	**0.005**	7.96
W17	04-Jan-11	0.008	8.3	**0.025**	0.033	0.00001	**0.0005**	0.004	**0.005**	0.007	0.001	**0.0001**	0.0024	3	**0.005**	7.94
W17	03-Jan-11	0.008	7.1	**0.025**	0.075	0.00004	**0.0005**	0.002	**0.005**	0.007	0.002	**0.0001**	0.0028	1	**0.005**	7.98
W17	02-Jan-11	0.014	11.8	**0.0025**	0.227	0.00026	**0.0005**	0.006	**0.005**	0.007	0.002	**0.0001**	0.0028	2	**0.005**	8.07
W17	01-Jan-11	0.012	11.8	**0.0025**	0.014	0.00001	**0.0005**	0.003	**0.005**	0.007	0.001	**0.0001**	0.0026	2	**0.005**	

Note:

Values in bold indicate half of the value of the analytical detection limit

Highlighted values indicate exceedance of Water Use License QZ96-006 Amendment 7 Limits

ɿrt_and_Long_Term\100 Discharge Support\Memo Discharge Rationale\[MintoWQ_W16_W17_2011.xlsm]W1(

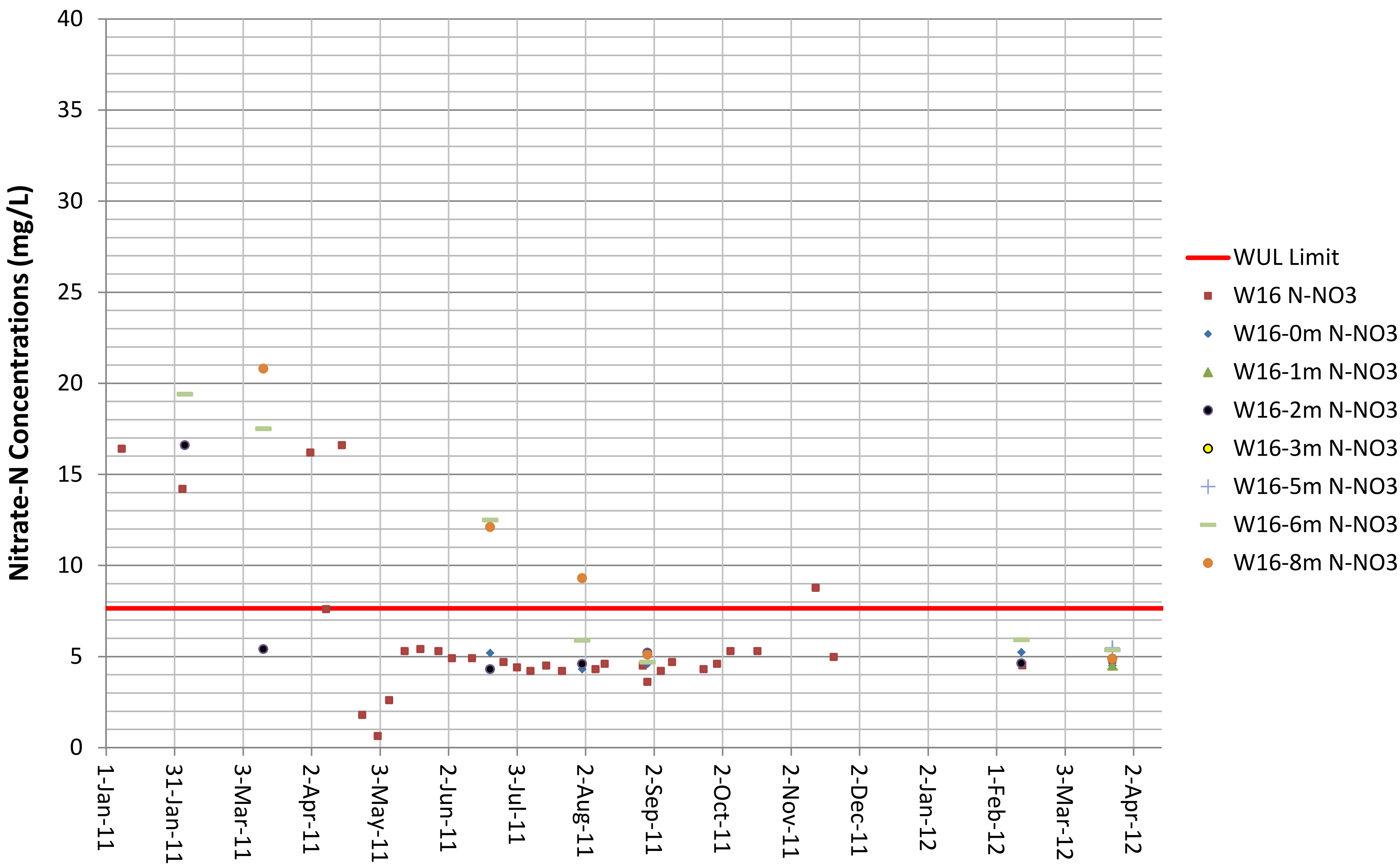

Figure 1 Nitrate-N Concentrations at W16 (2011 and 2012)

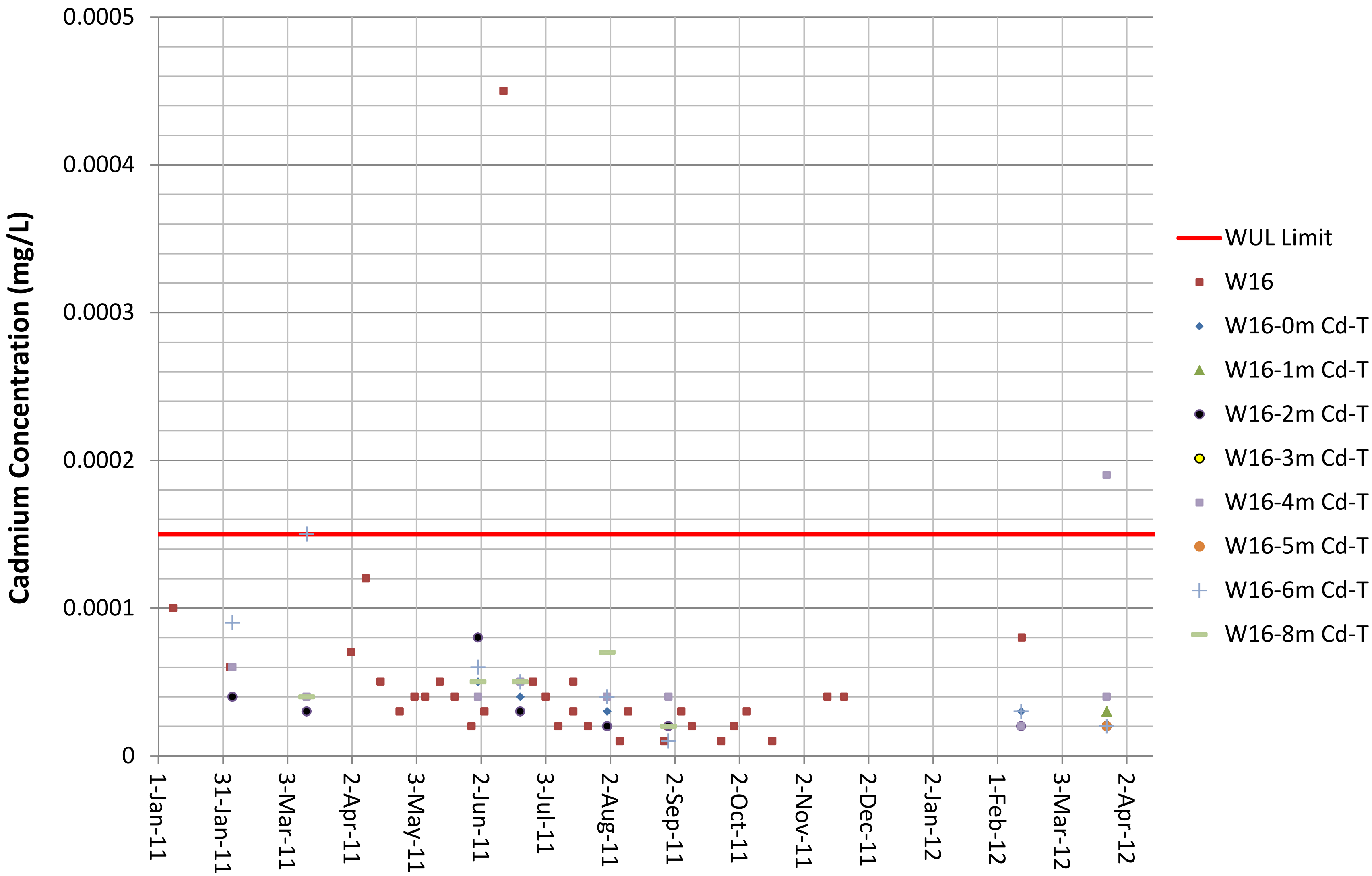

Figure 2 Total Cadmium Concentrations at W16 (2011 to 2012)

Appendix G: Assessment on Receiving Water Quality, Effectiveness of AMMP during Freshet and Non-Freshet Conditions and Overall Effect of the Site Discharge Management Regime on the Aquatic Ecosystem

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March 29, 2013

Ms. Jennie Gjertsen
Environmental Manager
Minto Mine
Minto Explorations Ltd.
Suite 900 - 999 West Hastings Street
Vancouver, BC
V6C 2W2

Dear Ms. Gjertsen,

Re: Minto Mine WUL Clause 94 - Water Quality Standard for Copper

As part of Amendment 8 to the Minto Mine's Water Use Licence (WUL), the Yukon Water Board (YWB) provided a list of conditions to be met by the Minto Mine. Clause 94 states:

> "On or before March 31st, 2013, the Licensee shall submit to the Board an assessment of the receiving water quality standard for copper of 0.013 mg/L, the effectiveness of the AMMP during freshet and non-freshet conditions and the overall effect of the site discharge management regime on the aquatic ecosystem."

To assist in addressing this clause, the Minto Mine asked Minnow Environmental Inc. (Minnow) to provide an assessment of the receiving water quality standard for copper of 0.013 mg/L. This brief letter report provides some background information on the standard, and reviews available water quality and biological monitoring data to assess the receiving water quality standard as required under Clause 94.

Background

In 2009, in recognition of naturally-elevated concentrations of a number of metals in Minto Creek, the Access Consulting Group (ACG), acting on behalf of Minto Mine, retained Minnow to evaluate the background water quality of Minto Creek (Minnow 2009). Concentrations of aluminum, chromium, copper and iron were identified as naturally elevated in Minto Creek relative to Canadian Water Quality Guidelines for the protection of aquatic life (CWQGs; CCME 1999). Site-specific water quality objectives (SSWQOs) were derived for these four metals using the Background Concentration Procedure (BCP). Application of this procedure identified a 95th percentile copper concentration of 0.013 mg/L based on Minto Creek background water quality data with concentrations of total suspended solids <50 mg/L (Minnow 2009). This concentration was validated against the original dataset to verify that it did, indeed adequately represent a concentration above which only 5% of data points would sit. In recognition of the natural exceedence rate, it was recommended that exceedence of the SSWQOs at a rate of 10% or more (or identification of an unusually high concentration or a known cause) be used by the Minto Mine to trigger more detailed examination of water quality data including comparison to background concentrations of dissolved metals and comparison to the relationships between background concentrations of total metals and TSS (Minnow 2009). In the event of exceedence of the SSWQO for copper (0.013 mg/L), it was also recommended that copper concentrations be compared to the results of the toxicity-based water-effect ratio procedure (WERP) derived SSWQO for copper of 0.017 mg/L (Minnow 2009). These SSWQOs were developed as tools for the Minto Mine to use in their interpretation of water quality monitoring data, allowing them to distinguish water quality conditions that warranted attention (i.e., concentrations greater than SSWQO) from conditions that did not (i.e., concentrations lower than SSWQO), and for use in the development of effluent quality targets.

Site-specific water quality objectives are intended to be concentrations that establish the conditions necessary to support and protect the most sensitive designated use of water at a specified site (CCME 2003). Background-based SSWQOs are considered to be “zero-risk” concentrations because they represent concentrations that occur rarely (5% of the time) under natural conditions (as represented in the available data). In other words, they represent conditions to which environmental receptors are exposed naturally and accordingly within which no adverse effects would be expected. However, they do not represent conditions above which biological effects are expected. Application of the toxicity-based WERP indicated that 0.017 mg/L copper represented a biologically-based SSWQO below which no adverse effects would be expected and a better estimate of a concentration above which adverse biological effects could occur.

In 2011, the YWB issued WUL Amendment 7 that applied the SSWQOs as standards for lower Minto Creek. Due to some uncertainty at the time over whether effects of copper to fish olfaction may be more sensitive to copper than conventional toxicological endpoints underlying the WERP, the BCP-based SSWQO of 0.013 mg/L was applied as the standard for copper in Amendment 7. Application of BCP-based SSWQOs as standards is problematic by definition. Simply stated, it is mathematically impossible for such standards to be met even in the absence of any mine influence (they are naturally exceeded at a rate of 5%). In 2012, the Minto Mine applied for another WUL Amendment primarily to authorize mining activities associated with the Phase IV

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expansion. Under the Minto Mine WUL Amendment 8, the YWB required the Minto Mine to assess the receiving water quality standard for copper of 0.013 mg/L, the effectiveness of the AMMP during freshet and non-Freshet conditions and the overall effect of the site discharge management regime on the aquatic ecosystem. This assessment provides a valuable opportunity to examine the SSWQO and the overall influence of the Minto Mine on aquatic life in light of a significant quantity of data collected since 2008.

Copper in Minto Creek Waters

Concentrations of total copper in lower Minto Creek were often greater than the WUL standard of 0.013 mg/L (Figure 1). Under the assumption that natural conditions had remained unchanged relative to those represented by the background dataset defined by Minnow (2009), an exceedence frequency of 5% would be expected. The exceedence frequency was much greater (14%), indicating some influence on water quality that was not captured in the dataset used previously (i.e., either a mine-related influence or a natural change).

Concentrations of total metals, including copper, in Minto Creek have long been known to be related to concentrations of total suspended solids (TSS), and concentrations of TSS in lower Minto Creek have often been quite high and were exceptionally high in 2012 (Appendix Figure 1). The regression relationship of total copper with TSS in lower Minto Creek (2006-2012) was statistically significant and TSS explained a meaningful proportion of the variation in total copper concentrations (53%; Appendix Figure 2). This relationship indicated that, on average, total copper would naturally be expected to be greater than 0.013 mg/L at a TSS concentration of 113 mg/L or more (which often occurs in lower Minto Creek; Appendix Figure 1). The regression relationship of dissolved copper with TSS in lower Minto Creek (2006-2012) was also statistically significant, but TSS explained a much lower proportion of variation (Appendix Figure 3). It is therefore clear that concentrations of total copper are highly influenced by TSS concentrations, which are naturally elevated in lower Minto Creek. Activities of the Minto Mine also have the potential to affect TSS concentrations. However, based on reference data updated through 2012, the Access Consulting Group (ACG) recalculated the BCP-based SSWQO for copper (0.053 mg/L). The exceedence frequency of this updated SSWQO is consistent with the theoretical rate (2% versus a theoretical 5%; Figure 2).

Concentrations of dissolved copper have exceeded the WUL standard of 0.013 mg/L at a much lower frequency than total copper (2%; Appendix Figure 4). It is generally

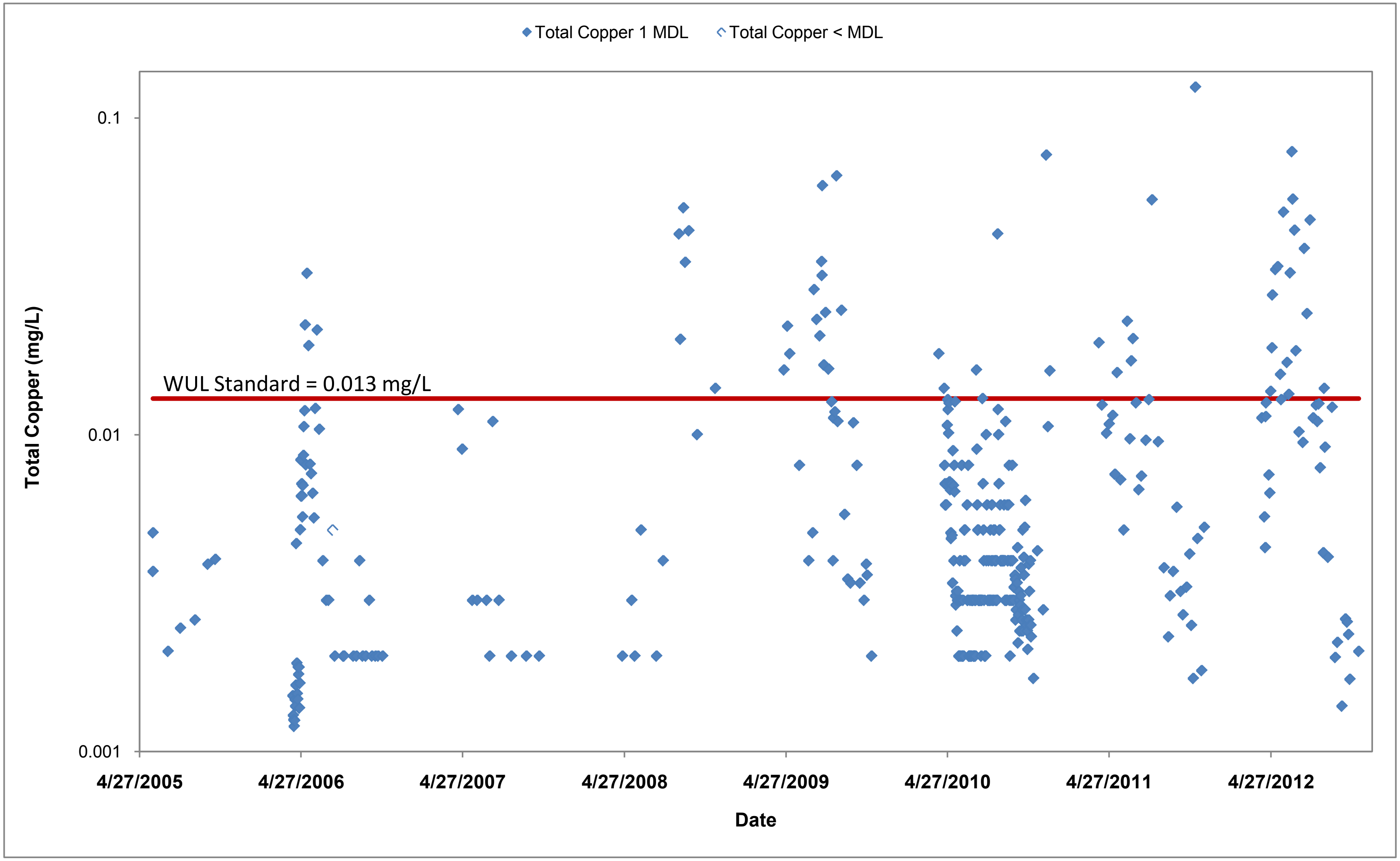


Figure 1: Total copper (mg/L) at Minto Creek from 2005 to 2012 relative to the Water Use Licence Standard. Open points are values that were less than MDL.

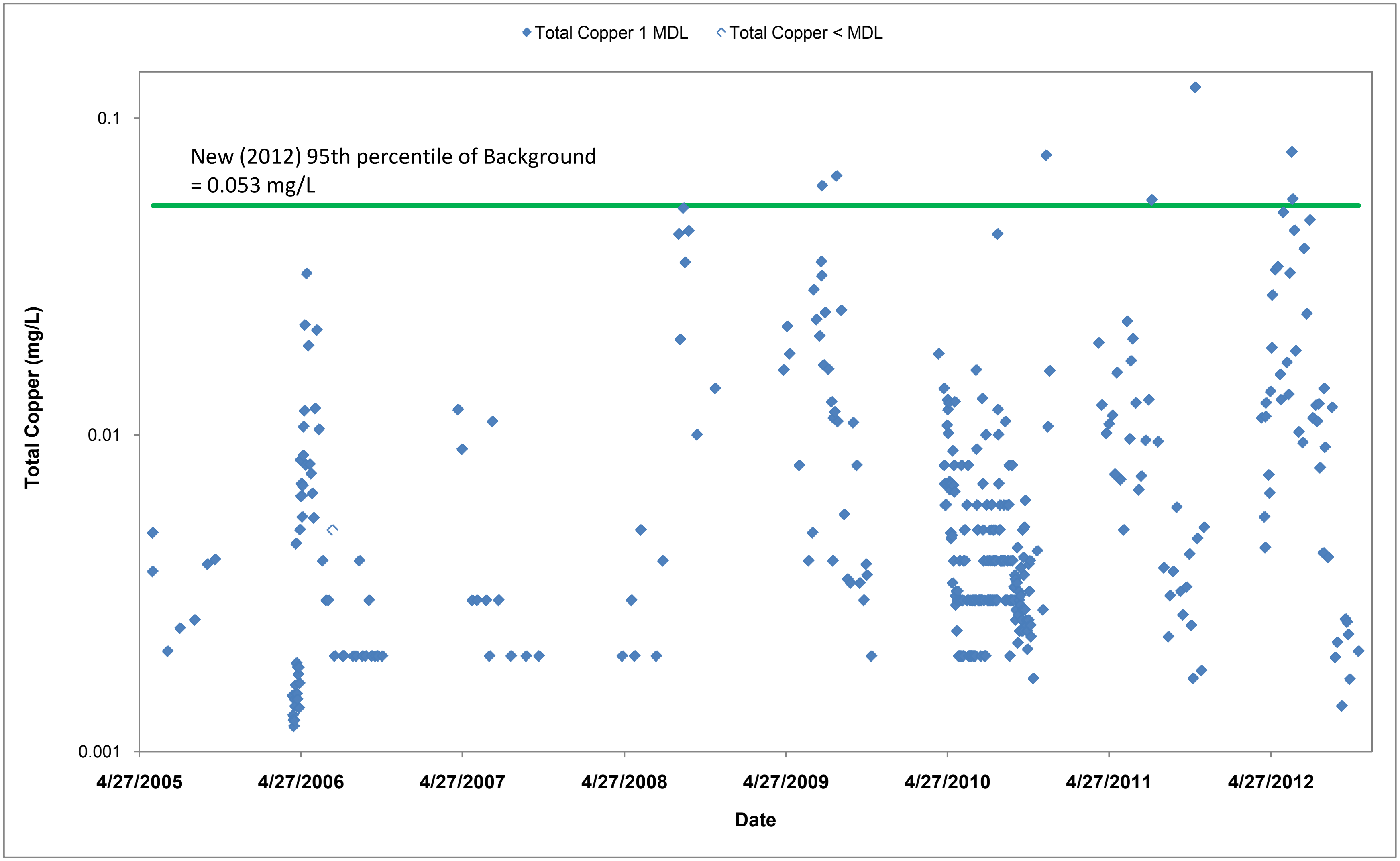


Figure 2: Total copper (mg/L) at Minto Creek from 2006 to 2012 relative to the New 95th Percentile of Background. Values with open points were less than MDL. The updated background/reference 95th percentile was provided by the Access Consulting Group.

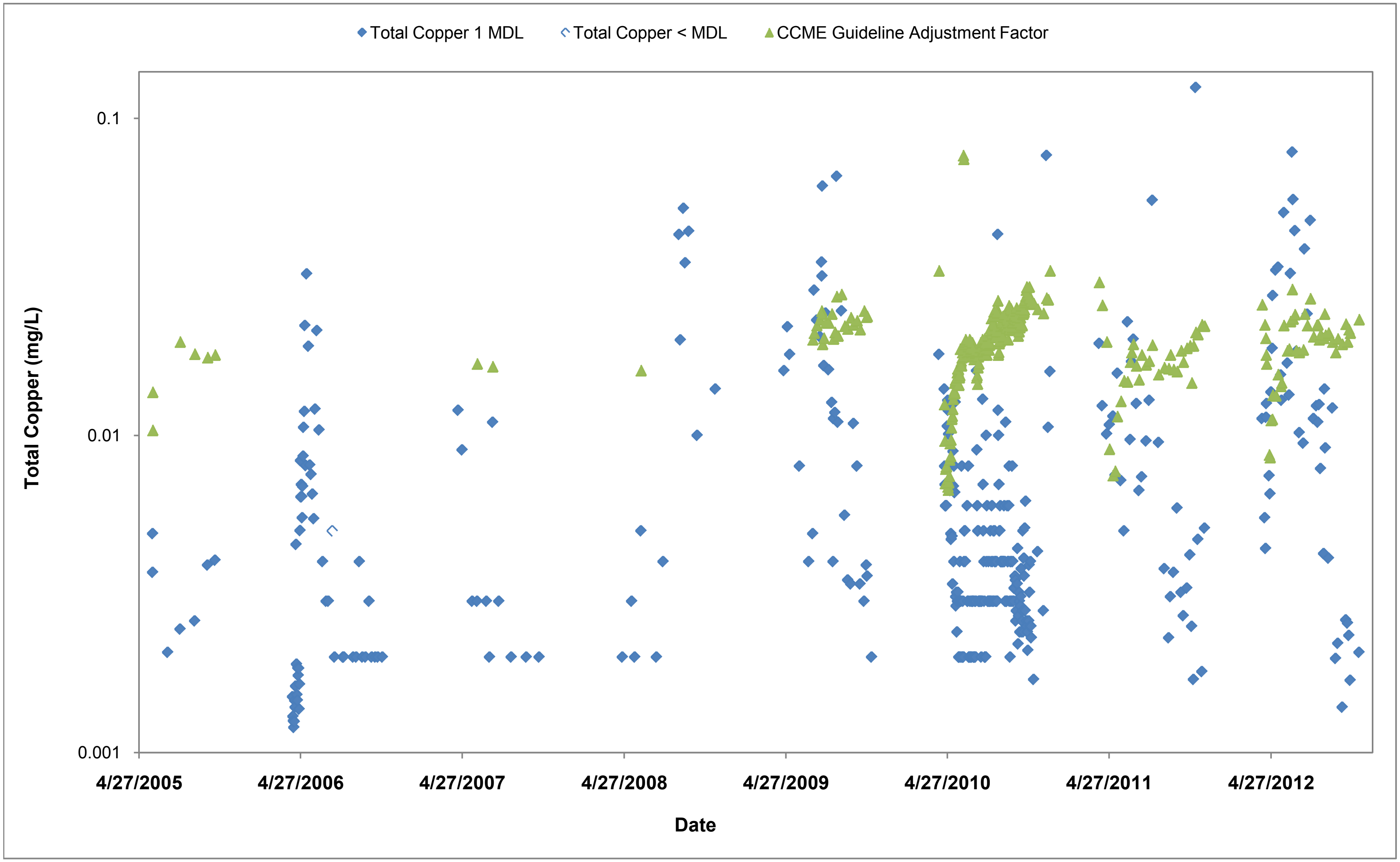
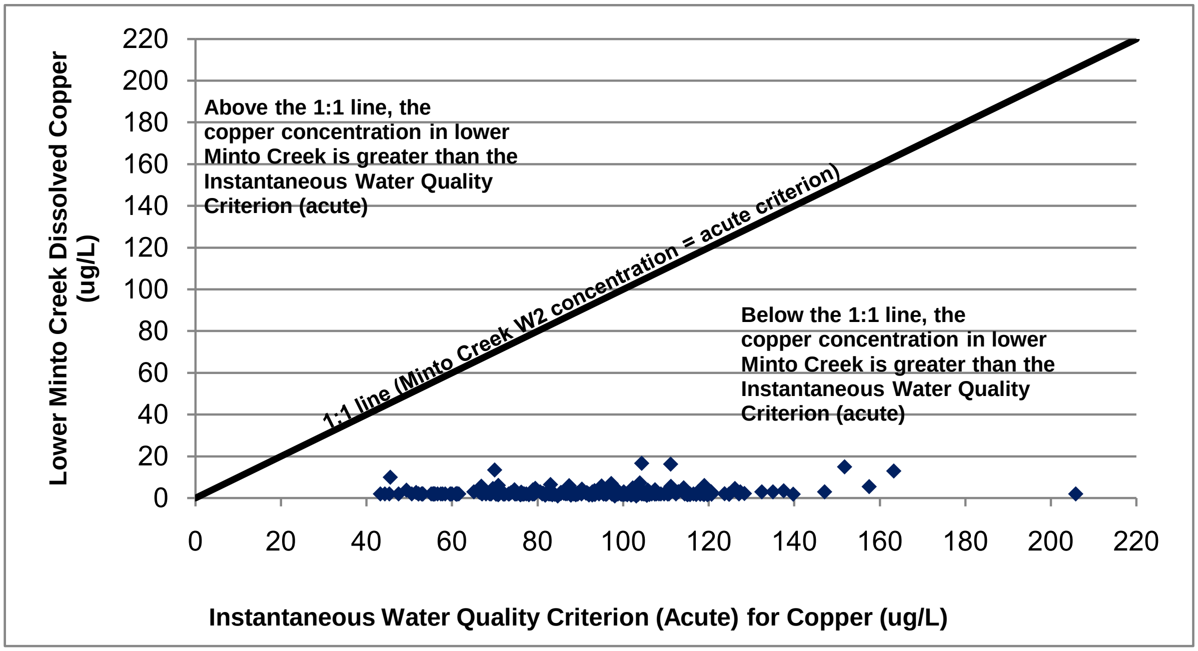


Figure 3: Total copper (mg/L) at Minto Creek from 2006 to 2012 relative to the WERP-derived SSWQO (CWQG * 5.8). Values with open points were less than MDL.



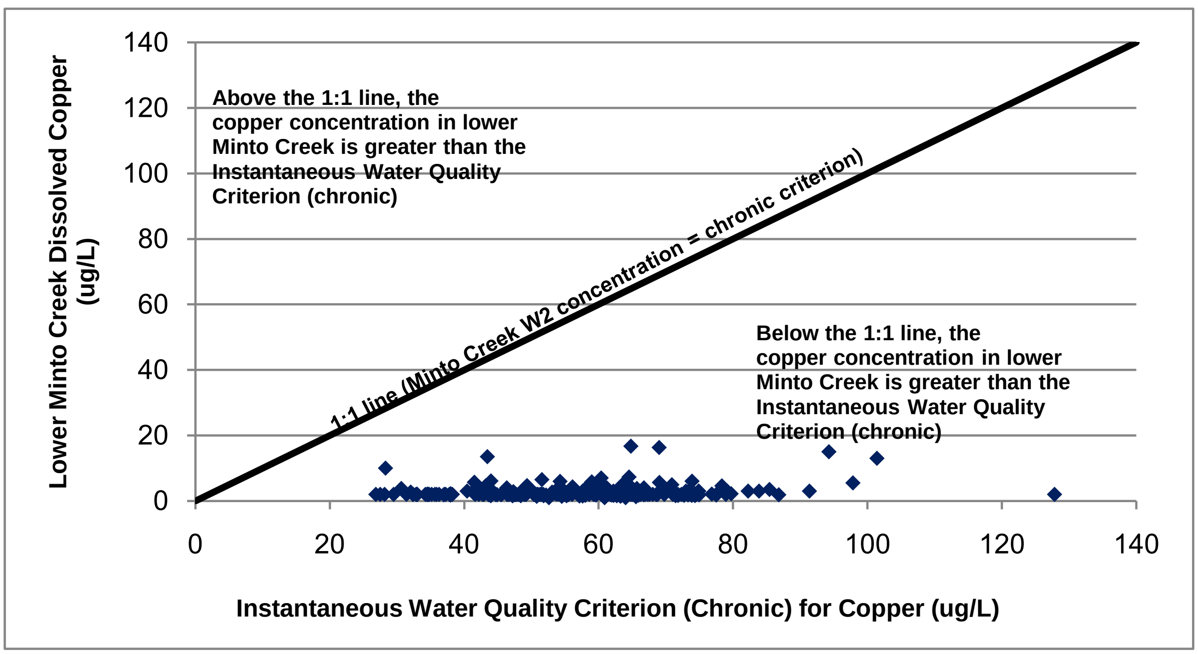


Figure 4: Minto Creek Copper relative to Instantaneous Water Quality Criteria: a) Acute; b) Chronic.

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recognized that dissolved copper better represents the bioavailable fraction of copper as particle-associated copper is not generally bioavailable (e.g., Morel 1983).

The bioavailability of copper is determined by a number of abiotic and biotic factors. Water quality characteristics such as pH, alkalinity, hardness, and dissolved organic carbon are important determinants of copper bioavailability, mainly through copper complexation and competition for uptakes sites at an organism (Morel 1983; Pagenkopf 1983; DiToro et al. 2001; Paquin et al. 2002; Niyogi and Wood 2004; USEPA 2007). In recognition of water quality conditions in lower Minto creek that would be expected to result in much lower than average copper bioavailability, Water-Effect Ratio (WER) testing was conducted in 2009 and documented that it took 5.8 times more copper to cause toxicity in lower Minto Creek water than in laboratory water (Minnow 2009). Accordingly, the Canadian Water Quality Guideline (CWQG) for copper was determined to be 5.8 times overprotective for Minto Creek. As there have been no apparent changes in the key factors influencing copper bioavailability in lower Minto Creek (Appendix Figure 5) and concerns over the potentially greater sensitivity of fish olfaction versus conventional toxicity endpoints have been addressed (Meyer and Adams 2010; Kennedy et al. 2012), application of the WER is supported. Application of 5.8-times the applicable copper CWQG to evaluate concentrations of total copper in lower Minto Creek indicates an exceedance frequency of 9% (Figure 3).

Copper concentrations in water of lower Minto Creek were also evaluated using the Biotic Ligand Model (BLM; DiToro et al. 2001; Santore et al. 2001; USEPA 2007). This model accounts for the major water quality characteristics that affect copper bioavailability through complexation and competition. The model can provide toxicity estimates under different water quality conditions and calculates the USEPA (2007) acute and chronic criteria for copper applicable under different water conditions (Instantaneous Water Quality Criteria; IWQC). The IWQC derived by BLM are called “instantaneous” because they specifically apply to the water quality conditions encountered at that instant. They are based on dissolved copper which better represents bioavailable copper than does total copper. BLM results for water quality data available for Minto Creek (2006-2012) indicate that there has never been an instance of exceedence of an acute or chronic criterion for copper in lower Minto Creek (Figure 4). The average instantaneous acute criterion was 0.091 mg/L and the average instantaneous chronic criterion was 0.057 mg/L; minimums were 0.043 and 0.027 mg/L, respectively). Toxic units (the ratio of measured copper concentration to the concurrent IWQC) have been very low (Figure 5), indicating no risk of copper-associated toxicity. The highest acute toxic unit result was 0.22 toxic units. Under average conditions, copper in lower Minto Creek was present at 0.056 chronic toxic units (0.037 under

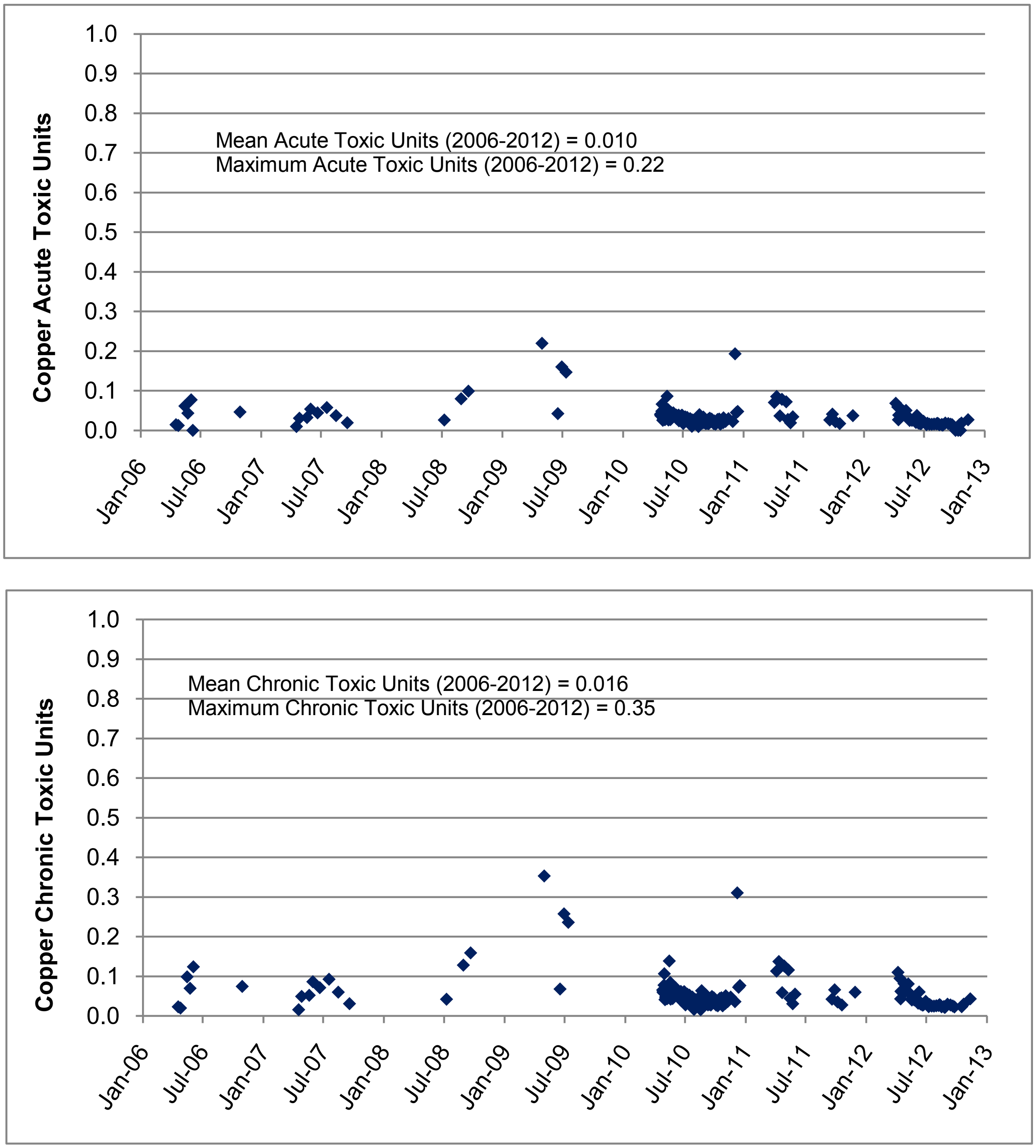

Figure 5: Copper Toxic Unit Plots. a) Acute; b) Chronic.

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median conditions). To put this into perspective, at 0.056 chronic toxic units, it would take chronic exposure to an approximate 18x greater concentration of dissolved copper to become toxic.

Biological Monitoring

Biological monitoring has been undertaken under the federal Environmental Effects Monitoring (EEM) program (Minnow/Access 2009; 2012) and under the WUL (Minnow 2011; 2012b; Minnow 2013). EEM studies have investigated the erosional benthic invertebrate community of upper Minto Creek and have shown greater benthic invertebrate density and subtle differences in community composition (including fewer EPT taxa [Ephemeroptera, Plecoptera and Trichoptera or mayflies, stoneflies and caddisflies, respectively] in both cycles and more oligichaetes [worms] and chironomids [non-biting midges] in Cycle 1 and Cycle 2, respectively). These differences are consistent with a modest stimulatory effect and generally appeared to be related to higher temperature (mine-related due to heating of water in the Water Storage Pond) and a combination of alkalinity, conductivity and concentrations of mine-related metals. The Cycle 2 fish study documented moderately greater growth of juvenile Chinook salmon reared in site water (Minto Creek water mixed with 12% Minto Water Storage Pond [WSP] water) relative to hatchery water. Overall, EEM has indicated a slight stimulation of the upper Minto Creek benthic invertebrate community and stimulation of fish reared in mixtures of lower Minto Creek water and WSP water. The cause of the observed differences in the benthic invertebrate community of upper Minto Creek relative to reference will be specifically investigated under federal EEM in 2014.

Annual WUL monitoring has assessed both erosional and depositional benthic invertebrate communities of lower Minto Creek. In 2010, monitoring of the depositional benthic invertebrate community of lower Minto Creek indicated greater density, more taxa, lower evenness and some subtle community level differences which appeared to be indicative of stimulation. In 2011, sediment toxicity testing indicated no effects on the survival or growth of the *Hyalella azteca* (an amphipod) and *Chironomus dilutus* (a midge larva). In 2011, the erosional benthic invertebrate community of lower Minto Creek had greater density, lower taxon richness and some community level differences (fewer EPT, fewer oligochates and more nematodes) relative to reference, but application of several approaches to data interpretation (Control-Impact comparisons and the Reference Condition Approach) did not provide any clear evidence of any impact to the erosional benthic invertebrate community of lower Minto Creek. In 2012, the benthic invertebrate community of lower Minto Creek differed from reference on the basis of density (lower), taxon richness (higher), Simpson's Diversity (higher), Bray-Curtis dissimilarity (greater), percent chironomids (lower), as well as for the first axis of Correspondence Analysis. A number of these differences were completely opposite to those observed in 2011, indicating high temporal variability (observed in both exposed and reference areas), presumably due to inter-annual variability in environmental conditions (e.g., flow, ice scour).

Overall, biological monitoring of Minto Creek and comparison to reference has demonstrated high temporal variability. The only consistent differences in benthic invertebrate communities of lower Minto Creek relative to reference appears to have been stimulatory rather than inhibitory and thus are not what would be expected of a toxic effect of copper.

Summary

Water quality of lower Minto Creek, collected from 2006-2012, were used to assess the receiving water quality standard for copper of 0.013 mg/L as required under Clause 94 of the WUL (Amendment 8). The evaluation demonstrated that the WUL standard for copper is not appropriate. Not only is it not appropriate as a standard by definition, more sophisticated means assessing the potential impact of copper suggest that it is generally overprotective. Application of the Water-Effect Ratio (WER) for Minto Creek and of Instantaneous Water Quality Criteria (IWQC) both serve to provide more effective evaluation of the potential for copper-related effects in Minto Creek. Either approach could be applied to define objectives for lower Minto Creek. In particular, application of the BLM-determined IWQC, which matches copper concentrations to the water quality conditions in which they occur, clearly suggest that copper concentrations have been much lower than concentrations associated with adverse effects to aquatic life (there has never been an instance of exceedence of an acute or chronic criterion for copper in lower Minto Creek). Furthermore, biological monitoring results do not point to any copper-related effects in lower Minto Creek, rather they suggest a potential stimulation due to higher temperature that is, in turn dwarfed by natural variability.

Overall, available data suggest that the WUL standard for copper in lower Minto Creek is unnecessarily low. In fact, the lowest IWQC observed in the seven year water quality dataset for lower Minto Creek was 0.027 mg/L dissolved copper (even the highest recorded dissolved copper [for which the matching IWQC was similarly high] over the same period was 0.023 mg/L). This evaluation has clearly demonstrated the utility of the BLM IWQC in evaluating potential copper-related effects. Accordingly, it is suggested

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that this approach be applied in the interpretation of the water quality of lower Minto Creek. Alternatively, if a "one number" approach is required, and given that olfactory concerns have been addressed, it is suggested that the WERP-based SSWQO of 0.017 mg/L copper could be applied as a screening tool (but not as a standard) and that any concentrations greater than 0.017 mg/L could then be investigated as recommended in 2009 (Minnow 2009). Specifically, it is still recommended that exceedence trigger more detailed examination of the data including comparison to background concentrations of dissolved metals and comparison to the relationships between background concentrations of total metals and TSS. In addition, it is strongly recommended that the examination include BLM to determine if any adverse effect would be predicted due to the copper concentration (exceedence concentration) under the specific water quality conditions in which it occurred.

I trust that this brief letter addresses Clause 94 to your satisfaction. If you require more detailed analysis or discussion of any of the items covered in this brief letter, I would be pleased to provide it. If you have any comments or questions on the content of this letter, I would be pleased to discuss them with you.

Sincerely,
Minnow Environmental Inc.

Pierre Stecko, M.Sc., EP, RPBio
Senior Aquatic Scientist / Principal

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Victoria, BC, V8T 2A2

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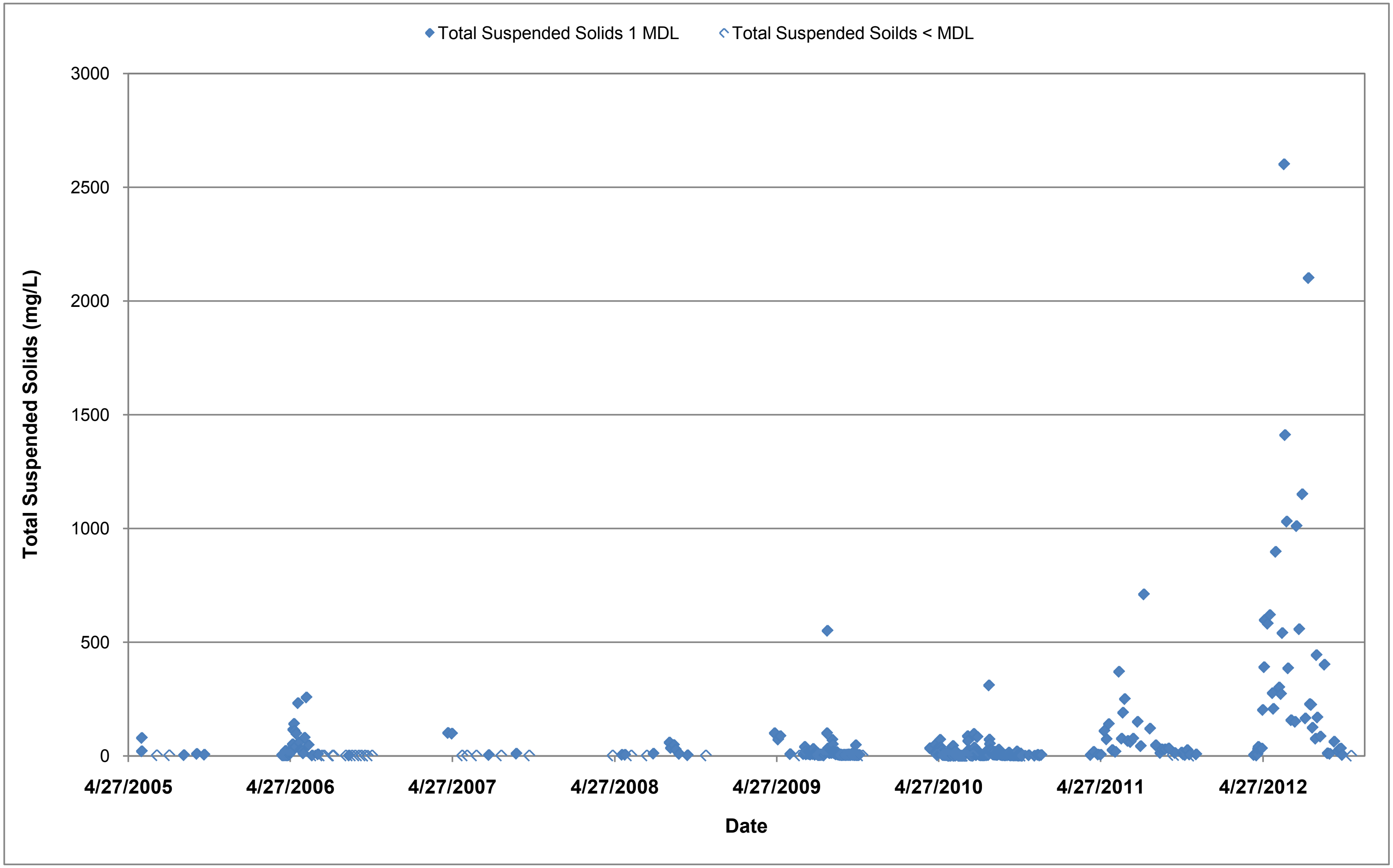
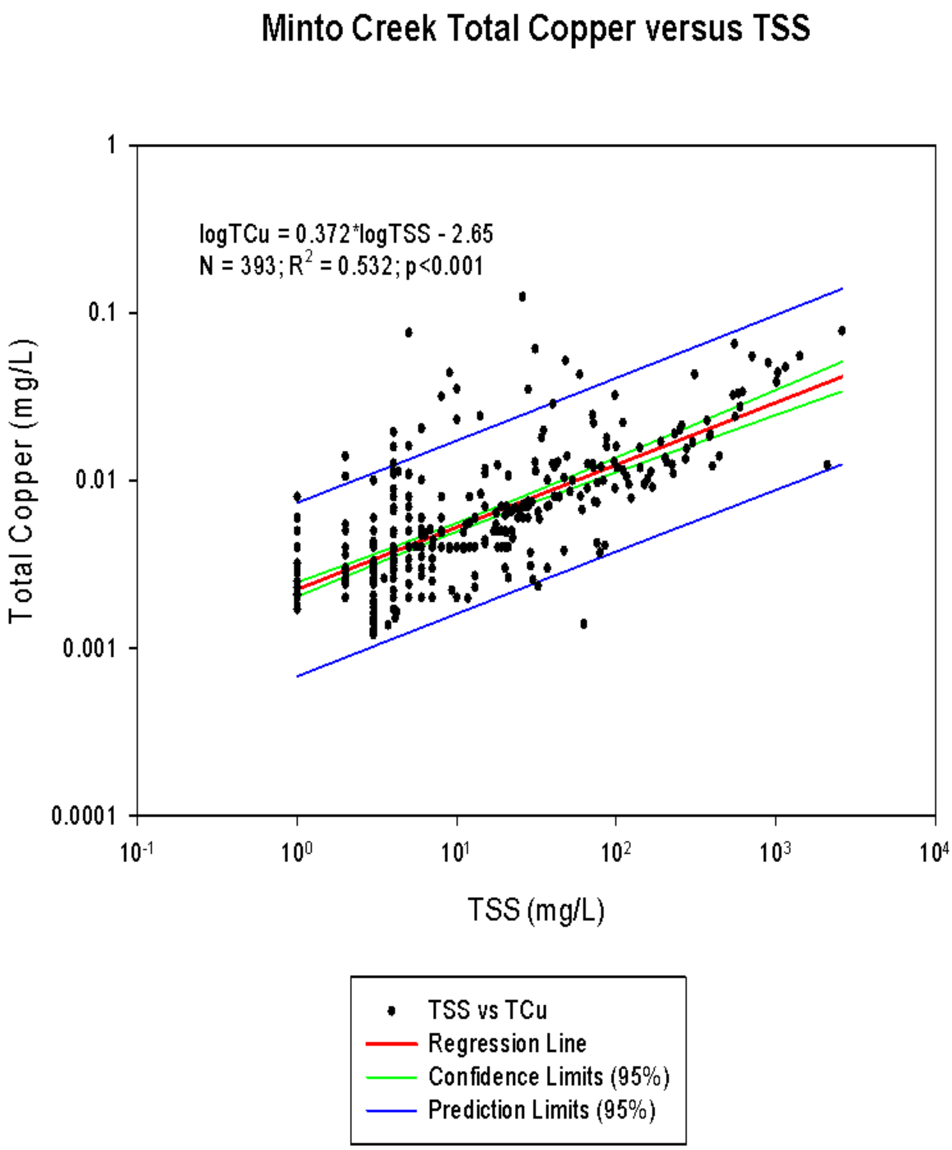
APPENDIX

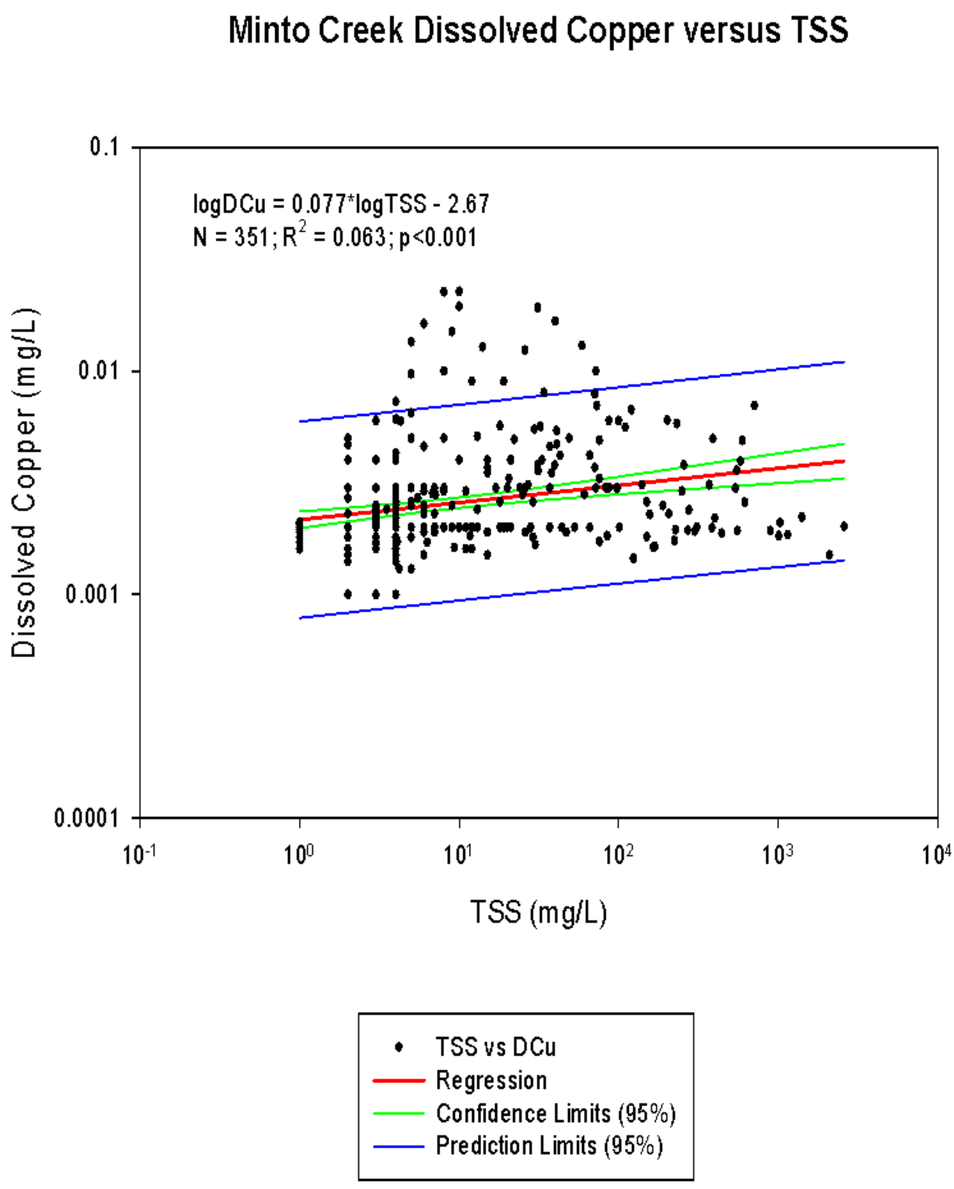
ADDITIONAL PLOTS



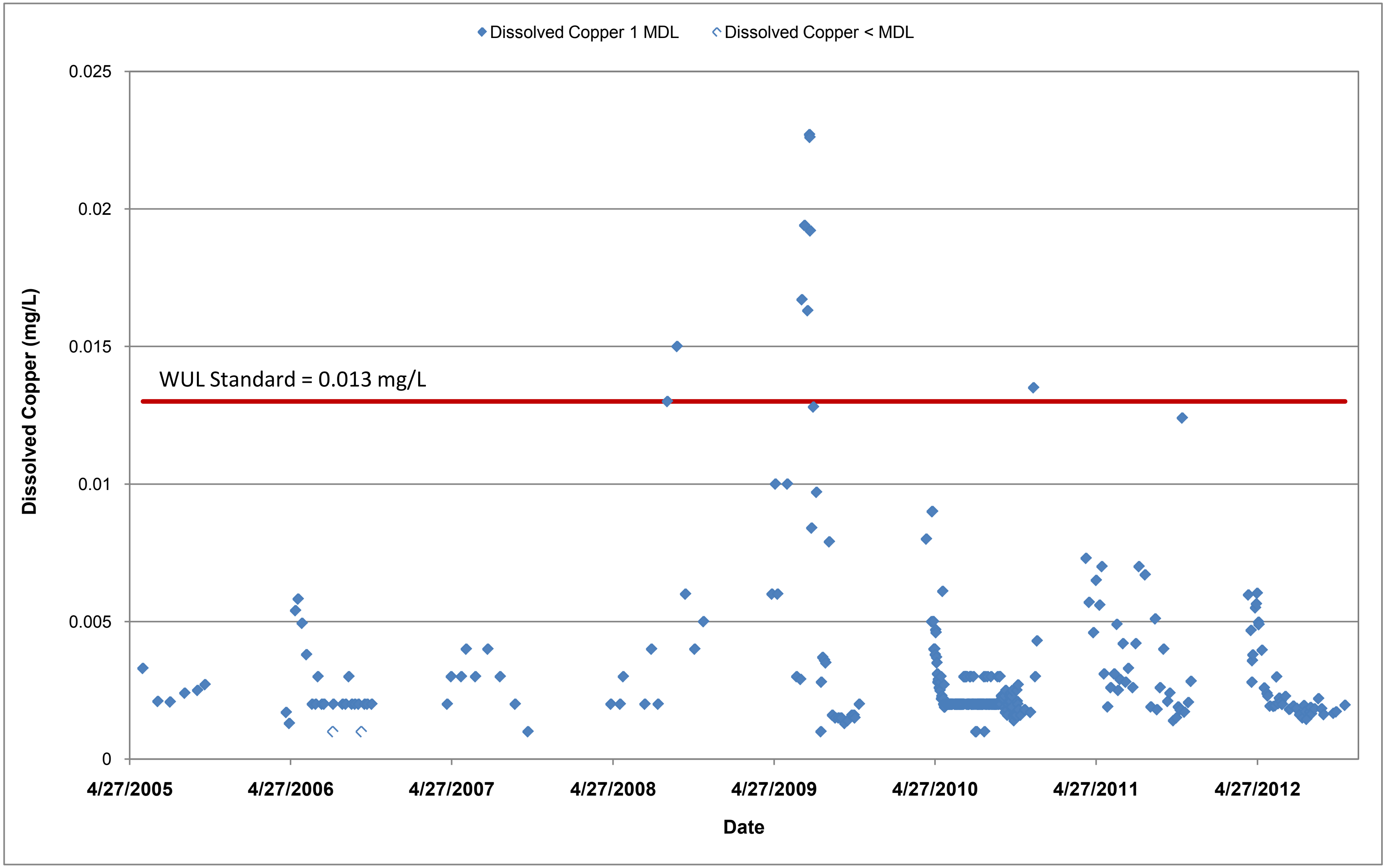
Appendix Figure 1: Total suspended solids (mg/L) at Minto Creek from 2006 to 2012. Values with open points were < MDL.



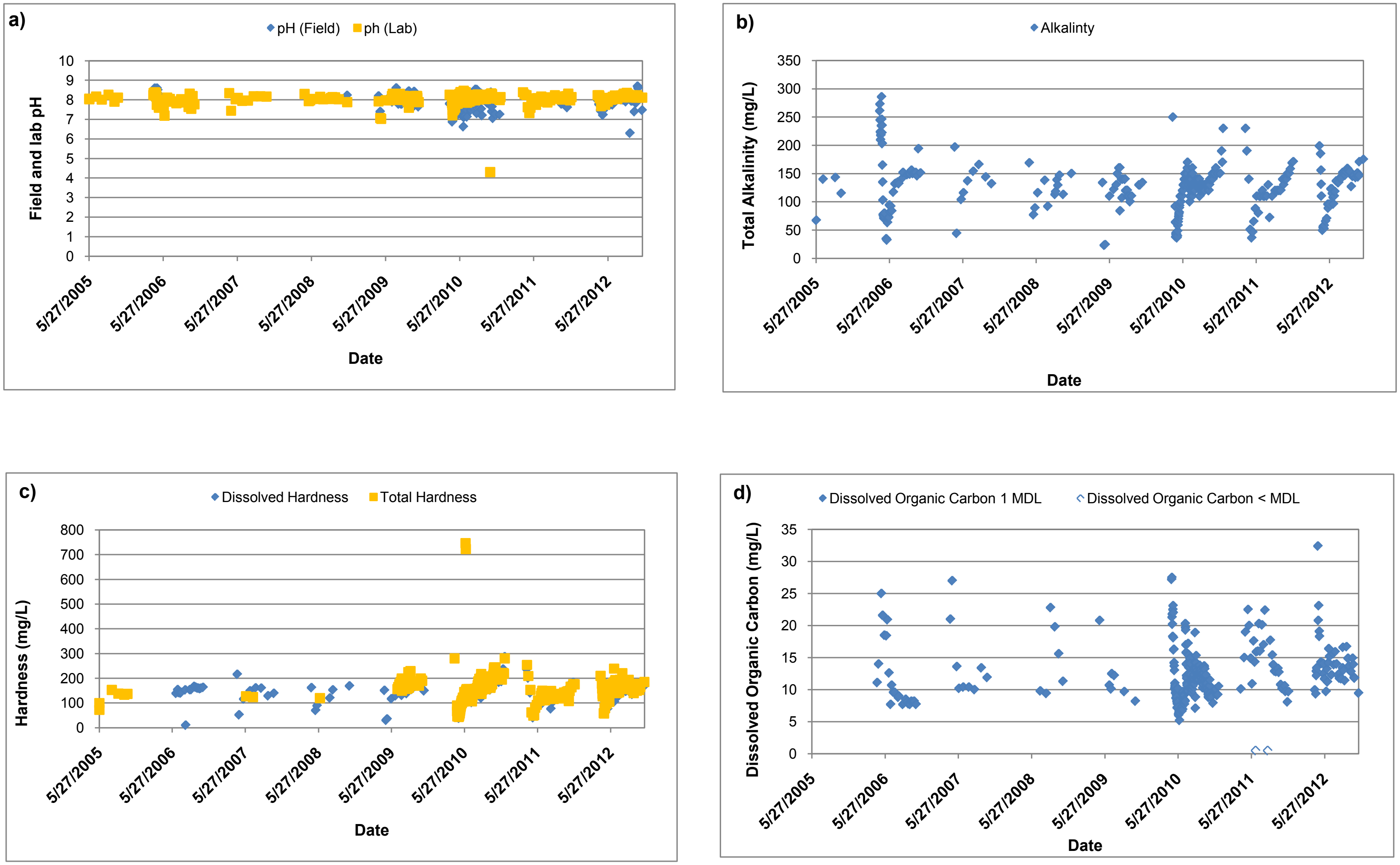
Appendix Figure 2: Total copper (mg/L) compared to TSS (mg/L) at Minto Creek



Appendix Figure 3: Dissolved copper (mg/L) compared to TSS (mg/L) at Minto Creek.



Appendix Figure 4: Dissolved Copper (mg/L) at Minto Creek from 2005 to 2012 relative to the Water Use Licence Standard. Values with open points were less than MDL.



Appendix Figure 5: Additional analyte plots at Minto Creek from 2005 to 2012. a) Field and lab pH, b) Alkalinity (mg/L) c) dissolved and total hardness (mg/L) d) dissolved organic carbon (mg/L). Values with open points were less than MDL

Appendix H: Groundwater Laboratory Results

Maxxam

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Your P.O. #: 113976
Your Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your C.O.C. #: EB456212

Attention: James Spencer
MINTO EXPLORATIONS LTD.
Yukon/Whitehorse
2 - 25 Pilgrim Way
Whitehorse, YT
CANADA Y1A 6E6

Report Date: 2012/05/23

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B239909
Received: 2012/05/15, 14:04

Sample Matrix: Water
Samples Received: 7

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	6	2012/05/16	2012/05/16	BBY6SOP-00026	SM2320B
Chloride by Automated Colourimetry	6	N/A	2012/05/16	BBY6SOP-00011	SM-4500-Cl-
Conductance - water	6	N/A	2012/05/16	BBY6SOP-00026	SM-2510B
Fluoride	6	N/A	2012/05/18	BBY6SOP-00038	SM - 4500 F C
Hardness (calculated as CaCO3)	1	N/A	2012/05/19	BBY WI-00033	Calculated Parameter
Hardness (calculated as CaCO3)	6	N/A	2012/05/23	BBY WI-00033	Calculated Parameter
Mercury (Dissolved) by CVAF	7	N/A	2012/05/18	65-A-002-10	EPA 1631B
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	1	N/A	2012/05/19	BBY7SOP-00002	EPA 6020A
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	6	N/A	2012/05/23	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (dissolved)	1	N/A	2012/05/19	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (dissolved)	6	N/A	2012/05/22	BBY7SOP-00002	EPA 6020A
Ammonia (N)	1	N/A	2012/05/16	BBY6SOP-00009	SM-4500NH3G
Ammonia-N	5	N/A	2012/05/16	BBY6SOP-00009	SM-4500NH3G
Nitrate + Nitrite (N)	6	N/A	2012/05/16	BBY6SOP-00010	USEPA 353.2
Nitrite (N) by CFA	6	N/A	2012/05/16	BBY6SOP-00010	EPA 353.2
Nitrogen - Nitrate (as N)	6	N/A	2012/05/18	BBY6SOP-00010	Based on EPA 353.2
Filter and HNO3 Preserve for Metals	7	N/A	2012/05/15	BBY6WI-00001	EPA 200.2
pH Water	6	N/A	2012/05/16	BBY6SOP-00026	SM-4500H+B
Sulphate by Automated Colourimetry	5	N/A	2012/05/16	BBY6SOP-00017	SM4500-SO42
Sulphate by Automated Colourimetry	1	N/A	2012/05/17	BBY6SOP-00017	SM4500-SO42
Total Dissolved Solids (Filt. Residue)	6	2012/05/17	2012/05/17	BBY6SOP-00033	SM 2540C
Total Phosphorus	6	N/A	2012/05/16	BBY6SOP-00013	SM 4500 PE

* Results relate only to the items tested.

Encryption Key

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

Kelly Janda, B.Sc, Burnaby Project Manager
Email: KJanda@maxxam.ca
Phone# (604) 638-5019

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

Total cover pages: 1

Maxxam Job #: B239909
Report Date: 2012/05/23

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		DK6058		DK6059	DK6060		
Sampling Date		2012/05/10		2012/05/10	2012/05/10		
	Units	**MW09-03-02**	**QC Batch**	**MW09-03-03**	**MW09-03-05**	**RDL**	**QC Batch**
ANIONS							
Nitrite (N)	mg/L	0.171(1)	5847598	0.0145(1)	<0.0050(1)	0.0050	5847598
Calculated Parameters							
Filter and HNO3 Preservation	N/A	FIELD	ONSITE	FIELD	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.100	5844306	0.302	<0.020	0.020	5844306
Misc. Inorganics							
Fluoride (F)	mg/L	0.750	5854073	0.300	<0.010	0.010	5854073
Alkalinity (Total as CaCO3)	mg/L	464	5846290	78.6	0.83	0.50	5846290
Alkalinity (PP as CaCO3)	mg/L	<0.50	5846290	<0.50	<0.50	0.50	5846290
Bicarbonate (HCO3)	mg/L	566	5846290	95.9	1.01	0.50	5846290
Carbonate (CO3)	mg/L	<0.50	5846290	<0.50	<0.50	0.50	5846290
Hydroxide (OH)	mg/L	<0.50	5846290	<0.50	<0.50	0.50	5846290
Anions							
Dissolved Sulphate (SO4)	mg/L	<0.50	5851448	11.2	<0.50	0.50	5847437
Dissolved Chloride (Cl)	mg/L	4.3	5847426	0.54	<0.50	0.50	5847426
Nutrients							
Ammonia (N)	mg/L	0.23	5845433	<0.0050	0.0069	0.0050	5845433
Nitrate plus Nitrite (N)	mg/L	0.271(1)	5847595	0.316(1)	<0.020(1)	0.020	5847595
Total Phosphorus (P)	mg/L	0.0093	5845209	<0.0050	<0.0050	0.0050	5845209
Physical Properties							
Conductivity	uS/cm	965	5846299	181	1.9	1.0	5846299
pH	pH Units	7.59	5846300	7.92	5.93		5846300
Physical Properties							
Total Dissolved Solids	mg/L	716	5848614	106	<10	10	5848614

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Samples arrived to laboratory past recommended hold time.

Maxxam Job #: B239909
Report Date: 2012/05/23

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		DK6061		DK6062		DK6063	DK6064		
Sampling Date		2012/05/10		2012/05/10		2012/05/11	2012/05/11		
	Units	**MW09-03-01**	**QC Batch**	**TB**	**QC Batch**	**REAGENT**	**EB**	**RDL**	**QC Batch**
ANIONS									
Nitrite (N)	mg/L	0.182(1)	5847598	<0.0050(1)	5847598	<0.0050(1)		0.0050	5847598
Calculated Parameters									
Filter and HNO3 Preservation	N/A	FIELD	ONSITE	FIELD	ONSITE	FIELD	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.109	5844306	<0.020	5844306	<0.020		0.020	5844306
Misc. Inorganics									
Fluoride (F)	mg/L	0.870	5854073	<0.010	5854073	0.870		0.010	5854073
Alkalinity (Total as CaCO3)	mg/L	133	5846290	0.57	5846290	0.87		0.50	5846290
Alkalinity (PP as CaCO3)	mg/L	<0.50	5846290	<0.50	5846290	<0.50		0.50	5846290
Bicarbonate (HCO3)	mg/L	162	5846290	0.70	5846290	1.06		0.50	5846290
Carbonate (CO3)	mg/L	<0.50	5846290	<0.50	5846290	<0.50		0.50	5846290
Hydroxide (OH)	mg/L	<0.50	5846290	<0.50	5846290	<0.50		0.50	5846290
Anions									
Dissolved Sulphate (SO4)	mg/L	21.4	5847437	<0.50	5847437	<0.50		0.50	5847437
Dissolved Chloride (Cl)	mg/L	<0.50	5847426	<0.50	5847426	<0.50		0.50	5847426
Nutrients									
Ammonia (N)	mg/L	0.073	5845433	0.0186(1)	5845432	0.017		0.0050	5845433
Nitrate plus Nitrite (N)	mg/L	0.290(1)	5847595	<0.020(1)	5847595	<0.020(1)		0.020	5847595
Total Phosphorus (P)	mg/L	0.0158	5845209	<0.0050	5845209	<0.0050		0.0050	5845209
Physical Properties									
Conductivity	uS/cm	302	5846299	1.1	5846299	1.3		1.0	5846299
pH	pH Units	7.99	5846300	6.03	5846300	6.14			5846300
Physical Properties									
Total Dissolved Solids	mg/L	162	5848614	<10	5848614	<10		10	5848614

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Samples arrived to laboratory past recommended hold time.

Maxxam Job #: B239909
Report Date: 2012/05/23

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		DK6058	DK6059	DK6060	DK6061		DK6062		DK6063	DK6064		
Sampling Date		2012/05/10	2012/05/10	2012/05/10	2012/05/10		2012/05/10		2012/05/11	2012/05/11		
	Units	**MW09-03-02**	**MW09-03-03**	**MW09-03-05**	**MW09-03-01**	**QC Batch**	**TB**	**QC Batch**	**REAGENT**	**EB**	**RDL**	**QC Batch**
Misc. Inorganics												
Dissolved Hardness (CaCO3)	mg/L	481	84.1	<0.50	146	5840747	<0.50	5840747	<0.50	<0.50	0.50	5840747
Elements												
Dissolved Mercury (Hg)	ug/L	<0.010	<0.010	<0.010	<0.010	5851706	<0.010	5851706	<0.010	<0.010	0.010	5851706

RDL = Reportable Detection Limit

Maxxam Job #: B239909
Report Date: 2012/05/23

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		DK6058	DK6059	DK6060	DK6061		DK6062		DK6063	DK6064		
Sampling Date		2012/05/10	2012/05/10	2012/05/10	2012/05/10		2012/05/10		2012/05/11	2012/05/11		
	Units	**MW09-03-02**	**MW09-03-03**	**MW09-03-05**	**MW09-03-01**	**QC Batch**	**TB**	**QC Batch**	**REAGENT**	**EB**	**RDL**	**QC Batch**
Dissolved Metals by ICPMS												
Dissolved Aluminum (Al)	ug/L	13.0	3.5	<3.0	5.4	5845177	<3.0	5845719	4.6	3.2	3.0	5845177
Dissolved Antimony (Sb)	ug/L	<0.50	<0.50	<0.50	<0.50	5845177	<0.50	5845719	<0.50	<0.50	0.50	5845177
Dissolved Arsenic (As)	ug/L	0.72	<0.10	<0.10	<0.10	5845177	<0.10	5845719	<0.10	<0.10	0.10	5845177
Dissolved Barium (Ba)	ug/L	774	39.6	<1.0	44.5	5845177	<1.0	5845719	<1.0	<1.0	1.0	5845177
Dissolved Beryllium (Be)	ug/L	<0.10	<0.10	<0.10	<0.10	5845177	<0.10	5845719	<0.10	<0.10	0.10	5845177
Dissolved Bismuth (Bi)	ug/L	<1.0	<1.0	<1.0	<1.0	5845177	<1.0	5845719	<1.0	<1.0	1.0	5845177
Dissolved Boron (B)	ug/L	375	<50	<50	143	5845177	<50	5845719	<50	<50	50	5845177
Dissolved Cadmium (Cd)	ug/L	0.028	0.069	<0.010	0.085	5845177	<0.010	5845719	<0.010	<0.010	0.010	5845177
Dissolved Chromium (Cr)	ug/L	<1.0	<1.0	<1.0	<1.0	5845177	<1.0	5845719	<1.0	<1.0	1.0	5845177
Dissolved Cobalt (Co)	ug/L	2.44	<0.50	<0.50	<0.50	5845177	<0.50	5845719	<0.50	<0.50	0.50	5845177
Dissolved Copper (Cu)	ug/L	1.07	3.20	0.22	2.81	5845177	<0.20	5845719	0.40	1.02	0.20	5845177
Dissolved Iron (Fe)	ug/L	19200	16.4	<5.0	<5.0	5845177	<5.0	5845719	<5.0	5.3	5.0	5845177
Dissolved Lead (Pb)	ug/L	<0.20	<0.20	<0.20	<0.20	5845177	<0.20	5845719	<0.20	<0.20	0.20	5845177
Dissolved Lithium (Li)	ug/L	<5.0	<5.0	<5.0	<5.0	5845177	<5.0	5845719	<5.0	<5.0	5.0	5845177
Dissolved Manganese (Mn)	ug/L	22100	234	<1.0	85.2	5845177	<1.0	5845719	<1.0	<1.0	1.0	5845177
Dissolved Molybdenum (Mo)	ug/L	17.2	6.1	<1.0	5.4	5845177	<1.0	5845719	<1.0	<1.0	1.0	5845177
Dissolved Nickel (Ni)	ug/L	<1.0	<1.0	<1.0	2.1	5845177	<1.0	5845719	<1.0	<1.0	1.0	5845177
Dissolved Phosphorus (P)	ug/L	<10	<10	<10	12	5845177	<10	5845719	<10	<10	10	5845177
Dissolved Selenium (Se)	ug/L	0.20	0.31	<0.10	<0.10	5845177	<0.10	5845719	<0.10	<0.10	0.10	5845177
Dissolved Silicon (Si)	ug/L	9030	4310	<100	4560	5845177	<100	5845719	<100	<100	100	5845177
Dissolved Silver (Ag)	ug/L	<0.020	<0.020	<0.020	<0.020	5845177	<0.020	5845719	<0.020	<0.020	0.020	5845177
Dissolved Strontium (Sr)	ug/L	1580	158	<1.0	798	5845177	<1.0	5845719	<1.0	<1.0	1.0	5845177
Dissolved Thallium (Tl)	ug/L	<0.050	<0.050	<0.050	<0.050	5845177	<0.050	5845719	<0.050	<0.050	0.050	5845177
Dissolved Tin (Sn)	ug/L	<5.0	<5.0	<5.0	<5.0	5845177	<5.0	5845719	<5.0	<5.0	5.0	5845177
Dissolved Titanium (Ti)	ug/L	<5.0	<5.0	<5.0	<5.0	5845177	<5.0	5845719	<5.0	<5.0	5.0	5845177
Dissolved Uranium (U)	ug/L	0.16	0.69	<0.10	1.58	5845177	<0.10	5845719	<0.10	<0.10	0.10	5845177
Dissolved Vanadium (V)	ug/L	<5.0	<5.0	<5.0	<5.0	5845177	<5.0	5845719	<5.0	<5.0	5.0	5845177
Dissolved Zinc (Zn)	ug/L	5.3	7.8	<5.0	17.1	5845177	<5.0	5845719	<5.0	<5.0	5.0	5845177
Dissolved Zirconium (Zr)	ug/L	<0.50	<0.50	<0.50	<0.50	5845177	<0.50	5845719	<0.50	<0.50	0.50	5845177
Dissolved Calcium (Ca)	mg/L	154	28.1	<0.050	42.0	5841368	<0.050	5841368	<0.050	<0.050	0.050	5841368
Dissolved Magnesium (Mg)	mg/L	23.4	3.36	<0.050	10.0	5841368	<0.050	5841368	<0.050	<0.050	0.050	5841368
Dissolved Potassium (K)	mg/L	4.44	1.80	<0.050	2.70	5841368	<0.050	5841368	<0.050	<0.050	0.050	5841368
Dissolved Sodium (Na)	mg/L	15.8	3.13	0.222	5.59	5841368	<0.050	5841368	<0.050	<0.050	0.050	5841368
Dissolved Sulphur (S)	mg/L	<3.0	4.1	<3.0	8.3	5841368	<3.0	5841368	<3.0	<3.0	3.0	5841368

RDL = Reportable Detection Limit

General Comments

Sample DK6058-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DK6059-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DK6060-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DK6061-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DK6062-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DK6063-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

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Success Through Science®

Maxxam Job #: B239909
Report Date: 2012/05/23

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
5845177	Dissolved Aluminum (Al)	2012/05/22	99	80 - 120	103	80 - 120	<3.0	ug/L	0.7	20
5845177	Dissolved Antimony (Sb)	2012/05/22	102	80 - 120	105	80 - 120	<0.50	ug/L	NC	20
5845177	Dissolved Arsenic (As)	2012/05/22	97	80 - 120	100	80 - 120	<0.10	ug/L	5.3	20
5845177	Dissolved Barium (Ba)	2012/05/22	NC	80 - 120	100	80 - 120	<1.0	ug/L	1.6	20
5845177	Dissolved Beryllium (Be)	2012/05/22	99	80 - 120	97	80 - 120	<0.10	ug/L	NC	20
5845177	Dissolved Bismuth (Bi)	2012/05/22	93	80 - 120	102	80 - 120	<1.0	ug/L	NC	20
5845177	Dissolved Cadmium (Cd)	2012/05/22	103	80 - 120	101	80 - 120	<0.010	ug/L	NC	20
5845177	Dissolved Chromium (Cr)	2012/05/22	97	80 - 120	99	80 - 120	<1.0	ug/L	NC	20
5845177	Dissolved Cobalt (Co)	2012/05/22	94	80 - 120	99	80 - 120	<0.50	ug/L	NC	20
5845177	Dissolved Copper (Cu)	2012/05/22	92	80 - 120	93	80 - 120	<0.20	ug/L	0.6	20
5845177	Dissolved Iron (Fe)	2012/05/22	NC	80 - 120	111	80 - 120	<5.0	ug/L	1.7	20
5845177	Dissolved Lead (Pb)	2012/05/22	97	80 - 120	98	80 - 120	<0.20	ug/L	NC	20
5845177	Dissolved Lithium (Li)	2012/05/22	97	80 - 120	96	80 - 120	<5.0	ug/L	NC	20
5845177	Dissolved Manganese (Mn)	2012/05/22	NC	80 - 120	104	80 - 120	<1.0	ug/L	2.5	20
5845177	Dissolved Molybdenum (Mo)	2012/05/22	NC	80 - 120	99	80 - 120	<1.0	ug/L	NC	20
5845177	Dissolved Nickel (Ni)	2012/05/22	94	80 - 120	96	80 - 120	<1.0	ug/L	NC	20
5845177	Dissolved Selenium (Se)	2012/05/22	113	80 - 120	112	80 - 120	<0.10	ug/L	NC	20
5845177	Dissolved Silver (Ag)	2012/05/22	102	80 - 120	102	80 - 120	<0.020	ug/L	NC	20
5845177	Dissolved Strontium (Sr)	2012/05/22	NC	80 - 120	101	80 - 120	<1.0	ug/L	0.2	20
5845177	Dissolved Thallium (Tl)	2012/05/22	108	80 - 120	109	80 - 120	<0.050	ug/L	NC	20
5845177	Dissolved Tin (Sn)	2012/05/22	95	80 - 120	103	80 - 120	<5.0	ug/L	NC	20
5845177	Dissolved Titanium (Ti)	2012/05/22	89	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
5845177	Dissolved Uranium (U)	2012/05/22	101	80 - 120	100	80 - 120	<0.10	ug/L	NC	20
5845177	Dissolved Vanadium (V)	2012/05/22	98	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
5845177	Dissolved Zinc (Zn)	2012/05/22	99	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
5845177	Dissolved Boron (B)	2012/05/22					<50	ug/L	NC	20
5845177	Dissolved Phosphorus (P)	2012/05/22					<10	ug/L	NC	20
5845177	Dissolved Silicon (Si)	2012/05/22					<100	ug/L	7.1	20
5845177	Dissolved Zirconium (Zr)	2012/05/22					<0.50	ug/L	NC	20
5845209	Total Phosphorus (P)	2012/05/16	NC	80 - 120	100	80 - 120	<0.0050	mg/L	NC	20
5845432	Ammonia (N)	2012/05/16	92	80 - 120	101	80 - 120	<0.0050	mg/L	NC(1)	20
5845433	Ammonia (N)	2012/05/16	NC	80 - 120	103	80 - 120	<0.0050	mg/L	NC	20
5845719	Dissolved Aluminum (Al)	2012/05/19	NC	80 - 120	104	80 - 120	<3.0	ug/L	2.7	20
5845719	Dissolved Antimony (Sb)	2012/05/19	NC	80 - 120	102	80 - 120	<0.50	ug/L	NC	20
5845719	Dissolved Arsenic (As)	2012/05/19	106	80 - 120	101	80 - 120	<0.10	ug/L	3.0	20
5845719	Dissolved Barium (Ba)	2012/05/19	NC	80 - 120	99	80 - 120	<1.0	ug/L	2.1	20
5845719	Dissolved Beryllium (Be)	2012/05/19	103	80 - 120	98	80 - 120	<0.10	ug/L	NC	20
5845719	Dissolved Bismuth (Bi)	2012/05/19	95	80 - 120	101	80 - 120	<1.0	ug/L	NC	20
5845719	Dissolved Cadmium (Cd)	2012/05/19	106	80 - 120	103	80 - 120	<0.010	ug/L	NC	20

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MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
5845719	Dissolved Chromium (Cr)	2012/05/19	103	80 - 120	102	80 - 120	<1.0	ug/L	NC	20
5845719	Dissolved Cobalt (Co)	2012/05/19	103	80 - 120	102	80 - 120	<0.50	ug/L	NC	20
5845719	Dissolved Copper (Cu)	2012/05/19	102	80 - 120	101	80 - 120	<0.20	ug/L	2.5	20
5845719	Dissolved Iron (Fe)	2012/05/19	103	80 - 120	113	80 - 120	<5.0	ug/L	1.6	20
5845719	Dissolved Lead (Pb)	2012/05/19	105	80 - 120	102	80 - 120	<0.20	ug/L	NC	20
5845719	Dissolved Lithium (Li)	2012/05/19	102	80 - 120	100	80 - 120	<5.0	ug/L	NC	20
5845719	Dissolved Manganese (Mn)	2012/05/19	NC	80 - 120	106	80 - 120	<1.0	ug/L	1.4	20
5845719	Dissolved Molybdenum (Mo)	2012/05/19	NC	80 - 120	103	80 - 120	<1.0	ug/L	0.4	20
5845719	Dissolved Nickel (Ni)	2012/05/19	102	80 - 120	102	80 - 120	<1.0	ug/L	NC	20
5845719	Dissolved Selenium (Se)	2012/05/19	107	80 - 120	107	80 - 120	<0.10	ug/L	NC	20
5845719	Dissolved Silver (Ag)	2012/05/19	104	80 - 120	105	80 - 120	<0.020	ug/L	NC	20
5845719	Dissolved Strontium (Sr)	2012/05/19	NC	80 - 120	102	80 - 120	<1.0	ug/L	1.3	20
5845719	Dissolved Thallium (Tl)	2012/05/19	117	80 - 120	110	80 - 120	<0.050	ug/L	NC	20
5845719	Dissolved Tin (Sn)	2012/05/19	NC	80 - 120	100	80 - 120	<5.0	ug/L	NC	20
5845719	Dissolved Titanium (Ti)	2012/05/19	95	80 - 120	96	80 - 120	<5.0	ug/L	NC	20
5845719	Dissolved Uranium (U)	2012/05/19	108	80 - 120	101	80 - 120	<0.10	ug/L	1.8	20
5845719	Dissolved Vanadium (V)	2012/05/19	NC	80 - 120	104	80 - 120	<5.0	ug/L	NC	20
5845719	Dissolved Zinc (Zn)	2012/05/19	108	80 - 120	104	80 - 120	<5.0	ug/L	NC	20
5845719	Dissolved Boron (B)	2012/05/19					<50	ug/L	NC	20
5845719	Dissolved Phosphorus (P)	2012/05/19					<10	ug/L		
5845719	Dissolved Silicon (Si)	2012/05/19					<100	ug/L	2.7	20
5845719	Dissolved Zirconium (Zr)	2012/05/19					<0.50	ug/L	NC	20
5846290	Alkalinity (Total as CaCO3)	2012/05/16	NC	80 - 120	98	80 - 120	0.54, RDL=0.50	mg/L	0.9	20
5846290	Alkalinity (PP as CaCO3)	2012/05/16					<0.50	mg/L	NC	20
5846290	Bicarbonate (HCO3)	2012/05/16					0.66, RDL=0.50	mg/L	0.9	20
5846290	Carbonate (CO3)	2012/05/16					<0.50	mg/L	NC	20
5846290	Hydroxide (OH)	2012/05/16					<0.50	mg/L	NC	20
5846299	Conductivity	2012/05/16			99	80 - 120	<1.0	uS/cm	0.5	20
5847426	Dissolved Chloride (Cl)	2012/05/16	101	80 - 120	102	80 - 120	<0.50	mg/L	1.1	20
5847437	Dissolved Sulphate (SO4)	2012/05/16	NC	80 - 120	99	80 - 120	0.63, RDL=0.50	mg/L	1.6	20
5847595	Nitrate plus Nitrite (N)	2012/05/16	NC	80 - 120	101	80 - 120	<0.020	mg/L	NC	25
5847598	Nitrite (N)	2012/05/16	100	80 - 120	99	80 - 120	<0.0050	mg/L	NC	20
5848614	Total Dissolved Solids	2012/05/17	NC	80 - 120	94	80 - 120	<10	mg/L	3.6	20
5851448	Dissolved Sulphate (SO4)	2012/05/17	NC	80 - 120	94	80 - 120	<0.50	mg/L	2.7	20

Maxxam Job #: B239909
Report Date: 2012/05/23

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
5851706	Dissolved Mercury (Hg)	2012/05/18	97	80 - 120	100	80 - 120	<0.010	ug/L	NC	20
5854073	Fluoride (F)	2012/05/18	90	80 - 120	100	80 - 120	<0.010	mg/L	0	20

N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - Samples arrived to laboratory past recommended hold time.

Maxxam

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

CHAIN OF CUSTODY RECORD

Maxxam Job #: B239909 COC #: EB456212 (Click here to get the COC number) Page: 1 of 1

Invoice To: Require Report? Yes ☐ No ☐

Invoice To		Report To	
Company Name:	Minto Explorations Ltd	Company Name:	Minto Explorations Ltd
Contact Name:	Elvina Wong	Contact Name:	Minto Environment
Address:	Suite 900 - 999 West Hastings St	Address:	Suite 900-999 West Hastings St
	Vancouver, B.C. PC: V6C 2W2		Vancovuer, B.C. PC: V6C 2W2
Phone / Fax#:	Ph: 604-684-8894 Fax: 604-688-2120	Phone / Fax#:	Ph: 604-684-8894 Fax: 604-688-2120
E-mail		E-mail	minto_environment@mintomine.com

PO #:	113796
Quotation #:	
Project # :	
Proj. Name:	Minto Env. Monitoring
Location:	Yukon
Sampled by:	

REGULATORY REQUIREMENTS:

- ☐ CSR
- ☑ CCME
- ☐ BC Water Quality
- ☐ Other
- ☐ DRINKING WATER

SERVICE REQUESTED:

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

SPECIAL INSTRUCTIONS:

Return Cooler ☐ **Ship Sample Bottles (please specify)** ☐

Complete TDS analysis last if there is remaining sample.

ANALYSIS REQUESTED

#	Sample Identification	Lab Identification (Lab Use Only)	Sample Type	Date/Time(24hr) Sampled	Dissolved Metals (DM) (Field Filtered? Y☑)	Total Metals (Field Acidified? Y☑)	Field Acidified? Y☑	☑ Nitrate ☑ Nitrite ☑ Ammonia	☐ Total Suspended Solids (TSS) ☐ TDS	☑ pH ☑ Conductivity ☑ Alkalinity	☑ Chloride ☑ Fluoride ☑ Sulphate	Phosphorous	TDS - last priority	Number of Containers
1	MW09-03-02	DK6058	water	10-May-12	x	x		x		x	x	x	x	3
2	MW09-03-03	DK6059	water	10-May-12	x	x		x		x	x	x	x	3
3	MW09-03-05	DK6060	water	10-May-12	x	x		x		x	x	x	x	3
4	MW09-03-01	DK6061	water	10-May-12	x	x		x		x	x	x	x	3
5	TB	DK6062	water		x	x		x		x	x	x	x	3
6	Reagent	DK6063	water	11-May-12	x	x		x		x	x	x	x	3
7	EB	DK6064	water	11-May-12	x	x								1
8														
9														
10														
11														
12														

B239909

*Relinquished By:	Date (yy/mm/dd):	Time (24hr):	Received by:	Date (yy/mm/dd):	Time (24 hr):	Time Sensitive	Temperature on Receipt (°C)	Custody Seal	Yes	No
Crystal Beaudry	11-May-12	11:00	[illegible signature]	2012/05/15	14:04	☑	A) 6 B) 7 C) 4	Present?	☐	☑
							Just sampled & rec'd on ice: ☐	Intact?	☐	☐ NA

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

Maxxam

Success Through Science®

Your P.O. #: 113976
Your Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your C.O.C. #: EB461712

Attention: James Spencer
MINTO EXPLORATIONS LTD.
Yukon/Whitehorse
2 - 25 Pilgrim Way
Whitehorse, YT
CANADA Y1A 6E6

Report Date: 2012/05/29

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B241822
Received: 2012/05/22, 09:58

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	1	2012/05/23	2012/05/23	BBY6SOP-00026	SM2320B
Alkalinity - Water	1	2012/05/28	2012/05/28	BBY6SOP-00026	SM2320B
Chloride by Automated Colourimetry	2	N/A	2012/05/23	BBY6SOP-00011	SM-4500-Cl-
Carbon (DOC)	2	N/A	2012/05/25	BBY6SOP-00003	SM-5310C
Conductance - water	2	N/A	2012/05/23	BBY6SOP-00026	SM-2510B
Fluoride	2	N/A	2012/05/28	BBY6SOP-00038	SM - 4500 F C
Hardness (calculated as CaCO3)	1	N/A	2012/05/24	BBY WI-00033	Calculated Parameter
Mercury (Dissolved) by CVAF	1	N/A	2012/05/28	65-A-002-10	EPA 1631B
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	1	N/A	2012/05/24	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (dissolved)	1	N/A	2012/05/23	BBY7SOP-00002	EPA 6020A
Ammonia-N	2	N/A	2012/05/23	BBY6SOP-00009	SM-4500NH3G
Nitrate + Nitrite (N)	2	N/A	2012/05/23	BBY6SOP-00010	USEPA 353.2
Nitrite (N) by CFA	2	N/A	2012/05/23	BBY6SOP-00010	EPA 353.2
Nitrogen - Nitrate (as N)	2	N/A	2012/05/24	BBY6SOP-00010	Based on EPA 353.2
Filter and HNO3 Preserve for Metals	1	N/A	2012/05/22	BBY6WI-00001	EPA 200.2
pH Water	2	N/A	2012/05/23	BBY6SOP-00026	SM-4500H+B
Sulphate by Automated Colourimetry	2	N/A	2012/05/24	BBY6SOP-00017	SM4500-SO42
Total Phosphorus	2	N/A	2012/05/24	BBY6SOP-00013	SM 4500 PE

* Results relate only to the items tested.

Encryption Key

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

Kelly Janda, B.Sc, Burnaby Project Manager
Email: KJanda@maxxam.ca
Phone# (604) 638-5019

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

Total cover pages: 1

Maxxam Job #: B241822
Report Date: 2012/05/29

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		DL9238		DL9239		
Sampling Date		2012/05/18		2012/05/18		
	Units	**MW11-04A**	**QC Batch**	**DUP01**	**RDL**	**QC Batch**
ANIONS						
Nitrite (N)	mg/L	0.0234(1)	5863106	0.0225(1)	0.0050	5863106
Calculated Parameters						
Filter and HNO3 Preservation	N/A	FIELD	ONSITE		N/A	
Nitrate (N)	mg/L	1.60	5856917	1.64	0.020	5856917
Misc. Inorganics						
Fluoride (F)	mg/L	0.130	5873989	0.130	0.010	5873989
Dissolved Organic Carbon (C)	mg/L	9.91	5868449	10.9	0.50	5868449
Alkalinity (Total as CaCO3)	mg/L	330	5874172	252	0.50	5863032
Alkalinity (PP as CaCO3)	mg/L	296	5874172	203	0.50	5863032
Bicarbonate (HCO3)	mg/L	<0.50	5874172	<0.50	0.50	5863032
Carbonate (CO3)	mg/L	40.3	5874172	59.5	0.50	5863032
Hydroxide (OH)	mg/L	89.3	5874172	52.0	0.50	5863032
Anions						
Dissolved Sulphate (SO4)	mg/L	<5.0(2)	5867910	<5.0(2)	5.0	5867910
Dissolved Chloride (Cl)	mg/L	1.4	5863082	1.6	0.50	5863082
Nutrients						
Ammonia (N)	mg/L	1.5	5860489	1.5	0.010	5860489
Nitrate plus Nitrite (N)	mg/L	1.62(1)	5863103	1.66(1)	0.020	5863103
Total Phosphorus (P)	mg/L	0.776	5865899	1.32	0.050	5865899
Physical Properties						
Conductivity	uS/cm	786	5863064	915	1.0	5863064
pH	pH Units	11.5	5863067	11.6		5863067

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Samples arrived to laboratory past recommended hold time.
(2) - RDL raised due to sample matrix interference.

Maxxam Job #: B241822
Report Date: 2012/05/29

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		DL9238		
Sampling Date		2012/05/18		
	Units	**MW11-04A**	**RDL**	**QC Batch**
Misc. Inorganics				
Dissolved Hardness (CaCO3)	mg/L	216	0.50	5856612
Elements				
Dissolved Mercury (Hg)	ug/L	<0.010	0.010	5871064

RDL = Reportable Detection Limit

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		DL9238		
Sampling Date		2012/05/18		
	Units	**MW11-04A**	**RDL**	**QC Batch**
Dissolved Metals by ICPMS				
Dissolved Aluminum (Al)	ug/L	1680	3.0	5860113
Dissolved Antimony (Sb)	ug/L	10.5	0.50	5860113
Dissolved Arsenic (As)	ug/L	3.41	0.10	5860113
Dissolved Barium (Ba)	ug/L	143	1.0	5860113
Dissolved Beryllium (Be)	ug/L	<0.10	0.10	5860113
Dissolved Bismuth (Bi)	ug/L	<1.0	1.0	5860113
Dissolved Boron (B)	ug/L	<50	50	5860113
Dissolved Cadmium (Cd)	ug/L	0.015	0.010	5860113
Dissolved Chromium (Cr)	ug/L	8.0	1.0	5860113
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	5860113
Dissolved Copper (Cu)	ug/L	93.2	0.20	5860113
Dissolved Iron (Fe)	ug/L	16.1	5.0	5860113
Dissolved Lead (Pb)	ug/L	<0.20	0.20	5860113
Dissolved Lithium (Li)	ug/L	8.3	5.0	5860113
Dissolved Manganese (Mn)	ug/L	2.6	1.0	5860113
Dissolved Molybdenum (Mo)	ug/L	10.0	1.0	5860113
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	5860113
Dissolved Phosphorus (P)	ug/L	25	10	5860113
Dissolved Selenium (Se)	ug/L	3.34	0.10	5860113
Dissolved Silicon (Si)	ug/L	6130	100	5860113
Dissolved Silver (Ag)	ug/L	0.035	0.020	5860113
Dissolved Strontium (Sr)	ug/L	2370	1.0	5860113
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	5860113
Dissolved Tin (Sn)	ug/L	<5.0	5.0	5860113
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	5860113
Dissolved Uranium (U)	ug/L	<0.10	0.10	5860113
Dissolved Vanadium (V)	ug/L	26.0	5.0	5860113
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	5860113
Dissolved Zirconium (Zr)	ug/L	<0.50	0.50	5860113
Dissolved Calcium (Ca)	mg/L	86.0	0.050	5856614
Dissolved Magnesium (Mg)	mg/L	0.391	0.050	5856614
Dissolved Potassium (K)	mg/L	28.5	0.050	5856614
Dissolved Sodium (Na)	mg/L	39.5	0.050	5856614
Dissolved Sulphur (S)	mg/L	4.0	3.0	5856614

RDL = Reportable Detection Limit

General Comments

Sample DL9238-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Sample DL9239-01: The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Maxxam Job #: B241822
Report Date: 2012/05/29

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
5860113	Dissolved Aluminum (Al)	2012/05/23	91	80 - 120	105	80 - 120	<3.0	ug/L	8.8	20
5860113	Dissolved Antimony (Sb)	2012/05/23	104	80 - 120	111	80 - 120	<0.50	ug/L	NC	20
5860113	Dissolved Arsenic (As)	2012/05/23	101	80 - 120	103	80 - 120	<0.10	ug/L	1.8	20
5860113	Dissolved Barium (Ba)	2012/05/23	NC	80 - 120	103	80 - 120	<1.0	ug/L	2.6	20
5860113	Dissolved Beryllium (Be)	2012/05/23	102	80 - 120	103	80 - 120	<0.10	ug/L	NC	20
5860113	Dissolved Bismuth (Bi)	2012/05/23	89	80 - 120	104	80 - 120	<1.0	ug/L	NC	20
5860113	Dissolved Cadmium (Cd)	2012/05/23	100	80 - 120	104	80 - 120	<0.010	ug/L	NC	20
5860113	Dissolved Chromium (Cr)	2012/05/23	98	80 - 120	103	80 - 120	<1.0	ug/L	NC	20
5860113	Dissolved Cobalt (Co)	2012/05/23	97	80 - 120	101	80 - 120	<0.50	ug/L	NC	20
5860113	Dissolved Copper (Cu)	2012/05/23	95	80 - 120	104	80 - 120	<0.20	ug/L	4.4	20
5860113	Dissolved Iron (Fe)	2012/05/23	NC	80 - 120	109	80 - 120	<5.0	ug/L	0.5	20
5860113	Dissolved Lead (Pb)	2012/05/23	98	80 - 120	100	80 - 120	<0.20	ug/L	NC	20
5860113	Dissolved Lithium (Li)	2012/05/23	95	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
5860113	Dissolved Manganese (Mn)	2012/05/23	NC	80 - 120	102	80 - 120	<1.0	ug/L	2.6	20
5860113	Dissolved Molybdenum (Mo)	2012/05/23	NC	80 - 120	105	80 - 120	<1.0	ug/L	NC	20
5860113	Dissolved Nickel (Ni)	2012/05/23	96	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
5860113	Dissolved Selenium (Se)	2012/05/23	100	80 - 120	94	80 - 120	<0.10	ug/L	NC	20
5860113	Dissolved Silver (Ag)	2012/05/23	99	80 - 120	103	80 - 120	<0.020	ug/L	NC	20
5860113	Dissolved Strontium (Sr)	2012/05/23	NC	80 - 120	100	80 - 120	<1.0	ug/L	2.0	20
5860113	Dissolved Thallium (Tl)	2012/05/23	111	80 - 120	112	80 - 120	<0.050	ug/L	NC	20
5860113	Dissolved Tin (Sn)	2012/05/23	92	80 - 120	105	80 - 120	<5.0	ug/L	NC	20
5860113	Dissolved Titanium (Ti)	2012/05/23	97	80 - 120	105	80 - 120	<5.0	ug/L	NC	20
5860113	Dissolved Uranium (U)	2012/05/23	97	80 - 120	100	80 - 120	<0.10	ug/L	1.4	20
5860113	Dissolved Vanadium (V)	2012/05/23	101	80 - 120	105	80 - 120	<5.0	ug/L	NC	20
5860113	Dissolved Zinc (Zn)	2012/05/23	118	80 - 120	106	80 - 120	<5.0	ug/L	NC	20
5860113	Dissolved Boron (B)	2012/05/23					<50	ug/L	NC	20
5860113	Dissolved Phosphorus (P)	2012/05/23					<10	ug/L	NC	20
5860113	Dissolved Silicon (Si)	2012/05/23					<100	ug/L	0.7	20
5860113	Dissolved Zirconium (Zr)	2012/05/23					<0.50	ug/L	NC	20
5860489	Ammonia (N)	2012/05/23	99	80 - 120	100	80 - 120	<0.0050	mg/L	NC	20
5863032	Alkalinity (Total as CaCO3)	2012/05/23	NC	80 - 120	98	80 - 120	<0.50	mg/L	NC	20
5863032	Alkalinity (PP as CaCO3)	2012/05/23					<0.50	mg/L	NC	20
5863032	Bicarbonate (HCO3)	2012/05/23					<0.50	mg/L		
5863032	Carbonate (CO3)	2012/05/23					<0.50	mg/L		
5863032	Hydroxide (OH)	2012/05/23					<0.50	mg/L		
5863064	Conductivity	2012/05/23			100	80 - 120	<1.0	uS/cm	NC	20
5863082	Dissolved Chloride (Cl)	2012/05/23	NC	80 - 120	100	80 - 120	<0.50	mg/L	1	20
5863103	Nitrate plus Nitrite (N)	2012/05/23	116	80 - 120	106	80 - 120	<0.020	mg/L	1.0	25
5863106	Nitrite (N)	2012/05/23	108	80 - 120	102	80 - 120	<0.0050	mg/L	0.8	20

Maxxam

Maxxam Job #: B241822
Report Date: 2012/05/29

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
5865899	Total Phosphorus (P)	2012/05/24	NC	80 - 120	89	80 - 120	<0.0050	mg/L	0.6(1)	20
5867910	Dissolved Sulphate (SO4)	2012/05/24			101	80 - 120	<0.50	mg/L	0.1	20
5868449	Dissolved Organic Carbon (C)	2012/05/25	88	80 - 120	103	80 - 120	<0.50	mg/L	13.5	20
5871064	Dissolved Mercury (Hg)	2012/05/28	103	80 - 120	103	80 - 120	<0.010	ug/L	NC	20
5873989	Fluoride (F)	2012/05/28	101	80 - 120	104	80 - 120	<0.010	mg/L	NC	20
5874172	Alkalinity (Total as CaCO3)	2012/05/28	NC	80 - 120	96	80 - 120	<0.50	mg/L	0.3	20
5874172	Alkalinity (PP as CaCO3)	2012/05/28					<0.50	mg/L	NC	20
5874172	Bicarbonate (HCO3)	2012/05/28					<0.50	mg/L	0.3	20
5874172	Carbonate (CO3)	2012/05/28					<0.50	mg/L	NC	20
5874172	Hydroxide (OH)	2012/05/28					<0.50	mg/L	NC	20

N/A = Not Applicable

RPD = Relative Percent Difference

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

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

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

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

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

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

(1) - Sample analysed past recommended hold time

Maxxam

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

CHAIN OF CUSTODY RECORD

Click here to get the COC number

Maxxam Job #: B241822 **COC #:** EB461712 Page: 1 of 1

Invoice To: Require Report? Yes ☐ No ☐

Company Name:	Minto Explorations Ltd
Contact Name:	Elvina Wong
Address:	Suite 900 - 999 West Hastings St
	Vancouver, B.C. PC: V6C 2W2
Phone / Fax#:	Ph: 604-684-8894 Fax: 604-688-2120
E-mail	

Report To:

Company Name:	Minto Explorations Ltd
Contact Name:	Minto Environment
Address:	Suite 900-999 West Hastings St
	Vancovuer, B.C. PC: V6C 2W2
Phone / Fax#:	Ph: 604-684-8894 Fax: 604-688-2120
E-mail	minto_environment@mintomine.com

PO #:	113796
Quotation #:	
Project # :	
Proj. Name:	Minto Env. Monitoring
Location:	Yukon
Sampled by:	

REGULATORY REQUIREMENTS:

- ☐ CSR
- ☑ CCME
- ☐ BC Water Quality
- ☐ Other
- ☐ DRINKING WATER

SERVICE REQUESTED:

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

SPECIAL INSTRUCTIONS:

Return Cooler ☐ **Ship Sample Bottles (please specify)** ☐

ANALYSIS REQUESTED

	Sample Identification	Lab Identification (Lab Use Only)	Sample Type	Date/Time(24hr) Sampled	Dissolved Metals (DM)	Total Metals	Nitrate ☑ Nitrite ☑ Ammonia	Total Suspended Solids (TSS) ☑ TDS	pH ☑ Conductivity ☑ Alkalinity	Chloride ☑ Fluoride ☑ Sulphate	Phosphate	DOC (Diss'd Organic Carbon)	TOC (Total Organic Carbon)	Ra 226	Number of Containers
				Field Filtered? ☑Y N	Field Acidified? ☑Y N	Field Acidified? ☑Y N	☑	☑	☑	☑					
1	EB	DL9237		12-May-12	x	x									1
2	MW11-04A	238		18-May-12	x	x	x		x	x	x	x			4
3	DUP01	239		18-May-12			x		x	x	x	x			3
4															
5															
6															
7															
8															
9															
10															
11															
12															

B241822

Print name and sign / Print name and sign / Laboratory Use Only

*Relinquished By:	Date (yy/mm/dd):	Time (24hr):	Received by:	Date (yy/mm/dd):	Time (24 hr):	Time Sensitive	Temperature on Receipt (°C)	Custody Seal	Yes	No
Crystal Beaudry	18-May-12		Andy Tong	2012/05/22	09:58	☑	A) 3 B) 2 C) 2	Present?	☐	☐
							Just sampled & rec'd on ice: ☐	Intact?	☐	☐

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

1,1,3
1,2,1 NA

Maxxam

Success Through Science®

Your P.O. #: 113976
Your Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your C.O.C. #: EB576612

Attention: MINTO DISTRIBUTION LIST
MINTO EXPLORATIONS LTD.
Yukon/Whitehorse
2 - 25 Pilgrim Way
Whitehorse, YT
CANADA Y1A 6E6

Report Date: 2012/11/20

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B2A2946
Received: 2012/11/13, 09:50

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	1	2012/11/15	2012/11/15	BBY6SOP-00026	SM2320B
Conductance - water	1	N/A	2012/11/15	BBY6SOP-00026	SM-2510B
Hardness Total (calculated as CaCO3)	1	N/A	2012/11/19	BBY WI-00033	Calculated Parameter
Hardness (calculated as CaCO3)	1	N/A	2012/11/19	BBY WI-00033	Calculated Parameter
Mercury (Dissolved) by CVAF	1	N/A	2012/11/19	BBY7SOP-00015	EPA 245.7
Mercury (Total) by CVAF	1	2012/11/19	2012/11/19	BBY7SOP-00015	EPA 245.7
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	1	N/A	2012/11/19	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (dissolved)	1	N/A	2012/11/18	BBY7SOP-00002	EPA 6020A
Na, K, Ca, Mg, S by CRC ICPMS (total)	1	2012/11/13	2012/11/19	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (total)	1	2012/11/15	2012/11/17	BBY7SOP-00002	EPA 6020A
Ammonia-N (Preserved)	1	N/A	2012/11/14	BBY6SOP-00009	SM-4500NH3G
Nitrate + Nitrite (N)	1	N/A	2012/11/14	BBY6SOP-00010	USEPA 353.2
Nitrite (N) by CFA	1	N/A	2012/11/14	BBY6SOP-00010	EPA 353.2
Nitrogen - Nitrate (as N)	1	N/A	2012/11/15	BBY6SOP-00010	Based on EPA 353.2
Filter and HNO3 Preserve for Metals	1	N/A	2012/11/13	BBY6WI-00001	EPA 200.2
Sulphate by Automated Colourimetry	1	N/A	2012/11/14	BBY6SOP-00017	SM4500-SO42
Total Dissolved Solids (Filt. Residue)	1	2012/11/16	2012/11/16	BBY6SOP-00033	SM 2540C

* Results relate only to the items tested.

Encryption Key

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

Lanoy Luangkhamdeng, Burnaby Project Manager
Email: LLuangkhamdeng@maxxam.ca
Phone# (604) 638-2636

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

Total cover pages: 1

Maxxam Job #: B2A2946
Report Date: 2012/11/20

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		EZ5236		
Sampling Date		2012/11/11 14:40		
	UNITS	**MW 12-05-01**	**RDL**	**QC Batch**
ANIONS				
Nitrite (N)	mg/L	0.0517	0.0050	6347489
Calculated Parameters				
Filter and HNO3 Preservation	N/A	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.368	0.020	6340033
Misc. Inorganics				
Alkalinity (Total as CaCO3)	mg/L	183	0.50	6346329
Alkalinity (PP as CaCO3)	mg/L	<0.50	0.50	6346329
Bicarbonate (HCO3)	mg/L	224	0.50	6346329
Carbonate (CO3)	mg/L	<0.50	0.50	6346329
Hydroxide (OH)	mg/L	<0.50	0.50	6346329
Anions				
Dissolved Sulphate (SO4)	mg/L	350	5.0	6345660
Nutrients				
Ammonia (N)	mg/L	<0.0050	0.0050	6341944
Nitrate plus Nitrite (N)	mg/L	0.420	0.020	6347389
Physical Properties				
Conductivity	uS/cm	1030	1.0	6346368
Physical Properties				
Total Dissolved Solids	mg/L	706	10	6350908

N/A = Not Applicable
RDL = Reportable Detection Limit

Maxxam Job #: B2A2946
Report Date: 2012/11/20

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		EZ5236		
Sampling Date		2012/11/11 14:40		
	UNITS	**MW 12-05-01**	**RDL**	**QC Batch**
Misc. Inorganics				
Dissolved Hardness (CaCO3)	mg/L	407	0.50	6338777
Elements				
Dissolved Mercury (Hg)	ug/L	<0.010	0.010	6355624

RDL = Reportable Detection Limit

Maxxam Job #: B2A2946
Report Date: 2012/11/20

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		EZ5236		
Sampling Date		2012/11/11 14:40		
	UNITS	**MW 12-05-01**	**RDL**	**QC Batch**
Dissolved Metals by ICPMS				
Dissolved Aluminum (Al)	ug/L	15.4	3.0	6352483
Dissolved Antimony (Sb)	ug/L	0.56	0.50	6352483
Dissolved Arsenic (As)	ug/L	1.17	0.10	6359444
Dissolved Barium (Ba)	ug/L	463	1.0	6352483
Dissolved Beryllium (Be)	ug/L	<0.10	0.10	6352483
Dissolved Bismuth (Bi)	ug/L	<1.0	1.0	6352483
Dissolved Boron (B)	ug/L	146	50	6352483
Dissolved Cadmium (Cd)	ug/L	0.140	0.010	6352483
Dissolved Chromium (Cr)	ug/L	<1.0	1.0	6352483
Dissolved Cobalt (Co)	ug/L	3.79	0.50	6352483
Dissolved Copper (Cu)	ug/L	7.37	0.20	6352483
Dissolved Iron (Fe)	ug/L	8.5	5.0	6352483
Dissolved Lead (Pb)	ug/L	<0.20	0.20	6352483
Dissolved Lithium (Li)	ug/L	6.3	5.0	6352483
Dissolved Manganese (Mn)	ug/L	110	1.0	6352483
Dissolved Molybdenum (Mo)	ug/L	12.0	1.0	6352483
Dissolved Nickel (Ni)	ug/L	4.3	1.0	6352483
Dissolved Phosphorus (P)	ug/L	<10	10	6352483
Dissolved Selenium (Se)	ug/L	0.47	0.10	6352483
Dissolved Silicon (Si)	ug/L	5590	100	6352483
Dissolved Silver (Ag)	ug/L	<0.020	0.020	6352483
Dissolved Strontium (Sr)	ug/L	3050	1.0	6352483
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	6352483
Dissolved Tin (Sn)	ug/L	<5.0	5.0	6352483
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	6352483
Dissolved Uranium (U)	ug/L	4.04	0.10	6352483
Dissolved Vanadium (V)	ug/L	<5.0	5.0	6352483
Dissolved Zinc (Zn)	ug/L	40.2	5.0	6352483
Dissolved Zirconium (Zr)	ug/L	<0.50	0.50	6352483
Dissolved Calcium (Ca)	mg/L	117	0.050	6339101
Dissolved Magnesium (Mg)	mg/L	27.8	0.050	6339101
Dissolved Potassium (K)	mg/L	3.57	0.050	6339101
Dissolved Sodium (Na)	mg/L	64.2	0.050	6339101
Dissolved Sulphur (S)	mg/L	122	3.0	6339101

RDL = Reportable Detection Limit

Maxxam Job #: B2A2946
Report Date: 2012/11/20

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

CCME TOTAL METALS IN WATER (WATER)

Maxxam ID		EZ5236		
Sampling Date		2012/11/11 14:40		
	UNITS	**MW 12-05-01**	**RDL**	**QC Batch**
Calculated Parameters				
Total Hardness (CaCO3)	mg/L	402	0.50	6339100
Elements				
Total Mercury (Hg)	ug/L	<0.010	0.010	6355643

RDL = Reportable Detection Limit

Maxxam Job #: B2A2946
Report Date: 2012/11/20

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

CCME TOTAL METALS IN WATER (WATER)

Maxxam ID		EZ5236		
Sampling Date		2012/11/11 14:40		
	UNITS	**MW 12-05-01**	**RDL**	**QC Batch**
Total Metals by ICPMS				
Total Aluminum (Al)	ug/L	183	3.0	6347603
Total Antimony (Sb)	ug/L	<0.50	0.50	6347603
Total Arsenic (As)	ug/L	0.98	0.10	6347603
Total Barium (Ba)	ug/L	429	1.0	6347603
Total Beryllium (Be)	ug/L	<0.10	0.10	6347603
Total Bismuth (Bi)	ug/L	<1.0	1.0	6347603
Total Boron (B)	ug/L	119	50	6347603
Total Cadmium (Cd)	ug/L	0.182	0.010	6347603
Total Chromium (Cr)	ug/L	<1.0	1.0	6347603
Total Cobalt (Co)	ug/L	3.53	0.50	6347603
Total Copper (Cu)	ug/L	8.92	0.20	6347603
Total Iron (Fe)	ug/L	209	5.0	6347603
Total Lead (Pb)	ug/L	0.56	0.20	6347603
Total Lithium (Li)	ug/L	<5.0	5.0	6347603
Total Manganese (Mn)	ug/L	107	1.0	6347603
Total Molybdenum (Mo)	ug/L	11.4	1.0	6347603
Total Nickel (Ni)	ug/L	4.5	1.0	6347603
Total Phosphorus (P)	ug/L	18	10	6347603
Total Selenium (Se)	ug/L	0.43	0.10	6347603
Total Silicon (Si)	ug/L	5930	100	6347603
Total Silver (Ag)	ug/L	0.095	0.020	6347603
Total Strontium (Sr)	ug/L	2950	1.0	6347603
Total Thallium (Tl)	ug/L	<0.050	0.050	6347603
Total Tin (Sn)	ug/L	<5.0	5.0	6347603
Total Titanium (Ti)	ug/L	6.2	5.0	6347603
Total Uranium (U)	ug/L	3.86	0.10	6347603
Total Vanadium (V)	ug/L	<5.0	5.0	6347603
Total Zinc (Zn)	ug/L	38.8	5.0	6347603
Total Zirconium (Zr)	ug/L	<0.50	0.50	6347603
Total Calcium (Ca)	mg/L	118	0.050	6339102
Total Magnesium (Mg)	mg/L	25.8	0.050	6339102
Total Potassium (K)	mg/L	3.10	0.050	6339102
Total Sodium (Na)	mg/L	56.8	0.050	6339102
Total Sulphur (S)	mg/L	108	3.0	6339102

RDL = Reportable Detection Limit

Sample EZ5236, Elements by CRC ICPMS (dissolved): Test repeated.

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Maxxam Job #: B2A2946
Report Date: 2012/11/20

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6341944	Ammonia (N)	2012/11/14	97	80 - 120	97	80 - 120	<0.0050	mg/L	NC	20
6345660	Dissolved Sulphate (SO4)	2012/11/14	NC	80 - 120	100	80 - 120	<0.50	mg/L	1.9	20
6346329	Alkalinity (Total as CaCO3)	2012/11/15	NC	80 - 120	91	80 - 120	<0.50	mg/L	2.1	20
6346329	Alkalinity (PP as CaCO3)	2012/11/15					<0.50	mg/L	NC	20
6346329	Bicarbonate (HCO3)	2012/11/15					<0.50	mg/L	2.0	20
6346329	Carbonate (CO3)	2012/11/15					<0.50	mg/L	NC	20
6346329	Hydroxide (OH)	2012/11/15					<0.50	mg/L	NC	20
6346368	Conductivity	2012/11/15			99	80 - 120	<1.0	uS/cm	0.5	20
6347389	Nitrate plus Nitrite (N)	2012/11/14	111	80 - 120	102	80 - 120	<0.020	mg/L	1.6	25
6347489	Nitrite (N)	2012/11/14			97	80 - 120	<0.0050	mg/L	0.07	20
6347603	Total Aluminum (Al)	2012/11/17	NC	80 - 120	102	80 - 120	<3.0	ug/L	1.6	20
6347603	Total Antimony (Sb)	2012/11/17	98	80 - 120	91	80 - 120	<0.50	ug/L	NC	20
6347603	Total Arsenic (As)	2012/11/17	94	80 - 120	92	80 - 120	0.11, RDL=0.10	ug/L	NC	20
6347603	Total Barium (Ba)	2012/11/17	97	80 - 120	94	80 - 120	<1.0	ug/L	NC	20
6347603	Total Beryllium (Be)	2012/11/17	90	80 - 120	88	80 - 120	<0.10	ug/L	NC	20
6347603	Total Bismuth (Bi)	2012/11/17	98	80 - 120	97	80 - 120	<1.0	ug/L	NC	20
6347603	Total Cadmium (Cd)	2012/11/17	92	80 - 120	92	80 - 120	<0.010	ug/L	NC	20
6347603	Total Chromium (Cr)	2012/11/17	101	80 - 120	99	80 - 120	<1.0	ug/L	NC	20
6347603	Total Cobalt (Co)	2012/11/17	99	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
6347603	Total Copper (Cu)	2012/11/17	NC	80 - 120	95	80 - 120	<0.20	ug/L	1.7	20
6347603	Total Iron (Fe)	2012/11/17	129(1)	80 - 120	106	80 - 120	<5.0	ug/L	4.0	20
6347603	Total Lead (Pb)	2012/11/17	100	80 - 120	96	80 - 120	<0.20	ug/L	3.2	20
6347603	Total Lithium (Li)	2012/11/17	95	80 - 120	93	80 - 120	<5.0	ug/L	NC	20
6347603	Total Manganese (Mn)	2012/11/17	NC	80 - 120	99	80 - 120	<1.0	ug/L	0.8	20
6347603	Total Molybdenum (Mo)	2012/11/17	100	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
6347603	Total Nickel (Ni)	2012/11/17	NC	80 - 120	101	80 - 120	<1.0	ug/L	2.0	20
6347603	Total Selenium (Se)	2012/11/17	88	80 - 120	93	80 - 120	<0.10	ug/L	NC	20
6347603	Total Silver (Ag)	2012/11/17	NC	80 - 120	93	80 - 120	<0.020	ug/L	2.5	20
6347603	Total Strontium (Sr)	2012/11/17	NC	80 - 120	96	80 - 120	<1.0	ug/L	1.9	20
6347603	Total Thallium (Tl)	2012/11/17	101	80 - 120	99	80 - 120	<0.050	ug/L	NC	20
6347603	Total Tin (Sn)	2012/11/17	NC	80 - 120	102	80 - 120	<5.0	ug/L	2.5	20
6347603	Total Titanium (Ti)	2012/11/17	102	80 - 120	106	80 - 120	<5.0	ug/L	NC	20
6347603	Total Uranium (U)	2012/11/17	96	80 - 120	93	80 - 120	<0.10	ug/L	NC	20
6347603	Total Vanadium (V)	2012/11/17	98	80 - 120	101	80 - 120	<5.0	ug/L	NC	20
6347603	Total Zinc (Zn)	2012/11/17	NC	80 - 120	106	80 - 120	<5.0	ug/L	NC	20
6347603	Total Boron (B)	2012/11/17					<50	ug/L	NC	20
6347603	Total Phosphorus (P)	2012/11/17					<10	ug/L		
6347603	Total Silicon (Si)	2012/11/17					<100	ug/L	2.6	20
6347603	Total Zirconium (Zr)	2012/11/17					<0.50	ug/L	NC	20

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Maxxam Job #: B2A2946
Report Date: 2012/11/20

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6350908	Total Dissolved Solids	2012/11/16	NC	80 - 120	100	80 - 120	<10	mg/L	0.5	20
6352483	Dissolved Aluminum (Al)	2012/11/18	98	80 - 120	104	80 - 120	<3.0	ug/L	NC	20
6352483	Dissolved Antimony (Sb)	2012/11/18	101	80 - 120	103	80 - 120	<0.50	ug/L	NC	20
6352483	Dissolved Barium (Ba)	2012/11/18	NC	80 - 120	98	80 - 120	<1.0	ug/L	2.7	20
6352483	Dissolved Beryllium (Be)	2012/11/18	101	80 - 120	99	80 - 120	<0.10	ug/L	NC	20
6352483	Dissolved Bismuth (Bi)	2012/11/18	95	80 - 120	94	80 - 120	<1.0	ug/L	NC	20
6352483	Dissolved Cadmium (Cd)	2012/11/18	98	80 - 120	98	80 - 120	<0.010	ug/L	NC	20
6352483	Dissolved Chromium (Cr)	2012/11/18	98	80 - 120	97	80 - 120	<1.0	ug/L	NC	20
6352483	Dissolved Cobalt (Co)	2012/11/18	100	80 - 120	98	80 - 120	<0.50	ug/L	NC	20
6352483	Dissolved Copper (Cu)	2012/11/18	96	80 - 120	96	80 - 120	<0.20	ug/L	NC	20
6352483	Dissolved Iron (Fe)	2012/11/18	102	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
6352483	Dissolved Lead (Pb)	2012/11/18	96	80 - 120	96	80 - 120	<0.20	ug/L	NC	20
6352483	Dissolved Lithium (Li)	2012/11/18	98	80 - 120	99	80 - 120	<5.0	ug/L	NC	20
6352483	Dissolved Manganese (Mn)	2012/11/18	100	80 - 120	96	80 - 120	<1.0	ug/L	NC	20
6352483	Dissolved Molybdenum (Mo)	2012/11/18	NC	80 - 120	98	80 - 120	<1.0	ug/L	NC	20
6352483	Dissolved Nickel (Ni)	2012/11/18	96	80 - 120	99	80 - 120	<1.0	ug/L	NC	20
6352483	Dissolved Selenium (Se)	2012/11/18	111	80 - 120	104	80 - 120	<0.10	ug/L	NC	20
6352483	Dissolved Silver (Ag)	2012/11/18	101	80 - 120	104	80 - 120	<0.020	ug/L	NC	20
6352483	Dissolved Strontium (Sr)	2012/11/18	NC	80 - 120	96	80 - 120	<1.0	ug/L	3.7	20
6352483	Dissolved Thallium (Tl)	2012/11/18	100	80 - 120	92	80 - 120	<0.050	ug/L	NC	20
6352483	Dissolved Tin (Sn)	2012/11/18	108	80 - 120	103	80 - 120	<5.0	ug/L	NC	20
6352483	Dissolved Titanium (Ti)	2012/11/18	94	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
6352483	Dissolved Uranium (U)	2012/11/18	96	80 - 120	93	80 - 120	<0.10	ug/L	1.3	20
6352483	Dissolved Vanadium (V)	2012/11/18	102	80 - 120	96	80 - 120	<5.0	ug/L	NC	20
6352483	Dissolved Zinc (Zn)	2012/11/18	116	80 - 120	102	80 - 120	<5.0	ug/L	NC	20
6352483	Dissolved Boron (B)	2012/11/18					<50	ug/L	NC	20
6352483	Dissolved Phosphorus (P)	2012/11/18					<10	ug/L	NC	20
6352483	Dissolved Silicon (Si)	2012/11/18					<100	ug/L	2.5	20
6352483	Dissolved Zirconium (Zr)	2012/11/18					<0.50	ug/L	NC	20
6355624	Dissolved Mercury (Hg)	2012/11/19	105	80 - 120	98	80 - 120	<0.010	ug/L	NC	20

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Maxxam Job #: B2A2946
Report Date: 2012/11/20

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**UNITS**	**Value (%)**	**QC Limits**
6355643	Total Mercury (Hg)	2012/11/19	103	80 - 120	101	80 - 120	<0.010	ug/L	NC	20
6359444	Dissolved Arsenic (As)	2012/11/20			98	80 - 120	<0.10	ug/L		

N/A = Not Applicable

RDL = Reportable Detection Limit

RPD = Relative Percent Difference

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

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

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

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

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

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

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

Maxxam

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

CHAIN OF CUSTODY RECORD

Click here to get the COC number

Maxxam Job #: B2A2946 **COC #:** EB576612 Page: 1 of 1

Invoice To: Require Report? Yes ☐ No ☐

Company Name:	Minto Explorations Ltd		
Contact Name:	Elvina Wong		
Address:	Suite 900 - 999 West Hastings St		
	Vancouver, B.C.	PC:	V6C 2W2
Phone / Fax#:	Ph: 604-684-8894	Fax:	604-688-2120
E-mail			

Report To:

Company Name:	Minto Explorations Ltd		
Contact Name:	Minto Environment		
Address:	Suite 900-999 West Hastings St		
	Vancouver, B.C.	PC:	V6C 2W2
Phone / Fax#:	Ph: 604-684-8894	Fax:	604-688-2120
E-mail	minto_environment@mintomine.com		

PO #:	113796
Quotation #:	
Project # :	
Proj. Name:	Minto Env. Monitoring
Location:	Yukon
Sampled by:	

REGULATORY REQUIREMENTS:

- ☐ CSR
- ☐ CCME
- ☐ BC Water Quality
- ☑ Other low detection limits
- ☐ DRINKING WATER

SERVICE REQUESTED:

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

SPECIAL INSTRUCTIONS:

Return Cooler ☐ **Ship Sample Bottles (please specify)** ☐

Need low dectection limits. TM- only need total phosphorous

Please copy results to Jcherian@srk.com and jandrews@srk.com

ANALYSIS REQUESTED

Analysis column options: Dissolved Metals (DM) – Field Filtered? Y ☑ N ☐; Field Acidified? Y ☑ N ☐; Total Metals – Field Acidified? Y ☑ N ☐; ☑ Nitrate ☑ Nitrite ☑ Ammonia; Total Suspended Solids (TSS) ☐ TDS ☑; pH ☐ Conductivity ☑ Alkalinity ☑; Chloride ☐ Fluoride ☐ Sulphate ☑; DOC (Diss'd Organic Carbon); TOC (Total Organic Carbon); Phosphate; Ra 226

Lab Use Only

	Sample Identification	Lab Identification	Sample Type	Date/Time(24hr) Sampled	Dissolved Metals (DM)	Field Acidified?	Total Metals	Nitrate / Nitrite / Ammonia	Total Suspended Solids (TSS) / TDS	pH / Conductivity / Alkalinity	Chloride / Fluoride / Sulphate	DOC (Diss'd Organic Carbon)	TOC (Total Organic Carbon)	Phosphate	Ra 226	Number of Containers
1	MW12-05-01	BZ5236	water	11/11/2012 14:40	X	X	X	X	X	X	X					5
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																

B2A2946

Print name and sign / Print name and sign / Laboratory Use Only

*Relinquished By:	Date (yy/mm/dd):	Time (24hr):	Received by :	Date (yy/mm/dd):	Time (24 hr):	Time Sensitive	Temperature on Receipt (°C)	Custody Seal	Yes	No
Phil Emerson	12-Nov-12	7:30	[signature]	2012/11/13	09:50	☑	A) 4 B) 4 C) 4	Present?	☐	☐
							Just sampled & rec'd on ice: ☐	Intact?	☐	☐

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

Maxxam

Success Through Science®

Your P.O. #: 113976
Your Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your C.O.C. #: EB576412

Attention: MINTO DISTRIBUTION LIST
MINTO EXPLORATIONS LTD.
Yukon/Whitehorse
2 - 25 Pilgrim Way
Whitehorse, YT
CANADA Y1A 6E6

Report Date: 2012/11/19

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B2A3069
Received: 2012/11/13, 09:30

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	3	2012/11/15	2012/11/15	BBY6SOP-00026	SM2320B
Conductance - water	3	N/A	2012/11/15	BBY6SOP-00026	SM-2510B
Hardness (calculated as CaCO3)	3	N/A	2012/11/17	BBY WI-00033	Calculated Parameter
Mercury (Dissolved) by CVAF	3	N/A	2012/11/16	BBY7SOP-00015	EPA 245.7
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	3	N/A	2012/11/17	BBY7SOP-00002	EPA 6020A
Elements by CRC ICPMS (dissolved)	3	N/A	2012/11/16	BBY7SOP-00002	EPA 6020A
Ammonia-N (Unpreserved)	1	N/A	2012/11/14	BBY6SOP-00009	SM-4500NH3G
Ammonia-N (Preserved)	2	N/A	2012/11/14	BBY6SOP-00009	SM-4500NH3G
Nitrate + Nitrite (N)	3	N/A	2012/11/14	BBY6SOP-00010	USEPA 353.2
Nitrite (N) by CFA	3	N/A	2012/11/14	BBY6SOP-00010	EPA 353.2
Nitrogen - Nitrate (as N)	3	N/A	2012/11/15	BBY6SOP-00010	Based on EPA 353.2
Filter and HNO3 Preserve for Metals	3	N/A	2012/11/13	BBY6WI-00001	EPA 200.2
Sulphate by Automated Colourimetry	2	N/A	2012/11/14	BBY6SOP-00017	SM4500-SO42
Sulphate by Automated Colourimetry	1	N/A	2012/11/15	BBY6SOP-00017	SM4500-SO42
Total Dissolved Solids (Filt. Residue)	3	2012/11/16	2012/11/16	BBY6SOP-00033	SM 2540C

* Results relate only to the items tested.

Encryption Key

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

Lanoy Luangkhamdeng, Burnaby Project Manager
Email: LLuangkhamdeng@maxxam.ca
Phone# (604) 638-2636

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

Total cover pages: 1

Success Through Science®

Maxxam Job #: B2A3069
Report Date: 2012/11/19

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		EZ6095			EZ6096		EZ6097		
Sampling Date		2012/11/03 16:50			2012/11/03 09:08		2012/11/03 10:38		
	UNITS	**MW12-07-01**	**RDL**	**QC Batch**	**MW12-07-02**	**RDL**	**MW12-07-03**	**RDL**	**QC Batch**
ANIONS									
Nitrite (N)	mg/L	0.0731(1)	0.0050	6347489	0.148(1)	0.0050	0.141(1)	0.0050	6347489
Calculated Parameters									
Filter and HNO3 Preservation	N/A	FIELD	N/A	ONSITE	FIELD	N/A	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	53.2	2.0	6340033	21.3	0.40	53.5	2.0	6340033
Misc. Inorganics									
Alkalinity (Total as CaCO3)	mg/L	296	0.50	6346329	197	0.50	310	0.50	6346329
Alkalinity (PP as CaCO3)	mg/L	<0.50	0.50	6346329	<0.50	0.50	<0.50	0.50	6346329
Bicarbonate (HCO3)	mg/L	361	0.50	6346329	240	0.50	378	0.50	6346329
Carbonate (CO3)	mg/L	<0.50	0.50	6346329	<0.50	0.50	<0.50	0.50	6346329
Hydroxide (OH)	mg/L	<0.50	0.50	6346329	<0.50	0.50	<0.50	0.50	6346329
Anions									
Dissolved Sulphate (SO4)	mg/L	193	0.50	6349626	283	5.0	185	0.50	6345660
Nutrients									
Ammonia (N)	mg/L	<0.0050(1)	0.0050	6341937	<0.0050	0.0050	0.012	0.0050	6341944
Nitrate plus Nitrite (N)	mg/L	53.3(1)	2.0	6347389	21.5(1)	0.40	53.7(1)	2.0	6347389
Physical Properties									
Conductivity	uS/cm	1250	1.0	6346368	1070	1.0	1250	1.0	6346368
Physical Properties									
Total Dissolved Solids	mg/L	870(1)	10	6350908	782(1)	10	924(1)	10	6350908

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Sample arrived to laboratory past recommended hold time.

Maxxam Job #: B2A3069
Report Date: 2012/11/19

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		EZ6095	EZ6096	EZ6097		
Sampling Date		2012/11/03 16:50	2012/11/03 09:08	2012/11/03 10:38		
	UNITS	**MW12-07-01**	**MW12-07-02**	**MW12-07-03**	**RDL**	**QC Batch**
Misc. Inorganics						
Dissolved Hardness (CaCO3)	mg/L	599	496	592	0.50	6338777
Elements						
Dissolved Mercury (Hg)	ug/L	<0.010	<0.010	<0.010	0.010	6350132

RDL = Reportable Detection Limit

Maxxam Job #: B2A3069
Report Date: 2012/11/19

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		EZ6095	EZ6096	EZ6097		
Sampling Date		2012/11/03 16:50	2012/11/03 09:08	2012/11/03 10:38		
	UNITS	**MW12-07-01**	**MW12-07-02**	**MW12-07-03**	**RDL**	**QC Batch**
Dissolved Metals by ICPMS						
Dissolved Aluminum (Al)	ug/L	28.1	6.0	9.8	3.0	6350289
Dissolved Antimony (Sb)	ug/L	<0.50	<0.50	<0.50	0.50	6350289
Dissolved Arsenic (As)	ug/L	0.74	0.24	0.73	0.10	6350289
Dissolved Barium (Ba)	ug/L	171	54.6	169	1.0	6350289
Dissolved Beryllium (Be)	ug/L	<0.10	<0.10	<0.10	0.10	6350289
Dissolved Bismuth (Bi)	ug/L	<1.0	<1.0	<1.0	1.0	6350289
Dissolved Boron (B)	ug/L	76	105	127	50	6350289
Dissolved Cadmium (Cd)	ug/L	0.224	0.269	0.633	0.010	6350289
Dissolved Chromium (Cr)	ug/L	<1.0	<1.0	<1.0	1.0	6350289
Dissolved Cobalt (Co)	ug/L	<0.50	<0.50	<0.50	0.50	6350289
Dissolved Copper (Cu)	ug/L	77.0	21.7	76.7	0.20	6350289
Dissolved Iron (Fe)	ug/L	230	6.9	189	5.0	6350289
Dissolved Lead (Pb)	ug/L	0.41	0.56	0.58	0.20	6350289
Dissolved Lithium (Li)	ug/L	10.1	22.0	10.3	5.0	6350289
Dissolved Manganese (Mn)	ug/L	299	89.9	289	1.0	6350289
Dissolved Molybdenum (Mo)	ug/L	19.2	33.4	19.6	1.0	6350289
Dissolved Nickel (Ni)	ug/L	5.1	1.7	4.0	1.0	6350289
Dissolved Phosphorus (P)	ug/L	11	<10	<10	10	6350289
Dissolved Selenium (Se)	ug/L	33.7	14.8	34.7	0.10	6350289
Dissolved Silicon (Si)	ug/L	6830	6610	6790	100	6350289
Dissolved Silver (Ag)	ug/L	0.021	<0.020	<0.020	0.020	6350289
Dissolved Strontium (Sr)	ug/L	5320	3680	5370	1.0	6350289
Dissolved Thallium (Tl)	ug/L	<0.050	<0.050	<0.050	0.050	6350289
Dissolved Tin (Sn)	ug/L	<5.0	<5.0	<5.0	5.0	6350289
Dissolved Titanium (Ti)	ug/L	<5.0	<5.0	<5.0	5.0	6350289
Dissolved Uranium (U)	ug/L	6.22	5.75	6.09	0.10	6350289
Dissolved Vanadium (V)	ug/L	<5.0	<5.0	<5.0	5.0	6350289
Dissolved Zinc (Zn)	ug/L	56.2	38.5	63.7	5.0	6350289
Dissolved Zirconium (Zr)	ug/L	<0.50	<0.50	<0.50	0.50	6350289
Dissolved Calcium (Ca)	mg/L	177	140	176	0.050	6339101
Dissolved Magnesium (Mg)	mg/L	38.3	35.5	37.2	0.050	6339101
Dissolved Potassium (K)	mg/L	5.74	5.92	5.68	0.050	6339101
Dissolved Sodium (Na)	mg/L	34.4	38.9	34.1	0.050	6339101
Dissolved Sulphur (S)	mg/L	67.5	104	67.5	3.0	6339101

RDL = Reportable Detection Limit

Maxxam Job #: B2A3069
Report Date: 2012/11/19

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6341937	Ammonia (N)	2012/11/14	83	80 - 120	100	80 - 120	<0.0050	mg/L	NC	20
6341944	Ammonia (N)	2012/11/14	97	80 - 120	97	80 - 120	<0.0050	mg/L	NC	20
6345660	Dissolved Sulphate (SO4)	2012/11/14	NC	80 - 120	100	80 - 120	<0.50	mg/L	1.9	20
6346329	Alkalinity (Total as CaCO3)	2012/11/15	NC	80 - 120	91	80 - 120	<0.50	mg/L	2.1	20
6346329	Alkalinity (PP as CaCO3)	2012/11/15					<0.50	mg/L	NC	20
6346329	Bicarbonate (HCO3)	2012/11/15					<0.50	mg/L	2.0	20
6346329	Carbonate (CO3)	2012/11/15					<0.50	mg/L	NC	20
6346329	Hydroxide (OH)	2012/11/15					<0.50	mg/L	NC	20
6346368	Conductivity	2012/11/15			99	80 - 120	<1.0	uS/cm	0.5	20
6347389	Nitrate plus Nitrite (N)	2012/11/14	111	80 - 120	102	80 - 120	<0.020	mg/L	0.7	25
6347489	Nitrite (N)	2012/11/14			97	80 - 120	<0.0050	mg/L	0.07	20
6349626	Dissolved Sulphate (SO4)	2012/11/15			101	80 - 120	<0.50	mg/L	NC	20
6350132	Dissolved Mercury (Hg)	2012/11/16	99	80 - 120	97	80 - 120	<0.010	ug/L	NC	20
6350289	Dissolved Aluminum (Al)	2012/11/16	102	80 - 120	105	80 - 120	<3.0	ug/L	NC	20
6350289	Dissolved Antimony (Sb)	2012/11/16	96	80 - 120	101	80 - 120	<0.50	ug/L	NC	20
6350289	Dissolved Arsenic (As)	2012/11/16	107	80 - 120	103	80 - 120	<0.10	ug/L	NC	20
6350289	Dissolved Barium (Ba)	2012/11/16	NC	80 - 120	99	80 - 120	<1.0	ug/L	2.9	20
6350289	Dissolved Beryllium (Be)	2012/11/16	111	80 - 120	107	80 - 120	<0.10	ug/L	NC	20
6350289	Dissolved Bismuth (Bi)	2012/11/16	95	80 - 120	102	80 - 120	<1.0	ug/L	NC	20
6350289	Dissolved Cadmium (Cd)	2012/11/16	103	80 - 120	101	80 - 120	<0.010	ug/L	5.4	20
6350289	Dissolved Chromium (Cr)	2012/11/16	101	80 - 120	103	80 - 120	<1.0	ug/L	NC	20
6350289	Dissolved Cobalt (Co)	2012/11/16	100	80 - 120	103	80 - 120	<0.50	ug/L	NC	20
6350289	Dissolved Copper (Cu)	2012/11/16	NC	80 - 120	102	80 - 120	<0.20	ug/L	3.3	20
6350289	Dissolved Iron (Fe)	2012/11/16	91	80 - 120	108	80 - 120	<5.0	ug/L	31.1(1)	20
6350289	Dissolved Lead (Pb)	2012/11/16	98	80 - 120	100	80 - 120	<0.20	ug/L	NC	20
6350289	Dissolved Lithium (Li)	2012/11/16	112	80 - 120	110	80 - 120	<5.0	ug/L	NC	20
6350289	Dissolved Manganese (Mn)	2012/11/16	99	80 - 120	103	80 - 120	<1.0	ug/L	NC	20
6350289	Dissolved Molybdenum (Mo)	2012/11/16	NC	80 - 120	102	80 - 120	<1.0	ug/L	NC	20
6350289	Dissolved Nickel (Ni)	2012/11/16	98	80 - 120	105	80 - 120	<1.0	ug/L	NC	20
6350289	Dissolved Selenium (Se)	2012/11/16	111	80 - 120	106	80 - 120	<0.10	ug/L	11.0	20
6350289	Dissolved Silver (Ag)	2012/11/16	98	80 - 120	96	80 - 120	<0.020	ug/L	NC	20
6350289	Dissolved Strontium (Sr)	2012/11/16	NC	80 - 120	100	80 - 120	<1.0	ug/L	1.1	20
6350289	Dissolved Thallium (Tl)	2012/11/16	98	80 - 120	104	80 - 120	<0.050	ug/L	NC	20
6350289	Dissolved Tin (Sn)	2012/11/16	102	80 - 120	107	80 - 120	<5.0	ug/L	NC	20
6350289	Dissolved Titanium (Ti)	2012/11/16	87	80 - 120	102	80 - 120	<5.0	ug/L	NC	20
6350289	Dissolved Uranium (U)	2012/11/16	100	80 - 120	98	80 - 120	<0.10	ug/L	0.3	20
6350289	Dissolved Vanadium (V)	2012/11/16	104	80 - 120	100	80 - 120	<5.0	ug/L	NC	20
6350289	Dissolved Zinc (Zn)	2012/11/16	NC	80 - 120	111	80 - 120	<5.0	ug/L	NC	20
6350289	Dissolved Boron (B)	2012/11/16					<50	ug/L	NC	20

Maxxam Job #: B2A3069
Report Date: 2012/11/19

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6350289	Dissolved Phosphorus (P)	2012/11/16					<10	ug/L	NC	20
6350289	Dissolved Silicon (Si)	2012/11/16					<100	ug/L	0.8	20
6350289	Dissolved Zirconium (Zr)	2012/11/16					<0.50	ug/L	NC	20
6350908	Total Dissolved Solids	2012/11/16	NC	80 - 120	100	80 - 120	<10	mg/L	0.5	20

N/A = Not Applicable

RPD = Relative Percent Difference

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

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

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

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

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

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

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

Maxxam

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

CHAIN OF CUSTODY RECORD

Click here to get the COC number

Maxxam Job #: B2A3069 **COC #:** EB576412 Page: 1 of 1

Invoice To: Require Report? Yes ☐ No ☐

	Invoice To		Report To
Company Name:	Minto Explorations Ltd	Company Name:	Minto Explorations Ltd
Contact Name:	Elvina Wong	Contact Name:	Minto Environment
Address:	Suite 900 - 999 West Hastings St	Address:	Suite 900-999 West Hastings St
	Vancouver, B.C. PC: V6C 2W2		Vancouver, B.C. PC: V6C 2W2
Phone / Fax#:	Ph: 604-684-8894 Fax: 604-688-2120	Phone / Fax#:	Ph: 604-684-8894 Fax: 604-688-2120
E-mail		E-mail	minto_environment@mintomine.com

PO #:	113796
Quotation #:	
Project # :	
Proj. Name:	Minto Env. Monitoring
Location:	Yukon
Sampled by:	

REGULATORY REQUIREMENTS:

- ☐ CSR
- ☐ CCME
- ☐ BC Water Quality
- ☑ Other low detection limits reque
- ☐ DRINKING WATER

SERVICE REQUESTED:

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

SPECIAL INSTRUCTIONS:

Return Cooler ☐ **Ship Sample Bottles (please specify)** ☐

ANALYSIS REQUESTED

Field Filtered? ☑ Y ☐ N; Field Acidified? ☑ Y ☐ N (Dissolved Metals (DM)); Field Acidified? ☐ Y ☐ N (Total Metals)

	Sample Identification	[redacted]	Sample Type	Date/Time(24hr) Sampled	Dissolved Metals (DM)		Total Metals	Nitrate ☑ Nitrite ☑ Ammonia ☑	Total Suspended Solids (TSS) ☑ TDS ☐	pH ☐ Conductivity ☑ Alkalinity ☑	Chloride ☐ Fluoride ☐ Sulphate ☑	Number of Containers
1	MW12-07-01	[redacted]	Ground W	12/11/03 16:50	x			x	x	x	x	4
2	MW12-07-02	[redacted]	Ground W	12/11/04 9:08	x			x	x	x	x	4
3	MW12-07-03	[redacted]	Ground W	12/11/04 10:38	x			x	x	x	x	3
4		[redacted]			Note: please cc a copy of emailed test							
5		[redacted]										
6												
7												
8												
9												
10												
11												
12		[redacted]										

B2A3069

Print name and sign

*Relinquished By:	Date (yy/mm/dd):	Time (24hr):	[redacted]	Time Sensitive	Temperature on Receipt (°C)	Custody Seal	Yes	No
Phil Emerson	10-Nov-12	8:00	[redacted]	☑	A) 7 B) 6 C) 5	Present	☐	☐
					Jars Sampled/Cooled on ice ☐	Intact?	☐	☐

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

BBY FCD-00077R2_C

Maxxam

Success Through Science®

Your P.O. #: 113796
Your Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your C.O.C. #: EB580212

Attention: MINTO DISTRIBUTION LIST
MINTO EXPLORATIONS LTD.
Yukon/Whitehorse
2 - 25 Pilgrim Way
Whitehorse, YT
CANADA Y1A 6E6

Report Date: 2012/11/22

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B2A4288
Received: 2012/11/16, 08:15

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	4	2012/11/20	2012/11/21	BBY6SOP-00026	SM2320B
Conductance - water	4	N/A	2012/11/21	BBY6SOP-00026	SM-2510B
Hardness (calculated as CaCO3)	4	N/A	2012/11/20	BBY WI-00033	Calculated Parameter
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	4	N/A	2012/11/20	BBY7SOP-00002	EPA 6020A
Elements by ICPMS Low Level (dissolved)	2	N/A	2012/11/19	BBY7SOP-00002	EPA 6020A
Elements by ICPMS Low Level (dissolved)	2	N/A	2012/11/20	BBY7SOP-00002	EPA 6020A
Elements by ICPMS Low Level (total)	1	N/A	2012/11/19	BBY7SOP-00002	EPA 6020A
Elements by ICPMS Low Level (total)	3	N/A	2012/11/20	BBY7SOP-00002	EPA 6020A
Ammonia-N (Preserved)	4	N/A	2012/11/19	BBY6SOP-00009	SM-4500NH3G
Nitrate + Nitrite (N)	3	N/A	2012/11/17	BBY6SOP-00010	USEPA 353.2
Nitrate + Nitrite (N)	1	N/A	2012/11/20	BBY6SOP-00010	USEPA 353.2
Nitrite (N) by CFA	3	N/A	2012/11/17	BBY6SOP-00010	EPA 353.2
Nitrite (N) by CFA	1	N/A	2012/11/20	BBY6SOP-00010	EPA 353.2
Nitrogen - Nitrate (as N)	3	N/A	2012/11/20	BBY6SOP-00010	Based on EPA 353.2
Nitrogen - Nitrate (as N)	1	N/A	2012/11/21	BBY6SOP-00010	Based on EPA 353.2
Filter and HNO3 Preserve for Metals	4	N/A	2012/11/16	BBY6WI-00001	EPA 200.2
Sulphate by Automated Colourimetry	4	N/A	2012/11/19	BBY6SOP-00017	SM4500-SO42
Total Dissolved Solids (Filt. Residue)	4	2012/11/19	2012/11/19	BBY6SOP-00033	SM 2540C

* Results relate only to the items tested.

Encryption Key

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

Lanoy Luangkhamdeng, Burnaby Project Manager
Email: LLuangkhamdeng@maxxam.ca
Phone# (604) 638-2636

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

Total cover pages: 1

Maxxam Job #: B2A4288
Report Date: 2012/11/22

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113796
Sampler Initials: JC

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		FA2751			FA2752	FA2753		FA2754		
Sampling Date		2012/11/12 00:00			2012/11/12 00:00	2012/11/12 00:00		2012/11/12 00:00		
	UNITS	**MW12-05-02**	**RDL**	**QC Batch**	**MW12-05-03**	**MW12-05-04**	**RDL**	**MW12-05-05**	**RDL**	**QC Batch**
ANIONS										
Nitrite (N)	mg/L	0.109(1)	0.0050	6362222	0.195(1)	0.0298(1)	0.0050	0.0936(1)	0.0050	6353934
Calculated Parameters										
Filter and HNO3 Preservation	N/A	FIELD	N/A	ONSITE	FIELD	FIELD	N/A	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.030	0.020	6350143	0.817	<0.020	0.020	0.068	0.020	6350143
Misc. Inorganics										
Alkalinity (Total as CaCO3)	mg/L	193	0.50	6362204	221	216	0.50	192	0.50	6362204
Alkalinity (PP as CaCO3)	mg/L	1.75	0.50	6362204	<0.50	2.89	0.50	0.75	0.50	6362204
Bicarbonate (HCO3)	mg/L	231	0.50	6362204	269	256	0.50	232	0.50	6362204
Carbonate (CO3)	mg/L	2.10	0.50	6362204	<0.50	3.47	0.50	0.90	0.50	6362204
Hydroxide (OH)	mg/L	<0.50	0.50	6362204	<0.50	<0.50	0.50	<0.50	0.50	6362204
Anions										
Dissolved Sulphate (SO4)	mg/L	456	5.0	6359097	46.3	40.6	0.50	462	5.0	6359097
Nutrients										
Ammonia (N)	mg/L	0.019	0.0050	6355022	0.016	0.21	0.0050	0.015	0.0050	6355022
Nitrate plus Nitrite (N)	mg/L	0.139(1)	0.020	6362221	1.01(1)	0.041(1)	0.020	0.162(1)	0.020	6353932
Physical Properties										
Conductivity	uS/cm	1240	1.0	6362206	515	486	1.0	1240	1.0	6362206
Physical Properties										
Total Dissolved Solids	mg/L	880	10	6357401	288	260	10	898	10	6357401

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Sample arrived to laboratory past recommended hold time.

Maxxam Job #: B2A4288
Report Date: 2012/11/22

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113796
Sampler Initials: JC

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		FA2751	FA2752	FA2753	FA2754		
Sampling Date		2012/11/12 00:00	2012/11/12 00:00	2012/11/12 00:00	2012/11/12 00:00		
	UNITS	**MW12-05-02**	**MW12-05-03**	**MW12-05-04**	**MW12-05-05**	**RDL**	**QC Batch**
Misc. Inorganics							
Dissolved Hardness (CaCO3)	mg/L	516	231	214	492	0.50	6353503

RDL = Reportable Detection Limit

Maxxam

Maxxam Job #: B2A4288
Report Date: 2012/11/22

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113796
Sampler Initials: JC

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		FA2751	FA2752	FA2753	FA2754		
Sampling Date		2012/11/12 00:00	2012/11/12 00:00	2012/11/12 00:00	2012/11/12 00:00		
	UNITS	**MW12-05-02**	**MW12-05-03**	**MW12-05-04**	**MW12-05-05**	**RDL**	**QC Batch**
Dissolved Metals by ICPMS							
Dissolved Aluminum (Al)	ug/L	4.30	4.59	3.63	15.6	0.20	6355128
Dissolved Antimony (Sb)	ug/L	0.197	0.086	0.134	0.386	0.020	6355128
Dissolved Arsenic (As)	ug/L	0.307	0.329	0.917	0.192	0.020	6355128
Dissolved Barium (Ba)	ug/L	143	93.6	142	149	0.020	6355128
Dissolved Beryllium (Be)	ug/L	<0.010	<0.010	<0.010	<0.010	0.010	6355128
Dissolved Bismuth (Bi)	ug/L	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	6355128
Dissolved Boron (B)	ug/L	77	<50	54	66	50	6355128
Dissolved Cadmium (Cd)	ug/L	0.214	0.0160	<0.0050	0.324	0.0050	6355128
Dissolved Chromium (Cr)	ug/L	<0.10	<0.10	<0.10	<0.10	0.10	6355128
Dissolved Cobalt (Co)	ug/L	5.51	0.522	0.249	5.53	0.0050	6355128
Dissolved Copper (Cu)	ug/L	2.20	1.54	0.477	2.66	0.050	6355128
Dissolved Iron (Fe)	ug/L	98.1	15.2	867	150	1.0	6355128
Dissolved Lead (Pb)	ug/L	0.124	0.0550	0.0390	0.665	0.0050	6355128
Dissolved Lithium (Li)	ug/L	4.76	4.39	2.47	4.74	0.50	6355128
Dissolved Manganese (Mn)	ug/L	647	198	411	658	0.050	6355128
Dissolved Molybdenum (Mo)	ug/L	11.2	15.3	3.46	12.1	0.050	6355128
Dissolved Nickel (Ni)	ug/L	3.28	0.905	0.970	3.17	0.020	6355128
Dissolved Selenium (Se)	ug/L	0.364	0.164	0.108	0.345	0.040	6355128
Dissolved Silicon (Si)	ug/L	5030	5800	5270	4530	100	6355128
Dissolved Silver (Ag)	ug/L	0.0050	<0.0050	<0.0050	0.0070	0.0050	6355128
Dissolved Strontium (Sr)	ug/L	3890	816	534	4110	0.050	6355128
Dissolved Thallium (Tl)	ug/L	0.0040	0.0020	<0.0020	0.0050	0.0020	6355128
Dissolved Tin (Sn)	ug/L	<0.20	<0.20	<0.20	<0.20	0.20	6355128
Dissolved Titanium (Ti)	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	6355128
Dissolved Uranium (U)	ug/L	4.10	2.73	2.27	4.31	0.0020	6355128
Dissolved Vanadium (V)	ug/L	<0.20	0.50	0.33	<0.20	0.20	6355128
Dissolved Zinc (Zn)	ug/L	31.2	6.55	5.38	26.2	0.10	6355128
Dissolved Zirconium (Zr)	ug/L	<0.10	<0.10	<0.10	<0.10	0.10	6355128
Dissolved Calcium (Ca)	mg/L	120	47.2	49.4	110	0.050	6351135
Dissolved Magnesium (Mg)	mg/L	52.7	27.4	22.1	53.0	0.050	6351135
Dissolved Potassium (K)	mg/L	4.17	2.55	1.79	4.25	0.050	6351135
Dissolved Sodium (Na)	mg/L	67.6	18.5	17.9	67.7	0.050	6351135
Dissolved Sulphur (S)	mg/L	166	17.3	14.4	167	3.0	6351135

RDL = Reportable Detection Limit

Maxxam Job #: B2A4288
Report Date: 2012/11/22

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113796
Sampler Initials: JC

LOW LEVEL TOTAL METALS IN WATER (WATER)

Maxxam ID		FA2751	FA2752	FA2753	FA2754		
Sampling Date		2012/11/12 00:00	2012/11/12 00:00	2012/11/12 00:00	2012/11/12 00:00		
	UNITS	**MW12-05-02**	**MW12-05-03**	**MW12-05-04**	**MW12-05-05**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total Phosphorus (P)	ug/L	5.8	3.5	12.5	6.3	2.0	6355136

RDL = Reportable Detection Limit

Maxxam Job #: B2A4288
Report Date: 2012/11/22

Success Through Science®

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113796
Sampler Initials: JC

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6353932	Nitrate plus Nitrite (N)	2012/11/17	97	80 - 120	106	80 - 120	<0.020	mg/L	3.9	25
6353934	Nitrite (N)	2012/11/17	96	80 - 120	97	80 - 120	<0.0050	mg/L	3.1	20
6355022	Ammonia (N)	2012/11/19	NC	80 - 120	96	80 - 120	<0.0050	mg/L	NC	20
6355128	Dissolved Aluminum (Al)	2012/11/19	98	80 - 120	103	80 - 120	<0.20	ug/L	1.5	20
6355128	Dissolved Antimony (Sb)	2012/11/19	99	80 - 120	97	80 - 120	<0.020	ug/L	NC	20
6355128	Dissolved Arsenic (As)	2012/11/19	100	80 - 120	96	80 - 120	<0.020	ug/L	NC	20
6355128	Dissolved Barium (Ba)	2012/11/19	96	80 - 120	95	80 - 120	<0.020	ug/L	1.6	20
6355128	Dissolved Beryllium (Be)	2012/11/19	101	80 - 120	95	80 - 120	<0.010	ug/L	NC	20
6355128	Dissolved Bismuth (Bi)	2012/11/19	99	80 - 120	94	80 - 120	<0.0050	ug/L	NC	20
6355128	Dissolved Cadmium (Cd)	2012/11/19	99	80 - 120	99	80 - 120	<0.0050	ug/L	NC	20
6355128	Dissolved Chromium (Cr)	2012/11/19	102	80 - 120	102	80 - 120	<0.10	ug/L	NC	20
6355128	Dissolved Cobalt (Co)	2012/11/19	101	80 - 120	102	80 - 120	<0.0050	ug/L	NC	20
6355128	Dissolved Copper (Cu)	2012/11/19	100	80 - 120	103	80 - 120	<0.050	ug/L	8.6	20
6355128	Dissolved Iron (Fe)	2012/11/19	112	80 - 120	110	80 - 120	<1.0	ug/L	11.5	20
6355128	Dissolved Lead (Pb)	2012/11/19	98	80 - 120	101	80 - 120	0.0090, RDL=0.0050	ug/L	NC	20
6355128	Dissolved Lithium (Li)	2012/11/19	95	80 - 120	100	80 - 120	<0.50	ug/L	NC	20
6355128	Dissolved Manganese (Mn)	2012/11/19	100	80 - 120	103	80 - 120	<0.050	ug/L	NC	20
6355128	Dissolved Molybdenum (Mo)	2012/11/19	99	80 - 120	102	80 - 120	<0.050	ug/L	NC	20
6355128	Dissolved Nickel (Ni)	2012/11/19	103	80 - 120	104	80 - 120	<0.020	ug/L	NC	20
6355128	Dissolved Selenium (Se)	2012/11/19	114	80 - 120	108	80 - 120	<0.040	ug/L	NC	20
6355128	Dissolved Silver (Ag)	2012/11/19	102	80 - 120	103	80 - 120	<0.0050	ug/L	NC	20
6355128	Dissolved Strontium (Sr)	2012/11/19	NC	80 - 120	100	80 - 120	<0.050	ug/L	1.3	20
6355128	Dissolved Thallium (Tl)	2012/11/19	97	80 - 120	102	80 - 120	<0.0020	ug/L	NC	20
6355128	Dissolved Tin (Sn)	2012/11/19	102	80 - 120	102	80 - 120	<0.20	ug/L	NC	20
6355128	Dissolved Titanium (Ti)	2012/11/19	100	80 - 120	98	80 - 120	<0.50	ug/L		
6355128	Dissolved Uranium (U)	2012/11/19	101	80 - 120	101	80 - 120	<0.0020	ug/L	NC	20
6355128	Dissolved Vanadium (V)	2012/11/19	102	80 - 120	101	80 - 120	<0.20	ug/L	NC	20
6355128	Dissolved Zinc (Zn)	2012/11/19	111	80 - 120	109	80 - 120	<0.10	ug/L	NC	20
6355128	Dissolved Boron (B)	2012/11/19					<50	ug/L	NC	20
6355128	Dissolved Silicon (Si)	2012/11/19					<100	ug/L		
6355128	Dissolved Zirconium (Zr)	2012/11/19					<0.10	ug/L		
6355136	Total Phosphorus (P)	2012/11/20					<2.0	ug/L		
6357401	Total Dissolved Solids	2012/11/19	NC	80 - 120	96	80 - 120	<10	mg/L	1.7	20
6359097	Dissolved Sulphate (SO4)	2012/11/19	NC	80 - 120	100	80 - 120	<0.50	mg/L	0.2	20
6362204	Alkalinity (Total as CaCO3)	2012/11/21	NC	80 - 120	93	80 - 120	<0.50	mg/L	1	20
6362204	Alkalinity (PP as CaCO3)	2012/11/21					<0.50	mg/L	NC	20
6362204	Bicarbonate (HCO3)	2012/11/21					<0.50	mg/L	0.9	20
6362204	Carbonate (CO3)	2012/11/21					<0.50	mg/L	NC	20
6362204	Hydroxide (OH)	2012/11/21					<0.50	mg/L	NC	20

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6362206	Conductivity	2012/11/21			98	80 - 120	1.1, RDL=1.0	uS/cm	0.2	20
6362221	Nitrate plus Nitrite (N)	2012/11/20	102	80 - 120	105	80 - 120	<0.020	mg/L	0.8(1)	25
6362222	Nitrite (N)	2012/11/20	102	80 - 120	98	80 - 120	<0.0050	mg/L	2.0(1)	20

N/A = Not Applicable

RDL = Reportable Detection Limit

RPD = Relative Percent Difference

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

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

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

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

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

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

(1) - Sample arrived to laboratory past recommended hold time.

Maxxam

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

CHAIN OF CUSTODY RECORD

Click here to get the COC number

Maxxam Job #: B2A4288 **COC #:** EB580212 Page: 1 of 1

Invoice To: Require Report? Yes ☐ No ☐

Company Name:	Minto Explorations Ltd		
Contact Name:	Elvina Wong		
Address:	Suite 900 - 999 West Hastings St		
	Vancouver, B.C.	PC:	V6C 2W2
Phone / Fax#:	Ph: 604-684-8894	Fax:	604-688-2120
E-mail			

Report To:

Company Name:	Minto Explorations Ltd		
Contact Name:	Minto Environment		
Address:	Suite 900-999 West Hastings St		
	Vancouver, B.C.	PC:	V6C 2W2
Phone / Fax#:	Ph: 604-684-8894	Fax:	604-688-2120
E-mail	minto_environment@mintomine.com		

PO #:	113796
Quotation #:	
Project # :	
Proj. Name:	Minto Env. Monitoring
Location:	Yukon
Sampled by:	Jay Cherian

REGULATORY REQUIREMENTS:

- ☐ CSR
- ☐ CCME
- ☐ BC Water Quality
- ☑ Other low detection limits
- ☐ DRINKING WATER

SERVICE REQUESTED:

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

SPECIAL INSTRUCTIONS:

Return Cooler ☐ **Ship Sample Bottles (please specify)** ☐

Need low dectection limits. TM- only need total phosphorous

Please copy results to Jcherian@srk.com and jandrews@srk.com

ANALYSIS REQUESTED

#	Sample Identification	[redacted]	Sample Type	Date/Time(24hr) Sampled	Dissolved Metals (DM) (Field Filtered? ☑Y ☐N)	Total Metals (Field Acidified? ☑Y ☐N)	Field Acidified? ☑Y ☐N	☑ Nitrate ☑ Nitrite ☑ Ammonia	☑ Total Suspended Solids (TSS) ☐ TDS	☐ pH ☐ Conductivity ☑ Alkalinity	☐ Chloride ☐ Fluoride ☑ Sulphate	DOC (Diss'd Organic Carbon)	TOC (Total Organic Carbon)	Phosphate	Ra 226	Number of Containers
1	MW12-05-02	[redacted]	Ground W	11/12/12 0:00	X	X	X	X	X	X	X					6
2	MW12-05-03	[redacted]	Ground W	11/12/12 0:00	X	X	X	X	X	X	X					6
3	MW12-05-04	[redacted]	Ground W	11/12/12 0:00	X	X	X	X	X	X	X					6
4	MW12-05-05	[redacted]	Ground W	11/12/12 0:00	X	X	X	X	X	X	X					6
5		[redacted]														
6		[redacted]														
7		[redacted]														
8		[redacted]														
9		[redacted]														
10		[redacted]														
11		[redacted]														
12		[redacted]														

B2A4288

Print name and sign

*Relinquished By:	Date (yy/mm/dd):	Time (24hr):	[redacted]	Time Sensitive	Laboratory Use Only
Chris Harry	15-Nov-12	7:00	[redacted]	☑	Temperature (°C) on Receipt; Custody Seal Present? Yes ☐ No ☑; Intact?

0815

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

Maxxam

Success Through Science®

Your P.O. #: 113976
Your Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your C.O.C. #: EB581312

Attention: MINTO DISTRIBUTION LIST
MINTO EXPLORATIONS LTD.
Yukon/Whitehorse
2 - 25 Pilgrim Way
Whitehorse, YT
CANADA Y1A 6E6

Report Date: 2012/11/23

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B2A4950
Received: 2012/11/19, 08:30

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	4	2012/11/21	2012/11/22	BBY6SOP-00026	SM2320B
Conductance - water	4	N/A	2012/11/21	BBY6SOP-00026	SM-2510B
Hardness (calculated as CaCO3)	4	N/A	2012/11/22	BBY WI-00033	Calculated Parameter
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	4	N/A	2012/11/22	BBY7SOP-00002	EPA 6020A
Elements by ICPMS Low Level (dissolved)	4	N/A	2012/11/22	BBY7SOP-00002	EPA 6020A
Elements by ICPMS Low Level (total)	4	N/A	2012/11/21	BBY7SOP-00002	EPA 6020A
Ammonia-N (Preserved)	4	N/A	2012/11/19	BBY6SOP-00009	SM-4500NH3G
Nitrate + Nitrite (N)	4	N/A	2012/11/19	BBY6SOP-00010	USEPA 353.2
Nitrite (N) by CFA	4	N/A	2012/11/19	BBY6SOP-00010	EPA 353.2
Nitrogen - Nitrate (as N)	4	N/A	2012/11/20	BBY6SOP-00010	Based on EPA 353.2
Filter and HNO3 Preserve for Metals	4	N/A	2012/11/19	BBY6WI-00001	EPA 200.2
Sulphate by Automated Colourimetry	2	N/A	2012/11/19	BBY6SOP-00017	SM4500-SO42
Sulphate by Automated Colourimetry	2	N/A	2012/11/20	BBY6SOP-00017	SM4500-SO42
Total Dissolved Solids (Filt. Residue)	4	2012/11/21	2012/11/21	BBY6SOP-00033	SM 2540C

* Results relate only to the items tested.

Encryption Key

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

Lanoy Luangkhamdeng, Burnaby Project Manager
Email: LLuangkhamdeng@maxxam.ca
Phone# (604) 638-2636

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

Total cover pages: 1

Maxxam Job #: B2A4950
Report Date: 2012/11/23

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: JC

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		FA7567			FA7568	FA7569			FA7570		
Sampling Date		2012/11/16 00:00			2012/11/16 00:00	2012/11/16 00:00			2012/11/16 00:00		
	UNITS	**MW 12-06-01**	**RDL**	**QC Batch**	**MW 12-06-02**	**MW 12-06-03**	**RDL**	**QC Batch**	**MW 12-06-04**	**RDL**	**QC Batch**
ANIONS											
Nitrite (N)	mg/L	0.263	0.0050	6358744	0.229	0.0651	0.0050	6358744	0.215	0.0050	6358744
Calculated Parameters											
Filter and HNO3 Preservation	N/A	FIELD	N/A	ONSITE	FIELD	FIELD	N/A	ONSITE	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.081	0.020	6354842	0.080	0.450	0.020	6354842	0.066	0.020	6354842
Misc. Inorganics											
Alkalinity (Total as CaCO3)	mg/L	316	0.50	6364310	403	345	0.50	6364310	311	0.50	6364310
Alkalinity (PP as CaCO3)	mg/L	<0.50	0.50	6364310	<0.50	<0.50	0.50	6364310	<0.50	0.50	6364310
Bicarbonate (HCO3)	mg/L	386	0.50	6364310	492	421	0.50	6364310	380	0.50	6364310
Carbonate (CO3)	mg/L	<0.50	0.50	6364310	<0.50	<0.50	0.50	6364310	<0.50	0.50	6364310
Hydroxide (OH)	mg/L	<0.50	0.50	6364310	<0.50	<0.50	0.50	6364310	<0.50	0.50	6364310
Anions											
Dissolved Sulphate (SO4)	mg/L	208	5.0	6359097	178	171	0.50	6361642	213	5.0	6359097
Nutrients											
Ammonia (N)	mg/L	0.0074	0.0050	6355022	0.0059	0.085	0.0050	6355022	0.0096	0.0050	6355022
Nitrate plus Nitrite (N)	mg/L	0.343	0.020	6358742	0.309	0.515	0.020	6358742	0.281	0.020	6358742
Physical Properties											
Conductivity	uS/cm	962	1.0	6364309	1000	905	1.0	6364309	957	1.0	6364309
Physical Properties											
Total Dissolved Solids	mg/L	636	10	6363236	618	538	10	6363236	618	10	6363236

N/A = Not Applicable
RDL = Reportable Detection Limit

Maxxam Job #: B2A4950
Report Date: 2012/11/23

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: JC

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		FA7567		FA7568	FA7569	FA7570		
Sampling Date		2012/11/16 00:00		2012/11/16 00:00	2012/11/16 00:00	2012/11/16 00:00		
	UNITS	**MW 12-06-01**	**QC Batch**	**MW 12-06-02**	**MW 12-06-03**	**MW 12-06-04**	**RDL**	**QC Batch**
Misc. Inorganics								
Dissolved Hardness (CaCO3)	mg/L	412	6355452	467	425	407	0.50	6355452

RDL = Reportable Detection Limit

Maxxam Job #: B2A4950
Report Date: 2012/11/23

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: JC

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		FA7567		FA7568	FA7569	FA7570		
Sampling Date		2012/11/16 00:00		2012/11/16 00:00	2012/11/16 00:00	2012/11/16 00:00		
	UNITS	**MW 12-06-01**	**QC Batch**	**MW 12-06-02**	**MW 12-06-03**	**MW 12-06-04**	**RDL**	**QC Batch**
Dissolved Metals by ICPMS								
Dissolved Aluminum (Al)	ug/L	5.87	6362590	3.70	2.39	3.17	0.20	6362594
Dissolved Antimony (Sb)	ug/L	0.136	6362590	0.116	0.096	0.231	0.020	6362594
Dissolved Arsenic (As)	ug/L	3.04	6362590	1.63	0.090	2.98	0.020	6362594
Dissolved Barium (Ba)	ug/L	51.9	6362590	42.5	25.3	51.9	0.020	6362594
Dissolved Beryllium (Be)	ug/L	0.027	6362590	0.019	<0.010	0.020	0.010	6362594
Dissolved Bismuth (Bi)	ug/L	<0.0050	6362590	<0.0050	<0.0050	<0.0050	0.0050	6362594
Dissolved Boron (B)	ug/L	185	6362590	149	83	115	50	6362594
Dissolved Cadmium (Cd)	ug/L	0.0470	6362590	0.0120	0.0120	0.0160	0.0050	6362594
Dissolved Chromium (Cr)	ug/L	<0.10	6362590	<0.10	<0.10	<0.10	0.10	6362594
Dissolved Cobalt (Co)	ug/L	0.307	6362590	0.210	0.218	0.309	0.0050	6362594
Dissolved Copper (Cu)	ug/L	1.15	6362590	0.106	0.261	0.231	0.050	6362594
Dissolved Iron (Fe)	ug/L	726	6362590	717	83.3	736	1.0	6362594
Dissolved Lead (Pb)	ug/L	0.0990	6362590	0.0310	0.0610	0.0290	0.0050	6362594
Dissolved Lithium (Li)	ug/L	9.19	6362590	6.54	5.09	8.92	0.50	6362594
Dissolved Manganese (Mn)	ug/L	55.4	6362590	57.0	100	51.9	0.050	6362594
Dissolved Molybdenum (Mo)	ug/L	16.4	6362590	10.2	6.60	16.4	0.050	6362594
Dissolved Nickel (Ni)	ug/L	1.21	6362590	0.513	0.514	0.949	0.020	6362594
Dissolved Selenium (Se)	ug/L	0.238	6362590	0.083	0.511	0.140	0.040	6362594
Dissolved Silicon (Si)	ug/L	7540	6362590	7410	6290	7090	100	6362594
Dissolved Silver (Ag)	ug/L	0.0100	6362590	<0.0050	<0.0050	0.0080	0.0050	6362594
Dissolved Strontium (Sr)	ug/L	8800	6362590	3210	1760	8590	0.050	6362594
Dissolved Thallium (Tl)	ug/L	<0.0020	6362590	<0.0020	<0.0020	<0.0020	0.0020	6362594
Dissolved Tin (Sn)	ug/L	<0.20	6362590	<0.20	<0.20	<0.20	0.20	6362594
Dissolved Titanium (Ti)	ug/L	<0.50	6362590	<0.50	<0.50	<0.50	0.50	6362594
Dissolved Uranium (U)	ug/L	5.44	6362590	6.81	4.82	5.75	0.0020	6362594
Dissolved Vanadium (V)	ug/L	<0.20	6362590	<0.20	0.26	<0.20	0.20	6362594
Dissolved Zinc (Zn)	ug/L	11.1	6362590	8.07	3.12	7.48	0.10	6362594
Dissolved Zirconium (Zr)	ug/L	<0.10	6362590	<0.10	<0.10	<0.10	0.10	6362594
Dissolved Calcium (Ca)	mg/L	113	6361012	97.2	81.2	111	0.050	6361012
Dissolved Magnesium (Mg)	mg/L	31.6	6361012	54.4	53.9	31.7	0.050	6361012
Dissolved Potassium (K)	mg/L	4.01	6361012	3.81	3.57	3.95	0.050	6361012
Dissolved Sodium (Na)	mg/L	42.9	6361012	33.7	32.9	42.9	0.050	6361012
Dissolved Sulphur (S)	mg/L	76.5	6361012	58.3	58.3	72.7	3.0	6361012

RDL = Reportable Detection Limit

Maxxam Job #: B2A4950
Report Date: 2012/11/23

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: JC

LOW LEVEL TOTAL METALS IN WATER (WATER)

Maxxam ID		FA7567	FA7568	FA7569	FA7570		
Sampling Date		2012/11/16 00:00	2012/11/16 00:00	2012/11/16 00:00	2012/11/16 00:00		
	UNITS	**MW 12-06-01**	**MW 12-06-02**	**MW 12-06-03**	**MW 12-06-04**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total Phosphorus (P)	ug/L	26.5	22.9	4.7	18.3	2.0	6363117

RDL = Reportable Detection Limit

Maxxam Job #: B2A4950
Report Date: 2012/11/23

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: JC

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6355022	Ammonia (N)	2012/11/19	NC	80 - 120	96	80 - 120	<0.0050	mg/L	NC	20
6358742	Nitrate plus Nitrite (N)	2012/11/19	102	80 - 120	109	80 - 120	<0.020	mg/L	1.5	25
6358744	Nitrite (N)	2012/11/19	102	80 - 120	98	80 - 120	<0.0050	mg/L	2.0	20
6359097	Dissolved Sulphate (SO4)	2012/11/19	NC	80 - 120	100	80 - 120	<0.50	mg/L	0.2	20
6361642	Dissolved Sulphate (SO4)	2012/11/20	NC	80 - 120	104	80 - 120	<0.50	mg/L	1.2	20
6362590	Dissolved Aluminum (Al)	2012/11/22	110	80 - 120	107	80 - 120	<0.20	ug/L	NC	20
6362590	Dissolved Antimony (Sb)	2012/11/22	107	80 - 120	103	80 - 120	<0.020	ug/L	NC	20
6362590	Dissolved Arsenic (As)	2012/11/22	97	80 - 120	101	80 - 120	<0.020	ug/L	NC	20
6362590	Dissolved Barium (Ba)	2012/11/22	101	80 - 120	100	80 - 120	<0.020	ug/L	NC	20
6362590	Dissolved Beryllium (Be)	2012/11/22	109	80 - 120	101	80 - 120	<0.010	ug/L	NC	20
6362590	Dissolved Bismuth (Bi)	2012/11/22	70 (1)	80 - 120	98	80 - 120	<0.0050	ug/L	NC	20
6362590	Dissolved Cadmium (Cd)	2012/11/22	103	80 - 120	99	80 - 120	<0.0050	ug/L	NC	20
6362590	Dissolved Chromium (Cr)	2012/11/22	105	80 - 120	107	80 - 120	<0.10	ug/L	NC	20
6362590	Dissolved Cobalt (Co)	2012/11/22	104	80 - 120	104	80 - 120	<0.0050	ug/L	NC	20
6362590	Dissolved Copper (Cu)	2012/11/22	104	80 - 120	106	80 - 120	<0.050	ug/L	NC	20
6362590	Dissolved Iron (Fe)	2012/11/22	108	80 - 120	109	80 - 120	<1.0	ug/L	NC	20
6362590	Dissolved Lead (Pb)	2012/11/22	101	80 - 120	101	80 - 120	<0.0050	ug/L	NC	20
6362590	Dissolved Lithium (Li)	2012/11/22	103	80 - 120	99	80 - 120	<0.50	ug/L	NC	20
6362590	Dissolved Manganese (Mn)	2012/11/22	100	80 - 120	103	80 - 120	<0.050	ug/L	NC	20
6362590	Dissolved Molybdenum (Mo)	2012/11/22	91	80 - 120	97	80 - 120	<0.050	ug/L	NC	20
6362590	Dissolved Nickel (Ni)	2012/11/22	104	80 - 120	105	80 - 120	<0.020	ug/L	NC	20
6362590	Dissolved Selenium (Se)	2012/11/22	113	80 - 120	105	80 - 120	<0.040	ug/L	NC	20
6362590	Dissolved Silver (Ag)	2012/11/22	111	80 - 120	109	80 - 120	<0.0050	ug/L	NC	20
6362590	Dissolved Strontium (Sr)	2012/11/22	102	80 - 120	102	80 - 120	<0.050	ug/L	NC	20
6362590	Dissolved Thallium (Tl)	2012/11/22	93	80 - 120	99	80 - 120	0.0030, RDL=0.0020	ug/L	NC	20
6362590	Dissolved Tin (Sn)	2012/11/22	100	80 - 120	104	80 - 120	<0.20	ug/L	NC	20
6362590	Dissolved Titanium (Ti)	2012/11/22	98	80 - 120	104	80 - 120	<0.50	ug/L	NC	20
6362590	Dissolved Uranium (U)	2012/11/22	97	80 - 120	100	80 - 120	<0.0020	ug/L	NC	20
6362590	Dissolved Vanadium (V)	2012/11/22	105	80 - 120	103	80 - 120	<0.20	ug/L	NC	20
6362590	Dissolved Zinc (Zn)	2012/11/22	114	80 - 120	107	80 - 120	<0.10	ug/L	NC	20
6362590	Dissolved Boron (B)	2012/11/22					<50	ug/L	NC	20
6362590	Dissolved Silicon (Si)	2012/11/22					<100	ug/L	NC	20
6362590	Dissolved Zirconium (Zr)	2012/11/22					<0.10	ug/L	NC	20
6362594	Dissolved Aluminum (Al)	2012/11/22	NC	80 - 120	109	80 - 120	<0.20	ug/L	5.3	20
6362594	Dissolved Antimony (Sb)	2012/11/22	106	80 - 120	104	80 - 120	<0.020	ug/L	NC	20
6362594	Dissolved Arsenic (As)	2012/11/22	105	80 - 120	98	80 - 120	<0.020	ug/L	NC	20
6362594	Dissolved Barium (Ba)	2012/11/22	NC	80 - 120	103	80 - 120	<0.020	ug/L	0.5	20
6362594	Dissolved Beryllium (Be)	2012/11/22	101	80 - 120	102	80 - 120	<0.010	ug/L	5.2	20
6362594	Dissolved Bismuth (Bi)	2012/11/22	91	80 - 120	97	80 - 120	<0.0050	ug/L	NC	20

Maxxam Job #: B2A4950
Report Date: 2012/11/23

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: JC

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6362594	Dissolved Cadmium (Cd)	2012/11/22	NC	80 - 120	101	80 - 120	<0.0050	ug/L	3.1	20
6362594	Dissolved Chromium (Cr)	2012/11/22	103	80 - 120	108	80 - 120	<0.10	ug/L	NC	20
6362594	Dissolved Cobalt (Co)	2012/11/22	NC	80 - 120	103	80 - 120	<0.0050	ug/L	1.3	20
6362594	Dissolved Copper (Cu)	2012/11/22	NC	80 - 120	102	80 - 120	<0.050	ug/L	0.2	20
6362594	Dissolved Iron (Fe)	2012/11/22	NC	80 - 120	109	80 - 120	<1.0	ug/L	3.4	20
6362594	Dissolved Lead (Pb)	2012/11/22	100	80 - 120	101	80 - 120	<0.0050	ug/L	3.2	20
6362594	Dissolved Lithium (Li)	2012/11/22	98	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
6362594	Dissolved Manganese (Mn)	2012/11/22	NC	80 - 120	103	80 - 120	<0.050	ug/L	0.5	20
6362594	Dissolved Molybdenum (Mo)	2012/11/22	94	80 - 120	99	80 - 120	<0.050	ug/L	NC	20
6362594	Dissolved Nickel (Ni)	2012/11/22	104	80 - 120	106	80 - 120	<0.020	ug/L	9.3	20
6362594	Dissolved Selenium (Se)	2012/11/22	117	80 - 120	108	80 - 120	<0.040	ug/L	NC	20
6362594	Dissolved Silver (Ag)	2012/11/22	108	80 - 120	110	80 - 120	<0.0050	ug/L	NC	20
6362594	Dissolved Strontium (Sr)	2012/11/22	NC	80 - 120	105	80 - 120	<0.050	ug/L	2.5	20
6362594	Dissolved Thallium (Tl)	2012/11/22	94	80 - 120	98	80 - 120	<0.0020	ug/L	1.6	20
6362594	Dissolved Tin (Sn)	2012/11/22	108	80 - 120	105	80 - 120	<0.20	ug/L	NC	20
6362594	Dissolved Titanium (Ti)	2012/11/22	83	80 - 120	102	80 - 120	<0.50	ug/L	NC	20
6362594	Dissolved Uranium (U)	2012/11/22	100	80 - 120	101	80 - 120	<0.0020	ug/L	12.1	20
6362594	Dissolved Vanadium (V)	2012/11/22	109	80 - 120	102	80 - 120	<0.20	ug/L	NC	20
6362594	Dissolved Zinc (Zn)	2012/11/22	NC	80 - 120	104	80 - 120	<0.10	ug/L	2.2	20
6362594	Dissolved Boron (B)	2012/11/22					<50	ug/L	NC	20
6362594	Dissolved Silicon (Si)	2012/11/22					<100	ug/L	NC	20
6362594	Dissolved Zirconium (Zr)	2012/11/22					<0.10	ug/L	NC	20
6363117	Total Phosphorus (P)	2012/11/21					<2.0	ug/L		
6363236	Total Dissolved Solids	2012/11/21	NC	80 - 120	94	80 - 120	<10	mg/L	1.9	20
6364309	Conductivity	2012/11/21			99	80 - 120	<1.0	uS/cm	3.3	20
6364310	Alkalinity (Total as CaCO3)	2012/11/22	NC	80 - 120	96	80 - 120	<0.50	mg/L	11.5	20
6364310	Alkalinity (PP as CaCO3)	2012/11/22					<0.50	mg/L	NC	20
6364310	Bicarbonate (HCO3)	2012/11/22					<0.50	mg/L	11.5	20

Maxxam Job #: B2A4950
Report Date: 2012/11/23

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: JC

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6364310	Carbonate (CO3)	2012/11/22					<0.50	mg/L	NC	20
6364310	Hydroxide (OH)	2012/11/22					<0.50	mg/L	NC	20

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

Maxxam

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

CHAIN OF CUSTODY RECORD

Click here to get the COC number

Maxxam Job #: B2A4950 **COC #:** EB581312 Page: 1 of 1

Invoice To: Require Report? Yes ☐ No ☐

Company Name: Minto Explorations Ltd
Contact Name: Elvina Wong
Address: Suite 900 - 999 West Hastings St
Vancouver, B.C. PC: V6C 2W2
Phone / Fax#: Ph: 604-684-8894 Fax: 604-688-2120
E-mail:

Report To:

Company Name: Minto Explorations Ltd
Contact Name: Minto Environment
Address: Suite 900-999 West Hastings St
Vancouver, B.C. PC: V6C 2W2
Phone / Fax#: Ph: 604-684-8894 Fax: 604-688-2120
E-mail: minto_environment@mintomine.com

PO #:	113796
Quotation #:	
Project #:	
Proj. Name:	Minto Env. Monitoring
Location:	Yukon
Sampled by:	Jay Cherian

REGULATORY REQUIREMENTS:

- ☐ CSR
- ☐ CCME
- ☐ BC Water Quality
- ☑ Other low detection limits
- ☐ DRINKING WATER

SERVICE REQUESTED:

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

SPECIAL INSTRUCTIONS:

Return Cooler ☐ **Ship Sample Bottles (please specify)** ☐

Need low dectection limits. TM- only need total phosphorous

Please copy results to Jcherian@srk.com and jandrews@srk.com

ANALYSIS REQUESTED

#	Sample Identification	Lab Identification (Lab Use Only)	Sample Type	Date/Time(24hr) Sampled	Dissolved Metals (DM) (Field Filtered? Y)	Field Acidified? Y	Total Metals (Field Acidified? Y)	☑ Nitrate ☑ Nitrite ☑ Ammonia	Total Suspended Solids (TSS) ☐ TDS ☑	☐ pH ☑ Conductivity ☑ Alkalinity	☐ Chloride ☐ Fluoride ☐ Sulphate ☑	DOC (Diss'd Organic Carbon)	TOC (Total Organic Carbon)	Phosphate	Ra 226	Number of Containers
1	MW12-06-01	FA7517	Ground W	11/16/12 0:00	X	X	X	X	X	X	X					6
2	MW12-06-02	FA7518	Ground W	11/16/12 0:00	X	X	X	X	X	X	X					6
3	MW12-06-03	FA7520	Ground W	11/16/12 0:00	X	X	X	X	X	X	X					6
4	MW12-06-04	FA7521	Ground W	11/16/12 0:00	X	X	X	X	X	X	X					6
5																
6																
7																
8																
9																
10																
11																
12																

B2A4950

*Relinquished By:	Date (yy/mm/dd):	Time (24hr):	Received by:	Date (yy/mm/dd):	Time (24 hr):	Time Sensitive	Temperature on Receipt (°C)	Custody Seal	Yes	No
Chris Harry	16-Nov-12	7:00	[signature]	2012/11/19	08:30	☑	A) 3 B) 3 C) 4	Present?	☐	☑
							Just sampled & rec'd on ice: ☐	Intact?	☐	NA

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

Maxxam

Success Through Science®

Your P.O. #: 113976
Your Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your C.O.C. #: EB581712

Attention: MINTO DISTRIBUTION LIST
MINTO EXPLORATIONS LTD.
Yukon/Whitehorse
2 - 25 Pilgrim Way
Whitehorse, YT
CANADA Y1A 6E6

Report Date: 2012/11/27

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B2A5339
Received: 2012/11/20, 09:10

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	5	2012/11/21	2012/11/22	BBY6SOP-00026	SM2320B
Conductance - water	5	N/A	2012/11/22	BBY6SOP-00026	SM-2510B
Hardness (calculated as CaCO3)	5	N/A	2012/11/26	BBY WI-00033	Calculated Parameter
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	5	N/A	2012/11/26	BBY7SOP-00002	EPA 6020A
Elements by ICPMS Low Level (dissolved)	5	N/A	2012/11/23	BBY7SOP-00002	EPA 6020A
Elements by ICPMS Low Level (total)	5	N/A	2012/11/23	BBY7SOP-00002	EPA 6020A
Ammonia-N (Preserved)	5	N/A	2012/11/20	BBY6SOP-00009	SM-4500NH3G
Nitrate + Nitrite (N)	5	N/A	2012/11/20	BBY6SOP-00010	USEPA 353.2
Nitrite (N) by CFA	5	N/A	2012/11/20	BBY6SOP-00010	EPA 353.2
Nitrogen - Nitrate (as N)	5	N/A	2012/11/21	BBY6SOP-00010	Based on EPA 353.2
Filter and HNO3 Preserve for Metals	5	N/A	2012/11/20	BBY6WI-00001	EPA 200.2
Sulphate by Automated Colourimetry	5	N/A	2012/11/21	BBY6SOP-00017	SM4500-SO42
Total Dissolved Solids (Filt. Residue)	5	2012/11/21	2012/11/21	BBY6SOP-00033	SM 2540C

* Results relate only to the items tested.

Encryption Key

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

Lanoy Luangkhamdeng, Burnaby Project Manager
Email: LLuangkhamdeng@maxxam.ca
Phone# (604) 638-2636

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

Total cover pages: 1

Maxxam Job #: B2A5339
Report Date: 2012/11/27

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: JC

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		FA9889	FA9890	FA9891	FA9892	FA9893		
Sampling Date		2012/11/17	2012/11/17	2012/11/17	2012/11/17	2012/11/17		
	UNITS	**MW09-03-01**	**MW09-03-02**	**MW09-03-03**	**MW09-03-04**	**MW09-03-05**	**RDL**	**QC Batch**
ANIONS								
Nitrite (N)	mg/L	0.118	0.0924	0.0058	<0.0050	<0.0050	0.0050	6362222
Calculated Parameters								
Filter and HNO3 Preservation	N/A	FIELD	FIELD	FIELD	FIELD	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.069	0.035	0.248	0.248	<0.020	0.020	6360683
Misc. Inorganics								
Alkalinity (Total as CaCO3)	mg/L	134	491	89.0	88.4	1.47	0.50	6364851
Alkalinity (PP as CaCO3)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	6364851
Bicarbonate (HCO3)	mg/L	164	599	109	108	1.79	0.50	6364851
Carbonate (CO3)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	6364851
Hydroxide (OH)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	6364851
Anions								
Dissolved Sulphate (SO4)	mg/L	22.2	<0.50	9.79	10.2	<0.50	0.50	6364663
Nutrients								
Ammonia (N)	mg/L	0.12	0.23	0.0054	0.027	<0.0050	0.0050	6360490
Nitrate plus Nitrite (N)	mg/L	0.187	0.127	0.254	0.248	<0.020	0.020	6362221
Physical Properties								
Conductivity	uS/cm	310	979	200	201	2.2	1.0	6364938
Physical Properties								
Total Dissolved Solids	mg/L	160	648	114	108	<10	10	6363236

N/A = Not Applicable
RDL = Reportable Detection Limit

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Maxxam Job #: B2A5339
Report Date: 2012/11/27

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: JC

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		FA9889		FA9890		FA9891	FA9892	FA9893		
Sampling Date		2012/11/17		2012/11/17		2012/11/17	2012/11/17	2012/11/17		
	UNITS	**MW09-03-01**	**RDL**	**MW09-03-02**	**RDL**	**MW09-03-03**	**MW09-03-04**	**MW09-03-05**	**RDL**	**QC Batch**
Misc. Inorganics										
Dissolved Hardness (CaCO3)	mg/L	159	0.50	499	0.50	95.3	93.1	<0.50	0.50	6360129
Dissolved Metals by ICPMS										
Dissolved Aluminum (Al)	ug/L	4.92	0.20	4.1	1.0	1.87	1.80	1.25	0.20	6369001
Dissolved Antimony (Sb)	ug/L	0.181	0.020	0.24	0.10	0.077	0.079	0.033	0.020	6369001
Dissolved Arsenic (As)	ug/L	0.037	0.020	0.76	0.10	0.103	0.102	<0.020	0.020	6369001
Dissolved Barium (Ba)	ug/L	48.5	0.020	692	0.10	68.7	64.7	1.36	0.020	6369001
Dissolved Beryllium (Be)	ug/L	<0.010	0.010	<0.050	0.050	<0.010	<0.010	<0.010	0.010	6369001
Dissolved Bismuth (Bi)	ug/L	<0.0050	0.0050	<0.025	0.025	<0.0050	<0.0050	<0.0050	0.0050	6369001
Dissolved Boron (B)	ug/L	120	50	387	250	<50	<50	<50	50	6369001
Dissolved Cadmium (Cd)	ug/L	0.683	0.0050	<0.025	0.025	0.0230	0.0150	<0.0050	0.0050	6369001
Dissolved Chromium (Cr)	ug/L	0.14	0.10	0.58	0.50	0.13	0.13	<0.10	0.10	6369001
Dissolved Cobalt (Co)	ug/L	0.205	0.0050	1.23	0.025	0.149	0.183	<0.0050	0.0050	6369001
Dissolved Copper (Cu)	ug/L	1.82	0.050	0.73	0.25	1.74	2.05	0.107	0.050	6369001
Dissolved Iron (Fe)	ug/L	11.6	1.0	19400	5.0	11.3	8.0	1.6	1.0	6369001
Dissolved Lead (Pb)	ug/L	0.0360	0.0050	0.152	0.025	0.0160	0.0110	0.0140	0.0050	6369001
Dissolved Lithium (Li)	ug/L	2.84	0.50	<2.5	2.5	0.86	0.80	<0.50	0.50	6369001
Dissolved Manganese (Mn)	ug/L	96.1	0.050	17800	0.25	385	364	0.227	0.050	6369001
Dissolved Molybdenum (Mo)	ug/L	5.16	0.050	16.7	0.25	11.3	11.8	0.578	0.050	6369001
Dissolved Nickel (Ni)	ug/L	5.62	0.020	1.23	0.10	0.266	0.263	<0.020	0.020	6369001
Dissolved Selenium (Se)	ug/L	0.052	0.040	<0.20	0.20	0.414	0.301	<0.040	0.040	6369001
Dissolved Silicon (Si)	ug/L	5550	100	10900	500	4960	4960	<100	100	6369001
Dissolved Silver (Ag)	ug/L	<0.0050	0.0050	<0.025	0.025	0.0090	0.0120	<0.0050	0.0050	6369001
Dissolved Strontium (Sr)	ug/L	809	0.050	1570	0.25	200	174	3.87	0.050	6369001
Dissolved Thallium (Tl)	ug/L	0.0030	0.0020	<0.010	0.010	0.0030	0.0040	<0.0020	0.0020	6369001
Dissolved Tin (Sn)	ug/L	<0.20	0.20	<1.0	1.0	<0.20	<0.20	<0.20	0.20	6369001
Dissolved Titanium (Ti)	ug/L	<0.50	0.50	<2.5	2.5	<0.50	<0.50	<0.50	0.50	6369001
Dissolved Uranium (U)	ug/L	1.55	0.0020	0.208	0.010	0.842	0.799	0.0250	0.0020	6369001
Dissolved Vanadium (V)	ug/L	<0.20	0.20	<1.0	1.0	0.28	0.28	0.38	0.20	6369001
Dissolved Zinc (Zn)	ug/L	10.8	0.10	7.95	0.50	1.36	1.04	0.46	0.10	6369001
Dissolved Zirconium (Zr)	ug/L	<0.10	0.10	<0.50	0.50	<0.10	<0.10	<0.10	0.10	6369001
Dissolved Calcium (Ca)	mg/L	46.9	0.050	161	0.25	31.9	31.1	<0.050	0.050	6365676
Dissolved Magnesium (Mg)	mg/L	10.3	0.050	23.4	0.25	3.80	3.72	<0.050	0.050	6365676
Dissolved Potassium (K)	mg/L	3.08	0.050	4.66	0.25	2.18	2.19	<0.050	0.050	6365676
Dissolved Sodium (Na)	mg/L	5.52	0.050	15.5	0.25	3.33	3.23	<0.050	0.050	6365676
Dissolved Sulphur (S)	mg/L	9.4	3.0	<15	15	3.7	4.0	<3.0	3.0	6365676

RDL = Reportable Detection Limit

Maxxam

Success Through Science®

Maxxam Job #: B2A5339
Report Date: 2012/11/27

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: JC

LOW LEVEL TOTAL METALS IN WATER (WATER)

Maxxam ID		FA9889		FA9890		FA9891	FA9892	FA9893		
Sampling Date		2012/11/17		2012/11/17		2012/11/17	2012/11/17	2012/11/17		
	UNITS	**MW09-03-01**	**RDL**	**MW09-03-02**	**RDL**	**MW09-03-03**	**MW09-03-04**	**MW09-03-05**	**RDL**	**QC Batch**
Total Metals by ICPMS										
Total Phosphorus (P)	ug/L	4.2	2.0	<10	10	4.0	2.1	<2.0	2.0	6369480

RDL = Reportable Detection Limit

LOW LEVEL DISSOLVED METALS IN WATER (WATER) Comments

Sample FA9890-05 Elements by ICPMS Low Level (dissolved): RDL raised due to sample matrix interference.

LOW LEVEL TOTAL METALS IN WATER (WATER) Comments

Sample FA9890-04 Elements by ICPMS Low Level (total): RDL raised due to sample matrix interference.

Success Through Science®

Maxxam Job #: B2A5339
Report Date: 2012/11/27

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: JC

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6360490	Ammonia (N)	2012/11/20	NC	80 - 120	97	80 - 120	<0.0050	mg/L	0.04	20
6362221	Nitrate plus Nitrite (N)	2012/11/20	102	80 - 120	105	80 - 120	<0.020	mg/L	0.8(1)	25
6362222	Nitrite (N)	2012/11/20	102	80 - 120	98	80 - 120	<0.0050	mg/L	2.0(1)	20
6363236	Total Dissolved Solids	2012/11/21	NC	80 - 120	94	80 - 120	<10	mg/L	1.9	20
6364663	Dissolved Sulphate (SO4)	2012/11/21	NC	80 - 120	98	80 - 120	0.58, RDL=0.50	mg/L	NC	20
6364851	Alkalinity (Total as CaCO3)	2012/11/21	NC	80 - 120	98	80 - 120	<0.50	mg/L	NC	20
6364851	Alkalinity (PP as CaCO3)	2012/11/21					<0.50	mg/L	NC	20
6364851	Bicarbonate (HCO3)	2012/11/21					<0.50	mg/L	NC	20
6364851	Carbonate (CO3)	2012/11/21					<0.50	mg/L	NC	20
6364851	Hydroxide (OH)	2012/11/21					<0.50	mg/L	NC	20
6364938	Conductivity	2012/11/21			99	80 - 120	1.0, RDL=1.0	uS/cm	NC	20
6369001	Dissolved Aluminum (Al)	2012/11/23	93	80 - 120	104	80 - 120	<0.20	ug/L	0.3	20
6369001	Dissolved Antimony (Sb)	2012/11/23	95	80 - 120	104	80 - 120	<0.020	ug/L	0.6	20
6369001	Dissolved Arsenic (As)	2012/11/23	107	80 - 120	101	80 - 120	<0.020	ug/L	NC	20
6369001	Dissolved Barium (Ba)	2012/11/23	NC	80 - 120	108	80 - 120	<0.020	ug/L	3.7	20
6369001	Dissolved Beryllium (Be)	2012/11/23	91	80 - 120	95	80 - 120	<0.010	ug/L	NC	20
6369001	Dissolved Bismuth (Bi)	2012/11/23	87	80 - 120	93	80 - 120	<0.0050	ug/L	NC	20
6369001	Dissolved Cadmium (Cd)	2012/11/23	90	80 - 120	99	80 - 120	<0.0050	ug/L	0.9	20
6369001	Dissolved Chromium (Cr)	2012/11/23	95	80 - 120	95	80 - 120	<0.10	ug/L	NC	20
6369001	Dissolved Cobalt (Co)	2012/11/23	91	80 - 120	93	80 - 120	<0.0050	ug/L	6.1	20
6369001	Dissolved Copper (Cu)	2012/11/23	84	80 - 120	93	80 - 120	<0.050	ug/L	0.05	20
6369001	Dissolved Iron (Fe)	2012/11/23	96	80 - 120	106	80 - 120	<1.0	ug/L	2.1	20
6369001	Dissolved Lead (Pb)	2012/11/23	89	80 - 120	97	80 - 120	<0.0050	ug/L	5.7	20
6369001	Dissolved Lithium (Li)	2012/11/23	89	80 - 120	97	80 - 120	<0.50	ug/L	0.1	20
6369001	Dissolved Manganese (Mn)	2012/11/23	NC	80 - 120	92	80 - 120	<0.050	ug/L	1	20
6369001	Dissolved Molybdenum (Mo)	2012/11/23	NC	80 - 120	110	80 - 120	<0.050	ug/L	0.7	20
6369001	Dissolved Nickel (Ni)	2012/11/23	NC	80 - 120	93	80 - 120	<0.020	ug/L	5.1	20
6369001	Dissolved Selenium (Se)	2012/11/23	106	80 - 120	110	80 - 120	<0.040	ug/L	NC	20
6369001	Dissolved Silver (Ag)	2012/11/23	94	80 - 120	108	80 - 120	<0.0050	ug/L	NC	20
6369001	Dissolved Strontium (Sr)	2012/11/23	NC	80 - 120	103	80 - 120	<0.050	ug/L	0.9	20
6369001	Dissolved Thallium (Tl)	2012/11/23	90	80 - 120	98	80 - 120	0.0030, RDL=0.0020	ug/L	NC	20
6369001	Dissolved Tin (Sn)	2012/11/23	98	80 - 120	105	80 - 120	<0.20	ug/L	NC	20
6369001	Dissolved Titanium (Ti)	2012/11/23	90	80 - 120	95	80 - 120	<0.50	ug/L	NC	20
6369001	Dissolved Uranium (U)	2012/11/23	88	80 - 120	94	80 - 120	<0.0020	ug/L	0.7	20
6369001	Dissolved Vanadium (V)	2012/11/23	103	80 - 120	99	80 - 120	<0.20	ug/L	NC	20
6369001	Dissolved Zinc (Zn)	2012/11/23	NC	80 - 120	97	80 - 120	<0.10	ug/L	2.4	20
6369001	Dissolved Boron (B)	2012/11/23					<50	ug/L	NC	20
6369001	Dissolved Silicon (Si)	2012/11/23					<100	ug/L	1.2	20

Maxxam Job #: B2A5339
Report Date: 2012/11/27

MINTO EXPLORATIONS LTD.
Client Project #: MINTO ENV. MONITORING
Site Location: YUKON
Your P.O. #: 113976
Sampler Initials: JC

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6369001	Dissolved Zirconium (Zr)	2012/11/23					<0.10	ug/L	NC	20
6369480	Total Phosphorus (P)	2012/11/23					<2.0	ug/L		

N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - Sample arrived to laboratory past recommended hold time.

Maxxam

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

CHAIN OF CUSTODY RECORD

Click here to get the COC number

Maxxam Job #: B2A5339 **COC #:** EB581712 Page: 1 of 1

Invoice To: Require Report? Yes ☐ No ☐		**Report To:**	
Company Name:	Minto Explorations Ltd	Company Name:	Minto Explorations Ltd
Contact Name:	Elvina Wong	Contact Name:	Minto Environment
Address:	Suite 900 - 999 West Hastings St	Address:	Suite 900-999 West Hastings St
	Vancouver, B.C. PC: V6C 2W2		Vancouver, B.C. PC: V6C 2W2
Phone / Fax#:	Ph: 604-684-8894 Fax: 604-688-2120	Phone / Fax#:	Ph: 604-684-8894 Fax: 604-688-2120
E-mail		E-mail	minto_environment@mintomine.com

PO #:	113796
Quotation #:	
Project # :	
Proj. Name:	Minto Env. Monitoring
Location:	Yukon
Sampled by:	Jay Cherian/Chris Harry

REGULATORY REQUIREMENTS:

- ☐ CSR
- ☐ CCME
- ☐ BC Water Quality
- ☑ Other low detection limits
- ☐ DRINKING WATER

SERVICE REQUESTED:

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

SPECIAL INSTRUCTIONS:

Return Cooler ☐ **Ship Sample Bottles (please specify)** ☐

Need low dectection limits. TM- only need total phosphorous

Please copy results to Jcherian@srk.com and jandrews@srk.com

ANALYSIS REQUESTED

#	Sample Identification	Lab Use Only: Lab Identification	Sample Type	Date/Time(24hr) Sampled	Dissolved Metals (DM) (Field Filtered? ☑Y ☐N)	Field Acidified? (☑Y ☐N)	Total Metals (Field Acidified? ☑Y ☐N)	Nitrate ☑ Nitrite ☑ Ammonia ☑	Total Suspended Solids (TSS) ☐ TDS ☑	pH ☐ Conductivity ☑ Alkalinity ☑	Chloride ☐ Fluoride ☐ Sulphate ☑	DOC (Diss'd Organic Carbon)	TOC (Total Organic Carbon)	Phosphate	Ra 226	Number of Containers
1	MW09-03-01	[illegible]	Ground W	11/17/12 0:00	X	X	X	X	X	X	X					6
2	MW09-03-02	[illegible]	Ground W	11/17/12 0:00	X	X	X	X	X	X	X					6
3	MW09-03-03	[illegible]	Ground W	11/17/12 0:00	X	X	X	X	X	X	X					6
4	MW09-03-04	[illegible]	Ground W	11/17/12 0:00	X	X	X	X	X	X	X					6
5	MW09-03-05	[illegible]	Ground W	11/17/12 0:00	X	X	X	X	X	X	X					6
6																
7																
8																
9																
10																
11																
12																

B2A5339

Print name and sign

*Relinquished By:	Date (yy/mm/dd):	Time (24hr):	Received by:	Date (yy/mm/dd)	Time (24 hr):	Time Sensitive	Temperature on Receipt (°C)	Custody Seal	Yes	No
Chris Harry	19-Nov-12	7:00	[illegible]	2012/11/20	09:10	☑	A) 1 B) 2 C) 2	Present?	☐	☑
							Just sampled & rec'd on ice: ☐	Intact?	☐	☐

Laboratory Use Only

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

Appendix I: 2012 July – December Bi-Annual Acid-Base Accounting Report

Minto Mine
Water Licence QZ96-006
July - December 2012 ABA Bi-annual Report

Prepared by:
Capstone Mining Corp.
Minto Mine

March, 2013

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1.0 Objectives

This report is submitted to meet requirements under Capstone Mining Corp., Minto Mine Type "A" Water Use License QZ96-006, specifically Clause 87 and Appendix 6 – ABA Test Program. This program requires submission of sampling results and interpretation bi-annually.

The objective of this program is to determine the Neutralization Potential Ratio, otherwise referred to as the NPR (Neutralizing Potential divided by Acid Potential [NP/AP]) for overburden and waste rock. An NPR value of 3 or greater generally indicates non-acid generating material. Between July and December 2012 (reporting period) 254 waste rock and overburden samples were collected and 135 were analyzed in time for this report (119 results pending).

A separate, parallel program was run to determine the NPR of the tailings solids. In this reporting period 3 monthly tailings composites (July to September – October pending results) were collected and analyzed. On November 1st, Minto Mine switched from dry stack tailings to slurry tails and Minto is in the process of setting up a sampling procedure. Although an NPR value of 3 or greater is generally considered to indicate non-acid generating material in tailings solids, Appendix 6 states that the monitoring objective is to confirm that the NPR of tailings solids is greater than 4.

2.0 Waste Rock and Overburden

2.1 Frequency of Sampling

In general a sample of drill cuttings was collected from waste blasts with a frequency of approximately 1 sample for every 7 holes drilled. The composite sample is generally made up of 4-5 individual samples.

Sampling locations during this reporting period were located in Area 2 Pit. The locations with ABA ID and NPR value are illustrated in Appendix A.

2.2 Sample Preparation

The composite samples were reduced to 1-2 kg in mass using a riffle splitter. The resulting split sample was labeled according to the ABA sample naming standards and shipped to an accredited laboratory (SGS Canada Inc. [SGS], 6927 Antrim Avenue, Burnaby, BC, V5J 4M5). This labeling methodology is consistent with the Mine Environmental Database.

2.3 Test Work and Evaluation

SGS conducted ABA analysis by the BC Research Standard Method as required by the Water Use License (WUL). Reported results were entered into the Mine Environmental Database.

Waste rock and overburden composite samples were also analyzed for total metals for the entire duration of the reporting period. The results obtained from SGS were entered into the Mine Environmental Database.

In order to confirm that the predominant neutralizing mineral is calcite, the residual liquid phase from one out of approximately every ten NP determinations was submitted for multi-element ICP analysis (included calcium, magnesium, aluminium and iron after filtration at 0.45 µm). Calcium values for the residual liquid phase and inorganic carbonate values for the sample were compared with values reported in *An Assessment of the Results of Acid Base Accounting (ABA) and Mineralogical Test work of Eight Samples for the Proposed Minto, Yukon Territory, Minesite* (Mills, C. (1997), Report to The Selkirk First Nation, Pelly Crossing, Yukon Territory, 30p.) [The Mills report]. Visible calcite has been noted on fracture faces and small veinlets within the current mining area.

The results obtained from SGS have been compared against those in the Mine Environmental Database and will also be used for future comparisons.

2.4 Discussion

Blasts are numbered by bench (denoted by the toe elevation) and by the sequential blast number for that bench (e.g. 784-01 being the first blast of the bench with 784 as the toe elevation).

The Northing and Easting of each blast is derived from the location of the blast's centroid. This centroid is found by using the surveyed blast perimeter and querying the center of mass for that polygon using Vulcan 3D Modeling software. In the case of ice-rich overburden, where the material was ripped and not blasted, one representative composite sample was taken for the area and the approximate location of the sample was noted.

The primary lithology of the deposit is granodiorite. This lithology is further classified as equigranular granodiorite (eG), porphyroblastic granodiorite (pG), and foliated granodiorite (fG). Locally, very highly-weathered granodiorite near the surface is described as residuum. Other lithological units are overburden (Ovb), pegmatite (Peg), Andesite (And) and Aplite (Ap). These lithologies are noted for the samples taken.

2.5 Results

The 135 samples for the period of July to October were analyzed by SGS and results were reported according to the BC Research Standard Method. The NPR values range between 0.34 and 138.33 with a mean of 28.30 and a median of 10.30. A summary of the results for ABA analysis are attached as Appendix B; as well the raw lab result files are attached as Appendix E.

2.5.1 NPR

The NPR results for the 2012 bi-annual reporting periods are comparable to the results from 2011 in Table 1.

Table 1. NPR Values from SGS				
Period Ending	Min (NPR)	Max (NPR)	Mean (NP:AP)	Median (NPR)
2011 (January 1 to December 31, 2011)	2.40	184.20	10.5	32.80
2012 (January 1 to June 28, 2012)	0.80	112.50	3.3	6.00
2012 (July 1 to October 19, 2012)	0.34	138.33	3.6	10.30

Table 1. NPR Results Summary for 2011 and January to October 19, 2012.

During this reporting period from July to October 19, 26 samples returned NPR values below the threshold of 3.0. The low NPR is not due to the lack of NP but rather an increase in sulphide sulphur (and therefore AP) found in these samples. Only 2 of the 26 samples represented areas of Low Grade Waste, and one additional sample was from a combined composite of both Low Grade and Medium Grade Waste. Only one zone of Low Grade Waste with NPR below the threshold of 3.0 was placed in the Mill Valley Fill. The other minimal zone of Low Grade Waste was placed in the DSTSF berm. The remaining 23 samples were from zones determined to be Medium Grade and High Grade Waste or zones deemed on site to be material less than the NPR threshold of 3. These waste categories were dispatched to appropriate areas according to the Waste Rock and Overburden Management Plan. All material that was classified by onsite testing as less than the NPR threshold of 3 was sent to the Main Pit and disposed over below the closure high water level.

2.5.2 Paste pH

The paste pH results for the period of July to October 19, were between 7.95 and 9.46 with a mean value of 8.72 and a median value of 8.68. The results are all well above the minimum required value of 5.0. The paste pH results for this reporting period are displayed in Table 2 with 2011 results. .

Table 2. Paste pH from SGS				
Period Ending	Min (pH)	Max (pH)	Mean (pH)	Median (pH)
2011 (January 1 to December 9, 2011)	6.95	9.19	8.54	8.59
2012 (January 1 to June 28, 2012)	7.71	9.70	8.66	8.70
2012 (July to October 19,, 2012)	7.95	9.46	8.72	8.68

Table 2. Paste pH Results Summary for 2011 and January to October 19, 2012.

2.5.3 Sulphide Sulphur

The sulphide sulphur content "$S(S^2)$%" results for the reporting period ranged from 0.01 to 2.83%, as summarized in Table 3. The license requirement of less than 0.3% sulphide sulphur for construction rock was not met for 2 samples, and these are discussed further below.

Table 3. Sulphide-Sulphur % from SGS Cemi				
Period Ending	Min ($S(S^{2-})$)	Max ($S(S^{2-})$)	Mean ($S(S^{2-})$)	Median ($S(S^{2-})$)
2011 (January 1 to December 9, 2011)	<0.01%	0.66%	0.09%	0.02%
2012 (January 1 to June 28, 2012)	<0.01%	1.70%	0.33%	0.20%
2012 (July to October 19, 2012)	0.01%	2.83%	0.29%	0.11%

Table 3. Sulphide Sulphur Results Summary for 2011 and January to October 19, 2012.

A total of 28 samples exceeded the sulphide sulphur threshold of 0.3% during the reporting period. Only 2 zones of waste rock material deemed to be above the 0.3% sulphide sulphur were placed in areas requiring construction rock material (these are the same samples noted previously which had NPR<3). The material from one zone ($S(S^2)$ = 0.34% was placed in the DSTF berm and the other material ($S(S^2)$ = 0.47%was placed in the Mill Valley Fill area. The material with sulphide sulphur > 0.3% is surrounded by and mixed with material that has lower sulphide sulphur content and NPR values greater than 3 and therefore is believed to pose little risk of acid rock drainage. The remaining blasts that the NPR<3 composite samples represent were mined and placed according to the Waste Rock and Overburden Management Plan in either the Medium Grade waste or High Grade waste areas of the Southwest Waste Dump or in the area designated for material that did not exceed the NPR threshold of 3.

Figure 1 is a plot of sulphide sulphur vs NPR. This plot illustrates that 28 samples had sulphide sulphur higher than 0.30% and 26 samples did not meet the NPR threshold of 3 (see Figure 1 and discussion in Section 2.5.1).

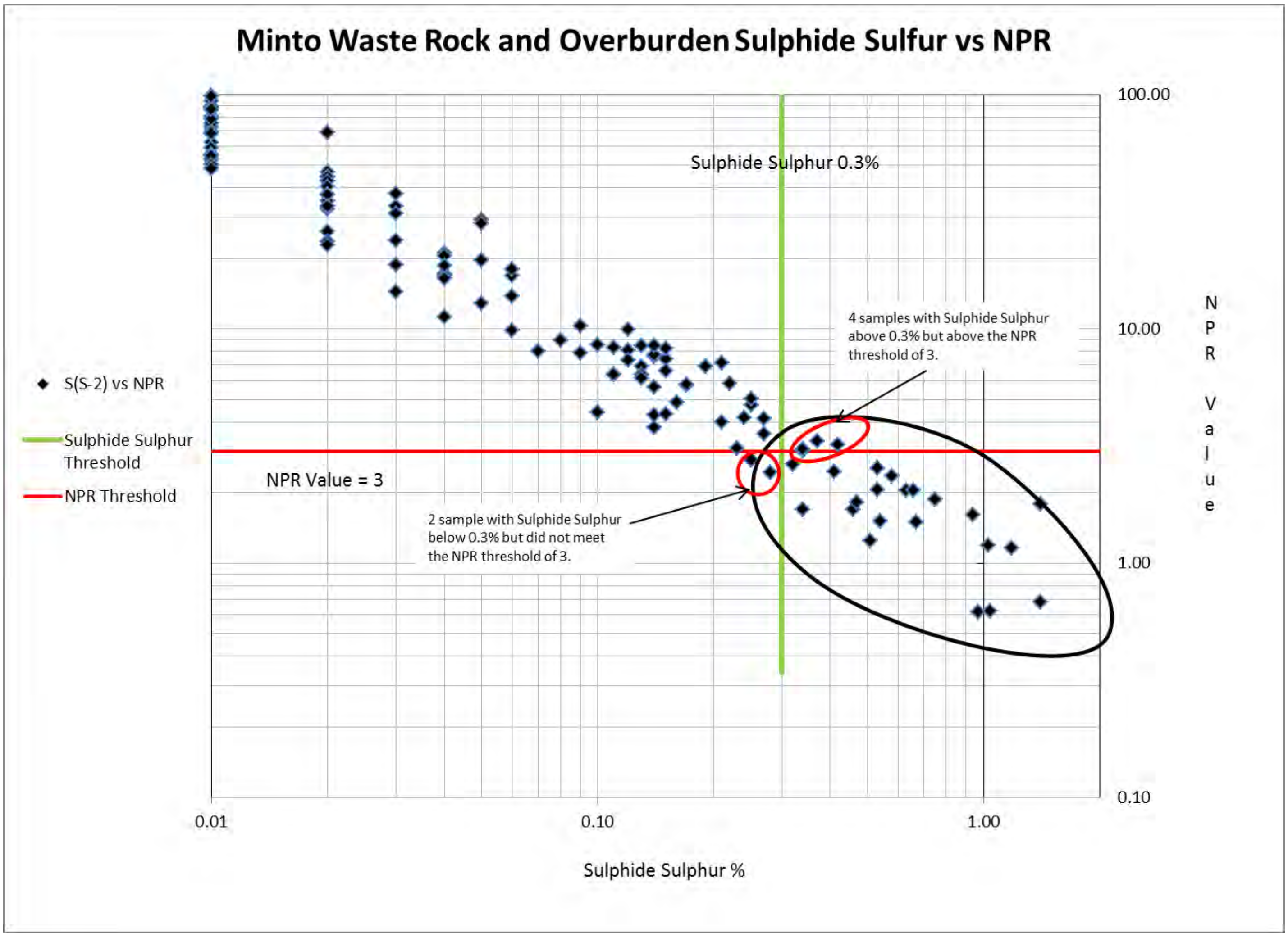


Figure 1. NPR vs. Sulphide Sulphur of the waste rock samples.

2.6 NP Leachate Analyses

21 samples, for the period July to October 19, had ICP-OES analyses done on the residual liquid phase following NP determinations in accordance with the BC Research NP Procedure. Using Table 2.4 from the Mills report as the basis of comparison for calcium (Ca) content:

- The range of the Ca content of the liquid residue from the NP determination on the Mills report samples was 36.1 to 479.4 ppm with a mean of 272.35 ppm and a median of 285.25 ppm:

- In comparison, the Ca content of the liquid residue from the NP determination for the samples in this reporting period ranged from 279 to 751 mg/L (equivalent to ppm) with a mean of 517.75 mg/L (ppm) and a median of 564 mg/L (ppm).

Using Table 2.1 from the Mills report as a basis for comparison of inorganic carbon values:

- The TIC (Total Inorganic Carbon) for the Mills Report samples ranged from 0.30% to 0.33% with a mean of 0.31% and a median of 0.31%.
- In comparison, the TIC for the 21 samples submitted for leachate analysis during this reporting period ranged from 0.09 to 0.46% with a mean of 0.22% and a median of 0.19%
- See Figure 2 for the comparison between July to October 2012 Ca ICP results and Mills Report Ca ICP results. Figure 2 illustrates that Ca is greater on average during this reporting period than the results found in the Mills Report.

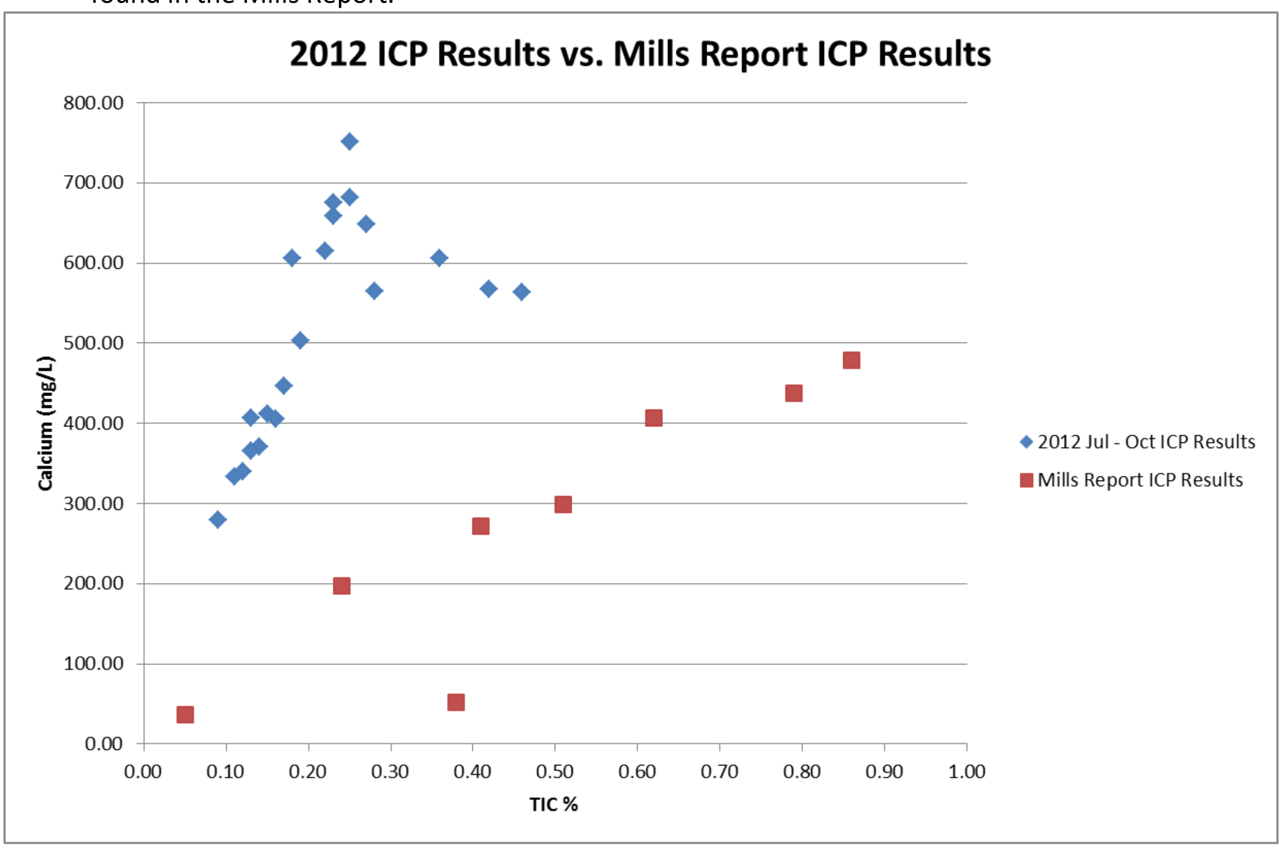


Figure 2. 2011 ICP Results vs. Mills Report ICP Results

The minimum carbonate equivalent value was higher than the minimum from Mills (10.0 compared to <1.1). The maximum was also higher (22.7 compared to 19.5).

The Mills report compared calcium (Ca) and magnesium (Mg) concentrations in the NP test leachate (by way of a ratio (Ca/Mg) and found that, for the eight samples tested, the leachates had a mean Ca/Mg ratio of 19.7. From the high Ca/ low Mg concentrations in the NP test leachate, Mills concluded that the dominant mineral providing acid neutralization potential was calcite (calcium carbonate, $CaCO_3$). For the current (July to October 2012) period, calculation of the Ca/Mg ratio yields an average value of 18.01. On this basis, the 2012 results for NP test leachate analysis indicate that calcite continues to be the predominant neutralizing mineral. For complete NP test leachate results see Appendix D. For raw lab results see Appendix E.

Table 4. July to October 2012 Leachate ICP results					
Sample Number	Ca (mg/L)	Mg (mg/L)	Al (mg/L)	Fe (mg/L)	TIC (%)
31982	446.00	34.00	3.70	44.00	0.17
31983	279.00	22.60	40.00	138.00	0.09
31991	751.00	27.50	44.40	118.00	0.25
31998	615.00	22.40	6.26	35.80	0.22
34826	563.00	40.20	38.30	111.00	0.46
34835	682.00	30.60	41.60	129.00	0.25
34841	606.00	20.90	7.61	60.00	0.18
44501	340.00	20.50	41.90	115.00	0.12
44511	568.00	73.00	53.00	271.00	0.42
44515	334.00	19.60	31.60	55.40	0.11
40307	412.00	18.40	14.50	96.80	0.15
40311	407.00	14.90	7.33	61.50	0.13
40319	649.00	120.00	18.40	64.00	0.27
40325	659.00	37.50	63.50	163.00	0.23
41152	405.00	31.40	59.00	144.00	0.16
41159	565.00	90.30	71.80	268.00	0.28
42757	503.00	24.60	32.60	119.00	0.19
42764	371.00	20.60	33.40	115.00	0.14
42774	606.00	49.10	33.40	155.00	0.36
44518	675.00	33.30	74.80	149.00	0.23
44523	365.00	12.90	26.30	76.20	0.13

Table 4. Select ICP results from SGS.

3.0 TAILINGS

3.1 Frequency of Sampling and Sample Preparation

A sample of tailings solids was taken daily, split to 150 grams and air dried. These daily samples are then combined into a monthly sample and riffled down to produce a 1-2 kg composite. The labeling methodology used is consistent with the labeling protocol established in the Mine Environmental Database.

3.2 Test work and Evaluation

The monthly composites were sent to SGS where ABA analysis was conducted according to the BC Research Standard Method. The Acid Potential (AP) is determined from percent sulphide sulphur (obtained by subtracting percent sulphate sulphur from percent total sulphur). Additionally, paste pH and total inorganic carbon (TIC) were determined. All results were entered into the Mine Environmental Database.

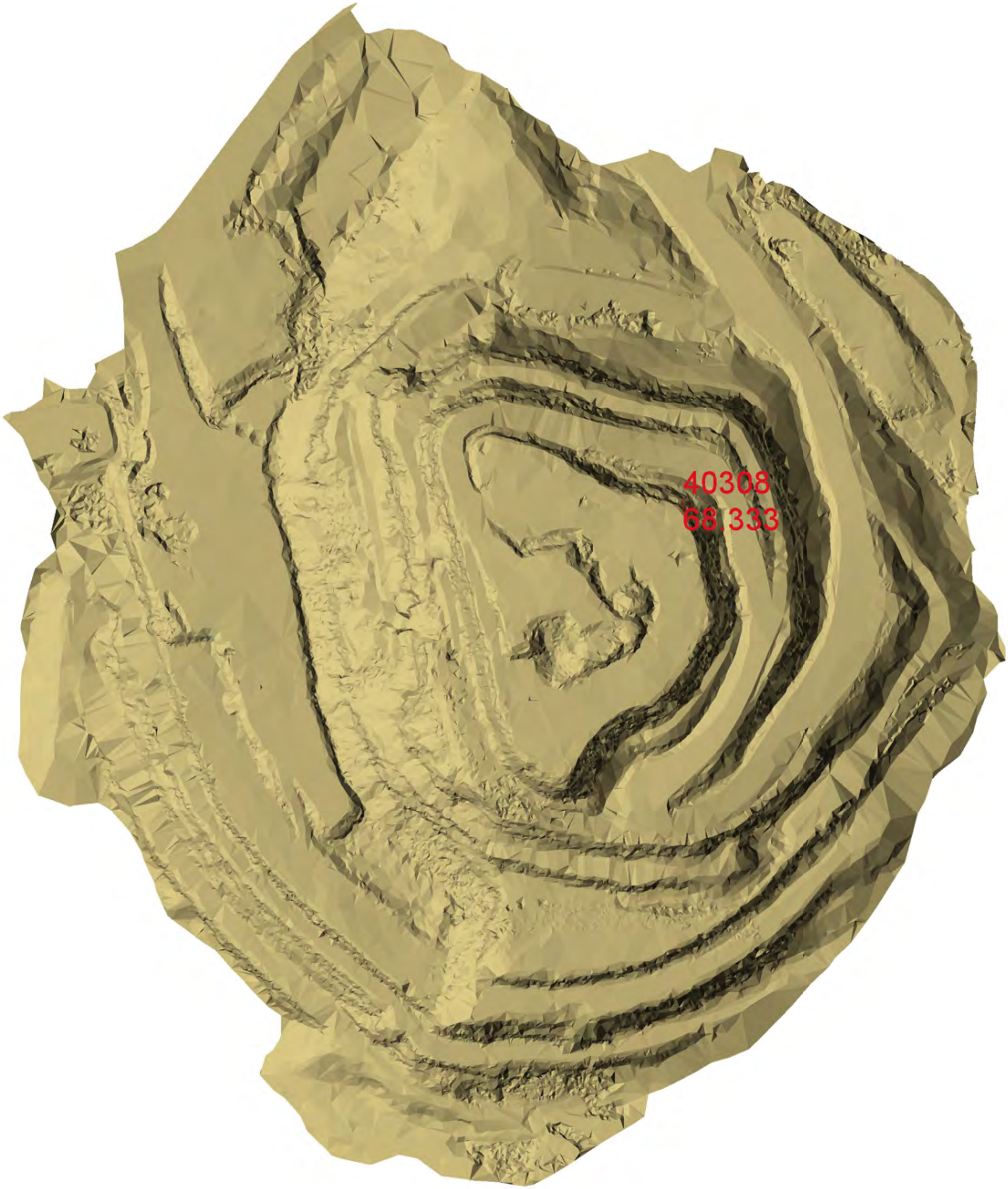
3.3 Results

The results from the laboratory test work show that all of the tailings samples were within the required limits (NPR >4). The results of those tests are summarized in the Appendix C with the raw lab results attached as Appendix E.

4.0 Conclusion

The results displayed in this report combined with the previous reporting periods are the foundation for the Mine Environmental ABA Database. The results for the 28 samples with sulphide sulphur > 0.3% will be further evaluated to gain a better understanding of the distribution of sulphide sulphur within the Area 2 waste rock. Preliminary assessment indicates that values > 0.30% mainly occurs in Medium and High Grade Waste areas. Further evaluation will include an assessment of reliability of the on-site waste rock characterization determination methods and estimations of potential volumes that may be encountered. Overburden and waste rock development will continue through the subsequent phases of mining and milling and will be sampled and analyzed using the BC Research Method for Minto Mine's ABA program.

Appendix A: Sample Location Figures for July to October 2012



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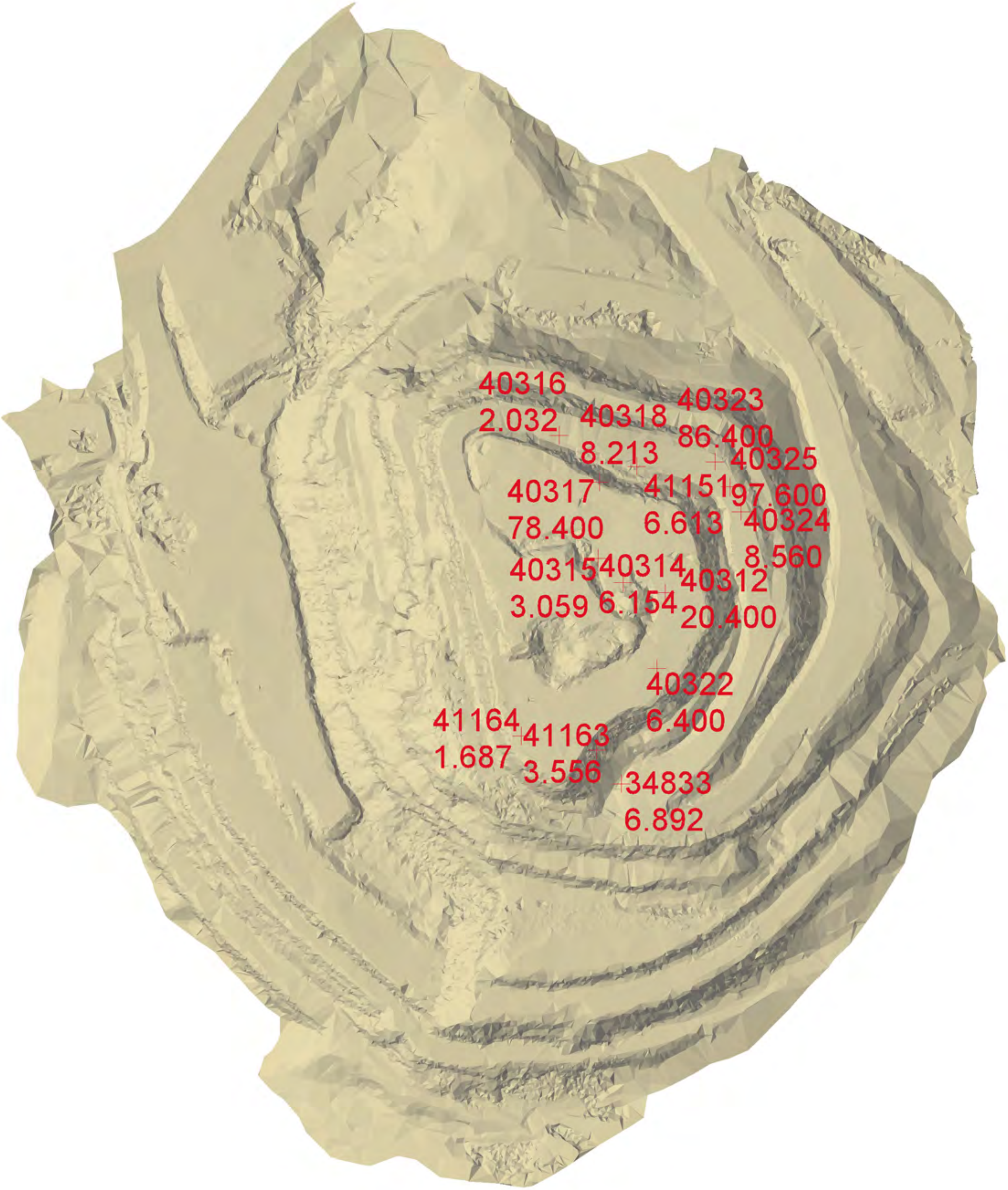
751 ABA



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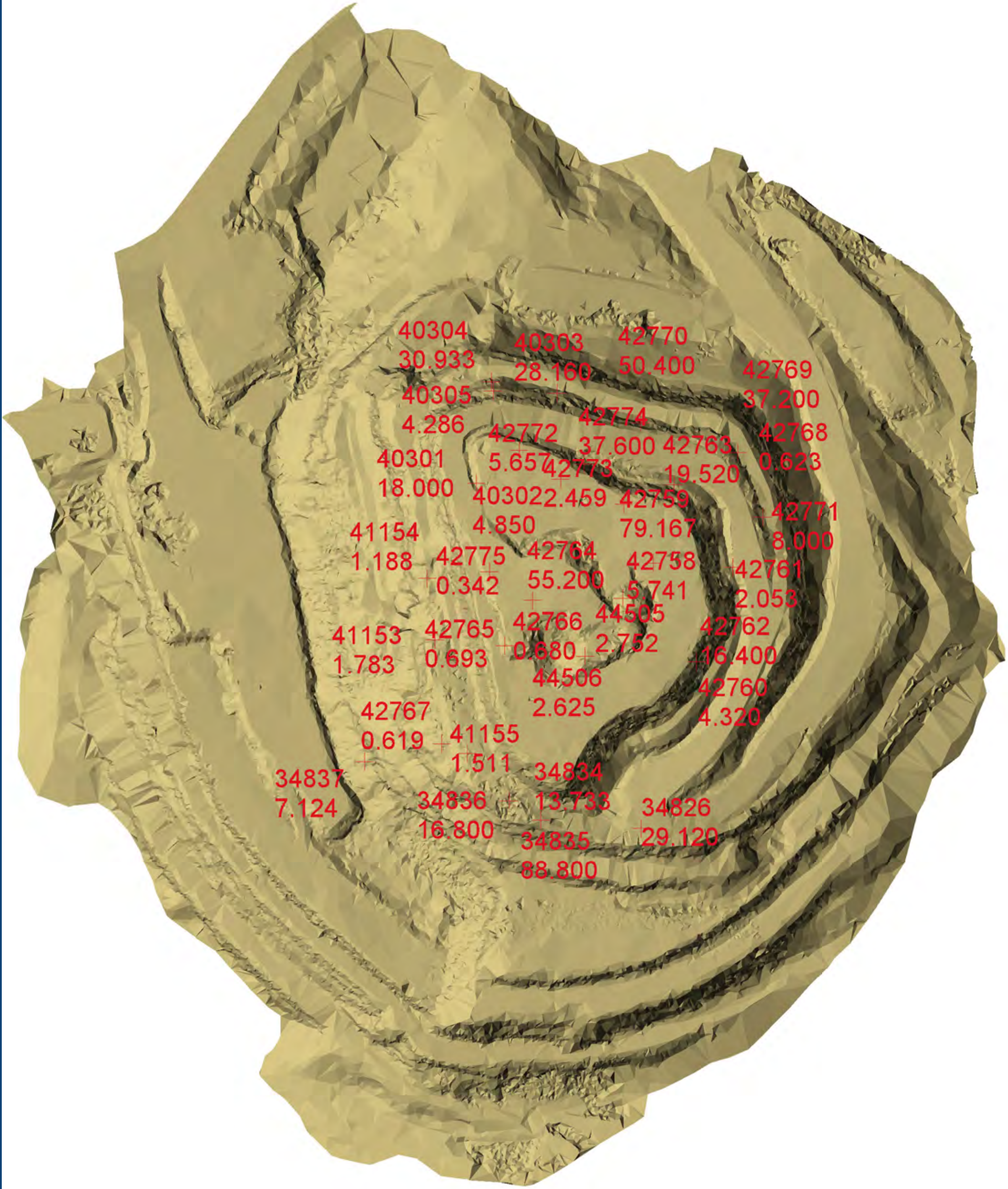

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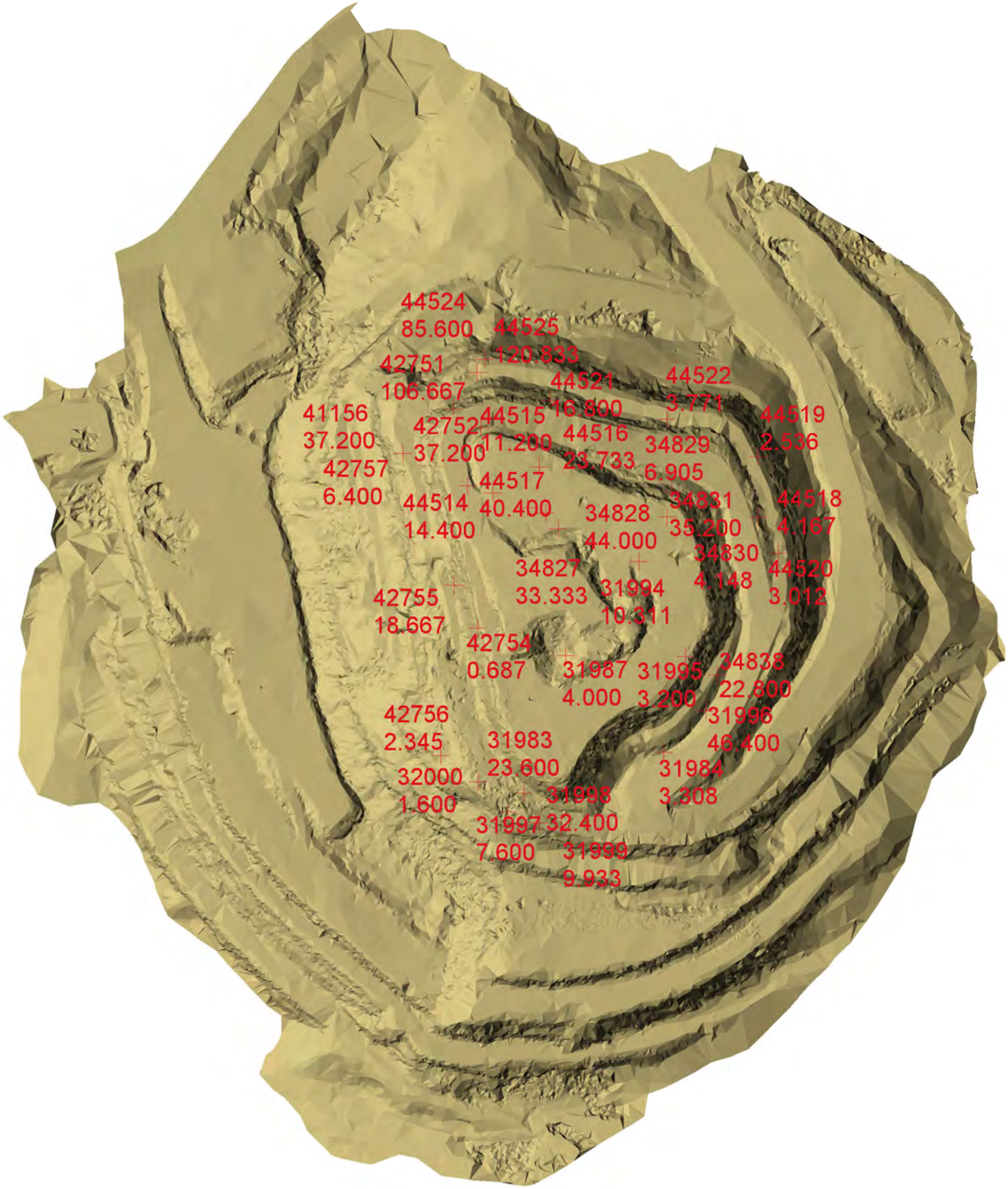

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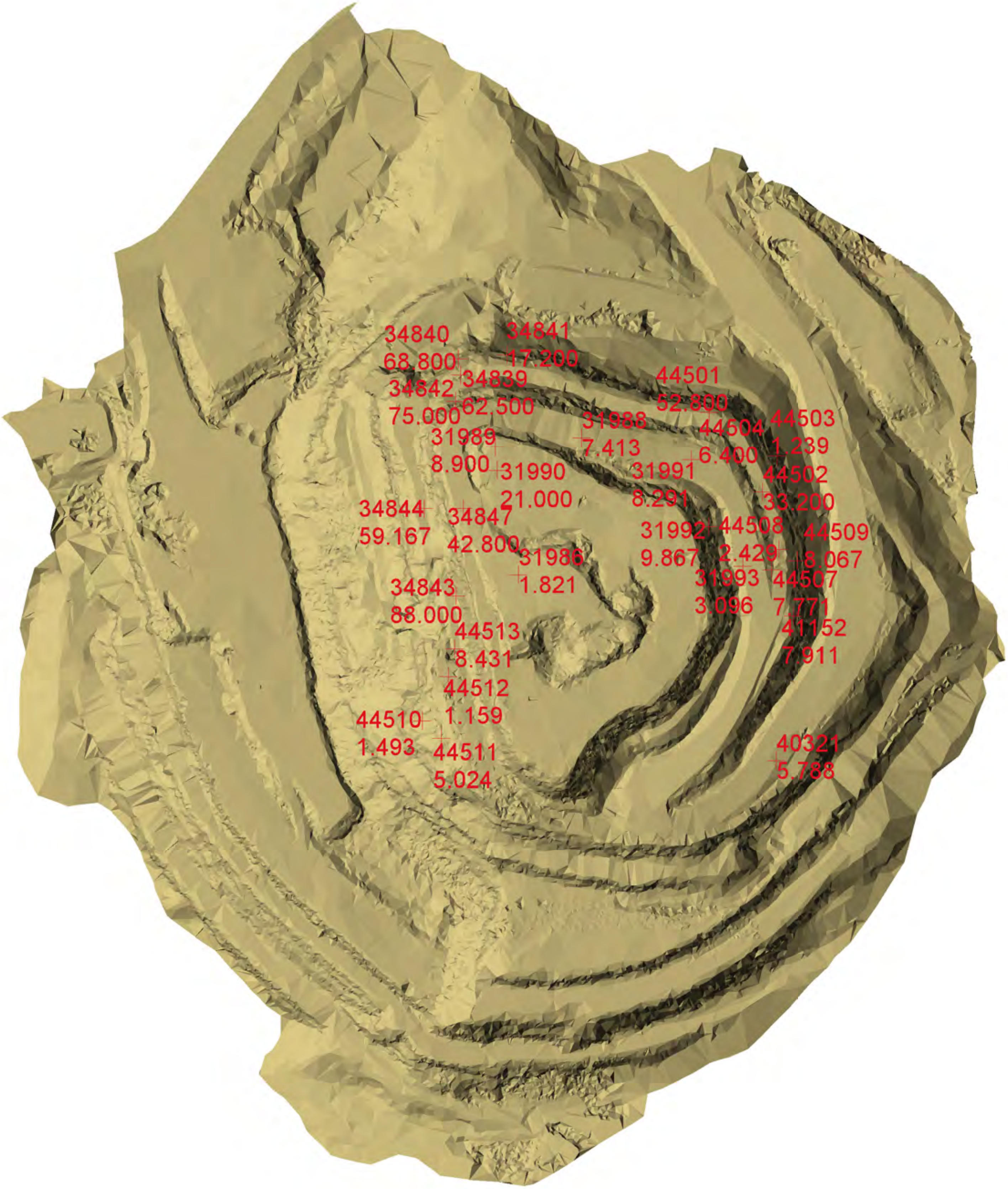
769 ABA



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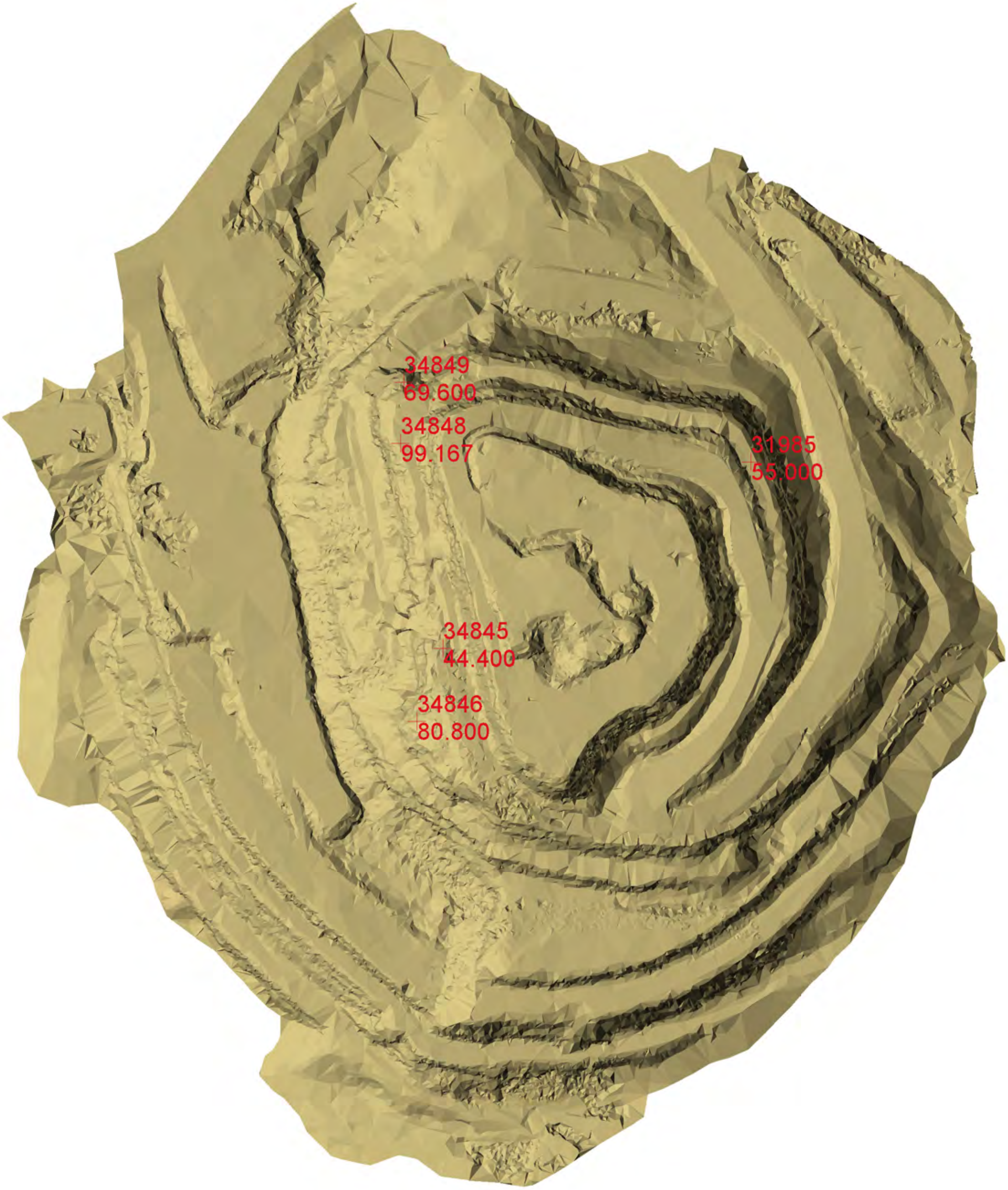

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MINTO MINE

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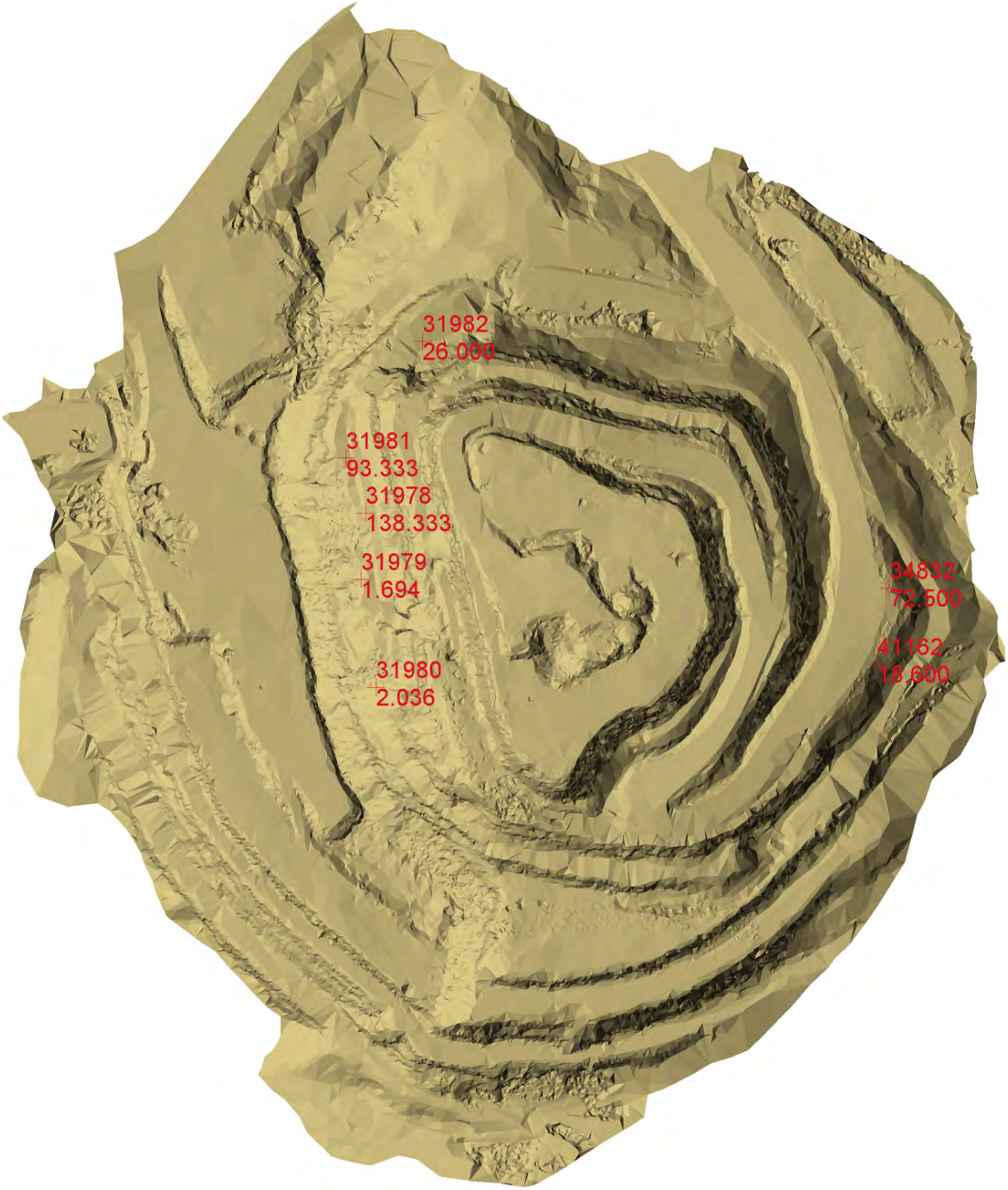
781 ABA



CAPSTONE MINING CORP.
MINTO MINE

N

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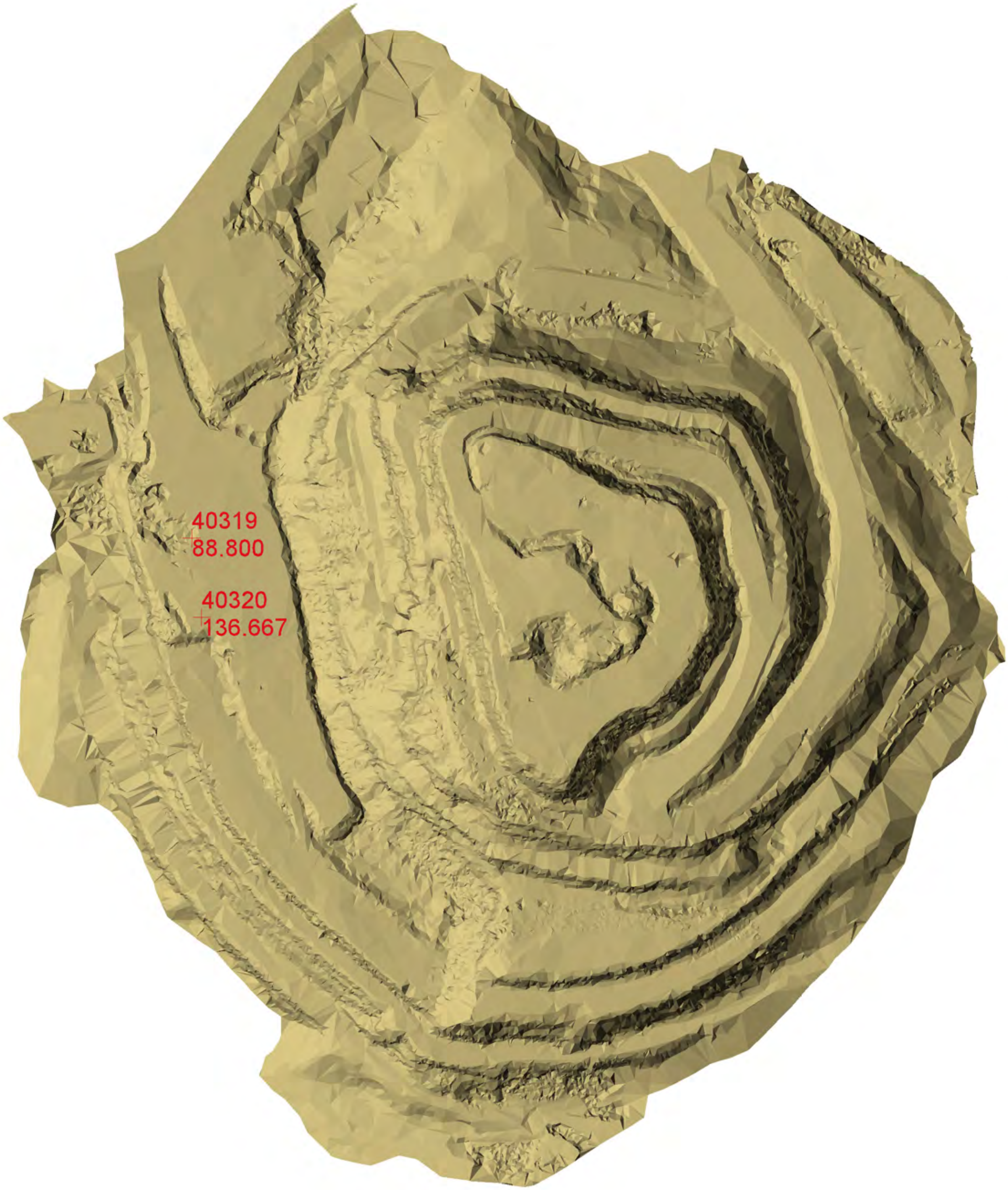
787 ABA



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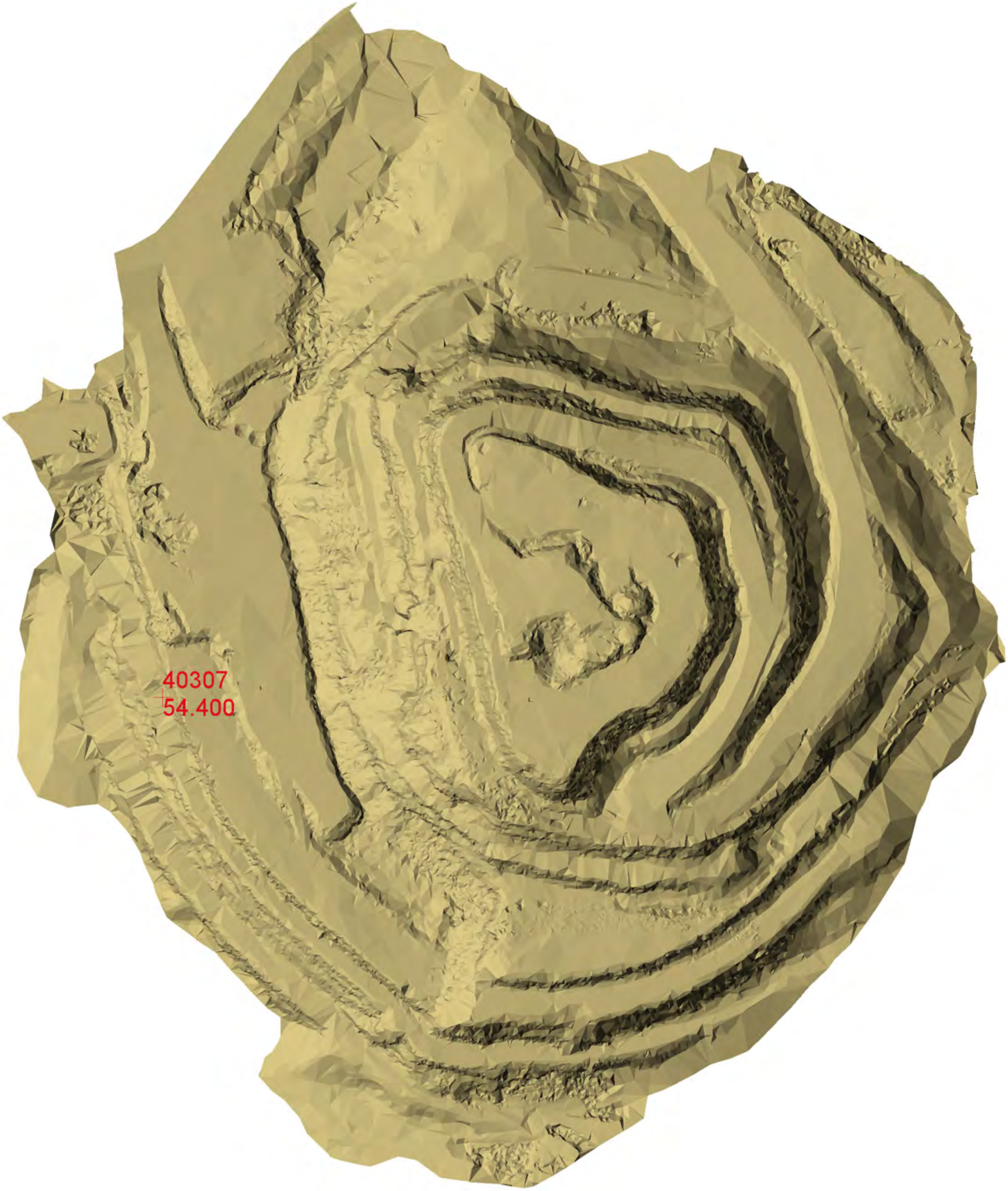
835 ABA



CAPSTONE MINING CORP.
MINTO MINE

N

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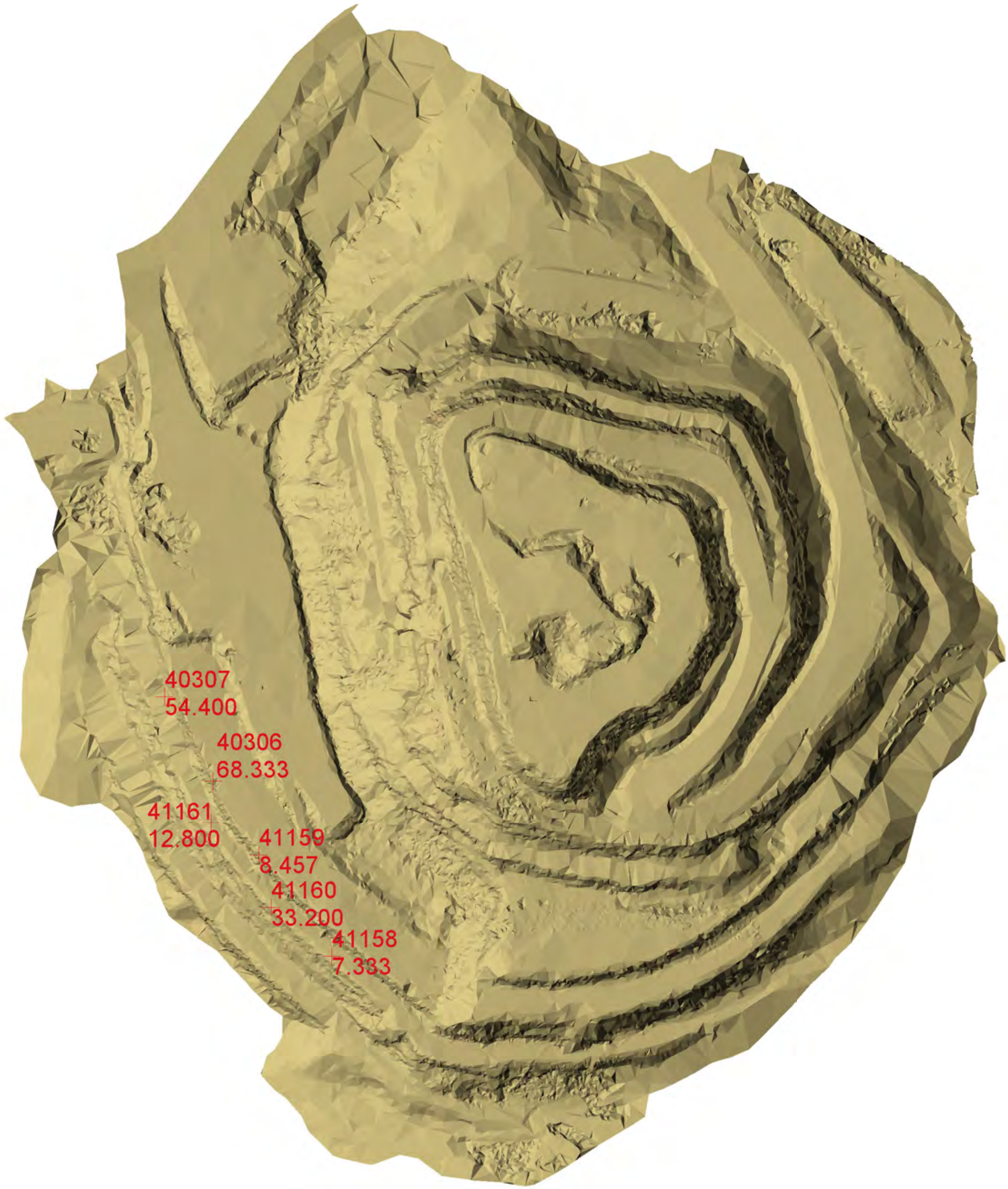
847 ABA



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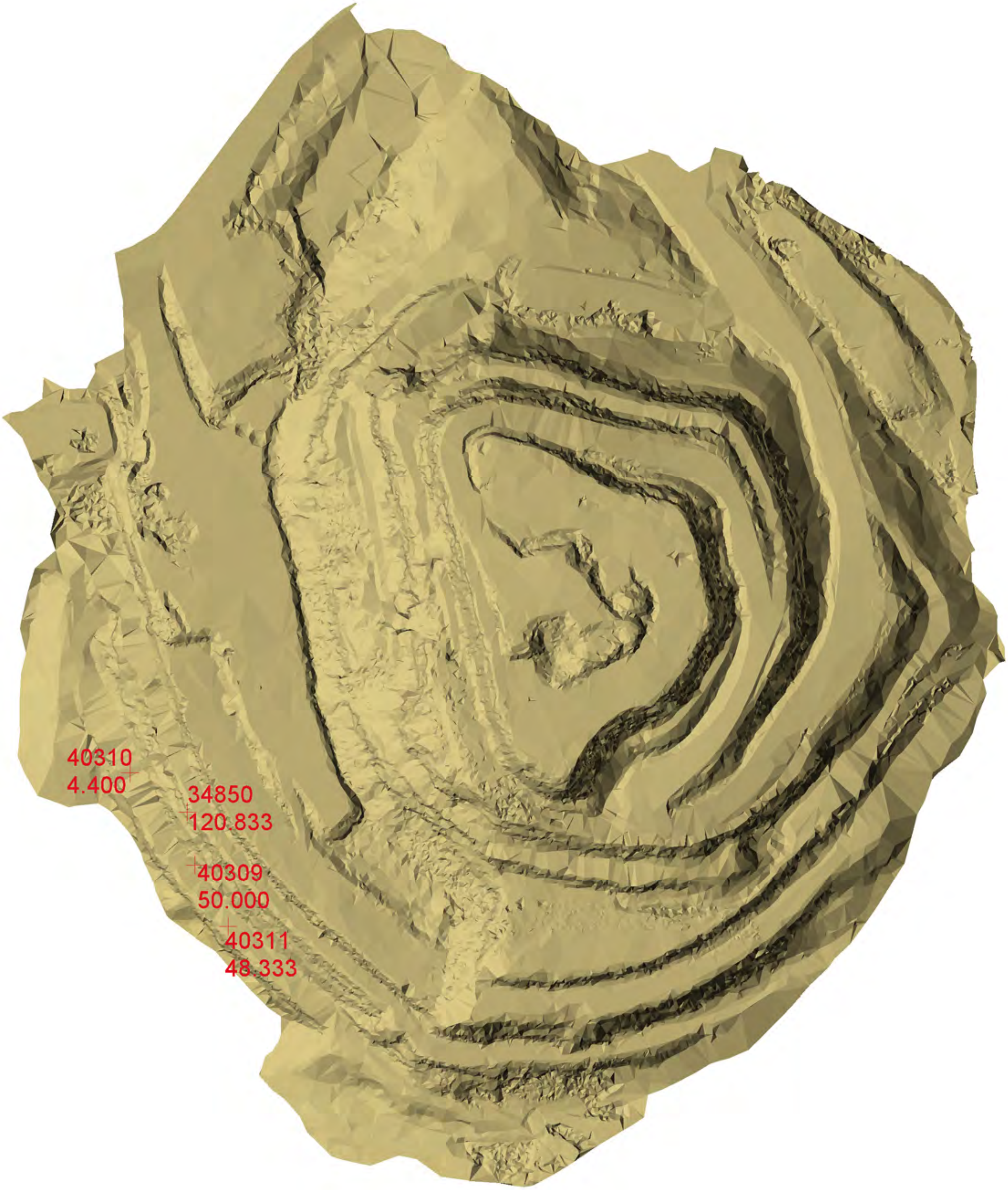

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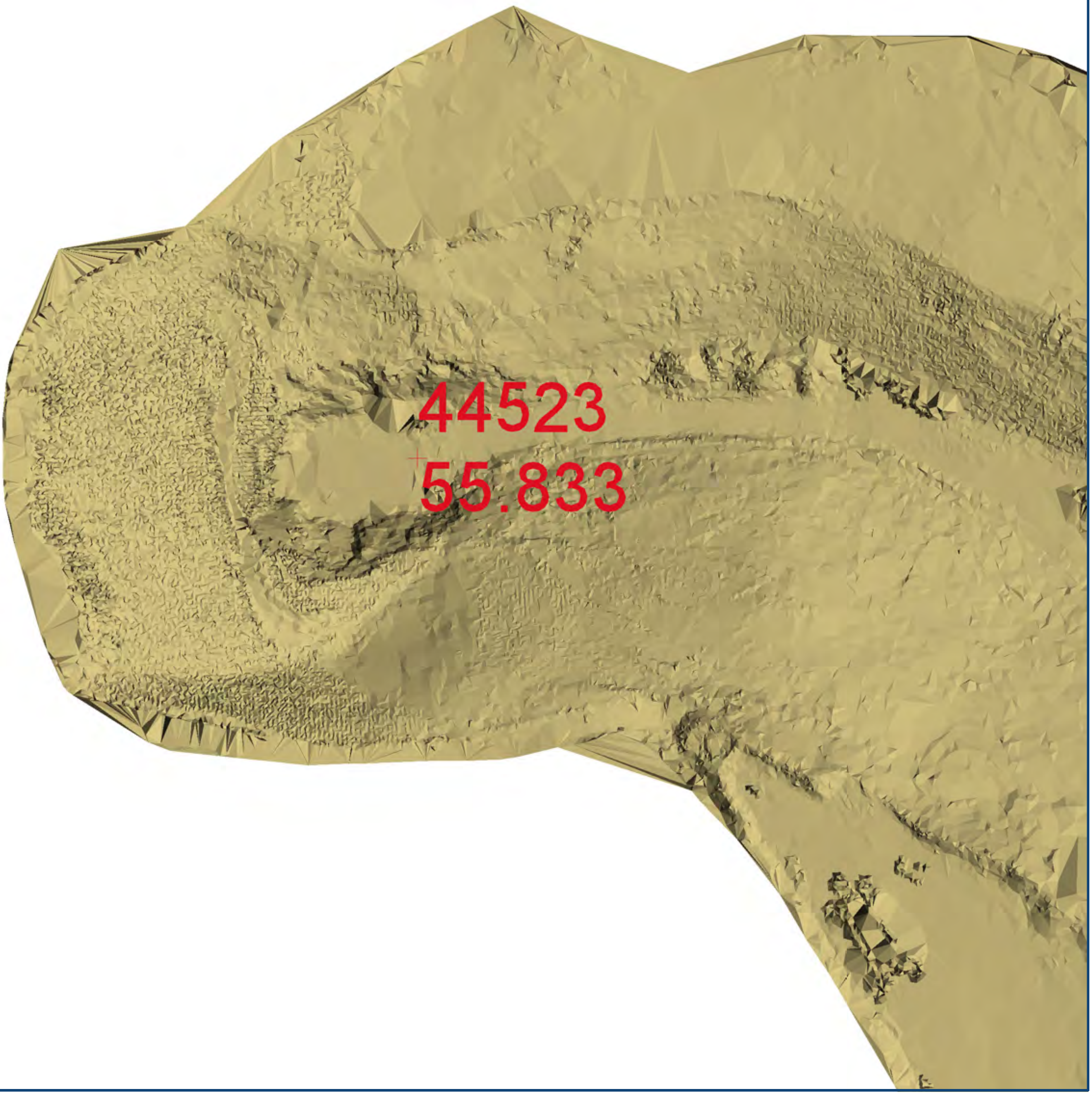

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Appendix B: BC Research Method ABA Results for Waste Rock and Overburden in July to October 2012

Appendix B. Summary ABA Analysis Reults from SGS Cemi for July to October 2012. Samples submitted for ICP-MS leachate analysis are highlighted below

Sample Date	ABA ID	Blast ID	Dispatch	Rock Type	Northing	Easting	Elevation	Paste pH	TIC %	$CaCO_3$ NP	S(T) %	$S(SO_4)$ %	$S(S^{2-})$ %	AP	NP H_2SO_4/tonne	NP $CaCO_3$/tonne	Net NP	NP:AP Ratio (NP/AP)	Fizz Test
27-Jun-12	31978	787-21	ZGW	eG	6944576	384834	787	8.37	0.33	27.5	<0.01	<0.01	<0.01	<0.3	40.7	41.5	41.5	138.3	slight
27-Jun-12	31979	787-21	LGW/MGW	eG	6944542	384873	787	8.65	0.21	17.5	0.34	<0.01	0.34	10.63	17.6	18.0	7.4	1.7	slight
27-Jun-12	31980	787-21	MGW	eG	6944487	384844	787	8.50	0.54	45.0	0.68	0.02	0.66	20.63	41.2	42.0	21.4	2.0	slight
30-Jun-12	31981	787-22	ZGW	eG	6944604	384842	787	8.66	0.20	16.7	<0.01	<0.01	<0.01	<0.3	27.4	28.0	28.0	93.3	slight
30-Jun-12	31982	787-22	LGW	eG	6944664	384849	787	8.35	0.17	14.2	0.02	<0.01	0.02	0.63	15.9	16.3	15.6	26.0	slight
02-Jul-12	31983	769-03-04	LGW/MGW	eG	6944433	384925	769	9.08	0.09	7.5	0.02	<0.01	0.02	0.60	14.5	14.8	14.1	23.6	slight
02-Jul-12	31984	769-03-04	MGW	eG	6944454	384996	769	8.58	0.43	35.8	0.37	<0.01	0.37	11.6	37.5	38.3	26.7	3.3	slight
10-Jul-12	31985	781-13	LGW	eG	6944602	385041	781	8.73	0.13	10.8	<0.01	<0.01	<0.01	<0.3	16.2	16.5	16.5	55.0	slight
10-Jul-12	31986	775-09	LGW	eG	6944545	384922	775	8.94	0.25	20.8	0.47	<0.01	0.47	14.7	26.2	26.8	12.1	1.8	slight
10-Jul-12	31987	769-05	LGW	eG	6944503	384946	769	8.91	0.26	21.7	0.21	<0.01	0.21	6.6	25.7	26.3	19.7	4.0	slight
12-Jul-12	31988	775-10	LGW	eG	6944610	384910	775	8.59	0.36	30.0	0.15	<0.01	0.15	4.7	34.1	34.8	30.1	7.4	slight
12-Jul-12	31989	775-13	LGW	eG	6944598	384911	775	8.85	0.21	17.5	0.08	<0.01	0.08	2.5	21.8	22.3	19.8	8.9	slight
14-Jul-12	31990	775-13	LGW	eG	6944615	384954	775	9.19	0.25	20.8	0.04	<0.01	0.04	1.3	25.7	26.3	25.0	21.0	slight
16-Jul-12	31991	775-11		eG	6944603	385010	775	9.11	0.25	20.8	0.11	<0.01	0.11	3.4	27.9	28.5	25.1	8.3	slight
16-Jul-12	31992	775-12	LGW	eG	6944569	385019	775	9.34	0.21	17.5	0.06	<0.01	0.06	1.9	18.1	18.5	16.6	9.9	slight
16-Jul-12	31993	775-12	MGW	eG	6944549	385037	775	9.23	0.18	15.0	0.23	<0.01	0.23	7.2	21.8	22.3	15.1	3.1	slight
24-Jul-12	31994	769-06	MGW	eG	6944551	384983	769	9.45	0.17	14.2	0.09	<0.01	0.09	2.8	28.4	29.0	26.2	10.3	slight
24-Jul-12	31995	769-06	HGW	eG	6944503	385007	769	9.07	0.37	30.8	0.43	0.01	0.42	13.1	41.2	42.0	28.9	3.2	slight
24-Jul-12	31996	769-06	LGW	eG	6944475	385018	769	9.43	0.23	19.2	0.02	<0.01	0.02	0.6	28.4	29.0	28.4	46.4	slight
31-Jul-12	31997	769-07	MGW	eG	6944423	384916	769	9.11	0.25	20.8	0.14	<0.01	0.14	4.4	32.6	33.3	28.9	7.6	slight
31-Jul-12	31998	769-07	LGW	eG	6944418	384932	769	9.09	0.22	18.3	0.02	<0.01	0.02	0.6	19.8	20.3	19.6	32.4	slight
31-Jul-12	31999	769-07	MGW	eG	6944416	384944	769	9.00	0.47	39.2	0.12	<0.01	0.12	3.8	36.5	37.3	33.5	9.9	slight
31-Jul-12	32000	769-07	HGW	eG	6944439	384901	769	8.72	0.59	49.2	0.94	<0.01	0.94	29.4	46.1	47.0	17.6	1.6	slight
31-Jul-12	34826	763-02	MGW	eG	6944415	384985	763	8.87	0.46	38.3	0.05	<0.01	0.05	1.6	44.6	45.5	43.9	29.1	slight
31-Jul-12	34827	769-08	MGW	eG	6944568	384942	769	9.26	0.28	23.3	0.03	<0.01	0.03	0.9	30.6	31.3	30.3	33.3	slight
31-Jul-12	34828	769-08	LGW	eG	6944576	384936	769	9.22	0.25	20.8	0.02	<0.01	0.02	0.6	27.0	27.5	26.9	44.0	slight
31-Jul-12	34829	769-08	MGW	eG	6944587	385000	769	8.95	0.4	33.3	0.19	<0.01	0.19	5.9	40.2	41.0	35.1	6.9	slight
31-Jul-12	34830	769-08	MGW	eG	6944567	385010	769	9.03	0.39	32.5	0.27	<0.01	0.27	8.4	34.3	35.0	26.6	4.1	slight
31-Jul-12	34831	769-08	LGW	eG	6944574	384998	769	9.36	0.2	16.7	0.02	<0.01	0.02	0.6	21.6	22.0	21.4	35.2	slight
02-Aug-12	34832	787-23	LGW	eG	6944538	385112	787	8.77	0.2	16.7	<0.01	<0.01	<0.01	<0.3	21.3	21.8	21.8	72.5	slight
2-Aug-12	34833	757-01	LGW	eG	6944438	384975	757	9.13	0.24	20.0	0.13	<0.01	0.13	4.1	27.4	28.0	23.9	6.9	slight
05-Aug-12	34834	763-03	MGW	eG	6944420	384933	763	9.21	0.23	19.2	0.06	<0.01	0.06	1.9	25.2	25.8	23.9	13.7	slight
05-Aug-12	34835	763-03	LGW	eG	6944420	384933	763	9.14	0.25	20.8	0.01	<0.01	0.01	0.3	27.2	27.8	27.4	88.8	slight
05-Aug-12	34836	763-04	LGW	eG	6944429	384917	763	9.07	0.33	27.5	0.06	<0.01	0.06	1.9	30.9	31.5	29.6	16.8	slight
05-Aug-12	34837	763-04	MGW	eG	6944449	384843	763	8.99	0.47	39.2	0.21	<0.01	0.21	6.6	45.8	46.8	40.2	7.1	slight
05-Aug-12	34838	769-09	MGW	eG	6944493	385024	769	9.46	0.09	7.5	0.02	<0.01	0.02	0.6	14.0	14.3	13.6	22.8	slight
6-Aug-12	34839	775-14	ZGW	eG	6944647	384893	775	9.02	0.16	13.3	<0.01	<0.01	<0.01	<0.3	18.4	18.8	18.8	62.5	slight
06-Aug-12	34840	775-14	LGW	eG	6944655	384891	775	8.70	0.44	36.7	0.02	<0.01	0.02	0.6	42.1	43.0	42.4	68.8	slight
06-Aug-12	34841	775-14	MGW	eG	6944657	384916	775	8.87	0.18	15.0	0.04	<0.01	0.04	1.3	21.1	21.5	20.3	17.2	slight

Appendix B. Summary ABA Analysis Reults from SGS Cemi for July to October 2012. Samples submitted for ICP-MS leachate analysis are highlighted below

Sample Date	ABA ID	Blast ID	Dispatch	Rock Type	Northing	Easting	Elevation	Paste pH	TIC %	$CaCO_3$ NP	S(T) %	$S(SO_4)$ %	$S(S^{2-})$ %	AP	NP H_2SO_4/tonne	NP $CaCO_3$/tonne	Net NP	NP:AP Ratio (NP/AP)	Fizz Test
6-Aug-12	34842	775-14	LGW	eG	6944633	384890	775	8.75	0.19	15.8	<0.01	<0.01	<0.01	<0.3	22.1	22.5	22.5	75.0	slight
11-Aug-12	34843	775-15a	ZGW	eG	6944534	384890	775	8.59	0.23	19.2	0.01	<0.01	0.01	0.3	27.0	27.5	27.2	88.0	slight
11-Aug-12	34844	775-15a	LGW	eG	6944578	384874	775	8.91	0.14	11.7	<0.01	<0.01	<0.01	<0.3	17.4	17.8	17.8	59.2	slight
11-Aug-12	34845	781-14	LGW	eG	6944507	384884	781	8.78	0.3	25.0	0.02	<0.01	0.02	0.6	27.2	27.8	27.1	44.4	slight
11-Aug-12	34846	781-14	LGW	eG	6944470	384870	781	8.53	0.25	20.8	0.01	<0.01	0.01	0.3	24.7	25.3	24.9	80.8	slight
14-Aug-12	34847	775-15b	LGW	eG	6944578	384894	775	8.51	0.21	17.5	0.02	<0.01	0.02	0.6	26.2	26.8	26.1	42.8	slight
14-Aug-12	34848	781-15	ZGW	eG	6944612	384862	781	8.43	0.27	22.5	<0.01	<0.01	<0.01	<0.3	29.2	29.8	29.8	99.2	slight
14-Aug-12	34849	781-15	LGW	eG	6944643	384864	781	9.25	0.19	15.8	0.01	<0.01	0.01	0.3	21.3	21.8	21.4	69.6	slight
15-Aug-12	34850	865-01	ZGW	eG	6944424	384753	865	8.80	0.16	13.3	<0.01	<0.01	<0.01	<0.3	35.5	36.3	36.3	120.8	slight
17-Aug-12	44501	775-17	LGW	eG	6944628	385019	775	9.35	0.12	10.0	0.01	<0.01	0.01	0.3	16.2	16.5	16.2	52.8	slight
17-Aug-12	44502	775-17	LGW	eG	6944587	385047	775	8.96	0.15	12.5	0.02	<0.01	0.02	0.6	20.3	20.8	20.1	33.2	slight
17-Aug-12	44503	775-17	MGW	eG	6944605	385054	775	8.68	0.17	14.2	0.56	0.05	0.51	15.9	19.4	19.8	3.8	1.2	slight
17-Aug-12	44504	775-17	MGW	eG	6944470	384873	775	8.92	0.28	23.3	0.67	<0.01	0.67	20.9	30.6	31.3	10.3	1.5	slight
20-Aug-12	44505	763-06	MGW	eG	6944605	385034	775	8.66	0.27	22.5	0.13	<0.01	0.13	4.1	25.5	26.0	21.9	6.4	slight
20-Aug-12	44506	763-06	MGW	eG	6944533	384975	763	9.33	0.19	15.8	0.25	<0.01	0.25	7.8	21.1	21.5	13.7	2.8	slight
26-Aug-12	44507	775-18	PAG MGW	eG	6944503	384956	763	9.18	0.36	30.0	0.32	<0.01	0.32	10.0	25.7	26.3	16.3	2.6	slight
26-Aug-12	44508	775-18	MGW	eG	6944547	385051	775	8.98	0.36	30.0	0.14	<0.01	0.14	4.4	33.3	34.0	29.6	7.8	slight
26-Aug-12	44509	775-18	HGW	eG	6944558	385055	775	8.67	0.32	26.7	0.28	<0.01	0.28	8.8	20.8	21.3	12.5	2.4	slight
26-Aug-12	44510	775-19	MGW	eG	6944552	385064	775	8.88	0.34	28.3	0.12	<0.01	0.12	3.8	29.6	30.3	26.5	8.1	slight
26-Aug-12	44511	775-19	PAG	eG	6944461	384883	775	8.95	0.42	35.0	0.25	<0.01	0.25	7.8	38.5	39.3	31.4	5.0	slight
26-Aug-12	44512	775-19	PAG	eG	6944493	384886	775	8.71	0.77	64.2	1.18	<0.01	1.18	36.9	41.9	42.8	5.9	1.2	slight
26-Aug-12	44513	775-19	LGW	eG	6944507	384889	775	9.10	0.27	22.5	0.13	<0.01	0.13	4.1	33.6	34.3	30.2	8.4	slight
26-Aug-12	44514	769-10	LGW	eG	6944590	384896	769	9.18	0.13	10.8	0.03	<0.01	0.03	0.9	13.2	13.5	12.6	14.4	slight
26-Aug-12	44515	Portal-1	PAG	eG	6944579	384926	769	9.31	0.11	9.2	0.04	<0.01	0.04	1.3	13.7	14.0	12.8	11.2	slight
26-Aug-12	44516	769-10	LGW	eG	6944599	384932	769	9.24	0.18	15.0	0.03	<0.01	0.03	0.9	21.8	22.3	21.3	23.7	slight
26-Aug-12	44517	769-10	ZGW	eG	6944586	384909	769	9.06	0.24	20.0	0.02	<0.01	0.02	0.6	24.7	25.3	24.6	40.4	slight
27-Aug-12	44518	769-11	MGW	eG	6944574	385044	769	8.35	0.23	19.2	0.24	<0.01	0.24	7.5	30.6	31.3	23.8	4.2	Slight
27-Aug-12	44519	769-11	MGW PAG	eG	6944605	385044	769	8.29	0.44	36.7	0.53	<0.01	0.53	16.6	41.2	42.0	25.4	2.5	Slight
27-Aug-12	44520	769-11	HGW	eG	6944555	385054	769	8.39	0.37	30.8	0.34	<0.01	0.34	10.6	31.4	32.0	21.4	3.0	Slight
30-Aug-12	44521	769-12	LGW	eG	6944634	384938	769	8.54	0.22	18.3	0.04	<0.01	0.04	1.3	20.6	21.0	19.8	16.8	Slight
30-Aug-12	44522	769-12	MGW PAG	eG	6944624	384998	769	8.31	0.14	11.7	0.17	0.03	0.14	4.4	16.2	16.5	12.1	3.8	Slight
05-Sep-12	42751	769-14	ZGW	eG	6944629	384889	769	8.33	0.29	24.2	<0.01	<0.01	<0.01	<0.3	31.4	32.0	32.0	106.7	Slight
05-Sep-12	42752	769-14	LGW	eG	6944620	384903	769	8.62	0.24	20.0	0.02	<0.01	0.02	0.6	22.8	23.3	22.6	37.2	Slight
5-Sep-12	44523	Portal-1	LGW	eG	6944072	384936	Por	8.70	0.13	10.8	<0.01	<0.01	<0.01	<0.3	16.4	16.8	16.8	55.8	Slight
5-Sep-12	44524	769-14	ZGW	eG	6944655	384905	769	8.42	0.26	21.7	0.01	<0.01	0.01	0.3	26.2	26.8	26.4	85.6	Slight
05-Sep-12	44525	769-14	LGW	eG	6944648	384901	769	8.47	0.37	30.8	<0.01	<0.01	<0.01	<0.3	35.5	36.3	36.3	120.8	Slight
18-Sep-12	42753	769-13	MGW	eG	6944539	6944458	769	8.17	0.49	40.8	2.07	0.01	2.06	64.4	30.9	31.5	-32.9	0.5	Slight
18-Sep-12	42754	769-13	MGW	eG	6944517	384901	769	8.09	1	83.3	2.84	0.01	2.83	88.4	59.5	60.8	-27.7	0.7	Slight

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Sample Date	ABA ID	Blast ID	Dispatch	Rock Type	Northing	Easting	Elevation	Paste pH	TIC %	$CaCO_3$ NP	S(T) %	$S(SO_4)$ %	$S(S^{2-})$ %	AP	NP H_2SO_4/tonne	NP $CaCO_3$/tonne	Net NP	NP:AP Ratio (NP/AP)	Fizz Test
18-Sep-12	42755	769-13	LGW	eG	6944539	384889	769	8.80	0.16	13.3	0.03	<0.01	0.03	0.9	17.2	17.5	16.6	18.7	Slight
18-Sep-12	42756	769-13	HGW	eG	6944452	384882	769	8.31	0.49	40.8	0.58	<0.01	0.58	18.1	41.7	42.5	24.4	2.3	Slight
18-Sep-12	42757	769-15	LGW	eG	6944606	384863	769	8.72	0.19	15.8	0.11	<0.01	0.11	3.4	21.6	22.0	18.6	6.4	Slight
18-Sep-12	42758	763-07	MGW	eG	6944551	384991	763	8.86	0.29	24.2	0.17	<0.01	0.17	5.3	29.9	30.5	25.2	5.7	Slight
18-Sep-12	42759	763-07	LGW	eG	6944581	384976	763	8.84	0.18	15.0	<0.01	<0.01	<0.01	<0.3	23.3	23.8	23.8	79.2	Slight
18-Sep-12	42760	763-08	MGW	eG	6944500	385013	763	8.63	0.19	15.8	0.15	<0.01	0.15	4.7	19.8	20.3	15.6	4.3	Slight
18-Sep-12	42761	763-08	MGW	eG	6944549	385031	763	8.59	0.35	29.2	0.53	<0.01	0.53	16.6	33.3	34.0	17.4	2.1	Slight
18-Sep-12	42762	763-08	LGW	eG	6944500	385013	763	8.55	0.17	14.2	0.04	<0.01	0.04	1.3	20.1	20.5	19.3	16.4	Slight
18-Sep-12	42763	763-09	LGW	eG	6944591	385002	763	8.44	0.3	25.0	0.05	<0.01	0.05	1.6	29.9	30.5	28.9	19.5	Slight
18-Sep-12	42764	763-11	LGW	eG	6944532	384929	763	8.87	0.14	11.7	0.01	<0.01	0.01	0.3	16.9	17.3	16.9	55.2	Slight
18-Sep-12	42765	763-11	MGW	eG	6944509	384915	763	8.20	0.6	50.0	2.49	0.02	2.47	77.2	52.4	53.5	-23.7	0.7	Slight
18-Sep-12	42766	763-11	MGW	eG	6944509	384915	763	8.36	0.37	30.8	1.4	<0.01	1.4	43.8	29.2	29.8	-14.0	0.7	Slight
18-Sep-12	42767	763-11	HGW	eG	6944458	384883	763	8.42	0.21	17.5	0.97	<0.01	0.97	30.3	18.4	18.8	-11.6	0.6	Slight
23-Sep-12	40301	763-10	LGW	eG	6944591	384901	763	8.64	0.33	27.5	0.06	<0.01	0.06	1.9	33.1	33.8	31.9	18.0	Slight
23-Sep-12	40302	763-10	LGW	eG	6944591	384901	763	8.62	0.24	20.0	0.16	<0.01	0.16	5.0	23.8	24.3	19.3	4.9	Slight
23-Sep-12	42768	763-12	MGW PAG	eG	6944607	385034	763	8.17	0.19	15.8	1.05	0.01	1.04	32.5	19.8	20.3	-12.3	0.6	Slight
23-Sep-12	42769	763-12	LGW	eG	6944607	385034	763	8.61	0.16	13.3	0.02	<0.01	0.02	0.6	22.8	23.3	22.6	37.2	Slight
23-Sep-12	42770	763-12	MGW	eG	6944622	384984	763	8.56	0.12	10.0	0.01	<0.01	0.01	0.3	15.4	15.8	15.4	50.4	Slight
23-Sep-12	42771	763-12	MGW PAG	eG	6944574	385047	763	8.82	0.16	13.3	0.07	<0.01	0.07	2.2	17.2	17.5	15.3	8.0	Slight
23-Sep-12	42772	763-13	LGW	eG	6944608	384922	763	8.66	0.27	22.5	0.14	<0.01	0.14	4.4	24.3	24.8	20.4	5.7	Slight
23-Sep-12	42773	763-13	MGW PAG	eG	6944594	384944	763	8.51	0.36	30.0	0.42	0.01	0.41	12.8	30.9	31.5	18.7	2.5	Slight
23-Sep-12	42774	763-13	LGW	eG	6944601	384956	763	8.68	0.36	30.0	0.03	<0.01	0.03	0.9	34.5	35.3	34.3	37.6	Slight
23-Sep-12	42775	763-10	MGW PAG	eG	6944546	384907	763	8.30	0.33	27.5	2.76	<0.01	2.76	86.3	28.9	29.5	-56.8	0.3	Slight
27-Sep-12	40303	763-14	MGW PAG	eG	6944637	384942	763	8.36	0.46	38.3	0.05	<0.01	0.05	1.6	43.1	44.0	42.4	28.2	Slight
27-Sep-12	40304	763-14	LGW	eG	6944643	384908	763	8.51	0.25	20.8	0.03	<0.01	0.03	0.9	28.4	29.0	28.1	30.9	Slight
27-Sep-12	40305	763-14	LGW	eG	6944639	384909	763	8.71	0.11	9.2	0.14	<0.01	0.14	4.4	18.4	18.8	14.4	4.3	Slight
27-Sep-12	40306	859-07	ZGW	eG	6944439	384765	859	8.39	0.18	15.0	<0.01	<0.01	<0.01	<0.3	20.1	20.5	20.5	68.3	Slight
27-Sep-12	40307	847-13	LGW	eG	6944482	384740	847	8.52	0.15	12.5	0.01	<0.01	0.01	0.3	16.7	17.0	16.7	54.4	Slight
27-Sep-12	40308	751-01	ZGW	eG	6944580	385006	751	8.73	0.19	15.8	<0.01	<0.01	<0.01	<0.3	20.1	20.5	20.5	68.3	Slight
27-Sep-12	40309	865-02	ZGW	eG	6944397	384757	865	8.45	0.15	12.5	<0.01	<0.01	<0.01	<0.3	14.7	15.0	15.0	50.0	Slight
27-Sep-12	40310	865-02	MGW	eG	6944444	384724	865	8.33	0.11	9.2	0.1	<0.01	0.1	3.1	13.5	13.8	10.6	4.4	Slight
27-Sep-12	40311	865-02	LGW	eG	6944365	384774	865	8.35	0.13	10.8	<0.01	<0.01	<0.01	<0.3	14.2	14.5	14.5	48.3	Slight
30-Sep-12	40312	757-02	NAG (LGW)	eG	6944536	384997	757	8.59	0.26	21.7	0.04	<0.01	0.04	1.3	25.0	25.5	24.3	20.4	Slight
30-Sep-12	40314	757-03	NAG (MGW)	eG	6944541	384976	757	8.78	0.22	18.3	0.13	<0.01	0.13	4.1	24.5	25.0	20.9	6.2	Slight
30-Sep-12	40315	757-03	MGW/HGW	eG	6944553	384963	757	8.61	0.33	27.5	0.34	<0.01	0.34	10.6	31.9	32.5	21.9	3.1	Slight
07-Oct-12	40316	757-05	PAG	eG	6944616	384943	757	8.2	0.42	35	0.63	<0.01	0.63	19.7	39.2	40	20.3	2	Slight

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Sample Date	ABA ID	Blast ID	Dispatch	Rock Type	Northing	Easting	Elevation	Paste pH	TIC %	$CaCO_3$ NP	S(T) %	$S(SO_4)$ %	$S(S^{2-})$ %	AP	NP H_2SO_4/tonne	NP $CaCO_3$/tonne	Net NP	NP:AP Ratio (NP/AP)	Fizz Test
07-Oct-12	40317	757-05	ZGW	eG	6944592	384964	757	8.68	0.18	15	0.01	<0.01	0.01	0.3	24	24.5	24.2	78.4	Slight
07-Oct-12	40318	757-05	NAG	eG	6944600	384983	757	8.49	0.36	30	0.15	<0.01	0.15	4.7	37.7	38.5	33.8	8.2	Slight
13-Oct-12	40319	835-15	ZGW	eG	6944564	384755	835	7.95	0.27	22.5	0.01	<0.01	0.01	0.3	27.2	27.8	27.4	88.8	Slight
13-Oct-12	40320	835-15	MGW	eG	6944523	384760	835	8.16	0.44	36.7	<0.01	<0.01	<0.01	<0.3	40.2	41.0	41.0	136.7	Slight
13-Oct-12	40321	775-21	HGW	eG	6944450	385054	775	8.39	0.3	25.0	0.17	<0.01	0.17	5.3	30.1	30.8	25.4	5.8	Slight
13-Oct-12	40322	757-04	MGW	eG	6944497	384993	757	8.78	0.17	14.2	0.11	<0.01	0.11	3.4	21.6	22.0	18.6	6.4	Slight
13-Oct-12	40323	757-07	LGW	eG	6944603	385022	757	8.64	0.24	20.0	0.01	<0.01	0.01	0.3	26.5	27.0	26.7	86.4	Slight
13-Oct-12	40324	757-07	LGW	eG	6944577	385036	757	8.61	0.21	17.5	0.1	<0.01	0.1	3.1	26.2	26.8	23.6	8.6	Slight
13-Oct-12	40325	757-07	MGW	eG	6944590	385030	757	8.60	0.23	19.2	0.01	<0.01	0.01	0.3	29.9	30.5	30.2	97.6	Slight
13-Oct-12	41151	757-07	MGW	eG	6944590	385030	757	8.68	0.24	20.0	0.15	<0.01	0.15	4.7	30.4	31.0	26.3	6.6	Slight
13-Oct-12	41152	775-20	MGW	eG	6944523	385062	775	8.54	0.16	13.3	0.09	<0.01	0.09	2.8	21.8	22.3	19.4	7.9	Slight
14-Oct-12	41153	763-15	MGW (PAG)	eG	6944512	384879	763	8.17	1.39	115.8	1.42	0.02	1.4	43.8	76.4	78.0	34.3	1.8	Slight
14-Oct-12	41154	763-15	LGW (PAG)	eG	6944543	384876	763	8.34	0.44	36.7	1.03	<0.01	1.03	32.2	37.5	38.3	6.1	1.2	Slight
14-Oct-12	41155	763-15B	MGW	eG	6944453	384896	763	8.63	0.29	24.2	0.54	<0.01	0.54	16.9	25.0	25.5	8.6	1.5	Slight
14-Oct-12	41156	769-16	MGW	eG	6944606	384863	769	8.70	0.2	16.7	0.02	<0.01	0.02	0.6	22.8	23.3	22.6	37.2	Slight
14-Oct-12	41158	859-08	MGW (PAG)	eG	6944350	384826	859	8.51	0.25	20.8	0.12	<0.01	0.12	3.8	27.0	27.5	23.8	7.3	Slight
14-Oct-12	41159	859-08	MGW (PAG)	eG	6944401	384789	859	8.45	0.28	23.3	0.14	<0.01	0.14	4.4	36.3	37.0	32.6	8.5	Slight
14-Oct-12	41160	859-08	LGW	eG	6944375	384795	859	8.74	0.15	12.5	0.02	<0.01	0.02	0.6	20.3	20.8	20.1	33.2	Slight
14-Oct-12	41161	859-08	LGW	eG	6944418	384764	859	8.32	0.19	15.8	0.05	<0.01	0.05	1.6	19.6	20.0	18.4	12.8	Slight
19-Oct-12	41162	787-24	MGW	eG	6944499	385105	787	8.26	0.19	15.8	0.04	<0.01	0.04	1.3	22.8	23.3	22.0	18.6	Slight
19-Oct-12	41163	757-09	HGW (PAG)	eG	6944455	384962	757	8.64	0.18	15.0	0.27	<0.01	0.27	8.4	29.4	30.0	21.6	3.6	Slight
19-Oct-12	41164	757-09	MGW(PAG)	eG	6944463	384924	757	8.45	0.31	25.8	0.46	<0.01	0.46	14.4	23.8	24.3	9.9	1.7	Slight

Appendix C: BC Research Method ABA Results for Tailings July to September

Appendix C. Summary Tailings Analysis Results from SGS Cemi												
Monthly Tails Sample ID	Paste pH	TIC %	CaCO3 NP	S(T) %	S(SO4) %	S(S-2) %	AP	NP H2SO4/tonne	NP CaCO3/tonne	Net NP	NP:AP Ratio (NP/AP)	Fizz Test
Final Tails Monthly Composite Jul 2012	8.66	0.3	25.0	0.07	0.01	0.06	1.9	28.7	29.3	27.4	15.6	slight
Final Tails Monthly Composite Aug 2012	8.26	0.33	27.5	0.06	0.01	0.05	10.4	30.1	30.8	29.2	19.7	Slight
Final Tails Monthly Composite Sep 2012	7.88	0.31	25.8	0.13	0.02	0.11	22.0	28.9	29.5	26.1	8.6	Slight

Appendix D: ICP Results for July to October 2012

Appendix D. Leachate Analysis by ICP-OES

		Sample ID and NP Contribution																									
Metals		31982	NP	31983	NP	31991	NP	31998	NP	34826	NP	34835	NP	34841	NP	44501	NP	44511	NP	44515	NP	40307	NP	40311	NP	40319	NP	40325	NP
Al	mg/L	3.7		40.0		44.4		6.3		38.30		41.6		7.6		41.9		53.0		31.6		14.5		7.3		18.4		63.5	
Sb	mg/L	< 0.01		0.01		0.02		< 0.01		< 0.01		0.02		< 0.01		0.03		0.02		0.03		0.01		< 0.01		0.02		0.03	
As	mg/L	0.009		0.011		0.022		0.021		0.020		0.040		0.021		0.015		0.040		0.038		0.005		< 0.004		0.009		0.032	
Ba	mg/L	0.0531		0.0915		0.0869		0.0674		0.0601		0.0571		0.0764		0.1060		0.0592		0.093		0.0832		0.0800		0.0502		0.0762	
Be	mg/L	0.0017		0.0039		0.0075		0.0036		0.0205		0.0106		0.0018		0.0037		0.0114		0.0033		0.0026		0.0018		0.0042		0.0081	
Bi	mg/L	< 0.02		0.20		0.17		< 0.02		0.12		0.22		0.05		0.18		0.32		0.03		0.18		0.12		0.13		0.38	
B	mg/L	1.58		1.15		0.65		0.76		1.66		0.89		1.70		5.49		3.45		2.43		0.41		0.710		1.20		2.29	
Cd	mg/L	0.0097		0.0078		0.0079		0.0022		0.0081		0.0089		0.0063		0.0073		0.0231		0.0045		0.0071		0.0057		0.0075		0.0105	
Ca	mg/L	446	11.1	279	7.0	751	18.7	615	15.3	563	14.0	682	17.0	606	15.1	340	8.5	568	14.2	334	8.3	412	10.3	407	10.2	649	16.2	659	16.4
Cr	mg/L	0.006		1.070		1.180		0.00		0.582		1.650		0.037		0.866		0.989		0.200		0.193		0.075		0.173		1.33	
Co	mg/L	0.046		0.033		0.031		0.014		0.026		0.029		0.069		0.043		0.068		0.016		0.054		0.091		0.095		0.045	
Cu	mg/L	11.50		1.45		0.884		0.0		2.7		0.91		2.850		1.36		15.7		0.45		5.57		1.2		0.68		1.74	
Fe	mg/L	44		138		118		36		111.0		129.0		60.0		115.0		271		55.4		96.8		62		64		163	
Pb	mg/L	0.006		0.008		0.024		< 0.005		0.008		0.008		0.009		0.006		0.027		0.007		< 0.005		< 0.005		< 0.005		0.016	
Li	mg/L	< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1	
Mg	mg/L	34	1.4	23	0.9	27.5	1.1	22	0.9	40.2	1.7	30.6	1.3	20.9	0.9	20.5	0.8	73.0	3.0	19.6	0.8	18.4	0.8	14.9	0.6	120.0	4.9	37.5	1.5
Mn	mg/L	12.5		5.6		7.58		7.6		11.40		9.15		19.3		5.9		11.6		4.5		12.4		19.3		13.0		14.7	
Mo	mg/L	< 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	
Ni	mg/L	0.157		0.198		0.186		0.084		0.167		0.207		0.182		0.150		0.146		0.052		0.139		0.109		0.171		0.142	
P	mg/L	0.056		0.528		0.541		0.014		0.013		0.217		0.015		0.339		1.360		0.153		0.038		< 0.009		< 0.009		0.182	
K	mg/L	30.9	0.8	42.0	1.1	43.5	1.1	26.0	0.7	32.1	0.8	40.0	1.0	48.1	1.2	43.6	1.1	45.4	1.2	47.2	1.2	48.0	1.2	46.7	1.2	19.8	0.5	67.6	1.7
Se	mg/L	< 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	
Si	mg/L	37.3		55.8		48.4		24.0		55.6		49.2		44.5		110.0		88.0		62.0		35.4		29.4		55.3		82.3	
Ag	mg/L	< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08	
Na	mg/L	17.2	0.7	23.9	1.0	21.3	0.9	20.2	0.9	23.6	1.0	23.1	1.0	23.1	1.0	35.4	1.5	26.6	1.2	24.9	1.1	24.6	1.1	20.6	0.9	25.1	1.1	43.3	1.9
Sr	mg/L	1.56		1.80		2.40		3.08		3.62		3.11		1.76		1.81		3.59		1.89		1.27		1.36		1.72		3.23	
S	mg/L	470		429		841		589		665		773		617		487		873		424		497		435		805		868	
Tl	mg/L	0.010		< 0.005		< 0.005		< 0.005		0.01		< 0.005		0.010		< 0.005		< 0.005		< 0.005		0.01		0.02		0.01		0.01	
Sn	mg/L	< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03	
Ti	mg/L	0.009		0.063		0.169		< 0.001		0.003		0.006		0.017		0.098		0.026		0.022		0.013		0.007		0.007		0.009	
U	mg/L	< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2	
V	mg/L	0.003		0.065		0.072		0.004		0.018		0.074		0.003		0.061		0.297		0.040		0.006		0.001		0.002		0.076	
Zn	mg/L	0.271		0.225		0.174		0.083		0.205		0.210		0.225		0.246		0.768		0.139		0.254		0.171		0.182		0.410	
Zr	mg/L	< 0.007		< 0.007		< 0.007		< 0.007		< 0.007		< 0.007		< 0.007		0.009		0.012		< 0.007		< 0.007		< 0.007		< 0.007		< 0.007	
NP from Ca, Mg, Na & K (kg $CaCO_3$ Equiv./tonne)		31982	14.1	31983	10.0	31991	21.9	31998	17.8	34826	17.5	34835	20.3	34841	18.2	44501	12.0	44511	19.5	44515	11.4	40307	13.4	40311	12.9	40319	22.7	40325	21.5

Metals		41152	NP	41159	NP	42757	NP	42764	NP	42774	NP	44518	NP	44523	NP
Al	mg/L	59.0		71.8		32.6		33.4		33.4		74.8		26.3	
Sb	mg/L	0.02		0.06		0.02		0.01		0.04		0.02		< 0.01	
As	mg/L	0.018		0.051		0.034		0.127		0.028		0.061		< 0.004	
Ba	mg/L	0.0832		0.054		0.0727		0.0879		0.0675		0.08		0.0495	
Be	mg/L	0.0076		0.0079		0.0042		0.0036		0.0072		0.0066		0.0038	
Bi	mg/L	0.31		0.55		0.21		0.25		0.34		0.28		0.15	
B	mg/L	0.858		2.81		2.53		0.275		0.377		2.64		1.78	
Cd	mg/L	0.0110		0.0376		0.008		0.0072		0.0095		0.0206		0.0084	
Ca	mg/L	405	10.1	565	14.1	503	12.5	371	9.3	606	15.1	675	16.8	365	9.1
Cr	mg/L	1.28		3.26		0.621		1.12		1.59		1.25		0.323	
Co	mg/L	0.044		0.177		0.033		0.029		0.038		0.047		0.089	
Cu	mg/L	7.83		45.6		4		0.304		0.676		25.7		1.49	
Fe	mg/L	144		268		119		115		155		149		76.2	
Pb	mg/L	0.007		0.018		< 0.005		0.018		0.014		0.024		< 0.005	
Li	mg/L	< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1	
Mg	mg/L	31.4	1.3	90.3	3.7	24.6	1	20.6	0.8	49.1	2	33.3	1.4	12.9	0.5
Mn	mg/L	10.7		23.2		10.9		7.07		11.1		9.92		19.8	
Mo	mg/L	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
Ni	mg/L	0.144		0.187		0.162		0.17		0.161		0.169		0.138	
P	mg/L	0.549		10.9		0.331		0.541		0.254		0.726		< 0.009	
K	mg/L	59.6	1.5	80.5	2.1	60.4	1.5	53.1	1.4	41.2	1.1	56.6	1.4	51.6	1.3
Se	mg/L	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
Si	mg/L	55.9		102		64.8		38.4		38.6		112		50.3	
Ag	mg/L	< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08	
Na	mg/L	34.8	1.5	37.5	1.6	32	1.4	21.9	1	20.9	0.9	40	1.7	23	1
Sr	mg/L	2.47		2.57		2.83		3.86		3.77		2.85		1.02	
S	mg/L	629		999		629		513		778		900		460	
Tl	mg/L	< 0.005		< 0.005		< 0.005		< 0.005		< 0.005		< 0.005		0.02	
Sn	mg/L	< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03	
Ti	mg/L	0.023		0.043		0.012		0.009		0.006		0.074		0.004	
U	mg/L	< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2	
V	mg/L	0.116		0.801		0.039		0.043		0.067		0.147		0.002	
Zn	mg/L	0.456		1.79		0.214		0.157		0.269		0.599		0.354	
Zr	mg/L	< 0.007		0.012		< 0.007		< 0.007		< 0.007		0.014		< 0.007	
NP from Ca, Mg, Na & K (kg $CaCO_3$ Equiv./tonne)		41152	14.4	2306.2	21.5	1487.4	16.4	1180.5	12.5	1741.0	19.1	2085.3	21.3	1090.5	11.9

Appendix E: SGS Raw Lab Results

CLIENT : **Minto Mines**
PROJECT : **Minto Mines**
SGS PROJECT # : **0643**
Test : **BC Research NP and Modified NP Procedures**
Date : **August 16 - September 18, 2012**

Sample ID	Paste pH	TIC %	CaCO3 NP	S(T) %	S(SO4) %	S(S-2) %	AP	NP	NP H2SO4/tonne	NP CaCO3/tonne	Net NP	NP:AP Ratio (NP/AP)	Fizz Test
Method Code	Sobek	CSB02V	Calc	CSA06V	CSA07V	Calc	Calc	Modified	BC Research	Calc	Calc	Calc	Sobek
LOD	0.2	0.01	#N/A	0.01	0.01	#N/A	#N/A	0.5	0.5	#N/A	#N/A	#N/A	#N/A
27702	8.39	0.26	21.7	0.02	<0.01	0.02	0.6	26.1	28.4	29.0	28.4	46.4	slight
31978	8.37	0.33	27.5	<0.01	<0.01	<0.01	<0.3	32.1	40.7	41.5	41.5	138.3	slight
37979	8.65	0.21	17.5	0.34	<0.01	0.34	10.6	19.9	17.6	18.0	7.4	1.7	slight
31980	8.50	0.54	45.0	0.68	0.02	0.66	20.6	37.1	41.2	42.0	21.4	2.0	slight
31981	8.66	0.2	16.7	<0.01	<0.01	<0.01	<0.3	20.4	27.4	28.0	28.0	93.3	slight
31982	8.35	0.17	14.2	0.02	<0.01	0.02	0.6	16.8	15.9	16.3	15.6	26.0	slight
31983	9.08	0.09	7.5	0.02	<0.01	0.02	0.6	11.4	14.5	14.8	14.1	23.6	slight
31984	8.58	0.43	35.8	0.37	<0.01	0.37	11.6	35.1	37.5	38.3	26.7	3.3	slight
31985	8.73	0.13	10.8	<0.01	<0.01	<0.01	<0.3	14.9	16.2	16.5	16.5	55.0	slight
31986	8.94	0.25	20.8	0.47	<0.01	0.47	14.7	21.5	26.2	26.8	12.1	1.8	slight
31987	8.91	0.26	21.7	0.21	<0.01	0.21	6.6	21.9	25.7	26.3	19.7	4.0	slight
31988	8.59	0.36	30.0	0.15	<0.01	0.15	4.7	30.9	34.1	34.8	30.1	7.4	slight
31989	8.85	0.21	17.5	0.08	<0.01	0.08	2.5	20.0	21.8	22.3	19.8	8.9	slight
31990	9.19	0.25	20.8	0.04	<0.01	0.04	1.3	24.0	25.7	26.3	25.0	21.0	slight
31991	9.11	0.25	20.8	0.11	<0.01	0.11	3.4	23.4	27.9	28.5	25.1	8.3	slight
31992	9.34	0.21	17.5	0.06	<0.01	0.06	1.9	15.6	18.1	18.5	16.6	9.9	slight
31993	9.23	0.18	15.0	0.23	<0.01	0.23	7.2	19.3	21.8	22.3	15.1	3.1	slight
31994	9.45	0.17	14.2	0.09	<0.01	0.09	2.8	15.3	28.4	29.0	26.2	10.3	slight
31995	9.07	0.37	30.8	0.43	0.01	0.42	13.1	31.7	41.2	42.0	28.9	3.2	slight
31996	9.43	0.23	19.2	0.02	<0.01	0.02	0.6	21.4	28.4	29.0	28.4	46.4	slight
31997	9.11	0.25	20.8	0.14	<0.01	0.14	4.4	23.3	32.6	33.3	28.9	7.6	slight
31998	9.09	0.22	18.3	0.02	<0.01	0.02	0.6	20.7	19.8	20.3	19.6	32.4	slight
31999	9.00	0.47	39.2	0.12	<0.01	0.12	3.8	31.2	36.5	37.3	33.5	9.9	slight
32000	8.72	0.59	49.2	0.94	<0.01	0.94	29.4	41.1	46.1	47.0	17.6	1.6	slight
34826	8.87	0.46	38.3	0.05	<0.01	0.05	1.6	42.5	44.6	45.5	43.9	29.1	slight
34827	9.26	0.28	23.3	0.03	<0.01	0.03	0.9	20.9	30.6	31.3	30.3	33.3	slight
34828	9.22	0.25	20.8	0.02	<0.01	0.02	0.6	20.0	27.0	27.5	26.9	44.0	slight
34829	8.95	0.4	33.3	0.19	<0.01	0.19	5.9	34.3	40.2	41.0	35.1	6.9	slight
34830	9.03	0.39	32.5	0.27	<0.01	0.27	8.4	28.7	34.3	35.0	26.6	4.1	slight
34831	9.36	0.2	16.7	0.02	<0.01	0.02	0.6	17.2	21.6	22.0	21.4	35.2	slight
34832	8.77	0.2	16.7	<0.01	<0.01	<0.01	<0.3	20.0	21.3	21.8	21.8	72.5	slight
34833	9.13	0.24	20.0	0.13	<0.01	0.13	4.1	22.2	27.4	28.0	23.9	6.9	slight
34834	9.21	0.23	19.2	0.06	<0.01	0.06	1.9	21.8	25.2	25.8	23.9	13.7	slight
34835	9.14	0.25	20.8	0.01	<0.01	0.01	0.3	22.2	27.2	27.8	27.4	88.8	slight
34836	9.07	0.33	27.5	0.06	<0.01	0.06	1.9	25.9	30.9	31.5	29.6	16.8	slight
34837	8.99	0.47	39.2	0.21	<0.01	0.21	6.6	39.9	45.8	46.8	40.2	7.1	slight
34838	9.46	0.09	7.5	0.02	<0.01	0.02	0.6	12.0	14.0	14.3	13.6	22.8	slight
34839	9.02	0.16	13.3	<0.01	<0.01	<0.01	<0.3	18.7	18.4	18.8	18.8	62.5	slight
34840	8.70	0.44	36.7	0.02	<0.01	0.02	0.6	42.3	42.1	43.0	42.4	68.8	slight
34841	8.87	0.18	15.0	0.04	<0.01	0.04	1.3	21.2	21.1	21.5	20.3	17.2	slight
34842	8.75	0.19	15.8	<0.01	<0.01	<0.01	<0.3	18.8	22.1	22.5	22.5	75.0	slight
34843	8.59	0.23	19.2	0.01	<0.01	0.01	0.3	22.4	27.0	27.5	27.2	88.0	slight
34844	8.91	0.14	11.7	<0.01	<0.01	<0.01	<0.3	14.7	17.4	17.8	17.8	59.2	slight
34845	8.78	0.3	25.0	0.02	<0.01	0.02	0.6	20.9	27.2	27.8	27.1	44.4	slight
34846	8.53	0.25	20.8	0.01	<0.01	0.01	0.3	21.9	24.7	25.3	24.9	80.8	slight
34847	8.51	0.21	17.5	0.02	<0.01	0.02	0.6	20.5	26.2	26.8	26.1	42.8	slight
34848	8.43	0.27	22.5	<0.01	<0.01	<0.01	<0.3	25.9	29.2	29.8	29.8	99.2	slight
34849	9.25	0.19	15.8	0.01	<0.01	0.01	0.3	19.3	21.3	21.8	21.4	69.6	slight
34850	8.80	0.16	13.3	<0.01	<0.01	<0.01	<0.3	16.7	35.5	36.3	36.3	120.8	slight
44501	9.35	0.12	10.0	0.01	<0.01	0.01	0.3	12.0	16.2	16.5	16.2	52.8	slight
44502	8.96	0.15	12.5	0.02	<0.01	0.02	0.6	16.3	20.3	20.8	20.1	33.2	slight
44503	8.68	0.17	14.2	0.56	0.05	0.51	15.9	16.6	19.4	19.8	3.8	1.2	slight
44505	8.66	0.27	22.5	0.13	<0.01	0.13	4.1	24.0	25.5	26.0	21.9	6.4	slight
44506	9.33	0.19	15.8	0.25	<0.01	0.25	7.8	22.0	21.1	21.5	13.7	2.8	slight
44507	9.18	0.36	30.0	0.32	<0.01	0.32	10.0	17.9	25.7	26.3	16.3	2.6	slight
44508	8.98	0.36	30.0	0.14	<0.01	0.14	4.4	18.6	33.3	34.0	29.6	7.8	slight
44509	8.67	0.32	26.7	0.28	<0.01	0.28	8.8	32.4	20.8	21.3	12.5	2.4	slight
44510	8.88	0.34	28.3	0.12	<0.01	0.12	3.8	17.2	29.6	30.3	26.5	8.1	slight
44504	8.92	0.28	23.3	0.67	<0.01	0.67	20.9	27.1	30.6	31.3	10.3	1.5	slight
44511	8.95	0.42	35.0	0.25	<0.01	0.25	7.8	32.1	38.5	39.3	31.4	5.0	slight
44512	8.71	0.77	64.2	1.18	<0.01	1.18	36.9	34.4	41.9	42.8	5.9	1.2	slight
44513	9.10	0.27	22.5	0.13	<0.01	0.13	4.1	19.7	33.6	34.3	30.2	8.4	slight
44514	9.18	0.13	10.8	0.03	<0.01	0.03	0.9	14.4	13.2	13.5	12.6	14.4	slight
44515	9.31	0.11	9.2	0.04	<0.01	0.04	1.3	12.5	13.7	14.0	12.8	11.2	slight
44516	9.24	0.18	15.0	0.03	<0.01	0.03	0.9	18.1	21.8	22.3	21.3	23.7	slight
44517	9.06	0.24	20.0	0.02	<0.01	0.02	0.6	21.9	24.7	25.3	24.6	40.4	slight
July Final Tailings	8.66	0.3	25.0	0.07	0.01	0.06	1.9	21.7	28.7	29.3	27.4	15.6	slight
Duplicates													
31991				0.11									
34827				0.04									
44506				0.26									
44515				0.03									
27702					<0.01								
34850					<0.01								
31992		0.2											
34828		0.24											
34850		0.16											
July Final Tailings		0.32											
27702	8.48							26.5					slight
31996	9.46							21.8					slight
31997	9.09							22.2					slight
34841	8.94							20.9					slight
34842	8.92							19.1					slight
44511	8.90							32.7					slight
QC													
GTS-2A				0.33									
RTS-3A					1.06								
RTS-3A					1.09								
SY4		0.91											
SY4		0.91											
NBM-1								39.6					slight
Expected Value		0.95		0.35	1.10			42					slight
Tolerance +/-		0.06		0.03	0.1			3					

Note:

AP = Acid potential in tonnes CaCO3 equivalent per 1000 tonnes of material. AP is determined from calculated sulphide sulphur content: S(T) - S(SO4).

NP = Neutralization potential in tonnes CaCO3 equivalent per 1000 tonnes of material.

NET NP = NP - AP

Carbonate NP is calculated from TIC originating from carbonate minerals and is expressed in kg CaCO3/tonne.

CLIENT : Minto Mines
PROJECT : Minto Project
SGS Project # : 0643
Test : Metals by Aqua Regia Digestion with ICP-MS Finish
Date : Dec 3, 2012

Sample ID	Al %	B ppm	Ba ppm	Ca %	Cr ppm	Cu ppm	Fe %	K %	Li ppm	Mg %	Mn ppm	Na %	Ni ppm	P ppm	S %	Sr ppm	Ti %	V ppm	Zn ppm	Zr ppm	Ag ppm	As ppm	Be ppm	Bi ppm	Cd ppm	Ce ppm	Co ppm	Cs ppm	Ga ppm	Ge ppm	Hf ppm	Hg ppm	In ppm	La ppm	Lu ppm	Mo ppm
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
LOD	0.01	10	5	0.01	1	0.5	0.01	0.01	1	0.01	2	0.01	0.5	50	0.01	0.5	0.01	1	1	0.5	0.01	1	0.1	0.02	0.01	0.05	0.1	0.05	0.1	0.1	0.05	0.01	0.02	0.1	0.01	0.05
27702	1.13	30	263	1.2	83	231	2.52	0.25	9	0.64	495	0.05	19.2	860	0.02	51.4	0.08	51	62	8.4	0.12	5	0.4	0.08	0.22	28.1	8.8	0.88	4.5	<0.1	0.21	0.03	0.03	14.3	0.13	1.66
31978	1.2	40	312	1.4	75	4	2.47	0.43	6	0.67	615	0.05	2.6	800	<0.01	97.2	0.06	51	56	1.9	<0.01	<1	0.4	<0.02	0.03	16.8	6.9	0.29	6.3	<0.1	0.08	<0.01	0.03	7.6	0.17	0.46
37979	1.35	40	513	0.83	73	525	2.95	0.89	7	0.76	516	0.05	3.7	870	0.31	42.7	0.15	69	51	1.4	0.12	<1	0.2	0.02	0.03	26.4	9.2	0.48	6.9	<0.1	<0.05	<0.01	0.04	13.2	0.1	10.8
31980	1.17	40	595	1.51	69	2130	3.31	0.69	6	0.83	482	0.05	4.4	1130	0.6	68.7	0.11	83	59	1.6	0.49	<1	0.2	0.11	0.06	30.2	12.1	0.44	6.3	<0.1	<0.05	<0.01	0.09	15.8	0.12	61
31981	1.12	40	345	0.95	84	31.6	2.45	0.65	5	0.69	581	0.06	3.7	720	<0.01	47.1	0.11	52	58	1.5	0.03	<1	0.2	<0.02	0.03	20.7	6.3	0.39	5.2	<0.1	0.07	<0.01	0.02	10.2	0.14	0.57
31982	1.06	40	233	0.82	87	592	2.63	0.44	6	0.59	569	0.04	8.8	770	0.02	41.1	0.08	53	75	4	0.14	2	0.3	0.06	0.14	24.1	7.2	0.6	5.4	<0.1	0.1	<0.01	0.04	13	0.09	1.59
31983	1	40	197	0.73	78	243	2.17	0.46	5	0.65	487	0.07	3.8	650	0.02	44.8	0.13	49	58	1.7	0.11	<1	0.2	0.03	0.02	19.9	5.8	0.28	5.2	0.1	0.06	0.01	<0.02	10.3	0.07	0.95
31984	0.91	40	132	1.43	69	2600	2.5	0.23	7	0.61	379	0.04	3.7	770	0.33	62.1	0.03	42	61	1.5	0.64	<1	0.3	0.07	0.26	26.9	6.3	0.23	5.6	<0.1	<0.05	<0.01	0.09	14.6	0.06	2.46
31985	1.19	40	348	0.62	82	154	2.4	0.7	7	0.67	488	0.05	4	710	<0.01	33.2	0.12	54	59	1.2	0.04	<1	0.2	<0.02	0.03	17.7	6.5	0.43	6.2	<0.1	<0.05	<0.01	<0.02	9.3	0.06	1.83
31986	1.32	40	482	0.88	65	657	3.06	0.93	6	0.77	441	0.05	3	690	0.44	70.2	0.16	68	62	1.8	0.1	<1	0.2	0.04	0.06	29.3	9.4	0.68	7	0.1	<0.05	<0.01	0.04	15.6	0.09	35.5
31987	1.13	40	369	0.9	105	1350	2.87	0.65	7	0.68	514	0.05	3.5	620	0.2	73.2	0.11	62	73	1.3	0.64	<1	0.2	0.22	0.22	19.8	7.8	0.39	6.5	<0.1	<0.05	<0.01	0.04	9.9	0.08	3.93
31988	1.09	40	289	1.22	82	733	2.71	0.47	6	0.62	496	0.04	4.1	620	0.13	58.2	0.08	54	55	1.8	0.12	<1	0.2	<0.02	0.06	18	8.4	0.42	5.7	<0.1	<0.05	<0.01	0.04	9	0.08	7.59
31989	1.32	40	405	0.86	101	685	2.86	0.91	6	0.78	622	0.05	3.1	790	0.07	42.5	0.16	67	74	1.7	0.22	1	0.2	0.07	0.11	28.4	7.2	0.55	6	<0.1	0.05	<0.01	0.05	14.6	0.13	5.15
31990	1.47	40	543	1.04	79	348	3.01	1	7	0.83	686	0.06	3.5	880	0.04	51.2	0.17	68	65	1.4	0.09	<1	0.2	0.02	0.05	25.5	7.1	0.57	6.7	<0.1	<0.05	<0.01	0.05	12.4	0.16	0.97
31991	1.19	40	349	1.05	84	315	2.42	0.52	9	0.72	483	0.05	3	820	0.11	45	0.08	49	52	1.1	0.07	<1	0.2	<0.02	0.04	15.4	7	0.36	5.9	<0.1	<0.05	<0.01	0.02	7.7	0.08	1.1
31992	0.92	70	331	0.58	88	379	2.46	0.69	5	0.56	432	0.05	3.2	610	0.06	29.7	0.12	51	60	1.2	0.05	<1	0.2	<0.02	0.03	16.2	6.6	0.48	5	<0.1	<0.05	<0.01	0.03	8.3	0.06	7.55
31993	1.39	50	227	0.8	70	2920	3.37	1	7	0.84	582	0.05	2.2	920	0.21	41.6	0.17	67	100	1.7	0.82	<1	0.2	0.43	0.23	33.3	6.5	1.07	7.7	0.1	<0.05	<0.01	0.06	19	0.09	4.76
31994	1.09	40	373	0.66	103	1470	2.56	0.78	5	0.68	560	0.06	4	630	0.08	49.7	0.14	58	60	1.3	0.9	<1	0.2	0.35	0.06	22.7	6.2	0.4	5.5	0.1	<0.05	<0.01	0.04	11.5	0.08	4.08
31995	1.24	50	535	1.24	77	4050	3.08	0.79	7	0.76	566	0.05	3	780	0.37	87.4	0.14	68	81	1.4	1.25	<1	0.2	0.59	0.45	26.9	7.7	0.43	6.5	0.1	<0.05	<0.01	0.1	14.5	0.07	17.4
31996	1.05	40	220	1.08	72	191	2.1	0.49	7	0.63	451	0.06	3.6	580	0.02	93.8	0.12	44	59	1.3	0.09	<1	0.2	0.03	0.22	16.6	5.3	0.29	5.6	<0.1	<0.05	<0.01	<0.02	9	0.03	1.04
31997	1.07	40	202	1	91	1200	2.51	0.51	6	0.7	573	0.05	3.6	730	0.12	56.3	0.08	52	61	1.5	0.41	<1	0.2	0.11	0.1	25.2	6.3	0.32	5.3	<0.1	<0.05	<0.01	0.03	13.8	0.08	3.36
31998	0.92	40	160	0.9	100	222	2.05	0.3	6	0.57	450	0.05	3.7	580	0.02	56.4	0.04	40	54	1.4	0.15	<1	0.2	0.05	0.04	21.4	5.2	0.24	4.9	<0.1	<0.05	<0.01	<0.02	11.3	0.07	0.5
31999	0.93	40	388	1.26	79	812	2.49	0.46	5	0.61	444	0.05	3.6	690	0.12	60.7	0.07	54	62	1.4	0.28	<1	0.2	0.06	0.08	25.9	6.2	0.37	5.2	<0.1	<0.05	<0.01	0.05	13.9	0.06	2.96
32000	0.95	40	200	1.7	70	5130	3.03	0.22	7	0.68	345	0.04	2.8	940	0.85	65.7	0.03	57	67	2.3	1.04	1	0.2	0.32	0.31	36.3	9.2	0.2	6.1	<0.1	0.06	<0.01	0.2	20	0.11	9.46
34826	1.13	40	97	1.8	83	639	2.34	0.16	7	0.68	513	0.04	3.5	640	0.05	96	0.02	43	56	1.5	0.28	2	0.6	0.14	0.07	23.7	5.6	0.26	6.8	<0.1	<0.05	<0.01	0.03	12.1	0.1	0.74
34827	0.91	40	271	0.79	92	615	2.61	0.6	5	0.6	517	0.06	3	560	0.03	64.7	0.1	50	58	1.4	0.28	<1	0.2	0.13	0.05	24.4	5.4	0.39	4.7	<0.1	<0.05	<0.01	0.03	12.3	0.07	1.07
34828	1.03	40	290	0.82	95	98.5	2.37	0.63	5	0.65	541	0.06	3.2	570	0.01	67.6	0.1	49	57	1.2	0.04	<1	0.2	<0.02	0.02	22.6	5.7	0.4	5.1	<0.1	<0.05	<0.01	0.02	11.3	0.08	0.97
34829	1.02	40	115	1.32	97	1460	2.15	0.29	8	0.64	391	0.04	4	480	0.17	95.9	0.04	36	50	1.2	0.27	1	0.3	0.04	0.06	15.5	5.7	0.3	5.1	<0.1	<0.05	<0.01	0.04	8	0.06	4.04
34830	1.02	40	368	1.16	78	1840	2.51	0.55	6	0.62	469	0.05	3.1	700	0.25	73.2	0.1	53	60	1.7	0.4	<1	0.3	0.09	0.29	23.7	6.7	0.36	5.5	<0.1	<0.05	<0.01	0.06	12.2	0.07	12.6
34831	1.08	70	596	0.68	84	99	2.11	0.77	6	0.59	399	0.06	3.4	660	0.02	44.9	0.13	52	47	1	0.03	<1	0.2	<0.02	0.01	20.4	5.2	0.42	5.5	<0.1	<0.05	<0.01	0.02	10.5	0.07	1.27
34832	0.95	40	231	0.88	79	559	2.66	0.6	5	0.51	584	0.04	2.9	720	<0.01	35.2	0.1	57	67	1.9	0.07	3	0.2	0.06	0.06	22.8	6.8	0.48	5.3	0.1	0.05	<0.01	0.04	11.6	0.1	1.54
34833	1.12	70	178	1.1	87	843	2.57	0.37	7	0.73	527	0.06	3.7	630	0.13	49.5	0.09	52	62	1.4	0.23	<1	0.3	0.07	0.3	23.6	6.3	0.29	6	0.1	<0.05	<0.01	0.03	12.8	0.08	1.76
34834	1.04	40	188	1.01	87	725	2.45	0.42	6	0.7	537	0.07	3.9	780	0.06	64.8	0.08	52	59	1.7	0.25	<1	0.2	0.13	0.05	21.3	6	0.25	5.7	0.1	0.05	<0.01	0.03	11.5	0.11	0.66
34835	1.04	70	166	1.09	79	123	2.22	0.33	6	0.66	572	0.06	3.7	690	0.01	61.7	0.07	46	56	1.6	0.08	1	0.3	0.03	0.03	26.6	5.8	0.28	5.5	<0.1	<0.05	<0.01	0.02	14.8	0.09	1.31
34836	0.93	70	131	1.18	92	493	2.16	0.21	7	0.62	441	0.05	3.8	600	0.05	69.9	0.03	40	54	1.3	0.17	<1	0.3	0.06	0.05	20	5.1	0.23	5.1	<0.1	<0.05	<0.01	0.03	11	0.07	1.03
34837	0.91	40	186	1.71	76	2020	2.31	0.16	6	0.54	401	0.04	2.8	590	0.19	66.7	0.02	40	58	1.5	0.74	<1	0.2	0.34	0.33	21	5.1	0.18	5.4	<0.1	<0.05	<0.01	0.05	11.3	0.08	1.1
34838	1.08	40	237	0.67	82	85.3	2.28	0.6	6	0.71	536	0.08	3.8	670	<0.01	50	0.13	51	59	1.6	0.04	<1	0.2	<0.02	0.04	21.2	6.1	0.32	5.5	0.1	0.07	<0.01	0.02	11.7	0.07	0.93
34839	1.15	40	270	0.87	77	10.9	2.44	0.58	6	0.69	586	0.06	3.4	710	<0.01	48.3	0.1	55	61	1.5	0.01	<1	0.3	<0.02	0.02	17.7	6.5	0.35	5.5	<0.1	0.06	<0.01	<0.02	9.5	0.09	0.58
34840	1.15	40	419	1.72	76	122	2.82	0.43	6	0.65	705	0.04	2.8	930	0.02	67.2	0.07	62	65	1.8	0.05	1	0.3	0.04	0.04	28.8	7.4	0.3	6.3	0.1	0.06	<0.01	0.03	15.5	0.15	1.17
34841	1.2	70	309	0.95	125	624	2.72	0.71	6	0.66	654	0.06	4.1	790	0.04	40.7	0.11	60	70	1.8	0.11	1	0.3	0.05	0.05	20.6	7	0.49	5.9	0.1	0.06	<0.01	0.04	10.7	0.12	0.87
34842	1.45	70	388	0.85	100	71.7	2.88	0.94	7	0.78	728	0.06	3.5	800	<0.01	41.5	0.15	68	71	1.5	0.02	<1	0.2	<0.02	0.03	30.8	7	0.51	6.7	<0.1	0.05	<0.01	0.04	16.9	0.1	0.96
34843	1.24	40	209	1.19	98	11.8	2.6	0.41	8	0.86	592	0.07	3.8	750	<0.01	86.6	0.09	54	50	1.9	0.02	<1	0.4	<0.02	0.02	18.2	6.9	0.29	5.9	<0.1	0.07	<0.01	<0.02	9	0.13	1.9
34844	1.32	40	397	0.73	92	14.4	2.58	0.71	7	0.8	633	0.06	3.2	660	<0.01	67.5	0.12	56	54	1.2	0.01	<1	0.3	<0.02	0.02	22.3	6.3	0.31	6.1	<0.1	<0.05	<0.01	0.02	11.4	0.09	0.47
34845	0.93	40	340	0.88	121	78.6	2.08	0.52	5	0.54	356	0.05	2.9	510	0.03	62.1	0.08	43	40	1	0.03	<1	0.2	<0.02	0.01	18.2	5.1	0.32	4.8	<0.1	<0.05	<0.01	0.03	9.3	0.06	2.79
34846	1.25	40	405	1.02	113	130	2.44	0.67	7	0.78	549	0.05	4.8	730	0.02	69.4	0.12	59	48	1.2	0.04	<1	0.2	<0.02	0.02	17.3	6.1	0.34	5.7	<0.1	<0.05	<0.01	0.02	8.8	0.09	2.56
34847	1.11	40	244	0.96	93	238	2.42	0.58	6	0.68	599	0.06	3.2	700	0.01	58.2	0.1	54	58	1.7	0.17	<1	0.3	0.05	0.05	18	6.3	0.39	5.4	0.1	0.08	<0.01	0.03	9	0.13	0.56
34848	1.11	40	269	1.18	98	10.3	2.51	0.62	6	0.7	597	0.05	3.2	710	<0.01	59.6	0.1	55	57	1.5	0.01	<1	0.3	<0.02	0.02	18.4	6.5	0.42	5.4	0.1	0.07	<0.01	0.02	9.2	0.12	0.7
34849	1.18	70	316	0.96	104	114	2.56	0.65	6	0.7	591	0.06	3.9	740	<0.01	44.5	0.12	55	67	1.8	0.05	<1	0.3	0.02	0.06	17.5	6.4	0.38	5.6	0.1	0.07	<0.01	0.03	9	0.11	1.26
34850	1.11	40	285	0.81	93	35.7	2.7	0.68	5	0.61	688	0.04	3.4	760	<0.01	32	0.1	58	75	1.5	0.02	<1	0.2	<0.02	0.04	19.8	7.4	0.45	5.7	<0.1	0.06	<0.01	0.03	10.4	0.11	0.59
44501	0.9	40	242	0.51	77	88.9	2.09	0.54	5	0.52	391	0.05	3	410	0.01	35.5	0.1	43	51	1.2	0.03	<1	0.2	<0.02	0.01	12.2	4.8	0.34	4.6	<0.1	<0.05	<0.01	<0.02	6.3	0.04	0.87
44502	1.3	70	392	0.72	101	181	2.55	0.68	8	0.72	589	0.06	4.4	700	0.02	44.8	0.12	57	59	1.4	0.03	<1	0.2	<0.02	0.03	26.2	7.1	0.39	6.6	<0.1	<0.05	<0.01	0.02	13.7	0.07	1.89
44503	1.42	50	313	0.77	72	1860	4.13	0.71	8	0.79	602	0.05	3.4	820	0.55	65.5	0.12	82	76	2.1	0.4	1	0.2	0.13	0.08	26.9	14.1	0.59	7.9	<0.1	<0.05	<0.01	0.04	14	0.07	16.4
44505	1.27	40	459	0.92	123	971	2.7	0.91	6	0.75	517	0.06	4.2	680	0.12	66.4	0.16	64	69	1.3	0.14	<1	0.2	0.04	0.09	34.9	6.7	0.46	6.2	<0.1	<0.05	<0.01	0.04	18.7	0.06	7.46
44506	1.42	50	460	0.74	79	2700	2.94	0.98	7	0.76	493	0.06	3.3	740	0.23	89.9	0.17	72	80	1.5	0.61	<1	0.2	0.13	0.22	22.5	7.1	0.57	7.1	0.1	<0.05	<0.01	0.07	11.8	0.06	3.59
44507	0.93	70	128	0.71	99	3610	3.47	0.67	5	0.58	608	0.04	2.6	650	0.27	30.8	0.11	58	126	1.9	1.02	<1	0.2	0.31	0.51	18.6	6.1	0.75	5.8	<0.1	<0.05	<0.01	0.08	10.3	0.06	6.3
44508	1.11	40	204	1.34	93	3130	3.75	0.41	6	0.6	611	0.03	2.5	710	0.13	72.3	0.06	59	98	2.1	0.79	1	0.4	0.29	0.29	18.8	6.8	0.49	7.3	0.1	<0.05	<0.01	0.05	10.2	0.07	4.19
44509	0.97	50	193	0.61	118	3940	4.19	0.76	5	0.59	604	0.05	3.3	650	0.25	31.4	0.13	66	110	2.2	1.06	1	0.2	0.29	0.32	19.9	6.5	0.76	6.5	0.1	<0.05	<0.01	0.08	11.1	0.05	7.36
44510	1.07	70	386	1.08	72	999	2.34	0.46	6	0.66	349	0.05	4.3	670	0.11	64.9	0.07	49	51	1.3	0.25	<1	0.2	0.1	0.05	21.3	5.8	0.28	5.7	<0.1	<0.05	<0.01	0.04	10.8	0.06	2.63
44504	1.14	60	169	1.04	87	2110	3.26	0.29	9	0.68	499	0.04	3.8	530	0.6	49.4	0.04	52	66	2.5	0.4	1	0.2	0.1	0.08	17.5	13.6	0.35	6.3	<0.1	<0.05	<0.01	0.03	8.9	0.06	16.3
44511	1.1	70	333	1.26	79	2990	2.92	0.47	7	0.75	441	0.04	3.2	810	0.23	66.9	0.08	56	65	1.3	1.25	1	0.2	0.76	0.34	20.8	6.7	0.35	6.2	<0.1	<0.05	<0.01	0.05	10.8	0.08	2.43
44512	0.8	50	313	1.37	96	1530	4.2	0.39	5	0.6	576	0.04	3.6	910	1.12	65.3	0.05	59	58	2.3	0.24	<1	0.3	0.06	0.11	30.6	25	0.29	4.9	<0.1	<0.05	<0.01	0.06	16.2	0.13	15.7
44513	1.38	50	487	0.94	92	500	3.02	0.87	7	0.81	628	0.06	3.3	830	0.14	60.3	0.14	68	56	1.4	0.12	<1	0.2	0.02	0.05	32.7	10.5	0.49	6.8	0.1	<0.05	<0.01	0.04	16.7	0.1	1.62
44514	1.43	70	438	0.67	121	145	2.71	1.03	7	0.81	520	0.06	2.4	890	0.03	38.5	0.19	66	61	1	0.04	<1	0.2	<0.02	0.02	60.3	6.5	0.5	6.9	0.1	<0.05	<0.01	0.03	28.9	0.09	3.44
44515	1.39	40	443	0.53	118	79	2.44	0.96	7	0.77	412	0.06	3.6	630	0.04	35.8	0.16	62	44	0.9	0.03	<1	0.2	<0.02	<0.01	24.1	5.9	0.49	6.4	0.1	<0.05	<0.01	0.03	12.1	0.08	3.2
44516	1.26	70	399	0.76	58	46.9	2.4	0.83	6	0.72	480	0.06	3.1	740	0.02	44.7	0.16	61	48	2.8	0.02	<1	0.2	<0.02	0.02	15	6	0.43	6	<0.1	0.07	<0.01	0.03	7	0.09	0.87
44517	1.32	40	401	0.97	115	76.5	2.59	0.75	7	0.77	607	0.05	3.3	720	0.01	53.5	0.11	58	59	1.3	0.02	<1	0.2	<0.02	0.02	22.5	6.4	0.43	6.4	0.1	<0.05	<0.01	0.03	11.3	0.11	2.78
July Final Tailings	1.25	80	291	0.91	85	1470	4.78	0.74	7	0.76	691	0.05	4.3	720	0.06	56.2	0.12	82	126	2.2	0.87	<1	0.2	0.31	0.42	17	8.4	0.49	8.7	0.1	<0.05	0.01	0.08	8.9	0.06	2.35
Duplicate																																				
31991	1.2	40	351	1.08	82	310	2.46	0.52	8	0.72	491	0.05	4.6	850	0.1	45.5	0.08	49	52	1	0.07	<1	0.2	0.07	0.02	16	6.6	0.38	5.8	<0.1	<0.05	<0.01	0.02	8	0.09	1.44
34827	0.91	40	269	0.77	90	618	2.55	0.6	4	0.6	504	0.06	3.4	530	0.03	63.6	0.1	51	58	1.4	0.3	<1	0.2	0.11	0.07	25.9	5.4	0.39	4.8	<0.1	<0.05	<0.01	0.02	13	0.09	1.14
34849	1.16	30	323	0.93	103	112	2.51	0.63	6	0.7	582	0.05	3.2	730	<0.01	43.4	0.11	55	67	1.7	0.04	<1	0.2	0.02	0.07	17.9	6.4	0.39	5.6	0.1	0.06	<0.01	0.03	9.3	0.1	0.84
44514	1.41	70	442	0.67	119	145	2.69	1.02	7	0.8	521	0.06	3.1	890	0.03	38.3	0.18	66	59	1.1	0.04	<1	0.1	<0.02	0.03	64.1	6.3	0.5	6.8	0.1	<0.05	<0.01	0.03	30.8	0.09	3.36
QC																																				
CH4	1.75	50	280	0.58	102	2010	4.73	1.36	12	1.15	295	0.05	46.1	660	0.61	9	0.19	77	198	11.3	2.31	8	0.1	0.49	1.08	30	22.7	2.63	8.5	0.2	0.36	<0.01	0.1	15.3	0.06	2.72
CH4	1.82	70	284	0.59	103	1960	4.74	1.38	13	1.17	298	0.06	47	660	0.62	9.5	0.21	79	192	14.3	2.15	9	0.1	0.49	1.05	26.4	22.5	2.49	8.9	0.3	0.31	<0.01	0.09	13.5	0.05	2.98
Certified Values	1.85	#N/A	293	0.61	103.8	2000	4.79	1.43	12.6	1.18	324	0.06	49.57	719	0.73	9.38	0.21	79.27	189.4	9	2.13	8.14	0.11	0.51	1.17	28.18	22.8	2.6	8.72	0.21	0.29	#N/A	0.1	14	#N/A	3.05
Tolerance (%)	11.35	#N/A	14.3	14.1	12.4	10.1	10.52	11.74	29.84	12.3	11.5	50.3	12.52	27.4	13.4	23.3	23.3	13.2	11.3	17.7	10.9	13.1	241.3	19.7	12.1	10.4	11.1	14.8	12.9	127.4	52.8	#N/A	62.1	11.8	#N/A	14.1

Nb ppm	Pb ppm	Rb ppm	Sb ppm	Sc ppm	Se ppm	Sn ppm	Ta ppm	Tb ppm	Te ppm	Th ppm	Tl ppm	U ppm	W ppm	Y ppm	Yb ppm
ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
0.05	0.2	0.2	0.05	0.1	1	0.3	0.05	0.02	0.05	0.1	0.02	0.05	0.1	0.05	0.1
0.4	6.6	13.7	0.37	4.8	<1	0.5	<0.05	0.34	<0.05	3.7	0.12	0.54	<0.1	8.7	0.7
0.15	3.3	17.1	<0.05	5.8	<1	0.7	<0.05	0.37	<0.05	1.3	0.13	0.32	<0.1	12.9	1.3
0.42	3.2	38.9	<0.05	6.3	<1	1.6	<0.05	0.33	<0.05	2.6	0.3	0.54	0.3	9.17	0.8
0.24	3.4	31.8	<0.05	5.2	2	2.1	<0.05	0.37	0.09	1.8	0.21	0.85	<0.1	9.74	0.8
0.17	2.7	27.3	<0.05	4.5	<1	0.6	<0.05	0.32	<0.05	2.2	0.17	0.34	<0.1	9.7	0.9
0.48	4.6	22.6	0.11	4.3	<1	0.5	<0.05	0.25	<0.05	4.2	0.19	0.38	0.1	7.41	0.7
0.3	2.9	20.8	<0.05	3.6	<1	0.5	<0.05	0.17	<0.05	2.2	0.13	0.25	0.8	5.51	0.5
0.16	4.8	11.8	<0.05	3.4	1	0.9	<0.05	0.23	0.15	2.6	0.08	0.16	0.2	6.64	0.5
0.35	2.7	32.4	<0.05	3.8	<1	0.8	<0.05	0.18	<0.05	2.2	0.21	0.15	0.2	5.31	0.4
0.53	3.8	44.1	<0.05	3.9	<1	1.5	<0.05	0.28	<0.05	3.4	0.42	0.42	0.7	8.09	0.7
0.34	4.4	30.2	<0.05	4	<1	0.9	<0.05	0.23	0.25	2.3	0.22	0.21	0.3	6.75	0.6
0.22	4.5	22.5	<0.05	3.9	<1	1	<0.05	0.23	<0.05	1.3	0.15	0.44	<0.1	6.38	0.5
0.36	3.5	40.6	<0.05	5	<1	0.9	<0.05	0.33	0.08	3.4	0.29	0.3	<0.1	9.46	0.9
0.36	3.1	41.7	<0.05	5.8	<1	1	<0.05	0.39	<0.05	2.2	0.29	0.24	<0.1	11.6	1.1
0.21	4	24.3	<0.05	3.8	<1	0.9	<0.05	0.23	<0.05	1.7	0.17	0.2	<0.1	6.41	0.5
0.49	3.3	33.4	<0.05	3.2	<1	0.7	<0.05	0.16	<0.05	1.3	0.23	0.2	0.5	4.77	0.4
0.6	6.2	51.5	<0.05	5.2	2	0.9	<0.05	0.25	0.14	7.5	0.46	0.38	1	7.45	0.6
0.39	2.8	35.1	<0.05	6.1	<1	0.8	<0.05	0.27	0.1	3.2	0.25	0.19	0.5	7.19	0.6
0.37	3	35.6	<0.05	3.5	2	0.9	<0.05	0.24	0.11	2.1	0.24	0.3	0.5	6.54	0.5
0.28	3.4	23.1	<0.05	1.8	<1	0.3	<0.05	0.09	<0.05	1.9	0.15	0.65	0.3	2.65	0.2
0.2	3.8	24.6	<0.05	3.3	<1	0.5	<0.05	0.22	<0.05	4.5	0.15	0.33	<0.1	5.69	0.5
0.1	3.9	14.3	<0.05	2.9	<1	0.4	<0.05	0.19	<0.05	3	0.08	0.29	<0.1	4.93	0.4
0.19	3.3	21.9	<0.05	3.3	<1	0.6	<0.05	0.21	<0.05	2.5	0.14	0.16	0.1	6.1	0.4
0.1	7	11.3	<0.05	4.8	3	1.5	<0.05	0.38	0.15	3.3	0.09	0.24	0.3	10.9	0.8
0.09	5.8	7.6	<0.05	3.8	<1	0.5	<0.05	0.28	<0.05	2.4	0.04	0.24	<0.1	8.77	0.8
0.22	3.1	28.2	<0.05	4.1	<1	0.6	<0.05	0.24	0.07	3.3	0.17	0.24	<0.1	5.91	0.5
0.3	2.6	27.6	<0.05	4.7	<1	0.6	<0.05	0.24	<0.05	2.5	0.18	0.27	0.4	6.94	0.6
0.11	4.2	13.5	<0.05	2.2	<1	0.6	<0.05	0.18	<0.05	1.3	0.08	0.25	0.1	5.46	0.4
0.31	3.6	25.2	<0.05	3.1	1	0.8	<0.05	0.25	0.06	1.8	0.18	0.32	0.3	7.09	0.6
0.55	3.3	36	<0.05	4.3	<1	0.9	<0.05	0.18	<0.05	2	0.27	0.15	0.6	5.49	0.5
0.24	2.8	29.7	<0.05	4.5	<1	0.7	<0.05	0.25	<0.05	2.2	0.2	0.19	<0.1	8.03	0.7
0.21	3.6	18.1	<0.05	3.8	<1	0.6	<0.05	0.21	<0.05	2.4	0.12	0.3	0.1	6.12	0.5
0.21	3.5	19.1	<0.05	3.9	<1	0.6	<0.05	0.21	<0.05	2.4	0.12	0.24	0.3	6.55	0.6
0.14	4.1	15.8	<0.05	3.6	<1	0.5	<0.05	0.26	<0.05	4.7	0.1	0.36	<0.1	6.79	0.6
0.06	4.3	10.2	<0.05	3.6	<1	0.4	<0.05	0.19	<0.05	1.9	0.07	0.19	<0.1	5.23	0.5
<0.05	5.1	9	<0.05	2.7	2	0.6	<0.05	0.18	0.11	2.1	0.05	0.3	<0.1	4.86	0.4
0.28	2.6	26.6	<0.05	4.2	<1	0.5	<0.05	0.18	<0.05	2.2	0.17	0.26	0.4	5.55	0.5
0.19	2.7	24.2	<0.05	4.6	<1	0.5	<0.05	0.22	<0.05	1.8	0.17	0.25	0.1	7.41	0.7
0.13	3	18.5	<0.05	5	<1	0.6	<0.05	0.32	<0.05	3.5	0.12	0.4	<0.1	10.9	1
0.24	2.7	30.1	<0.05	5.1	<1	0.7	<0.05	0.27	<0.05	2.2	0.2	0.27	0.1	8.94	0.8
0.38	2.9	37.1	<0.05	6.4	<1	0.9	<0.05	0.29	<0.05	3.9	0.27	0.26	0.2	8.43	0.8
0.2	3.1	16.1	<0.05	4.2	<1	0.5	<0.05	0.24	<0.05	2	0.12	0.25	0.1	8.06	0.8
0.27	3	27.2	<0.05	4.6	<1	0.8	<0.05	0.24	<0.05	2.8	0.22	0.24	0.1	7.16	0.6
0.3	2.9	23	<0.05	4.2	<1	0.7	<0.05	0.2	<0.05	1.7	0.17	0.13	0.2	5.7	0.4
0.24	3	25.7	<0.05	4.6	<1	1.1	<0.05	0.25	<0.05	1.8	0.19	0.17	0.2	7.97	0.7
0.27	2.7	25.2	<0.05	4.4	<1	0.5	<0.05	0.26	<0.05	1.8	0.18	0.27	0.2	9.38	0.9
0.23	2.6	26.2	<0.05	4.6	<1	0.6	<0.05	0.26	<0.05	1.5	0.17	0.34	0.2	9.07	0.9
0.25	3	26.5	<0.05	4.4	<1	0.6	<0.05	0.24	<0.05	1.5	0.18	0.24	0.1	8.2	0.8
0.16	2.6	29.3	<0.05	5.4	<1	0.6	<0.05	0.27	<0.05	1.6	0.18	0.19	<0.1	8.96	0.8
0.22	2.7	24.3	<0.05	2.2	<1	0.4	<0.05	0.1	<0.05	1.3	0.16	0.12	0.5	3.18	0.2
0.28	3.4	30.9	<0.05	4.4	<1	0.9	<0.05	0.22	<0.05	3.4	0.23	0.18	0.2	6.29	0.5
0.26	4.2	32.7	<0.05	4.1	2	1.2	<0.05	0.26	0.13	2.3	0.2	0.4	0.2	7.36	0.5
0.39	2.9	41	<0.05	3.8	<1	0.8	<0.05	0.23	<0.05	3.9	0.29	0.26	0.5	6.01	0.5
0.38	3.3	42.5	<0.05	5.2	1	0.9	<0.05	0.19	0.05	2	0.3	0.14	0.3	5.44	0.4
0.44	9.4	35.8	<0.05	4.5	2	0.7	<0.05	0.18	0.16	6.3	0.31	0.24	1	5.58	0.4
0.23	6.4	21.7	<0.05	4.5	2	0.6	<0.05	0.18	0.15	4.3	0.18	0.29	0.2	5.87	0.5
0.41	6.1	41	<0.05	4.2	2	0.8	<0.05	0.18	0.14	5.7	0.35	0.23	0.8	5.16	0.4
0.44	3.3	20.7	<0.05	3.7	<1	0.9	<0.05	0.2	0.05	1.8	0.16	0.15	0.2	5.66	0.4
0.12	4.5	15.2	<0.05	2.9	2	0.7	<0.05	0.23	0.11	1.2	0.1	0.26	0.1	7.03	0.5
0.18	4	22.1	<0.05	3.6	3	0.8	<0.05	0.22	0.18	2	0.16	0.15	0.3	6.58	0.5
0.24	4.1	17.9	0.05	5	2	1.5	<0.05	0.39	0.06	2.6	0.14	0.51	0.3	11.6	0.9
0.38	3.1	35.6	<0.05	6.3	<1	1.6	<0.05	0.34	<0.05	3.4	0.28	0.17	0.3	9.69	0.8
0.39	3.1	43	0.14	4.5	<1	1.2	<0.05	0.3	<0.05	6	0.33	0.24	0.2	7.88	0.7
0.38	3.8	42	<0.05	7.2	<1	1.4	<0.05	0.27	<0.05	3.2	0.34	0.2	0.5	7.15	0.6
0.4	3.9	35.1	<0.05	5.9	<1	1.2	<0.05	0.26	<0.05	1.2	0.28	0.19	0.4	7.98	0.7
0.29	3.2	31.5	<0.05	5.6	<1	0.9	<0.05	0.29	<0.05	2.5	0.24	0.22	0.2	9.09	0.8
0.24	3.5	34	<0.05	4.1	<1	1.1	<0.05	0.18	0.21	3	0.26	0.27	<0.1	5.54	0.4
0.22	4.1	24.3	<0.05	3.8	<1	1	<0.05	0.23	<0.05	1.7	0.17	0.22	<0.1	6.61	0.6
0.25	3.1	28.6	<0.05	4.1	<1	0.6	<0.05	0.24	<0.05	3.6	0.19	0.24	<0.1	5.99	0.5
0.25	2.7	26.8	<0.05	4.3	<1	0.6	<0.05	0.23	<0.05	1.6	0.18	0.23	0.1	8.2	0.8
0.39	3.1	42.5	<0.05	4.6	<1	1.2	<0.05	0.31	<0.05	6.3	0.34	0.25	0.2	7.94	0.7
0.11	9.5	67.3	0.27	7.5	2	0.6	<0.05	0.29	0.4	2	0.4	0.29	2.1	5.63	0.4
0.11	8.7	63.3	0.19	7.9	2	0.6	<0.05	0.24	0.34	1.8	0.39	0.26	1.7	5.56	0.4
0.19	8.24	67	0.34	7.99	1.57	0.6	0.3	0.27	0.42	2.2	0.4	0.29	2.15	5.66	#N/A
75	16.1	10.7	47.3	13.1	169.6	134.5	51.7	28.4	39.6	21.2	22.6	52.9	21.6	12.2	#N/A

CLIENT : **Minto Mines**
PROJECT : **Minto Project**
SGS PROJECT # : **0643**
Test : **Leachate Analysis by ICP-OES**
Date **December 21/12**

Sample ID		31982	NP Contribution	31983	NP Contribution	31991	NP Contribution	31998	NP Contribution	34826	NP Contribution	34835	NP Contribution	34841	NP Contribution	44501	NP Contribution	44511	NP Contribution	44515	NP Contribution
Al	mg/L	3.66		40.0		44.4		6.26		38.3		41.6		7.61		41.9		53.0		31.6	
Sb	mg/L	< 0.01		0.01		0.02		< 0.01		< 0.01		0.02		< 0.01		0.03		0.02		0.03	
As	mg/L	0.009		0.011		0.022		0.021		0.020		0.040		0.021		0.015		0.040		0.038	
Ba	mg/L	0.0531		0.0915		0.0869		0.0674		0.0601		0.0571		0.0764		0.106		0.0592		0.0931	
Be	mg/L	0.0017		0.0039		0.0075		0.0036		0.0205		0.0106		0.0018		0.0037		0.0114		0.0033	
Bi	mg/L	< 0.02		0.20		0.17		< 0.02		0.12		0.22		0.05		0.18		0.32		0.03	
B	mg/L	1.58		1.15		0.652		0.756		1.66		0.887		1.70		5.49		3.45		2.43	
Cd	mg/L	0.0097		0.0078		0.0079		0.0022		0.0081		0.0089		0.0063		0.0073		0.0231		0.0045	
Ca	mg/L	446	11.1	279	7.0	751	18.7	615	15.3	563	14.0	682	17.0	606	15.1	340	8.5	568	14.2	334	8.3
Cr	mg/L	0.006		1.07		1.18		0.003		0.582		1.65		0.037		0.866		0.989		0.200	
Co	mg/L	0.046		0.033		0.031		0.014		0.026		0.029		0.069		0.043		0.068		0.016	
Cu	mg/L	11.5		1.45		0.884		0.031		2.72		0.911		2.85		1.36		15.7		0.447	
Fe	mg/L	43.7		138		118		35.8		111		129		60.0		115		271		55.4	
Pb	mg/L	0.006		0.008		0.024		< 0.005		0.008		0.008		0.009		0.006		0.027		0.007	
Li	mg/L	< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1	
Mg	mg/L	34.1	1.4	22.6	0.9	27.5	1.1	22.4	0.9	40.2	1.7	30.6	1.3	20.9	0.9	20.5	0.8	73.0	3.0	19.6	0.8
Mn	mg/L	12.5		5.63		7.58		7.63		11.4		9.15		19.3		5.85		11.6		4.52	
Mo	mg/L	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
Ni	mg/L	0.157		0.198		0.186		0.084		0.167		0.207		0.182		0.150		0.146		0.052	
P	mg/L	0.056		0.528		0.541		0.014		0.013		0.217		0.015		0.339		1.36		0.153	
K	mg/L	30.9	0.8	42.0	1.1	43.5	1.1	26.0	0.7	32.1	0.8	40.0	1.0	48.1	1.2	43.6	1.1	45.4	1.2	47.2	1.2
Se	mg/L	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
Si	mg/L	37.3		55.8		48.4		24.0		55.6		49.2		44.5		110		88.0		62.0	
Ag	mg/L	< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08	
Na	mg/L	17.2	0.7	23.9	1.0	21.3	0.9	20.2	0.9	23.6	1.0	23.1	1.0	23.1	1.0	35.4	1.5	26.6	1.2	24.9	1.1
Sr	mg/L	1.56		1.80		2.40		3.08		3.62		3.11		1.76		1.81		3.59		1.89	
S	mg/L	470		429		841		589		665		773		617		487		873		424	
Tl	mg/L	0.01		< 0.005		< 0.005		< 0.005		0.01		< 0.005		0.01		< 0.005		< 0.005		< 0.005	
Sn	mg/L	< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03	
Ti	mg/L	0.009		0.063		0.169		< 0.001		0.003		0.006		0.017		0.098		0.026		0.022	
U	mg/L	< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2	
V	mg/L	0.003		0.065		0.072		0.004		0.018		0.074		0.003		0.061		0.297		0.040	
Zn	mg/L	0.271		0.225		0.174		0.083		0.205		0.210		0.225		0.246		0.768		0.139	
Zr	mg/L	< 0.007		< 0.007		< 0.007		< 0.007		< 0.007		< 0.007		< 0.007		0.009		0.012		< 0.007	
NP from Ca, Mg, Na & K (kg CaCO3 Equiv./tonne)			**14.1**		**10.0**		**21.9**		**17.8**		**17.5**		**20.3**		**18.2**		**12.0**		**19.5**		**11.4**

CLIENT : **Minto Mines**
PROJECT : **Minto Mines**
SGS PROJECT # : **0643**
Test : **BC Research NP and Modified NP Procedures**
Date : **December 12, 2012 - February 20, 2013**

Sample ID	Paste pH	TIC %	CaCO3 NP	C(T) %	S(T) %	S(SO4) %	S(S-2) %	AP	NP	NP H2SO4/tonne	NP CaCO3/tonne	Net NP	NP:AP Ratio (NP/AP)	Fizz Test
Method Code	Sobek	CSB02V	Calc	CSA01V	CSA06V	CSA07V	Calc	Calc	Modified	BC Research	Calc	Calc	Calc	Sobek
LOD	0.2	0.01	#N/A	0.01	0.01	0.01	#N/A	#N/A	0.5	0.5	#N/A	#N/A	#N/A	#N/A
40301	8.64	0.33	27.5	0.39	0.06	<0.01	0.06	1.9	27.0	33.1	33.8	31.9	18.0	Slight
40302	8.62	0.24	20.0	0.33	0.16	<0.01	0.16	5.0	19.5	23.8	24.3	19.3	4.9	Slight
40303	8.36	0.46	38.3	0.5	0.05	<0.01	0.05	1.6	40.4	43.1	44.0	42.4	28.2	Slight
40304	8.51	0.25	20.8	0.35	0.03	<0.01	0.03	0.9	23.1	28.4	29.0	28.1	30.9	Slight
40305	8.71	0.11	9.2	0.15	0.14	<0.01	0.14	4.4	14.6	18.4	18.8	14.4	4.3	Slight
40306	8.39	0.18	15.0	0.2	<0.01	<0.01	<0.01	<0.3	18.4	20.1	20.5	20.5	68.3	Slight
40307	8.52	0.15	12.5	0.16	0.01	<0.01	0.01	0.3	16.4	16.7	17.0	16.7	54.4	Slight
40308	8.73	0.19	15.8	0.21	<0.01	<0.01	<0.01	<0.3	17.9	20.1	20.5	20.5	68.3	Slight
40309	8.45	0.15	12.5	0.17	<0.01	<0.01	<0.01	<0.3	14.8	14.7	15.0	15.0	50.0	Slight
40310	8.33	0.11	9.2	0.19	0.1	<0.01	0.1	3.1	12.8	13.5	13.8	10.6	4.4	Slight
40311	8.35	0.13	10.8	0.15	<0.01	<0.01	<0.01	<0.3	14.9	14.2	14.5	14.5	48.3	Slight
40312	8.59	0.26	21.7	0.33	0.04	<0.01	0.04	1.3	21.8	25.0	25.5	24.3	20.4	Slight
40314	8.78	0.22	18.3	0.29	0.13	<0.01	0.13	4.1	19.4	24.5	25.0	20.9	6.2	Slight
40315	8.61	0.33	27.5	0.39	0.34	<0.01	0.34	10.6	27.9	31.9	32.5	21.9	3.1	Slight
40316	8.20	0.42	35.0	0.46	0.63	<0.01	0.63	19.7	37.1	39.2	40.0	20.3	2.0	Slight
40317	8.68	0.18	15.0	0.23	0.01	<0.01	0.01	0.3	17.2	24.0	24.5	24.2	78.4	Slight
40318	8.49	0.36	30.0	0.45	0.15	<0.01	0.15	4.7	29.6	37.7	38.5	33.8	8.2	Slight
40319	7.95	0.27	22.5	0.37	0.01	<0.01	0.01	0.3	26.5	27.2	27.8	27.4	88.8	Slight
40320	8.16	0.44	36.7	0.48	<0.01	<0.01	<0.01	<0.3	40.4	40.2	41.0	41.0	136.7	Slight
40321	8.39	0.3	25.0	0.34	0.17	<0.01	0.17	5.3	26.4	30.1	30.8	25.4	5.8	Slight
40322	8.78	0.17	14.2	0.25	0.11	<0.01	0.11	3.4	17.9	21.6	22.0	18.6	6.4	Slight
40323	8.64	0.24	20.0	0.35	0.01	<0.01	0.01	0.3	22.9	26.5	27.0	26.7	86.4	Slight
40324	8.61	0.21	17.5	0.31	0.1	<0.01	0.1	3.1	20.3	26.2	26.8	23.6	8.6	Slight
40325	8.60	0.23	19.2	0.32	0.01	<0.01	0.01	0.3	23.0	29.9	30.5	30.2	97.6	Slight
41151	8.68	0.24	20.0	0.28	0.15	<0.01	0.15	4.7	23.5	30.4	31.0	26.3	6.6	Slight
41152	8.54	0.16	13.3	0.28	0.09	<0.01	0.09	2.8	16.4	21.8	22.3	19.4	7.9	Slight
41153	8.17	1.39	115.8	1.48	1.42	0.02	1.4	43.8	74.9	76.4	78.0	34.3	1.8	Slight
41154	8.34	0.44	36.7	0.52	1.03	<0.01	1.03	32.2	33.5	37.5	38.3	6.1	1.2	Slight
41155	8.63	0.29	24.2	0.39	0.54	<0.01	0.54	16.9	24.0	25.0	25.5	8.6	1.5	Slight
41156	8.70	0.2	16.7	0.23	0.02	<0.01	0.02	0.6	19.2	22.8	23.3	22.6	37.2	Slight
41158	8.51	0.25	20.8	0.27	0.12	<0.01	0.12	3.8	18.5	27.0	27.5	23.8	7.3	Slight
41159	8.45	0.28	23.3	0.35	0.14	<0.01	0.14	4.4	21.5	36.3	37.0	32.6	8.5	Slight
41160	8.74	0.15	12.5	0.21	0.02	<0.01	0.02	0.6	18.0	20.3	20.8	20.1	33.2	Slight
41161	8.32	0.19	15.8	0.29	0.05	<0.01	0.05	1.6	13.3	19.6	20.0	18.4	12.8	Slight
41162	8.26	0.19	15.8	0.27	0.04	<0.01	0.04	1.3	17.9	22.8	23.3	22.0	18.6	Slight
41163	8.64	0.18	15.0	0.25	0.27	<0.01	0.27	8.4	17.9	29.4	30.0	21.6	3.6	Slight
41164	8.45	0.31	25.8	0.46	0.46	<0.01	0.46	14.4	27.6	23.8	24.3	9.9	1.7	Slight
42751	8.33	0.29	24.2	0.34	<0.01	<0.01	<0.01	<0.3	28.0	31.4	32.0	32.0	106.7	Slight
42752	8.62	0.24	20.0	0.27	0.02	<0.01	0.02	0.6	19.0	22.8	23.3	22.6	37.2	Slight

42753	8.17	0.49	40.8	0.54	2.07	0.01	2.06	64.4	30.7	30.9	31.5	-32.9	0.5	Slight
42754	8.09	1	83.3	1.08	2.84	0.01	2.83	88.4	58.5	59.5	60.8	-27.7	0.7	Slight
42755	8.80	0.16	13.3	0.22	0.03	<0.01	0.03	0.9	16.4	17.2	17.5	16.6	18.7	Slight
42756	8.31	0.49	40.8	0.56	0.58	<0.01	0.58	18.1	37.6	41.7	42.5	24.4	2.3	Slight
42757	8.72	0.19	15.8	0.23	0.11	<0.01	0.11	3.4	17.8	21.6	22.0	18.6	6.4	Slight
42758	8.86	0.29	24.2	0.36	0.17	<0.01	0.17	5.3	22.9	29.9	30.5	25.2	5.7	Slight
42759	8.84	0.18	15.0	0.2	<0.01	<0.01	<0.01	<0.3	16.7	23.3	23.8	23.8	79.2	Slight
42760	8.63	0.19	15.8	0.25	0.15	<0.01	0.15	4.7	19.4	19.8	20.3	15.6	4.3	Slight
42761	8.59	0.35	29.2	0.45	0.53	<0.01	0.53	16.6	27.4	33.3	34.0	17.4	2.1	Slight
42762	8.55	0.17	14.2	0.23	0.04	<0.01	0.04	1.3	16.2	20.1	20.5	19.3	16.4	Slight
42763	8.44	0.3	25.0	0.36	0.05	<0.01	0.05	1.6	24.1	29.9	30.5	28.9	19.5	Slight
42764	8.87	0.14	11.7	0.21	0.01	<0.01	0.01	0.3	13.9	16.9	17.3	16.9	55.2	Slight
42765	8.20	0.6	50.0	0.67	2.49	0.02	2.47	77.2	41.3	52.4	53.5	-23.7	0.7	Slight
42766	8.36	0.37	30.8	0.42	1.4	<0.01	1.4	43.8	23.6	29.2	29.8	-14.0	0.7	Slight
42767	8.42	0.21	17.5	0.32	0.97	<0.01	0.97	30.3	18.3	18.4	18.8	-11.6	0.6	Slight
42768	8.17	0.19	15.8	0.23	1.05	0.01	1.04	32.5	17.7	19.8	20.3	-12.3	0.6	Slight
42769	8.61	0.16	13.3	0.24	0.02	<0.01	0.02	0.6	16.2	22.8	23.3	22.6	37.2	Slight
42770	8.56	0.12	10.0	0.16	0.01	<0.01	0.01	0.3	13.3	15.4	15.8	15.4	50.4	Slight
42771	8.82	0.16	13.3	0.24	0.07	<0.01	0.07	2.2	16.4	17.2	17.5	15.3	8.0	Slight
42772	8.66	0.27	22.5	0.33	0.14	<0.01	0.14	4.4	23.4	24.3	24.8	20.4	5.7	Slight
42773	8.51	0.36	30.0	0.45	0.42	0.01	0.41	12.8	27.5	30.9	31.5	18.7	2.5	Slight
42774	8.68	0.36	30.0	0.41	0.03	<0.01	0.03	0.9	29.6	34.5	35.3	34.3	37.6	Slight
42775	8.30	0.33	27.5	0.43	2.76	<0.01	2.76	86.3	24.4	28.9	29.5	-56.8	0.3	Slight
44518	8.35	0.23	19.2	0.31	0.24	<0.01	0.24	7.5	24.8	30.6	31.3	23.8	4.2	Slight
44519	8.29	0.44	36.7	0.47	0.53	<0.01	0.53	16.6	36.6	41.2	42.0	25.4	2.5	Slight
44520	8.39	0.37	30.8	0.45	0.34	<0.01	0.34	10.6	24.5	31.4	32.0	21.4	3.0	Slight
44521	8.54	0.22	18.3	0.3	0.04	<0.01	0.04	1.3	19.7	20.6	21.0	19.8	16.8	Slight
44522	8.31	0.14	11.7	0.24	0.17	0.03	0.14	4.4	17.9	16.2	16.5	12.1	3.8	Slight
44523	8.70	0.13	10.8	0.22	<0.01	<0.01	<0.01	<0.3	14.2	16.4	16.8	16.8	55.8	Slight
44524	8.42	0.26	21.7	0.35	0.01	<0.01	0.01	0.3	24.6	26.2	26.8	26.4	85.6	Slight
44525	8.47	0.37	30.8	0.41	<0.01	<0.01	<0.01	<0.3	34.1	35.5	36.3	36.3	120.8	Slight
August Final Tails	8.26	0.33	27.5	0.35	0.06	0.01	0.05	1.6	10.4	30.1	30.8	29.2	19.7	Slight
September Final Tails	7.88	0.31	25.8	0.33	0.13	0.02	0.11	3.4	22.0	28.9	29.5	26.1	8.6	Slight
Duplicates														
40301	8.56								27.2					Slight
40302					0.17									
40308		0.18												
40321	8.38					<0.01			26.5					Slight
40322	8.76								18.0					Slight
41159				0.35	0.14									
41160		0.16												
42753	8.19								30.5					Slight
42754	8.23								58.7					Slight
42756		0.49												
42760						<0.01								
42764				0.21	0.01									
42773	8.54								27.6					Slight
42774	8.54								29.7					Slight
44522					0.18									
44525		0.36												
QC														

GTS-2A				2.03	0.35									
GTS-2A				2.03	-									
RTS-3A						1.04								
RTS-3A						1.04								
SY4		0.91												
SY4		0.92												
NBM-1									41.2					Slight
Expected Values		0.95		2.01	0.35	1.10			42.0					Slight
Tolerance +/-		0.06		0.15	0.03	0.11			3.0					

Note:

AP = Acid potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material. AP is determined from calculated sulphide sulphur content: S(T) - $S(SO_4)$.

NP = Neutralization potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material.

NET NP = NP - AP

Carbonate NP is calculated from TIC originating from carbonate minerals and is expressed in kg $CaCO_3$/tonne.

CLIENT : Minto Mines
PROJECT : Minto Project
SGS Project # : 0643
Test : Metals by Aqua Regia Digestion with ICP-MS Finish
Date : January 9, 2013

Sample ID	Al %	B ppm	Ba ppm	Ca %	Cr ppm	Cu ppm	Fe %	K %	Li ppm	Mg %	Mn ppm	Na %	Ni ppm	P ppm	S %	Sr ppm	Ti %	V ppm	Zn ppm	Zr ppm	Ag ppm	As ppm	Be ppm	Bi ppm	Cd ppm	Ce ppm	Co ppm	Cs ppm	Ga ppm	Ge ppm	Hf ppm	Hg ppm	In ppm	La ppm	Lu ppm
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
LOD	0.01	10	5	0.01	1	0.5	0.01	0.01	1	0.01	2	0.01	0.5	50	0.01	0.5	0.01	1	1	0.5	0.01	1	0.1	0.02	0.01	0.05	0.1	0.05	0.1	0.1	0.05	0.01	0.02	0.1	0.01
40301	1.22	40	497	1.13	111	190	2.64	0.85	5	0.63	644	0.06	2.6	580	0.06	53.4	0.14	62	55	0.8	0.06	<1	0.2	0.03	0.02	23.7	6.3	0.41	5.3	0.1	0.06	0.01	0.03	12.4	0.13
40302	1.21	30	449	0.86	115	216	2.49	0.79	5	0.62	504	0.05	3.1	600	0.17	50.9	0.13	60	52	0.7	0.05	<1	0.2	<0.02	0.03	20.4	7.2	0.44	5.6	0.1	<0.05	<0.01	0.02	10.6	0.1
40303	1.24	30	417	1.6	96	370	2.35	0.74	5	0.62	546	0.05	2.6	610	0.05	71.2	0.12	66	50	0.8	0.08	<1	0.2	<0.02	0.06	18.9	6.2	0.5	5.8	<0.1	<0.05	<0.01	0.03	9.8	0.11
40304	1.19	30	381	0.97	92	141	2.25	0.71	6	0.61	488	0.05	2.5	670	0.02	39	0.12	57	50	0.7	0.04	<1	0.2	<0.02	0.02	20.3	5.5	0.4	5.7	<0.1	<0.05	<0.01	0.02	10.7	0.09
40305	1.33	40	528	0.59	91	1280	2.41	0.93	6	0.72	452	0.06	1.5	1000	0.13	31	0.16	75	51	<0.5	0.26	<1	0.1	0.05	0.12	18.5	6.3	0.47	6.1	0.1	<0.05	<0.01	0.04	9.5	0.11
40306	0.98	30	235	0.83	101	46.3	2.15	0.52	4	0.51	533	0.06	2.7	560	<0.01	33.4	0.09	52	58	0.8	0.02	<1	0.2	<0.02	0.03	14.4	5.5	0.35	4.6	0.1	0.06	<0.01	<0.02	7.6	0.1
40307	1.09	30	170	0.83	97	225	2.32	0.5	5	0.6	540	0.06	3.2	600	<0.01	42.1	0.1	51	64	1.2	0.12	<1	0.2	0.05	0.04	13.1	5.7	0.36	5.1	0.1	0.06	<0.01	<0.02	7	0.09
40308	0.97	30	168	0.82	93	35.9	2.07	0.39	6	0.62	527	0.07	2.6	520	<0.01	80.6	0.08	47	55	1	0.02	<1	0.2	<0.02	0.02	17.1	5.2	0.27	4.6	0.1	0.05	<0.01	<0.02	9.2	0.07
40309	1	30	298	0.71	97	73	2.33	0.63	5	0.53	562	0.05	2.2	650	<0.01	32.4	0.1	57	55	1	0.07	<1	0.2	<0.02	0.04	13.7	5.9	0.47	4.5	0.1	0.07	<0.01	0.02	6.9	0.1
40310	1.28	30	399	0.53	103	794	3.01	0.93	5	0.69	882	0.05	3.4	790	0.1	24.2	0.16	78	105	1.7	0.16	2	0.2	<0.02	0.21	23.8	10.2	0.52	5.8	0.1	0.07	<0.01	0.03	13.2	0.1
40311	1.13	30	379	0.73	86	144	2.65	0.76	5	0.6	614	0.05	1.9	830	<0.01	30.3	0.12	66	61	1.1	0.14	<1	0.2	<0.02	0.05	14.6	6.7	0.43	5.2	0.1	0.07	<0.01	0.03	7.2	0.14
40312	1.08	30	262	0.99	87	339	2.33	0.59	5	0.62	580	0.06	2.5	580	0.03	90.4	0.1	50	60	0.8	0.13	<1	0.2	0.06	0.03	18.7	5.7	0.35	5.1	<0.1	<0.05	<0.01	0.03	9.8	0.08
40314	1.35	30	395	0.82	99	782	2.93	0.96	6	0.72	526	0.06	2.4	690	0.1	63.3	0.17	74	69	0.8	0.15	<1	0.2	0.04	0.04	32.3	6.6	0.48	6.2	0.1	<0.05	<0.01	0.04	17.9	0.08
40315	1.27	40	343	1.12	85	2560	2.84	0.75	6	0.71	487	0.05	2.1	660	0.33	83.3	0.12	68	67	0.6	0.78	<1	0.2	0.27	0.18	25.2	7.1	0.37	6.1	<0.1	<0.05	<0.01	0.08	14	0.07
40316	1.3	30	312	1.46	97	4560	2.71	0.82	5	0.75	444	0.05	2.2	600	0.6	63.1	0.13	89	59	1.3	0.82	<1	0.2	0.07	0.44	31.1	7.4	0.56	6.2	0.1	0.05	0.01	0.17	16.9	0.12
40317	1.04	40	220	0.8	95	168	2.18	0.53	5	0.61	586	0.06	1.6	550	<0.01	61.8	0.1	53	60	0.8	0.08	<1	0.2	0.02	0.02	21.5	5.5	0.31	4.9	0.1	0.05	<0.01	0.02	11.6	0.08
40318	1.02	30	257	1.2	93	1250	2.42	0.48	5	0.56	498	0.05	2.2	560	0.13	65.1	0.08	55	58	0.9	0.34	<1	0.2	0.11	0.09	28	5.8	0.28	5.2	0.1	<0.05	<0.01	0.04	15.4	0.07
40319	1.15	30	202	1.07	102	77.1	2.19	0.22	9	0.61	417	0.04	9.3	700	<0.01	51.9	0.05	45	46	3.2	0.05	2	0.3	0.04	0.08	20.8	6.2	0.47	4.9	<0.1	0.09	0.02	<0.02	10.8	0.07
40320	1.34	30	89	1.8	66	336	2.24	0.13	8	0.63	509	0.07	1.4	580	<0.01	79.4	<0.01	42	53	<0.5	0.06	1	0.4	<0.02	0.04	21	5.5	0.24	6.6	<0.1	<0.05	<0.01	0.03	11	0.09
40321	1.12	30	200	1.11	81	2450	2.63	0.48	6	0.6	593	0.05	2.4	680	0.16	63.8	0.08	56	88	0.7	0.87	<1	0.2	0.43	0.17	17.3	5.5	0.34	5.7	0.1	<0.05	<0.01	0.04	9.4	0.07
40322	1.17	30	269	0.76	97	1440	2.54	0.62	6	0.64	495	0.06	3.5	570	0.1	77.1	0.1	61	72	0.8	0.61	<1	0.2	0.12	0.16	19.2	5.9	0.36	5.7	<0.1	<0.05	<0.01	<0.02	10.7	0.05
40323	1.18	40	267	1.06	97	199	2.49	0.55	6	0.65	597	0.08	1.7	610	<0.01	68.4	0.1	58	65	1	0.09	<1	0.2	0.04	0.04	20	5.8	0.27	5.5	<0.1	0.05	<0.01	0.03	10.7	0.1
40324	1.16	30	302	0.89	89	1250	2.55	0.64	5	0.6	571	0.08	2.2	610	0.09	57.4	0.11	59	71	1.1	0.42	<1	0.2	0.15	0.1	19.8	6.1	0.35	5.6	<0.1	0.05	<0.01	0.03	10.9	0.12
40325	1.12	30	221	1.03	96	124	2.39	0.47	6	0.61	574	0.07	1.9	550	<0.01	62.9	0.08	53	62	1	0.05	<1	0.3	0.03	0.04	18.8	5.8	0.28	5.5	<0.1	0.06	<0.01	0.02	10.3	0.08
41151	1.75	30	694	0.89	80	2850	3.93	1.31	8	0.99	835	0.08	2.5	800	0.13	58.4	0.23	100	119	1.2	1.07	<1	0.2	0.3	0.13	28.8	9.8	0.61	8.2	0.1	<0.05	<0.01	0.06	15.8	0.16
41152	1.19	30	200	0.77	97	953	2.51	0.6	6	0.61	516	0.07	2.4	580	0.07	55.2	0.1	55	69	1	0.25	<1	0.2	0.06	0.11	21.4	5.5	0.4	5.6	0.1	0.06	<0.01	0.03	11.7	0.08
41153	1.39	30	194	2.64	76	2870	5.73	0.82	4	0.89	837	0.04	<0.5	790	1.38	111	0.13	125	78	2.3	0.61	<1	0.5	0.18	0.18	44.2	34.3	0.61	7.8	0.1	0.09	<0.01	0.07	22.3	0.2
41154	1.05	30	222	1.31	82	651	2.77	0.42	5	0.53	479	0.05	2.2	760	1.05	70.3	0.05	41	40	1.4	0.09	<1	0.3	0.02	0.05	29.3	13.1	0.32	4.6	<0.1	0.06	<0.01	0.04	16.4	0.14
41155	1.13	30	251	1	91	5140	2.88	0.6	5	0.57	410	0.06	1.9	550	0.52	57.4	0.1	66	63	1.2	1.63	<1	0.2	0.79	0.38	23.6	6.9	0.36	5.7	0.1	<0.05	0.02	0.1	12.8	0.07
41156	1.34	30	424	0.89	101	97	2.54	0.83	6	0.69	640	0.07	2.9	650	<0.01	52.2	0.14	64	63	0.7	0.04	<1	0.2	<0.02	0.03	25.4	6.5	0.42	6.2	0.1	0.06	<0.01	0.03	13.3	0.12
41158	1.34	30	559	0.66	95	3820	3.45	1.03	5	0.72	775	0.05	2.9	820	0.12	40.3	0.18	90	99	1.5	1.93	2	0.2	0.04	0.13	17.9	8.8	0.85	6.3	<0.1	0.05	<0.01	0.04	9.5	0.09
41159	0.92	30	353	0.8	96	2230	2.29	0.64	3	0.52	553	0.05	2.2	650	0.13	49.4	0.1	63	73	1.5	0.68	5	0.2	0.13	0.41	17.8	5.7	0.5	4.3	<0.1	0.06	<0.01	0.06	9.4	0.09
41160	1.32	40	611	0.66	101	408	2.64	1.01	5	0.66	630	0.06	3.1	650	<0.01	36.8	0.17	72	58	0.8	0.09	1	0.2	<0.02	0.04	22	6.3	0.51	5.6	<0.1	<0.05	<0.01	0.04	11.8	0.12
41161	1.16	30	356	0.86	98	1160	2.68	0.7	5	0.59	632	0.06	3.1	760	0.03	40.8	0.12	67	65	1.6	0.21	<1	0.2	0.02	0.05	19.2	7	0.58	5.4	<0.1	0.07	<0.01	0.03	10	0.16
41162	1.15	30	188	0.8	88	1470	2.69	0.55	5	0.51	612	0.05	2.6	680	0.05	38.3	0.08	57	95	1.6	0.4	1	0.2	0.11	0.24	22.7	7.8	0.51	5.6	<0.1	0.07	<0.01	0.05	12.8	0.08
41163	0.92	30	194	0.78	117	4400	2.79	0.39	5	0.49	473	0.05	2.1	480	0.25	50.2	0.07	51	64	0.7	1.63	<1	0.2	0.83	0.27	11.9	4.8	0.24	5.1	<0.1	<0.05	<0.01	0.04	6.4	0.04
41164	1.15	40	286	1.17	108	3050	2.86	0.63	5	0.56	404	0.05	1.8	580	0.45	60.5	0.1	66	68	1	0.73	<1	0.2	0.35	0.4	22.6	7.1	0.36	5.7	<0.1	<0.05	<0.01	0.09	12.2	0.07
42751	1.17	30	322	1.17	99	58.2	2.38	0.57	5	0.59	579	0.05	2	660	<0.01	51.2	0.09	55	57	0.9	0.03	<1	0.2	<0.02	0.03	23.2	5.9	0.36	5.2	<0.1	0.05	<0.01	0.02	12.4	0.12
42752	1.15	30	453	0.77	107	54.2	2.22	0.82	5	0.58	540	0.06	3	580	<0.01	47	0.14	56	48	0.8	0.02	<1	0.1	<0.02	0.02	26.4	5.1	0.48	5.3	<0.1	<0.05	<0.01	0.03	13.9	0.14
42753	1.25	30	146	1.17	90	2320	4.39	0.79	4	0.67	481	0.03	1.3	750	2.11	65.1	0.12	75	52	1.8	0.27	<1	0.3	0.05	0.07	35.9	27.9	0.6	6	<0.1	0.07	<0.01	0.06	19.7	0.15
42754	1.01	20	168	2.03	90	3820	5.84	0.71	3	0.65	629	0.04	0.9	910	3	72.7	0.1	77	60	3.1	0.52	1	0.3	0.16	0.19	34.3	45.5	0.69	5.6	<0.1	0.09	0.02	0.06	19	0.2
42755	1.37	30	574	0.8	121	32.7	2.78	0.94	6	0.73	787	0.07	3.7	820	0.02	62.3	0.15	68	56	1.2	0.03	<1	0.3	0.05	0.02	24.1	7.1	0.84	5.8	0.1	0.06	0.01	0.04	11.2	0.18
42756	1.28	30	413	1.54	99	3280	3.13	0.8	5	0.62	448	0.05	1.7	660	0.57	56.1	0.13	78	79	2.1	0.83	<1	0.2	0.16	0.21	31.4	9	0.51	6.4	0.1	0.05	<0.01	0.16	17.2	0.1
42757	1.29	30	410	0.87	120	1200	2.72	0.86	6	0.69	602	0.07	3.7	720	0.11	55.1	0.14	67	66	1.2	0.39	<1	0.2	0.24	0.1	21.5	6.7	0.46	6	<0.1	0.05	0.01	0.04	11	0.12
42758	1.18	30	307	0.94	114	1170	2.84	0.82	5	0.63	489	0.06	2.7	640	0.14	67.8	0.14	65	68	1.4	0.36	<1	0.2	0.22	0.09	29	6.6	0.46	6.2	<0.1	<0.05	<0.01	0.05	16.1	0.07
42759	1.04	30	194	0.89	111	76.3	2.31	0.46	6	0.63	583	0.08	2.5	520	<0.01	71.3	0.09	47	59	1.2	0.03	1	0.3	<0.02	0.02	20.5	5.3	0.26	5.2	<0.1	<0.05	<0.01	0.02	10.9	0.08
42760	1.32	30	262	1.03	101	2210	2.99	0.66	6	0.74	630	0.07	3.3	780	0.14	82.4	0.13	66	86	1.4	1.02	1	0.3	0.48	0.18	22.4	7.4	0.4	6.4	<0.1	0.06	<0.01	0.04	12.2	0.09
42761	1.11	30	235	1.15	113	4540	3.15	0.73	4	0.71	525	0.06	3	780	0.5	76.1	0.12	71	80	1.6	1.31	<1	0.2	0.36	0.43	25.3	7.4	0.4	5.7	<0.1	<0.05	<0.01	0.12	13.8	0.08
42762	1.2	30	256	0.91	122	240	2.64	0.67	6	0.71	614	0.08	3.2	670	0.03	75.3	0.12	61	72	1.5	0.08	1	0.2	0.03	0.03	22.5	6.5	0.37	5.8	<0.1	0.07	<0.01	0.03	12.3	0.11
42763	1.01	30	209	1.02	119	288	2.29	0.43	6	0.6	503	0.06	2.5	520	0.04	79.4	0.06	48	61	1	0.08	1	0.3	0.03	0.04	23.7	5.8	0.29	5.3	<0.1	<0.05	<0.01	0.02	12.5	0.07
42764	1.37	30	514	0.62	120	32	2.64	0.99	6	0.67	478	0.08	3.5	670	<0.01	66	0.16	66	67	1.3	0.02	1	0.2	<0.02	0.03	63.2	6.5	0.48	6.8	<0.1	<0.05	<0.01	0.03	34.8	0.16
42765	1.06	30	86	1.53	97	4370	4.76	0.65	4	0.66	537	0.04	2.4	850	2.5	85.8	0.09	60	70	2.1	1.02	<1	0.2	0.43	0.32	34.9	38.5	0.33	5.1	<0.1	0.06	<0.01	0.07	20.3	0.15
42766	1.2	30	300	0.99	104	1770	3.82	0.8	5	0.63	456	0.04	2.4	590	1.47	58.9	0.11	59	66	2	0.33	<1	0.3	0.12	0.08	25.3	18.7	0.55	5.8	<0.1	0.06	<0.01	0.05	13.5	0.1
42767	1.09	30	143	0.82	118	5780	3.2	0.74	5	0.6	268	0.05	2.2	680	0.94	43.1	0.12	70	68	2.2	1.44	1	0.2	0.69	0.49	32.3	9.3	0.62	5.7	<0.1	0.07	<0.01	0.17	18.1	0.13
42768	0.98	30	144	0.86	116	1940	2.71	0.35	5	0.47	393	0.03	3.1	710	1.06	49.7	0.03	36	49	2	0.36	2	0.3	0.12	0.13	32	15.7	0.31	4.1	<0.1	0.07	<0.01	0.06	19.1	0.15
42769	1.23	30	308	0.9	127	254	3.31	0.67	6	0.71	682	0.08	3.3	630	0.01	45.5	0.12	79	81	1.7	0.11	1	0.3	0.05	0.08	17.8	7.2	0.36	6.3	<0.1	0.07	<0.01	0.02	9.1	0.1
42770	1.4	40	440	0.61	128	244	3.1	0.89	8	0.77	572	0.07	3.1	570	<0.01	39.8	0.14	68	80	1.3	0.03	<1	0.2	<0.02	0.03	18	8	0.45	6.6	<0.1	<0.05	<0.01	<0.02	9.2	0.05
42771	1.35	30	378	0.86	124	1160	3.17	0.92	6	0.78	705	0.08	3.1	830	0.06	47.7	0.15	72	89	1.2	0.58	<1	0.2	0.23	0.09	26.1	7.6	0.5	6.5	<0.1	0.05	0.01	0.03	14.4	0.1
42772	1.4	30	581	1.02	118	586	2.87	0.97	7	0.75	589	0.06	2.6	730	0.13	53.8	0.15	73	61	1	0.11	<1	0.2	0.03	0.03	24.3	7	0.48	6.5	<0.1	<0.05	<0.01	0.04	12.5	0.12
42773	1.17	30	687	1.18	125	2860	2.84	0.7	5	0.61	529	0.05	3.3	530	0.42	61.4	0.1	67	60	1.2	0.57	1	0.3	0.05	0.15	28.8	8.6	0.41	5.8	<0.1	<0.05	<0.01	0.09	14.8	0.1
42774	0.98	30	215	1.25	127	134	2.25	0.47	5	0.56	503	0.05	3	420	0.02	75	0.07	45	60	0.9	0.03	<1	0.3	<0.02	0.03	21.6	5.2	0.28	4.9	<0.1	<0.05	<0.01	<0.02	11.3	0.07
42775	1.16	30	71	1.1	109	1690	4.85	0.79	5	0.64	541	0.03	2.2	770	2.85	44.3	0.1	44	43	2.4	0.18	1	0.3	0.07	0.05	34.7	28.8	0.61	4.7	<0.1	0.07	<0.01	0.06	19.2	0.16
44518	1.41	30	302	1.14	104	3510	3.44	0.6	8	0.77	657	0.06	3.2	650	0.23	58.8	0.09	67	96	1.5	1.14	1	0.3	0.22	0.42	32.7	8.6	0.36	6.9	<0.1	<0.05	0.02	0.06	17.7	0.07
44519	1.5	20	523	1.51	103	4170	3.86	0.87	7	0.84	725	0.05	2.3	850	0.51	113	0.13	86	107	1.7	1.09	1	0.3	0.53	0.47	31.4	9.6	0.5	7.3	0.1	0.05	<0.01	0.11	17.7	0.11
44520	1.01	30	179	0.98	112	4560	3.96	0.66	4	0.59	565	0.04	1.9	640	0.3	37.8	0.1	65	117	1.9	1.17	1	0.3	0.37	0.38	18.6	6.1	0.56	5.8	<0.1	<0.05	<0.01	0.1	10.2	0.07
44521	1.24	30	349	0.9	120	184	2.52	0.76	6	0.6	534	0.06	3.4	580	0.03	42.8	0.11	55	55	0.9	0.04	<1	0.2	<0.02	0.03	21.1	6	0.39	5.9	<0.1	<0.05	<0.01	0.02	10.9	0.09
44522	1.34	30	83	0.84	101	898	2.87	0.28	12	0.77	532	0.05	2.3	1160	0.17	42.4	0.03	51	67	1.2	0.11	1	0.2	<0.02	0.06	16.8	10.2	0.28	6.9	<0.1	<0.05	<0.01	0.06	8.8	0.12
44523	1.35	30	397	0.63	110	104	3.44	1.06	8	0.65	849	0.06	3.1	700	<0.01	65.1	0.16	76	106	1.9	0.02	3	0.3	0.05	0.06	20.5	6.6	0.81	6.9	<0.1	<0.05	<0.01	0.18	10.7	0.12
44524	1.33	30	308	1.24	115	20.5	2.84	0.62	7	0.71	728	0.06	2.9	690	<0.01	56.1	0.1	59	72	1.2	0.02	1	0.4	<0.02	0.02	19.4	7.6	0.31	6	<0.1	0.06	<0.01	0.03	9.9	0.16
44525	1.15	30	320	1.52	115	36.5	2.5	0.62	5	0.54	631	0.05	2.5	620	<0.01	44.8	0.09	55	58	1.1	0.02	1	0.3	<0.02	0.02	23.5	5.9	0.38	5.4	<0.1	<0.05	<0.01	0.02	12.1	0.15
August Final Tailings	1.28	30	288	1.05	111	1310	4.66	0.76	6	0.72	722	0.05	3.2	730	0.06	62.7	0.11	87	134	1.7	0.69	1	0.3	0.3	0.39	18.9	8.2	0.48	7.7	<0.1	<0.05	<0.01	0.08	10.1	0.07
September Final Tailings	1.22	20	319	1.03	68	2440	4.54	0.72	5	0.71	687	0.04	3	680	0.13	61.8	0.11	86	126	1.6	0.97	1	0.2	0.54	0.34	20	8.1	0.47	7.4	<0.1	<0.05	<0.01	0.08	10.8	0.07
Duplicate																																			
40318	1.08	30	264	1.23	96	1270	2.51	0.51	6	0.59	514	0.05	2.3	530	0.13	66.9	0.09	57	60	0.9	0.42	<1	0.2	0.11	0.1	26.5	6.1	0.3	5.4	<0.1	<0.05	<0.01	0.05	14.4	0.07
42768	0.99	30	147	0.87	126	1920	2.82	0.37	5	0.49	407	0.03	2.6	710	1.07	49.5	0.03	38	52	2	0.39	2	0.2	0.12	0.12	32.4	14.9	0.34	4.2	<0.1	0.07	<0.01	0.06	19.4	0.14
QC																																			
CH4	1.78	20	274	0.61	103	1950	4.9	1.41	12	1.05	313	0.06	43.3	580	0.69	9.9	0.2	81	203	18.1	2.25	7	0.1	0.49	1	27.2	22.3	2.46	8.5	0.1	0.38	<0.01	0.1	14	0.07
Certified Values	1.85	#N/A	293	0.61	103.8	2000	4.79	1.43	12.6	1.18	324	0.06	49.57	719	0.73	9.38	0.21	79.27	189.4	9	2.13	8.14	0.11	0.51	1.17	28.18	22.8	2.6	8.72	0.21	0.29	#N/A	0.1	14	#N/A
Tolerance (%)	11.35	#N/A	14.3	14.1	12.4	10.1	10.52	11.74	29.84	12.3	11.5	50.3	12.52	27.4	13.4	23.3	23.3	13.2	11.3	17.7	10.9	13.1	241.3	19.7	12.1	10.4	11.1	14.8	12.9	127.4	52.8	#N/A	62.1	11.8	#N/A

Mo ppm	Nb ppm	Pb ppm	Rb ppm	Sb ppm	Sc ppm	Se ppm	Sn ppm	Ta ppm	Tb ppm	Te ppm	Th ppm	Tl ppm	U ppm	W ppm	Y ppm	Yb ppm
ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
0.05	0.05	0.2	0.2	0.05	0.1	1	0.3	0.05	0.02	0.05	0.1	0.02	0.05	0.1	0.05	0.1
1.07	0.77	2.9	31.1	<0.05	5.3	<1	0.9	<0.05	0.34	<0.05	2.8	0.22	0.21	0.3	9.79	0.9
2.87	0.72	3.1	32.2	<0.05	4.6	<1	1	<0.05	0.28	<0.05	2.5	0.24	0.21	0.4	7.65	0.7
3.02	0.63	3.2	30.5	<0.05	4.8	<1	1.2	<0.05	0.3	<0.05	1.7	0.21	0.31	0.4	8.76	0.7
0.84	0.69	3.3	29.9	<0.05	4.3	<1	0.9	<0.05	0.25	<0.05	2.4	0.22	0.24	0.4	7.23	0.6
2.22	0.67	3.3	39.7	<0.05	5	<1	1.3	<0.05	0.27	<0.05	2.3	0.29	0.24	0.6	7.58	0.7
0.54	0.36	2.2	21.4	<0.05	3.9	<1	0.5	<0.05	0.23	<0.05	1.2	0.13	0.2	<0.1	6.94	0.6
0.58	0.41	2.8	21.4	<0.05	3.3	<1	0.4	<0.05	0.18	<0.05	1.7	0.14	0.24	<0.1	5.59	0.5
0.66	0.32	2.3	15.8	<0.05	4	<1	0.5	<0.05	0.2	<0.05	2	0.09	0.19	0.2	5.59	0.5
0.55	0.33	1.5	24.1	<0.05	4.2	<1	0.5	<0.05	0.24	<0.05	1.1	0.14	0.16	0.2	7.26	0.7
6.1	0.77	3.7	43.2	<0.05	4.8	<1	0.7	<0.05	0.27	0.06	4.2	0.32	0.94	0.3	7.62	0.6
0.47	0.3	1.6	31.1	<0.05	4.9	<1	0.6	<0.05	0.29	<0.05	1.1	0.18	0.15	0.2	8.78	0.9
1.79	0.4	2.4	24.9	<0.05	3.7	<1	0.6	<0.05	0.25	<0.05	2.2	0.16	0.22	0.3	6.9	0.6
4.25	0.92	2.7	40.9	<0.05	5.8	<1	0.9	<0.05	0.27	<0.05	3.7	0.31	0.26	0.7	6.59	0.6
6.41	0.67	4	32.3	<0.05	4.3	2	1	<0.05	0.23	0.13	2.9	0.22	0.24	0.5	5.99	0.4
42.8	0.47	3.4	36.7	<0.05	5.1	3	2	<0.05	0.43	0.23	1.3	0.27	0.49	0.3	11.4	0.8
6.7	0.44	2.5	23	<0.05	3.3	<1	0.5	<0.05	0.22	<0.05	2.7	0.15	0.25	0.4	5.92	0.5
7.16	0.45	3	20.9	<0.05	3.4	<1	0.7	<0.05	0.26	0.08	3	0.14	0.35	0.4	6.57	0.5
1.2	0.35	4.2	10.3	0.2	3.3	<1	0.5	<0.05	0.24	<0.05	2.9	0.08	0.31	0.2	6	0.5
0.56	0.09	3.9	6.4	<0.05	3.7	<1	0.6	<0.05	0.24	<0.05	2.1	0.03	0.26	<0.1	6.77	0.6
2.71	0.45	5.7	22.1	<0.05	3.7	2	0.6	<0.05	0.19	0.16	3.3	0.15	0.19	0.3	5.67	0.5
1.03	0.3	2.3	27.2	<0.05	2.2	<1	0.5	<0.05	0.14	0.11	2.2	0.17	0.19	0.8	3.73	0.3
1.6	0.49	2.6	22.5	<0.05	4.3	<1	0.6	<0.05	0.25	<0.05	2.3	0.14	0.22	0.3	7.15	0.6
2.18	0.42	2.8	28.3	<0.05	4.1	<1	0.6	<0.05	0.21	0.08	2.1	0.17	0.2	0.3	6.22	0.5
0.65	0.36	3	19.9	<0.05	4.2	<1	0.6	<0.05	0.22	<0.05	2	0.12	0.22	0.3	6.45	0.6
1.32	0.52	2.6	54.3	<0.05	5.3	2	0.9	<0.05	0.3	0.23	3.2	0.35	0.32	0.4	7.79	0.6
50	0.61	3	26.4	<0.05	4.3	<1	0.7	<0.05	0.22	<0.05	3.6	0.18	0.24	0.4	6.3	0.6
24	1.31	5.2	36.7	<0.05	5.9	4	2.1	<0.05	0.7	0.13	1.8	0.26	0.62	0.3	18.4	1.4
73.3	0.37	4.7	18.6	<0.05	3.3	1	1	<0.05	0.35	<0.05	4.2	0.19	1.39	0.3	9.93	0.9
7.25	0.56	3.8	26.1	<0.05	3.5	3	1.2	<0.05	0.23	0.25	2.8	0.22	0.18	0.4	6.17	0.5
1.13	0.64	2.8	34.2	<0.05	5	<1	0.9	<0.05	0.32	<0.05	3.5	0.25	0.29	0.4	9.09	0.8
6.4	1	3.6	43.7	<0.05	4.7	<1	1	<0.05	0.24	0.06	3.2	0.3	0.22	0.5	7.26	0.6
1.88	0.47	2.9	26.3	0.19	4.8	1	0.7	<0.05	0.26	0.1	1.8	0.16	1.51	0.4	6.93	0.6
1.43	0.9	2.6	38.9	0.11	7	<1	1.1	<0.05	0.33	<0.05	3	0.28	0.12	0.5	8.69	0.8
4.18	0.54	2.2	29.4	0.09	4.7	<1	0.7	<0.05	0.31	<0.05	1.6	0.18	0.26	0.3	9.15	0.9
7.48	0.52	6.7	26.8	<0.05	4.4	<1	0.8	<0.05	0.24	0.05	5.1	0.22	0.28	0.3	6.39	0.5
0.83	0.46	3.7	17.5	<0.05	2.1	3	0.6	<0.05	0.12	0.32	1.7	0.12	0.16	0.7	3.36	0.3
4.22	0.61	3.7	28.1	<0.05	3.4	2	1	<0.05	0.24	0.14	2.4	0.19	0.19	0.5	6.18	0.5
0.86	0.48	2.6	21.9	<0.05	4.3	<1	0.7	<0.05	0.3	<0.05	2.6	0.15	0.28	0.4	8.69	0.8
0.53	1.24	2.6	33.6	<0.05	4.8	<1	1.1	<0.05	0.34	<0.05	3.2	0.25	0.72	0.6	9.65	0.9
48.9	1.08	4.1	34.8	<0.05	4.2	3	1.8	<0.05	0.44	0.1	3.9	0.3	0.82	0.7	11.6	1
47.9	1.4	3.1	31.5	<0.05	5.4	4	2.5	<0.05	0.5	0.15	3.9	0.27	0.47	1	14.4	1.3
1.22	1.12	1.2	37.5	<0.05	6.2	<1	1	<0.05	0.47	<0.05	3.5	0.38	0.68	1.1	13.7	1.3
10.6	1.02	2.3	33.8	<0.05	4.5	3	1.7	<0.05	0.38	0.14	2.5	0.24	0.15	0.7	9.2	0.7
0.9	1.02	2	35.2	<0.05	5.3	1	1	<0.05	0.33	0.08	2.6	0.27	0.28	0.6	9.42	0.8
3.23	1.01	1.9	36.7	<0.05	4.4	<1	1	<0.05	0.24	0.09	4.1	0.27	0.26	0.9	5.72	0.4
1.75	0.53	1.9	18.1	<0.05	4	<1	0.5	<0.05	0.23	<0.05	2.4	0.12	0.23	0.7	6.43	0.6
2.73	0.73	2.6	27.1	<0.05	4.1	1	0.6	<0.05	0.22	0.2	2.7	0.18	0.28	0.6	6.03	0.5
14.3	0.74	2.2	30.3	<0.05	4.6	2	1	<0.05	0.27	0.25	3.1	0.21	0.29	0.8	6.79	0.5
1.61	0.62	1.5	26.8	<0.05	5.3	<1	0.6	<0.05	0.24	<0.05	2.6	0.19	0.25	0.4	6.77	0.6
1.58	0.44	2.4	18.2	<0.05	3.2	<1	0.5	<0.05	0.22	<0.05	2.7	0.11	0.3	0.4	5.58	0.5
1.08	1.41	4.3	40	<0.05	5.4	<1	1.2	<0.05	0.33	<0.05	8.1	0.3	0.27	0.7	6.72	0.5
55	0.89	4.2	25.2	<0.05	3.4	4	1.4	<0.05	0.43	0.15	3.3	0.22	0.78	0.9	11.5	1
31.5	1.17	3.8	34.8	<0.05	3.9	2	1.5	<0.05	0.32	0.08	2.3	0.33	0.51	0.7	8.37	0.7
3.94	1.15	4.1	35.3	<0.05	5.4	4	2	<0.05	0.36	0.26	6	0.53	0.64	1.1	9.26	0.8
91.1	0.35	7.3	14.9	<0.05	2.2	2	0.6	<0.05	0.35	0.05	4.7	0.12	1.54	0.7	9.51	0.9
1.29	0.71	2.1	26.6	<0.05	4.1	<1	0.6	<0.05	0.26	<0.05	1.8	0.18	0.28	0.5	7.51	0.7
1.97	0.75	1.8	35.8	<0.05	2.7	<1	0.6	<0.05	0.16	<0.05	2.1	0.24	0.17	0.5	3.93	0.3
1.03	0.58	1.5	36.9	<0.05	5.4	<1	0.7	<0.05	0.27	0.16	3	0.25	0.28	1	7.34	0.6
5.78	0.95	2.1	36.2	<0.05	6.1	<1	1.2	<0.05	0.34	<0.05	2.5	0.29	0.25	0.4	8.87	0.8
18.8	0.95	2.5	28.4	<0.05	5.1	2	1.3	<0.05	0.38	0.1	2.3	0.23	0.39	0.3	9.32	0.7
1.75	0.51	1.7	19.8	<0.05	3	<1	0.5	<0.05	0.21	<0.05	2.4	0.14	0.31	0.2	5.55	0.5
28	1.1	4.5	34.3	<0.05	3.1	3	1.4	<0.05	0.47	0.06	5.3	0.47	1.73	0.7	12.1	1.1
1.55	0.47	2.3	23.3	<0.05	3.1	3	0.6	<0.05	0.23	0.35	3.8	0.16	0.28	0.4	5.78	0.5
21.8	0.67	3.3	33.2	<0.05	5.3	3	1.2	<0.05	0.35	0.2	3.3	0.24	0.65	<0.1	8.92	0.8
3.88	0.94	4	29.7	<0.05	3.8	3	0.7	<0.05	0.21	0.19	5.5	0.24	0.75	0.5	5.57	0.4
2.59	0.9	2.1	29.3	<0.05	4.8	<1	1	<0.05	0.25	<0.05	2.4	0.23	0.23	0.5	6.61	0.6
5.6	0.14	4.3	14.7	<0.05	4.6	<1	2.3	<0.05	0.3	<0.05	1.1	0.11	0.41	0.3	8.78	0.8
1.03	0.96	3.5	43.3	<0.05	8	<1	1.5	<0.05	0.32	0.08	3.8	0.46	0.17	0.8	8.71	0.8
0.76	0.67	2	20.8	<0.05	5	<1	0.7	<0.05	0.36	<0.05	1.9	0.16	0.32	0.5	10.9	1
0.69	0.68	2	22.2	<0.05	4.7	<1	0.8	<0.05	0.36	<0.05	2.6	0.17	0.26	0.4	10.7	1
2.35	0.58	2.4	31.2	<0.05	4.1	1	1.1	<0.05	0.21	0.21	3.2	0.25	0.29	<0.1	5.82	0.4
2.06	0.56	2.4	30.2	<0.05	4	2	1	<0.05	0.23	0.26	3	0.24	0.29	<0.1	5.9	0.5
7.45	0.52	2.9	22.3	<0.05	3.4	1	0.7	<0.05	0.25	0.11	2.8	0.14	0.32	0.4	6.43	0.5
99.8	0.31	7.3	15.1	<0.05	2.3	2	0.7	<0.05	0.35	0.07	4.8	0.12	1.3	0.6	9.51	1
3.26	0.43	7.3	60.8	0.35	7.7	2	0.6	<0.05	0.28	0.37	2	0.39	0.32	2.5	5.82	0.5
3.05	0.19	8.24	67	0.34	7.99	1.57	0.6	0.3	0.27	0.42	2.2	0.4	0.29	2.15	5.66	#N/A
14.1	75	16.1	10.7	47.3	13.1	169.6	134.5	51.7	28.4	39.6	21.2	22.6	52.9	21.6	12.2	#N/A

CLIENT : **Minto Mines**
PROJECT : **Minto Project**
SGS PROJECT # : **0643**
Test : **Leachate Analysis by ICP-OES**
Date : **January 8, 2013**

Sample ID		40307	NP Contribution	40311	NP Contribution	40319	NP Contribution	40325	NP Contribution	41152	NP Contribution	41159	NP Contribution	42757	NP Contribution	42764	NP Contribution	42774	NP Contribution	44518	NP Contribution	44523	NP Contribution
Al	mg/L	14.5		7.33		18.4		63.5		59.0		71.8		32.6		33.4		33.4		74.8		26.3	
Sb	mg/L	0.01		< 0.01		0.02		0.03		0.02		0.06		0.02		0.01		0.04		0.02		< 0.01	
As	mg/L	0.005		< 0.004		0.009		0.032		0.018		0.051		0.034		0.127		0.028		0.061		< 0.004	
Ba	mg/L	0.0832		0.0800		0.0502		0.0762		0.0832		0.0540		0.0727		0.0879		0.0675		0.0800		0.0495	
Be	mg/L	0.0026		0.0018		0.0042		0.0081		0.0076		0.0079		0.0042		0.0036		0.0072		0.0066		0.0038	
Bi	mg/L	0.18		0.12		0.13		0.38		0.31		0.55		0.21		0.25		0.34		0.28		0.15	
B	mg/L	0.407		0.710		1.20		2.29		0.858		2.81		2.53		0.275		0.377		2.64		1.78	
Cd	mg/L	0.0071		0.0057		0.0075		0.0105		0.0110		0.0376		0.0080		0.0072		0.0095		0.0206		0.0084	
Ca	mg/L	412	10.3	407	10.2	649	16.2	659	16.4	405	10.1	565	14.1	503	12.5	371	9.3	606	15.1	675	16.8	365	9.1
Cr	mg/L	0.193		0.075		0.173		1.33		1.28		3.26		0.621		1.12		1.59		1.25		0.323	
Co	mg/L	0.054		0.091		0.095		0.045		0.044		0.177		0.033		0.029		0.038		0.047		0.089	
Cu	mg/L	5.57		1.18		0.682		1.74		7.83		45.6		4.00		0.304		0.676		25.7		1.49	
Fe	mg/L	96.8		61.5		64.0		163		144		268		119		115		155		149		76.2	
Pb	mg/L	< 0.005		< 0.005		< 0.005		0.016		0.007		0.018		< 0.005		0.018		0.014		0.024		< 0.005	
Li	mg/L	< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1	
Mg	mg/L	18.4	0.8	14.9	0.6	120	4.9	37.5	1.5	31.4	1.3	90.3	3.7	24.6	1.0	20.6	0.8	49.1	2.0	33.3	1.4	12.9	0.5
Mn	mg/L	12.4		19.3		13.0		14.7		10.7		23.2		10.9		7.07		11.1		9.92		19.8	
Mo	mg/L	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
Ni	mg/L	0.139		0.109		0.171		0.142		0.144		0.187		0.162		0.170		0.161		0.169		0.138	
P	mg/L	0.038		< 0.009		< 0.009		0.182		0.549		10.9		0.331		0.541		0.254		0.726		< 0.009	
K	mg/L	48.0	1.2	46.7	1.2	19.8	0.5	67.6	1.7	59.6	1.5	80.5	2.1	60.4	1.5	53.1	1.4	41.2	1.1	56.6	1.4	51.6	1.3
Se	mg/L	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
Si	mg/L	35.4		29.4		55.3		82.3		55.9		102		64.8		38.4		38.6		112		50.3	
Ag	mg/L	< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08		< 0.08	
Na	mg/L	24.6	1.1	20.6	0.9	25.1	1.1	43.3	1.9	34.8	1.5	37.5	1.6	32.0	1.4	21.9	1.0	20.9	0.9	40.0	1.7	23.0	1.0
Sr	mg/L	1.27		1.36		1.72		3.23		2.47		2.57		2.83		3.86		3.77		2.85		1.02	
S	mg/L	497		435		805		868		629		999		629		513		778		900		460	
Tl	mg/L	0.01		0.02		0.01		0.01		< 0.005		< 0.005		< 0.005		< 0.005		< 0.005		< 0.005		0.02	
Sn	mg/L	< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03		< 0.03	
Ti	mg/L	0.013		0.007		0.007		0.009		0.023		0.043		0.012		0.009		0.006		0.074		0.004	
U	mg/L	< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2		< 0.2	
V	mg/L	0.006		0.001		0.002		0.076		0.116		0.801		0.039		0.043		0.067		0.147		0.002	
Zn	mg/L	0.254		0.171		0.182		0.410		0.456		1.79		0.214		0.157		0.269		0.599		0.354	
Zr	mg/L	< 0.007		< 0.007		< 0.007		< 0.007		< 0.007		0.012		< 0.007		< 0.007		< 0.007		0.014		< 0.007	
NP from Ca, Mg, Na & K (kg CaCO3 Equiv./tonne)			**13.3**		**12.9**		**22.7**		**21.6**		**14.4**		**21.5**		**16.5**		**12.4**		**19.1**		**21.4**		**12.0**

Appendix J: 2012 Minto Mine Site Water Balance and Water Quality Prediction Update

SRK Consulting (Canada) Inc.
Suite 2200 - 1066 West Hastings Street
Vancouver, BC V6E 3X2

T: +1.604.681.4196
F: +1.604.687.5532

vancouver@srk.com
www.srk.com

Memo

To:	Ryan Herbert, James Spencer	**Date:**	28 March 2013
Company:	Minto Explorations Ltd.	**From:**	Soren Jensen
Copy to:		**Project #:**	1CM002.0011
Subject:	2012 Water Balance and Water Quality Model Summary for the Minto Mine Site		

1 Introduction and Background

This memorandum provides a summary of water balance and water quality model updates for Minto Mine site for the period January 2012 through January 2013. The water quality update was limited to a comparison of water quality data collected in site in 2012 to water quality model predictions developed in 2011 and 2012 for the life of mine (Phase IV) and post-closure. The 2012 water balance is the latest in a series of water balance updates completed for the site annually since 2006. This water balance update is intended for inclusion in the 2012 Annual Water License Report for Minto Mine.

Annual water balance reports for the Minto Mine were completed by Access Consulting Group (ACG) and Clearwater Consultants Ltd. (Clearwater) from 2006 through 2011. Clearwater developed a monthly spreadsheet water balance model (Versions 1.0 to 1.5) using Microsoft Excel, which combined measured and modelled hydrological and meteorological inputs to produce a site-wide water balance.

In 2011/2012, Minto's water balance model was converted from Excel to the Goldsim software platform (version 10.5) by SRK Consulting (SRK). The primary benefit of the Goldsim model is the ability to incorporate stochastic variability in forecasts of annual precipitation and runoff volumes. Stochastic representation of future annual precipitation results in improved forecasts of runoff volumes, which in turn are helpful for developing appropriate water management plans. The water balance information presented here was used as a basis for developing a water management strategy for 2013; as in 2011/2012, the Goldsim water balance model for the site was used to carry out this update.

2 Water Balance Update

2.1 Precipitation

Table 1 shows a summary of monthly precipitation measured at the Minto Mine site in 2011/2012 along with precipitation data from the regional meteorological station at Pelly Ranch (Climate ID: 2100880). Minto Explorations Ltd. (Minto) operates two meteorological stations on the Minto Mine site: a HOBO Weather Station and a Campbell Scientific meteorological station. The HOBO station measures total rainfall and the Campbell Scientific station measures total precipitation. From October through May, total precipitation is measured using a snowfall conversion adaptor fitted on a tipping bucket rain gauge

Precipitation measurements from the Pelly Ranch weather station, which is located approximately 25 km north of Minto, have historically been reasonable well correlated with precipitation measurements collected at Minto Mine. Therefore, the long-term precipitation record available for the Pelly Ranch station is used as a basis for estimating the distribution of annual mean precipitation at the Minto Site. A description of correlation analysis was provided in the 2012 water balance update for the Minto Mine (Minto 2012).

Rainfall measurements for the two meteorological stations at Minto were in good agreement for the months of June, July and October 2012. However, the HOBO station measured considerably higher rates of rainfall than the Campbell Scientific station in August and September. The cause of this variability is not clear.

Table 1 Precipitation Records for Minto Mine and Pelly Ranch (Nov. 2011 to Dec. 2012)

		Minto Met. Stations		Regional Station
		HOBO	Campbell Scientific	Pelly Ranch (Climate ID 2100880)
		Mm	Mm	mm
2011	Oct	-	4.4	-
2011	Nov	-	0.15	56.7
2011	Dec	-	3.94	37.3
2012	Jan	-	9.0	39.4
2012	Feb	0.6	9.9	29
2012	Mar	0.6	34.9	29.5
2012	Apr	0.2	0.0	7.8
2012	May	8.6	0.1	27
2012	Jun	33.4	32.1	26.7
2012	Jul	44.0	44.8	71.4
2012	Aug	36.6	20.6	32.1
2012	Sept	36.0	26.1	28.3*
2012	Oct	13.8	16.5	25.6
2012	Nov	-	17.1	n/a
2012	Dec	-	18.4	23.5*
SUM Hydrological Year, Nov. 2011 to Oct. 2012		**174.2**	**198.2**	**324.8**

Notes: * - based on incomplete data set. n/a – not available.
Source: Minto Site Data: 01_SITES\Minto\!020_Site_Wide_Data\Water_and_Load_Balance_Files\01_Project_Phases\07_Phase_5_6\GoldSim_Input_Tracking_PhaseV_VI_1CM002.003_REV00_SRJ.xlsx
Pelly Ranch Data: obtained from Meteorological Service of Canada, Environment Canada.

Correlation analyses complete in past years have indicated that total annual precipitation at the Minto Site generally is 10% greater than at Pelly Ranch due to difference in mean elevation and micro-climatic conditions. However, in 2012 the total annual precipitation measurements at the Pelly Ranch station was approximately 125 mm or about 60% greater than the total annual precipitation measure at the mine site. The precipitation data from Pelly Ranch for 2012 does not meet SRK's quality criteria of 95% data availability for inclusion in the frequency distribution and correlation analysis for Minto. Therefore, the frequency distribution and correlation developed based on historical data up to 2011 remain unchanged.

Examination of the precipitation record from Minto shows that total precipitation measurements in November and December 2011 as well as January, February and March 2012 were much lower than expected based on a comparison with data from Pelly Ranch. Reports by environmental staff at the Minto Mine suggest that the precipitation adapter, which converts snowfall to total precipitation measurements, may not have operated correctly in the winter of 2011/2012 (the first season this adapter was used). Unfamiliarity with the operation of the precipitation adapter may in part explain the apparent unreliable performance of the unit in the 2011/2012 winter season. Total precipitation data for the November/ December 2012 period fall within the expected range.

Because of potential inaccuracies in the total precipitation measurements from site in 2011/2012, the total annual precipitation measured at Pelly Ranch was used as a basis for estimating the annual precipitation for the Minto Site for 2012.

2.2 Snow Course Data

Snow course surveys were completed at three snow survey stations at the Minto site in 2012. Table 2 shows a summary of the snow survey data from 2009 to 2012. The depth of the snow pack provides an indication of the volume of surface runoff that can be expected during freshet. Between January and late May 2012 approximately 525,000 m^3 of surface runoff flowed from catchments at the Minto Mine site upstream of the Water Storage Pond (WSP). This volume corresponds to roughly 55 mm of runoff, or about 40% of the snow pack water equivalent measured in April 2012. The remaining 60% of the water in the snow pack was assumed to be lost to sublimation, evaporation and to a lesser extent, groundwater recharge.

Table 2 Summary of Snow Survey Data for the Minto Mine Site

Year	February 1st			March 1st			April 1st		
	Snow Depth (cm)	Snow Density (%)	Water Equivalent (mm)	Snow Depth (cm)	Snow Density (%)	Water Equivalent (mm)	Snow Depth (cm)	Snow Density (%)	Water Equivalent (mm)
2009	55.6	16.6	92.7	70.2	15.7	110.0	67.4	22.3	150.7
2010	60.5	17.8	107.7	58.1	20.7	120.7	40.4	[A]13.9	56.0
2011	57.2	18.7	106.0	70.3	20.1	141.7	52.3	22.8	111.7
2012	54.7	20.3	111.0	64.6	19.6	127.0	61.3	21.5	132.7

Note: Source: Minto (2012). [A]zero snow at #3, density is an average of snowpack at #1 and #2, average depth and water-equivalent is average of all three sites

2.3 Surface Runoff

Figure 1 shows a schematic of water management infrastructure and piping in use at Minto in 2012. Primary infrastructure include:

- Main Pit: repository for surface water and seepage affected by the mine development. Water stored in the Main Pit is intended to be used as process water and for subaqueous tailings deposition.
- W15 sump: collects surface runoff and seepage from the Southwest Waste Dump, from part of the Main Waste Dump and from adjacent undisturbed catchments. Water collected at W15 is pumped to the Main Pit or to the WSP.
- W35a sump: collects surface runoff from the minimally disturbed southern catchments. Water collected at W35a is piped to the Main Pit or to the WSP.
- W36 sump (formerly W37 sump): collects surface runoff and seepage from the mill valley, including contributions from the DSTSF. Water collected at W36 is pumped to the Main Pit.
- South Diversion Ditch: diverts water from minimally disturbed southern catchments to the WSP.
- WSP: repository for water that meets discharge criteria and is destined for discharge to Minto Creek.

Surface runoff was managed as follows in 2012:

- ~ 170,000 m^3 of water was pumped from the WSP to Minto Creek.
- ~ 150,000 m^3 of water was pumped from the WSP to the Mill Pond for use as process water.
- ~ 165,000 m^3 of water collected at W15 was pumped to the Main Pit.
- ~100,000 m^3 of water collected at W35a was conveyed to the WSP.
- ~ 155,000 m^3 of water collected at W35a was pumped to the Main Pit.
- ~ 110,000 m^3 of surface runoff from the mine site, (including the Dry Stack Tailings Storage Facility (DSTSF) and the Mill Valley Fill Expansion (MVFE)) was collected in the W37 sump and pumped to the Main Pit.

In 2012, Minto and ACG monitored surface runoff at several hydrometric stations in Minto Creek and McGinty Creek. Results from the surface hydrology monitoring program are reported elsewhere (Minto 2013).

2.4 Site Water Inventory

The primary water reservoirs at the Minto Mine include the Main Pit, the WSP and the DSTSF. Changes to the total water inventory at Minto in 2012 were estimated as follows:

- Main Pit:
  - The water level increased from 754.39 m to 765.06 m between January 1, 2012 and January 3, 2013.
  - This water level increase corresponded to a volume increase of ~ 800,000 m^3.
  - ~ 85,000 bank meter cubed (BCM) of tailings and ~100,000 BCM of waste rock was deposited in the Main Pit over the same period.
  - Therefore, the net water inventory increase in the Main Pit (including water in the pores of tailings and waste rock) in 2012 was ~ 615,000 m^3.
- WSP:
  - inventory in the WSP changed from 258,000 m^3 on January 1, 2012 to 239,000 m^3 on January 3, 2013 – a net reduction of 19,000 m^3 in 2012.
- DSTSF:
  - The net water inventory increase in the DSTSF was approximately 150,000 m^3 in 2012 (assuming an average water content of the compacted tailings of 16%). Placement of tailings in the DSTSF ceased at the beginning of November 2012, and therefore there will be no future changes in water inventory related to the DSTSF.

The water inventory in the mill and mill pond are negligible compared to the inventory in the Main Pit, the WSP and the DSTSF and are therefore not reported here.

2.5 Water Balance Summary

Table 3 shows a summary of the 2012 water balance for the Minto site. The total surface runoff collected on site was estimated to be approximately 920,000 m^3 based on the change in the water inventory and the known volume of water released to Minto Creek.

The total catchment upstream of the WSP measures approximately 1040 ha. Approximately 920,000 m^3 of runoff from 1040 ha gives a yield of approximately 88 mm/year. The current water and load balance (Goldsim) model that is used for forecasting surface runoff volumes, the annual average runoff coefficient is assumed to be 0.30. Based on this runoff coefficient, the total annual precipitation can be estimated as:

Annual Yield/Runoff Coefficient = Total Annual Precipitation, or

88 mm / 0.30 = 294 mm

As discussed above, the measured annual precipitation at Pelly Ranch for the hydrological year of 2012 was 324.8 mm. Based on the measured value at Pelly Ranch, it is reasonable to expect the total annual precipitation for the 2012 hydrological year at Minto was in the range of 300 mm to 350 mm. In other words, the estimates of total surface runoff and precipitation at the Minto Mine in 2012 indicate that an average runoff coefficient of approximately 0.30 is likely a reasonable estimate for forecasting purposes.

Table 3 Water Balance Summary of the Minto Mine Site (January 1, 2012 through January 3, 2013)

	Units		
Pit Volume Increase 2012 (754.4 m to 765.1 m Level)	m^3	800,000	
Tailings to Main Pit, total	BCM	85,000	
PAG, deposited sub-aqueously in Main Pit	BCM	100,000	
Main Pit Water Volume Increase 2012	m^3		615,000
WSP Net Water Volume Increase 2012	m^3		-19,000
Water stored in DSTSF tailings	m^3		150,000
Water Discharged to Minto Creek in 2012	m^3		170,000
Total Surface Runoff Above WSP in 2012	$\mathbf{m^3}$		**~920,000**

Source: X:\01_SITES\Minto\!020_Site_Wide_Data\Water_and_Load_Balance_Files\01_Project_Phases\07_Phase_5_6\Minto_Global_Mass_Balance._1CM002_003_REV00_SRJ.xlsx

3 Water Quality Model Update

Table 4 shows model predictions of water quality for the Main Pit at Minto for the Phase IV operational phase (2012 to 2017) along with maximum concentrations measured in Main Pit in 2012. Main Pit represents the primary repository of both water and load, and a comparison of actual water quality from this location with concentrations predicted for pit water during pre-production environmental assessment provides a good measure of actual vs. expect geochemical performance of the site.

The majority sources of chemical loading at Minto are the DSTSF and the upland waste rock. Seepage chemistry was used as a basis for both tailings and waste rock source terms in the pre-production water quality prediction. For this update, the 2012 tailings and waste rock seepage chemistry data were reviewed, and concentrations were found to be similar to (or lower than) the concentrations previously adopted as source terms. As a result, the water quality model was not updated, as the mid-2012 prediction remains the most appropriate prediction of future reasonable worst case conditions.

As expected, all measured maximum concentrations are well below predicted maximum concentrations. The model predictions of maximum concentrations were developed as conservative estimates that are unlikely to be exceeded at any time during the Phase IV operation. Measured concentrations of arsenic, cadmium, copper, molybdenum, nickel, selenium and zinc are factors of 3 to 8 times less than predicted maximum concentrations. Measured dissolved aluminum and iron concentrations, which are sensitive to the pH of the mine water, are factors of 25 and 60 times less than predicted maximum concentrations.

Subaqueous deposition of tailings began in November 2012. The potential effect of tailings deposition on the chemistry of the pit lake will be evaluated through pit lake monitoring though 2013 and will be revisited during preparation of the 2013 annual report.

Table 4 Water Quality Model Predictions and Measured Concentrations in 2012

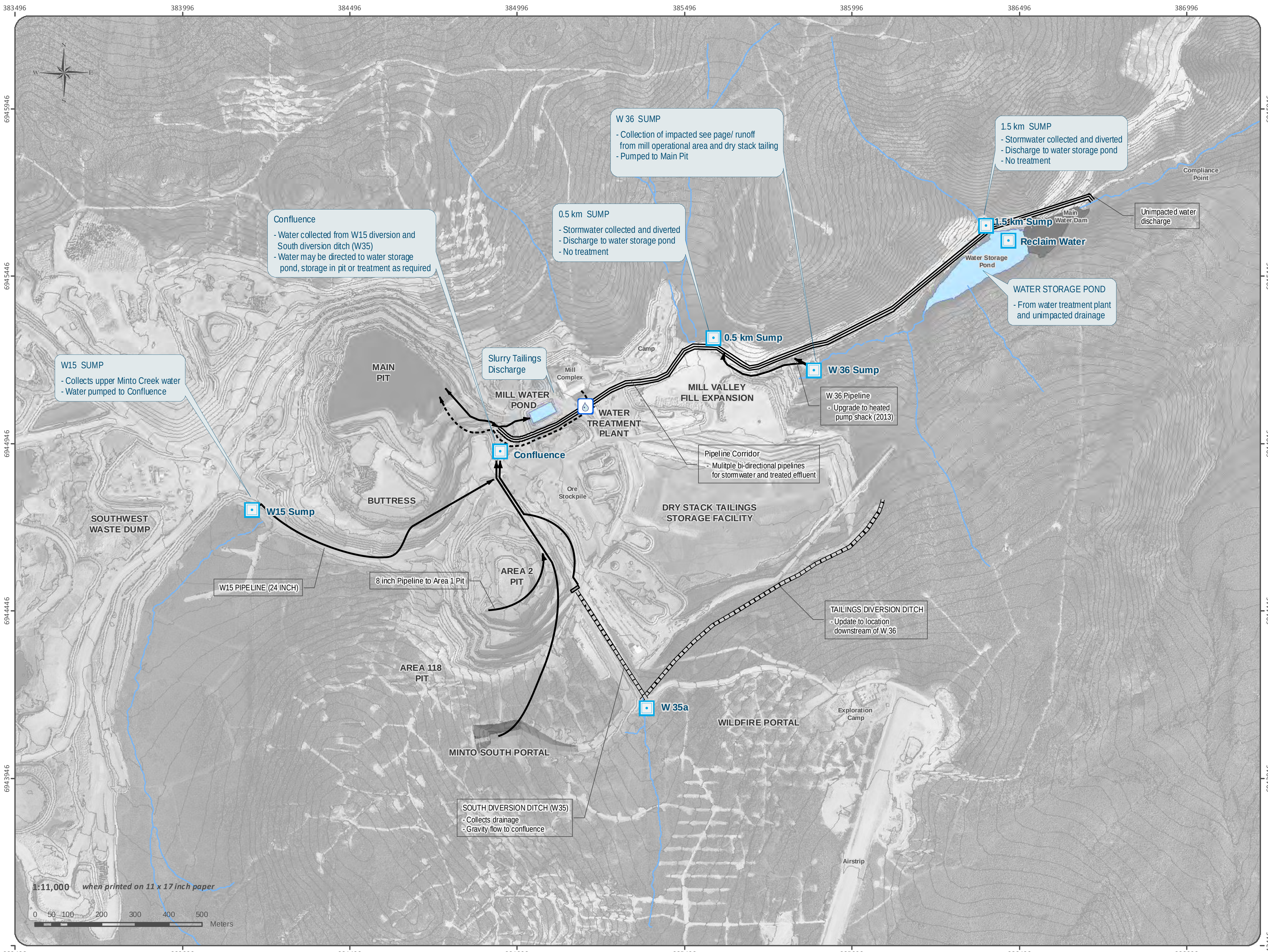
		Water Use Licence QZ96-006				Modelling Predictions of Main Pit Water Quality[B, C] Maximum Values (2012 to 2017)	Main Pit Concentrations Observed in 2012
Parameter		**From WTP to Minto Creek**	**Freshet[A] at W50 and W17**	**Non-Freshet at W50 and W17**	**Non-Freshet at W2**	**Max Concentration**	**Max Dissolved**
Ammonia	mg/L	0.89	0.89	0.89	0.35	-	0.32
N-NO2	mg/L	0.15	0.15	0.15	0.06	-	0.26
N-NO3	mg/L	7.65	7.65	7.65	2.9	>15	33.1
P		-	-	-	0.02	-	0.089
Al	mg/L	2.7	2.7	2.7	0.62	3.1	0.12
As	mg/L	-	-	-	0.005	0.0055	0.0010
Cd	mg/L	0.00015	0.00015	0.00015	0.00004	0.00065	0.00011
Cr	mg/L	0.008	0.008	0.008	0.002	0.0056	<DL
Cu	mg/L	0.05	0.08	0.05	0.013	0.40	0.081
Fe	mg/L	3.5	3.5	3.5	1.1	3.60	0.060
Pb	mg/L	0.02	0.02	0.02	0.004	0.0030	<DL
Mo	mg/L	0.4	0.4	0.4	0.073	0.13	0.029
Ni	mg/L	0.5	0.5	0.5	0.11	0.012	0.0030
Se	mg/L	0.003	0.003	0.003	0.001	0.057	0.007
Zn	mg/L	0.15	0.15	0.15	0.03	0.065	0.022

Notes: [A]April 1 to May 31
[B]Operational Predictions are for dissolved phases only. Effluent from the Minto Mine is assumed to be sourced from the Main Pit in the operational period from 2012 to 2017.
[C]Model Results from:
X:\01_SITES\Minto\!020_Site_Wide_Data\Water_and_Load_Balance_Files\01_Project_Phases\04_Amendment_8_Support\01_Goldsim_Model\MintoAmend8Support_1CM002.003_Rev34_TC_SRJ_500.gsm
Source: \\VAN-SVR0\Projects\01_SITES\Minto\1CM002.011_OperationalSupport_Environmental_2013\2013_Water_Balance_Update_For_Annual_Report\[All_Model_Results_for_WQ_Model_Comparison_for_2012_An_Report_1CM002_011_SRJ_Rev00.xlsx]WQ Summ Rev34

4 References

Minto Explorations Ltd. 2012. 2011 Annual Water Licence and Quartz Mining License Report.

Minto Explorations Ltd. 2013. 2012 Annual Water Licence and Quartz Mining License Report.



MINTO MINE

ANNUAL REPORT

FIGURE 1
OPERATIONAL WATER MANAGEMENT

MARCH 2013

Minto Explorations Ltd.
A SUBSIDIARY OF CAPSTONE MINING LTD.

- Collection Point
- Water Treatment Plant
- Pipe Alignment
- Piping Corridor
- Tailings Slury Discharge
- Diversion Ditch

ACCESS

Aerial imagery obtained from Challenger Geomatics. Imagery acquired August 14th 2012.
Site contours derived from 2012 aerial imagery obtained from Challenger Geomatics.

Hydrology data provided by Minto Explorations Ltd, May 2009.

Datum: NAD 83 Projection: UTM Zone 8N

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