APPENDIX A

AMMTEC LIMITED REPORT
“CARBON KINETICS, LOADING CAPACITY AND
CYANIDE DETOXIFICATION TEST WORK"

AMMTEC LTD

CARBON KINETICS, LOADING CAPACITY
AND CYANIDE DETOXIFICATION TESTWORK

ASSOCIATED WITH

THE TOUQUOY GOLD PROJECT

FOR

ATLANTIC GOLD EXPLORATION PTY LTD

REPORT NO. A10174

JUNE 2006

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SUMMARY

A sample of gravity tailings associated with the Touquoy Gold Project (Nova Scotia) was tested to define the parameters for gold adsorption (kinetics and loading capacity) and cyanidation residue detoxification using the air/SO_2 method.

1. Leach rate testing bulk samples of master composite TAM gravity tailing provided the following response :

Sample Purpose	Test No.	Gold Extraction (%) @ Time (hours)				Leach Residue Au (g/t)	Calc'd Head Au (g/t)	Reagent Consumption (kg/t)	
		4	8	12	20			NaCN	Lime
CIP	HS13918	73.17	82.80	86.65	88.58	0.089	0.779	0.55	0.40
Detox	HS13936	75.92	84.13	88.24	88.24	0.086	0.731	0.25	0.35

2. Carbon in pulp testing illustrated the following kinetic data :

Test No.	Pregnant Solution (g/t)		Carbon Loading (Calc'd) (g/t)		"*Fleming*" Kinetic Parameter Gold		"*Fleming*" Kinetic Parameter Silver	
	Au	Ag	Au	Ag	k	n	k	n
HS13918	0.46	0.05	771	56	223	0.72	176	0.69

3. Activated carbon gold and silver loading capacity was determined as follows :

Equilibrium Carbon Gold Load (g/t)			Equilibrium Carbon Silver Load (g/t)		
Equilibrium Solution 0.50 g/t	Equilibrium Solution 0.20 g/t	Equilibrium Solution 0.10 g/t	Equilibrium Solution 0.10 g/t	Equilibrium Solution 0.05 g/t	Equilibrium Solution 0.01 g/t
2936	1788	1229	1154	680	200

4. Slurry viscosity measurements of ground ore were determined at a range of density and pH as detailed in Appendix I.

5. Cyanide detoxification using the air/SO*2* method illustrated the following optimum response :

Test No.	Slurry Density (% solids w/w)	Test Conditions					Solution Assays	
		pH	Retention Time (minutes)	Reagents Used			Feed Effluent CN(wad) (mg/*l*)	Ave Treated Effluent CN_P[(1)] (mg/*l*)
				SO_2 (g/g CN[wad])	Cu^{2+} (mg/*l*)	Lime (g/g of SO_2)		
D1	44.8	9.06	80.2	4.52	19.3	1.05	163	0.75
D2	44.4	9.10	85.7	2.76	21.5	0.89	163	0.50
D3	50.0	8.18	83.3	2.75	21.5	0.68	163	1.17

Notes : (1) CN_P is equivalent to CN(wad)

1. INTRODUCTION

A program of testwork has been conducted on a sample of gold ore gravity tailing from the Touquoy Gold Project to define the parameters for gold and silver adsorption (kinetics and loading capacity) and cyanide detoxification (air/SO_2 method).

The work was coordinated with Mr Stuart Smith (Aurifex Pty Ltd) representing the Atlantic Gold Exploration Pty Ltd, Touquoy Project and the scope of work comprised the following :

- Leach/CIP/Carbon loading capacity testwork is detailed in Figure 1.
- Cyanide detoxification testwork is detailed in Figure 2.
- Slurry viscosity testwork is outlined in Figure 3.

2. THE SAMPLES

The following samples received from Metcon (Sydney) were utilised for test purposes :

- Master Composite TAM Gravity Tail : Wet Filter Cake (equiv 22 kg dry solids)
- Master Composite TAM Gravity Tail : Wet Filter Cake (equiv 20 kg dry solids)
- Master Composite TAM Ground Ore : Wet Filter Cake (equiv 3 kg dry solids)

Testing utilised Perth scheme water throughout where appropriate.

2.1 Sample Preparation

Wet filter cake samples were utilised in their "as received" condition. Moisture contents were determined to allow dry solids basis determinations.

2.2 Grind Establishment

The samples utilised in testwork were supplied as wet filter cake with an advised grind P_{80} = 150 µm.

3. ANALYTICAL

Chemical analyses were carried out at the AMMTEC analytical facility and the following analytical methods were employed :

Gold in solids :	Fire assay with AAS finish
Gold in solution :	SX with AAS finish
Silver in solution :	AAS
Silver :	Acid digest with AAS finish

Tests that required low detection solution gold analyses were completed with the use of large scale SX aliquots.

4. BULK CYANIDATION OF SAMPLE

Two bulk samples received had been ground to P_{80} = 150 µm and their cyanidation procedure adopted involved vat agitation leach over a 20-hour period and included the following :

- Agitate the pre-ground sample in a large capacity cylindrical baffled vat.
- Adjust the slurry density to 40% solids.
- Note the slurry pH and add commercial lime (60% CaO) to adjust to pH 10.5.
- Tests were conducted as direct leach (not CIL).
- Add an initial NaCN dosage to initiate leaching at 0.050% NaCN.
- Oxygenation of the slurry was by natural agitation in air only to provide DO typically 8-10 mgp*l*.
- At intervals (2, 4, 8 and 12 hours) during the leach sub-samples of slurry were taken to provide filtered solution for analysis. The slurry pH, DO and NaCN were monitored and cyanide added if required to maintain 0.020% NaCN.
- After 20 hours leaching the final slurry pH and DO were noted and solution and wash residue solids sampled for analysis.
- The CIP bulk slurry was then split to three portions for sequential carbon adsorption testing with the remainder filtered to provide pregnant liquor for carbon loading capacity testwork.

- The Detox bulk slurry was sub-sampled for specific analysis preparatory to immediate cyanide detoxification work with the bulk slurry stored in a cold room awaiting use.

Details and results of the leach tests (HS13918-36) appear as tables within Appendix I and a summary follows :

Sample Purpose	Test No.	Gold Extraction (%) @ Time (hours)				Leach Residue Au (g/t)	Calc'd Head Au (g/t)	Reagent Consumption (kg/t)	
		4	8	12	20			NaCN	Lime
CIP	HS13918	73.17	82.80	86.65	88.58	0.089	0.779	0.55	0.40
Detox	HS13936	75.92	84.13	88.24	88.24	0.086	0.731	0.25	0.35

5. CARBON IN PULP GOLD ADSORPTION

The bulk cyanidation pulp prepared in a bulk leach rate test (HS13918) was divided into discrete sub-samples as listed in Figure 1 for sequential carbon in pulp contact tests.

5.1 Sequential Carbon Contact

The adsorption of gold from solution onto activated carbon in a continuous CIP plant generally obeys the following empirical relationship :

$$\delta [Au]_c = k \times [Au]_s \times t^n$$

Where :

$\delta[Au]_c$ = Increase in the concentration of gold on the carbon (mg/*l* of carbon)

k = Empirical rate constant dependent upon slurry mixing efficiency, pulp viscosity and carbon particle size

$[Au]_s$ = Solution grade of gold

t = Elapsed time (hours)

n = Exponential constant

Although the above model was derived for continuous CIP plants, experience has shown that approximate values for k and n can be determined by applying regression analysis to the data from the first 6 hours of a sequential CIP test.

5.1.1 Test Procedure

A calculated carbon dose of between 4 to 6 g of *Haycarb YAO* carbon per batch of leached solids was used for the test. The carbon amount was based on an expected carbon gold loading through three CIP cycles to around 1500 times the pregnant solution tenor.

(1) The carbon charge was added to the first batch of leach slurry and continuously agitated.

(2) Solution samples were recovered over elapsed time periods of ½, 1 and 2 hours.

(3) The carbon particles were then recovered from the pulp and contacted with the second batch of leached slurry, with solution samples again recovered after elapsed periods of ½, 1 and 2 hours.

(4) The carbon particles were recovered from the second stage of contacting and transferred to the third batch of leached slurry, with solution samples recovered after elapsed time intervals of ½, 1, 2, 3, 4 and 20 hours.

(5) The carbon was recovered from the final stage of contact, washed, oven dried, weighed and all solutions were assayed for gold. Carbon was assayed for Au and Ag.

5.1.2 Test Results

Details and results for the three stage sequential batch CIP test (HS13918) appear as tables within Appendix II.

A summary of salient data follows :

Test No.	Pregnant Solution (g/t)		Carbon Loading (Calc'd) (g/t)		"*Fleming*" Kinetic Parameter Gold		"*Fleming*" Kinetic Parameter Silver	
	Au	Ag	Au	Ag	k	n	k	n
HS13918	0.46	0.05	771	56	223	0.72	176	0.69

Carbon recovered from the test assayed 747 g/t Au and 59 g/t Ag.

Reference to the text "The Chemistry of Gold Extraction" (John Marsden, Iain Howe) has provided the following comments :

- Chemical and physical factors which affect both the adsorption kinetics and the equilibrium gold loading capacity of gold and silver from cyanide solutions include :

    - Carbon type, activity and hardness.

    - Carbon particle size.

    - Mixing efficiency (for homogenous pulp and to maximise the mass transport rate of gold and silver cyanide species to the carbon surface).

    - The effect of solids pulp density, in relation to viscosity, and potential blinding of carbon surfaces and pores by fine ore particles.

    - Temperature, gold concentration, ph, other metals, dissolved oxygen.

    - Carbon fouling by organic chemical species.

- The initial rate of adsorption is rapid, with adsorption occurring at the most accessible sites in macropores, and possibly mesopores, but the kinetics decrease as equilibrium is approached. Under these conditions the rate is controlled by the mass transport of gold cyanide species to the activated carbon surfaces. Once this adsorption capacity has been utilised, a pseudo equilibrium is established beyond which adsorption must take place in the micropores. This requires diffusion of gold cyanide species along pores within the carbon structure, typically a much slower process than boundary layer diffusion due to the length of the pores.

- Historically, work carried out at AMMTEC on Australian and overseas gold ores has resulted in *Fleming* constants ranging :

    - • k (hr^{-1}) : 70 to 250
    - • n : 0.55 to 0.70

5.2 Carbon Loading Capacity

The rate and equilibrium loading of gold and silver cyanide species on activated carbon depends on the number of sites available, as mentioned earlier. As the sites become occupied, the concentration of gold in equilibrium increases. The carbon activity falls off exponentially and resembles the behaviour of catalysts or solids which adsorb gasses or organic molecules.

These materials follow Freundlich's isotherm and provide a straight-line plot of log (Au concentration on carbon) versus log (Au solution concentration) i.e. :

$$\log(x / m) = m \log C + \log k$$

Where :

x/m	=	Milligrams of gold adsorbed per gram of carbon at equilibrium
C	=	mg/*l* Au remaining in solution
k, m	=	Are constants (intercept and slope respectively)

5.2.1 Test Procedure

Bulk cyanidation pulp prepared for the leach rate and carbon in pulp kinetics test was utilised.
The bulk slurry was filtered to provide pregnant liquor for carbon contact loading tests.

The series of carbon-solution contact tests comprised :

(1) Prepare pregnant solution samples.

(2) Add varying quantities fresh activated carbon to pregnant solution samples and agitate for 24 hours. A total of five (5) tests for each series were carried out using agitated rolling bottles.

(3) Analyse solution after 24 hours and calculate gold and silver loading on carbon.

(4) Construct a Freundlich isotherm to relate loaded carbon gold grade to equilibrium solution gold grade. Silver likewise.

Data collection provided the following :

- Equilibrium solution assay and calculated carbon gold loadings for each carbon contact test based on the barren solution assays.
- Graphical presentation of the gold loading capacity relative to equilibrium solution tenor.
- Calculation of the carbon loading capacity at specified solution concentrations.

5.2.2 Test Results – Carbon Loading

The test data associated with the carbon loading tests are included in Appendix II and the calculated carbon loadings based on pregnant solution grades of 0.50, 0.20 and 0.10 mg/*l* Au (0.10, 0.05, 0.01 mg/*l* Ag) are presented in the following summary :

Equilibrium Carbon Gold Load (g/t)			Equilibrium Carbon Silver Load (g/t)		
Equilibrium Solution 0.50 g/t	Equilibrium Solution 0.20 g/t	Equilibrium Solution 0.10 g/t	Equilibrium Solution 0.10 g/t	Equilibrium Solution 0.05 g/t	Equilibrium Solution 0.01 g/t
2936	1788	1229	1154	680	200

6. GROUND ORE SLURRY VISCOSITY

Ground ore sample supplied (wet filter cake) was slurried to a range of density as detailed in Figure 3, adjusted to a pH target with lime and then subjected to slurry viscosity measurements using a *Bohlin Visco* 88 viscometer.

6.1 Test Procedure

Testing comprised :

(1) Pulp densities of 40, 50 and 60% solids.

(2) Pulp adjusted to pH 8.5 with hydrated lime and run a number of shear rates from 4.3 to 200 sec-1 increasing and then decreasing to generate a hysteresis curve.

(3) Adjust pH to 10.5 with hydrated lime and repeat the sequence.

6.2 Results

Details and results appear in Appendix III.

7. CYANIDE DETOXIFICATION TESTWORK

Several small-scale cyanide detoxification tests using the SO_2/air process were conducted on ore composite leach residue slurries. The continuous tests were conducted to evaluate detoxification performance with respect to key operating parameters. The target residual cyanide level in the treated effluent was specified as <2 mg/*l* CN(wad).

The bulk leach slurry (ex HS13936) was thickened to 50% solids (w/w) prior to the cyanide detoxification testwork. This was achieved by allowing the slurry to settle naturally without the aid of flocculants then decanting off excess leach solution. It was also necessary to screen the thickened slurry at 150 µm to remove coarse sands prior to testing. The screening step is not part of the envisaged process flowsheet but was necessary only in the laboratory to assist with pumping the slurry to the test rig. For the first two tests, the slurry was not readjusted back to 50% solids (w/w) after screening.

The following range of SO_2/air tests were conducted :

Test No.	Test Type	Slurry Density (% solids w/w)	Target Test Conditions			Purpose of Test
			pH	Retention Time (minutes)	SO_2 (g/g CN[wad])	
D1	Continuous	44.8	9	90	4.5	Process Evaluation Test
D2		44.4	9	90	2.75	
D3		50.0	8	90	2.75	

7.1 The SO_2/Air Process

The SO_2/Air oxidation process has been found to oxidise cyanide to cyanate effectively at bench, pilot and commercial scale.

The chemistry has been simplified as follows :

$$CN^{-}\,free + SO_2 + O_2 + H_2O \rightarrow CNO^{-} + H_2SO_4$$

$$Me(CN)_4^{2-} + 4SO_2 + 4O_2 + 4H_2O \rightarrow 4CNO^{-} + 4H_2SO_4 + Me^{2+}$$

Reaction requires copper to be present to act as a catalyst and based upon the above reaction, the theoretical requirement of SO_2 to CN is 2.47 g SO_2/g CN. However, due to SO_2 consumption by other chemical reactions the SO_2 dosage is greater; for example, thiocyanate can also be oxidised according to the following proposed reaction :

$$SCN^{-} + 4SO_2 + 4O_2 + 5H_2O \rightarrow CNO^{-} + 5H_2SO_4$$

The kinetics of thiocyanate oxidation is much slower than for cyanide however, so usual levels of thiocyanate in gold mill effluents do not generally adversely effect the SO_2 requirements of the process.

The SO_2/Air oxidation process also destroys the metal cyanide complexes typically present in gold mill effluents. The preferential order of metal cyanide complex removal is as follows :

$$Zn > Fe > Ni > Cu$$

The process is also capable of removing iron cyanide complexes from solution. The iron remains in the reduced ferrous state and is removed by precipitation of metal ferrocyanide compounds of the form $Me_2Fe(CN)_6$ where Me = Cu, Zn, Ni. Metals liberated from the cyanide complexes of Cu, Zn and Ni are removed by precipitation of metal hydroxides at the reaction pH.

When sodium metabisulphite is used as the SO_2 source, SO_2 is liberated according to the following reactions :

$$Na_2S_2O_5 + H_2O \ = \ Na_2SO_3 + H_2SO_3$$

$$Na_2SO_3 + CN^- + O_2 \rightarrow Na_2SO_4 + CNO^-$$

$$H_2SO_3 + CN^- + O_2 \rightarrow H_2SO_4 + CNO^-$$

Thus $Na_2S_2O_5$ has two SO_2 and one requires subsequent neutralisation.

The pH range for treatment is usually between 8.0 and 9.0 and is controlled by lime addition.

The oxygen requirements for reaction are obtained from air as it bubbles through the reaction vessel solution.

7.2 Stoichiometric Requirements

In literature the stoichiometric requirements are generally reported as g SO_2/g CN(total) and the requirement will be 2.47 g SO_2/g CN.

Additional requirements will be necessary for thiocyanate and thiosulphate oxidation and although estimates are calculated from experience data the actual requirement will become known from testwork. Also process reactions have an efficiency factor, which will be generally lower for slurry than for solution, and so calculations prior to testing assign an efficiency factor (e.g. 80% for solution).

7.2.1 Slurry Preparation for Detoxification

A 20 kg quantity of sample was leached as per the conditions used for the leach rate CIP testwork. Details and results (test HS13936) of the leach test appear within Appendix I.

7.3 Cyanide Detoxification Testing

The leach residue slurries were sampled and filtered before each test to provide solution for free and weak acid dissociable (WAD) cyanide determinations and for Cu, Fe, Ni and Zn analysis. The remaining slurry was used as feed to the cyanide detoxification mini plant.

7.3.1 Reaction Vessel and Equipment Arrangement

The laboratory testing procedure involved the continuous operation of a mini plant which incorporated the following :

(1) An agitated baffled reaction vessel of 500 m*l* live volume.

(2) Reagent dosage pumps for lime, sodium metabisulphite and copper sulphate solutions.

(3) pH measurement and controller for alkali (or acid) dosage to maintain reaction pH at ± 0.05.

(4) Aeration sparge capacity of 1-3 *l*/m/*l* reactor volume, typically 1 *l*/m/*l* rate.

(5) Redox and DO measurement.

7.3.2 Operation

The initial level of CN(wad) in the cyanide leach solution was estimated from the free cyanide titration together with analysis for Cu, Zn and Ni. This estimate allowed the required concentration of sodium metabisulphite solution to be prepared.

An initial operating pH of 9 was chosen for the testwork as this represents a typical optimum pH level for the SO_2/air detoxification process.

The test program involved the following :

(1) Calculations based upon effluent analysis.

(2) In continuous operation, feed was metered by pump at the desired rate into the reaction vessel. The desired amount of SO_2 was added in the form of a $Na_2S_2O_5$ aqueous solution. The pH was controlled at the desired set point by addition of a lime solution on demand by means of a titration device. The slurry was agitated vigorously at 750 rpm and air was introduced at a rate of at least 1 *l*/m/*l* of reactor volume.

(3) Typically a minimum of three reactor displacements are carried out for each test. Samples of treated effluent from each displacement were collected, filtered and analysed for weak-acid dissociable cyanide (CN(wad)) and for Cu, Ni, Fe and Zn.

7.3.3 Cyanide Analysis

Solutions were prepared for cyanide analysis using the following procedure :

(1) Slurry samples were coarse filtered and the filtrate collected.

(2) The filtrate was refiltered through a fine glass fibre paper (0.45 μm).

(3) Samples for analysis were placed in plastic bottles (zero headspace) and kept refrigerated until required for analysis.

Effluent solutions were analysed by AMMTEC for CN(wad) using a direct spectrophotometric determination with picric acid reagent. Cyanide determinations using this method have been identified in this report as CN_P.

7.3.4 Test Results

Details and results of the sets of continuous cyanide detoxification tests appear in Appendix IV. The optimised detoxification performance is briefly summarised in the table below :

Test No.	Slurry Density (% solids w/w)	Test Conditions					Solution Assays	
		pH	Retention Time (minutes)	Reagents Used			Feed Effluent CN(wad) (mg/*l*)	Ave Treated Effluent CN_P (1) (mg/*l*)
				SO_2 (g/g CN[wad])	Cu^{2+} (mg/*l*)	Lime (g/g of SO_2)		
D1	44.8	9.06	80.2	4.52	19.3	1.05	163	0.75
D2	44.4	9.10	85.7	2.76	21.5	0.89	163	0.50
D3	50.0	8.18	83.3	2.75	21.5	0.68	163	1.17

Notes : (1) CN_P is equivalent to CN(wad)

Observations from the cyanide detoxification testwork include the following :

- All displacement samples (3 per test) achieved <2 mg/*l* CN(wad) from all tests. The reduced SO_2 dose added to test D2 compared to test D1 still produced excellent CN(wad) removal. An SO_2 dose of 2.75 g/g SO_2 to CN(wad) is low and not far above the stoichiometric requirement.

- Reducing the operating pH from 9.0 to 8.2 appeared to result in slightly poorer performance in terms of CN(wad) removal but Fe removal was superior at the lower pH.

- A small amount of copper sulphate was required to catalyze the process as insufficient copper was present in the leach solution to do this.

- A target retention time of 90 minutes was adequate to produce treated effluent containing relatively low levels of CN(wad).

7.4 Solution Analyses

The leach solution (detoxification feed solution) and the detoxified solution from SO_2/Air test D2 were submitted to the Chemistry Centre (WA), for complete cyanide speciation analysis. The official analytical results appear in Appendix V.

7.5 Treated Effluent Speciation Analyses

Additional analytical requirements were requested by the client. The following samples were analysed for ICP scan (25 element), As, Hg and SO_4 :

1. Leach solution (detoxification feed solution).
2. Detoxification effluent solutions from test D2.

FIGURES

FIGURE 1 : METALLURGICAL TEST PROGRAM FLOWSHEET
CYANIDATION & CIP KINETICS

ATLANTIC GOLD EXPLORATION PTY LTD / AURIFEX PTY LTD : TOUQUOY GOLD PROJECT

1 x BULK SAMPLE OF GOLD ORE GRAVITY TAIL : MASTER COMPOSITE TAM (Gravity Tail)
DELIVERED AS WET FILTER CAKE
[CONTAINS 22kg OF DRY SOLIDS @ P80 : 150µm]

CONDUCT THE FOLLOWING

BULK CYANIDATION LEACH TESTWORK :

* GRIND SIZE : AS RECEIVED [P80 : 150µm]
* 40% SOLIDS [w/w]
* pH : 10.5 [LIME]
  MAINTAIN pH > 9.8
* NaCN : 0.05% (w/v)
  MAINTAIN NaCN > 0.02%
* DURATION : 20 HOURS
* SAMPLE @ 2, 4, 8, 12
  & 20 HOURS
* MONITOR pH, DO &
  NaCN LEVELS
* ANALYSE LEACH
  SOLUTIONS : Au, Ag
* ANALYSE LEACH
  RESIDUE : Au, Ag

SPLIT LEACH SLURRY

3 x SUB-SAMPLES TO CONTAIN EQUIVALENT OF 9.0kg OF SOLIDS

SEQUENTIAL TRIPLE CONTACT CIP TESTWORK

* CARBON Wt : 5.0g
* ASSAYS : Au, Ag

FILTER REMAINDER OF LEACH PULP

SOLIDS

WASH & STORE AS WET FILTER CAKE

PREGNANT LIQUOR

EQUILIBRIUM CARBON LOADING TESTWORK

* USE 2000mls PREG. LIQUOR
  PER CONTACT TEST.
* TEST 1 : 0.04g CARBON [10000g/t LOADING]
* TEST 2 : 0.08g CARBON [5000g/t LOADING]
* TEST 3 : 0.16g CARBON [2500g/t LOADING]
* TEST 4 : 0.40g CARBON [1000g/t LOADING]
* TEST 5 : 0.80g CARBON [500g/t LOADING]
* SUBMIT 70ml SOLUTION SAMPLES
  FOR ASSAY [LOW DETECTION Au, Ag]

NOTE : USE PERTH TAP WATER FOR ALL TESTWORK.

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FIGURE 2 : METALLURGICAL TEST PROGRAM FLOWSHEET
CYANIDATION & CYANIDE DETOX

ATLANTIC GOLD EXPLORATION PTY LTD / AURIFEX PTY LTD : TOUQUOY GOLD PROJECT

1 x BULK SAMPLE OF GOLD ORE GRAVITY TAIL : MASTER COMPOSITE TAM (Gravity Tail)
DELIVERED AS WET FILTER CAKE
[CONTAINS 20kg OF DRY SOLIDS @ P80 : 150μm]

CONDUCT THE FOLLOWING

BULK CYANIDATION LEACH TESTWORK :

* GRIND SIZE : AS RECEIVED [P80 : 150μm]
* 40% SOLIDS [w/w]
* pH : 10.5 [LIME]
MAINTAIN pH > 9.8
* NaCN : 0.05% (w/v)
MAINTAIN NaCN > 0.02%
* DURATION : 20 HOURS
* SAMPLE @ 2, 4, 8, 12
& 20 HOURS
* MONITOR pH, DO &
NaCN LEVELS
* ANALYSE LEACH
SOLUTIONS : Au, Ag
* ANALYSE LEACH
RESIDUE : Au, Ag

THICKEN BULK LEACH PULP TO 50% SOLIDS [w/w]

UTILISE BULK LEACH PULP
FOR CYANIDE DETOXIFICATION
TESTWORK

SOLUTION
ASSAY FOR As, SO4,
Hg, ICP SCAN
CYANIDE SPECIATION

SCREEN THICKENED PULP AT 150μm

-150μm SLURRY

+150μm SANDS

SO2/AIR CYANIDE DETOXIFICATION TESTS
CONTINUOUS TESTS USING MINI RIG
1. 4.5 g/g SO2:CN[WAD], pH 9
2. 2.75 g/g SO2:CN[WAD], pH 9
3. 2.75 g/g SO2:CN[WAD], pH 8

ANALYSE ALL SOLUTIONS FOR
Cu, Ni, Fe, Zn (ALL ICP) & CN[WAD] BY PICRIC ACID METHOD

ANALYSE SELECTED DETOXIFIED SOLUTION FOR
As, SO4, ICP SCAN, Hg & CYANIDE SPECIATION

NOTE : USE PERTH TAP WATER FOR ALL TESTWORK.

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FIGURE 3 : METALLURGICAL TEST PROGRAM FLOWSHEET
SLURRY VISCOSITY

ATLANTIC GOLD EXPLORATION PTY LTD / AURIFEX PTY LTD : TOUQUOY GOLD PROJECT

3 x 1.0kg SAMPLES OF GOLD ORE DELIVERED AS WET FILTER CAKE : MASTER COMPOSITE TAM

CONDUCT THE FOLLOWING

SLURRY VISCOSITY
MEASUREMENTS :
**** pH 8.5 [LIME]***
PULP DENSITIES :
60% SOLIDS (w/w)
50% SOLIDS (w/w)
40% SOLIDS (w/w)

FOR EACH SET
MEASUREMENTS
4.3 TO 200 TO 4.3 SEC^{-1}
SHEAR RATE RANGE

SLURRY VISCOSITY
MEASUREMENTS :
**** pH 10.5 [LIME]***
PULP DENSITIES :
60% SOLIDS (w/w)
50% SOLIDS (w/w)
40% SOLIDS (w/w)

FOR EACH SET
MEASUREMENTS
4.3 TO 200 TO 4.3 SEC^{-1}
SHEAR RATE RANGE

NOTE : USE PERTH TAP WATER FOR ALL TESTWORK.

APPENDICES

APPENDIX I

BULK CYANIDATION

DETAILS AND RESULTS

PROJECT	A10174 : TOUQUOY GOLD PROJECT
CLIENT	ATLANTIC GOLD EXPLORATION PTY LTD
TEST No	HS 13918
SAMPLE	**GRAVITY TAILING [MASTER COMPOSITE "TAM"]**
GRIND	**P 80 : 150 MICRONS [AS RECEIVED]**
WATER	PERTH TAP WATER
DATE	APRIL 2006

DIRECT CYANIDATION TIME LEACH TESTWORK : PRE-CARBON CONTACT BULK LEACH

TIME	ADDITIONS				SOLUTION DATA						EXTRACTION	
(Hrs)	Ore (g)	Water (g)	NaCN (g)	Lime (g)	Oxygen (ppm)	pH	NaCN (%)		Au (ppm)	Ag (ppm)	Au (%)	Ag (%)
	22000.0	33000.0			6.5	7.4						
0			16.50	8.77	7.2	10.5	0.050		0.00	0.00	0.00	0.00
2			0.00	0.00	7.6	10.2	0.018		0.26	0.03	50.06	36.00
4			0.00	0.00	8.1	10.1	0.015		0.38	0.04	73.17	48.00
8			0.00	0.00	8.8	10.1	0.015		0.43	0.05	82.80	60.00
12			0.00	0.00	8.4	10.0	0.015		0.45	0.05	86.65	60.00
20			0.00	0.00	8.5	10.0	0.013		0.46	0.05	88.58	60.00

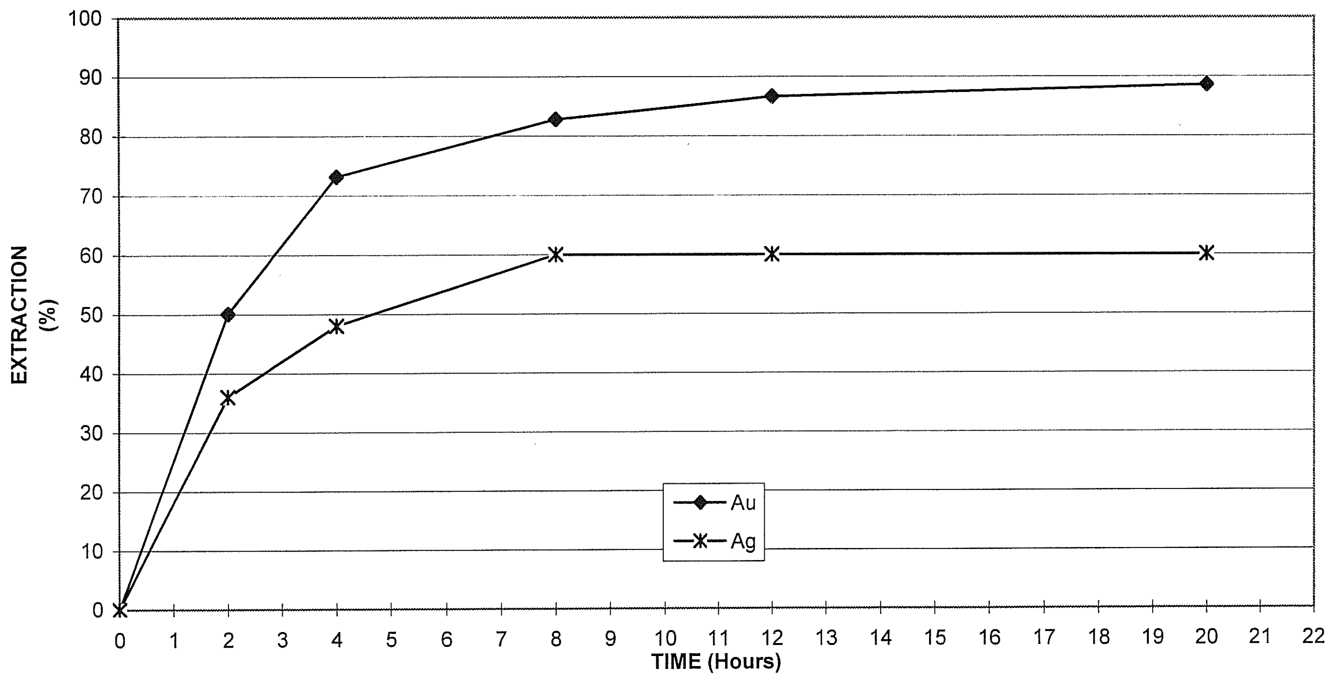
GOLD & SILVER EXTRACTION CALCULATIONS

Product	Quantity	GOLD			SILVER		
		Assay (ppm)	Total (µg)	Dist'n (%)	Assay (ppm)	Total (µg)	Dist'n (%)
Solids (g)	22000.0	0.089	1958	11.42	0.05	1100	40.00
Solution (mls)	33000.0	0.46	15180	88.58	0.05	1650	60.00
Total			17138	100.00		2750	100.00
Calc'd Head		0.779			0.1		

COMMENTS :

1. NaCN addition : 0.75 (Kg/t)
2. NaCN consum'n : 0.55 (Kg/t)
3. Lime consum'n : 0.40 (Kg/t)
4. Perth tap water : 1.000 (SG)
5. Grind Size P 80 : 150 (µm)
6. Leach test conducted in mechanically stirred vat.
7. Evaporation losses made up prior to sampling at each period.

RATE OF GOLD & SILVER DISSOLUTION



PROJECT	A10174 : TOUQUOY GOLD PROJECT
CLIENT	ATLANTIC GOLD EXPLORATION PTY LTD
TEST No	HS 13936
SAMPLE	**GRAVITY TAILING [MASTER COMPOSITE "TAM"]**
GRIND	**P 80 : 150 MICRONS [AS RECEIVED]**
WATER	PERTH TAP WATER
DATE	MAY 2006

DIRECT CYANIDATION TIME LEACH TESTWORK
BULK LEACH PULP GENERATION FOR DETOX TESTWORK

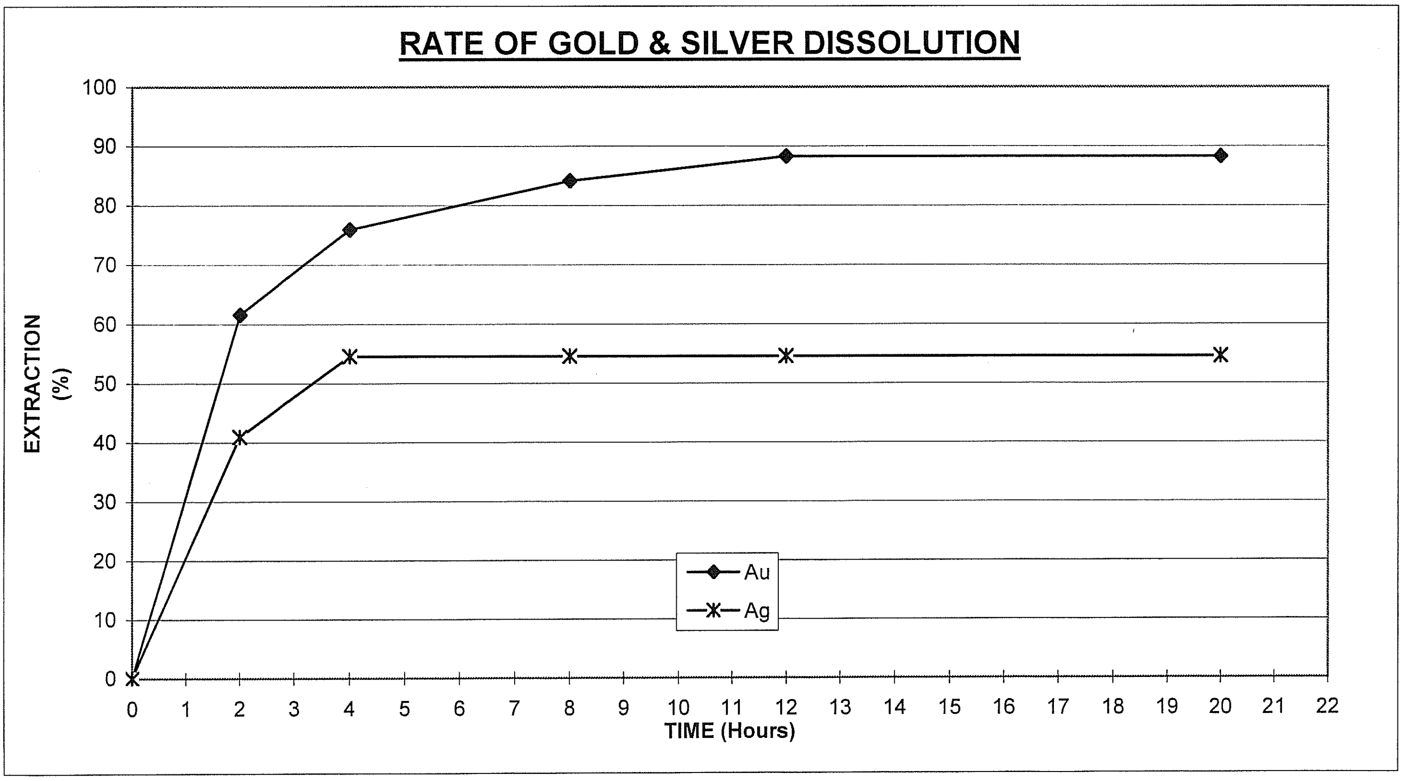
TIME	ADDITIONS				SOLUTION DATA						EXTRACTION	
(Hrs)	Ore (g)	Water (g)	NaCN (g)	Lime (g)	Oxygen (ppm)	pH	NaCN (%)		Au (ppm)	Ag (ppm)	Au (%)	Ag (%)
	20000.0	30000.0			6.7	7.4						
0			15.00	6.94	7.1	10.5	0.050		0.00	0.00	0.00	0.00
2			0.00	0.00	7.6	10.2	0.038		0.30	0.03	61.56	40.91
4			0.00	0.00	7.9	10.2	0.038		0.37	0.04	75.92	54.55
8			0.00	0.00	8.6	10.1	0.035		0.41	0.04	84.13	54.55
12			0.00	0.00	8.6	10.1	0.033		0.43	0.04	88.24	54.55
20			0.00	0.00	8.7	10.0	0.033		0.43	0.04	88.24	54.55

GOLD & SILVER EXTRACTION CALCULATIONS

Product	Quantity	GOLD			SILVER		
		Assay (ppm)	Total (µg)	Dist'n (%)	Assay (ppm)	Total (µg)	Dist'n (%)
Solids (g)	20000.0	0.086	1720	11.76	0.05	1000	45.45
Solution (mls)	30000.0	0.43	12900	88.24	0.04	1200	54.55
Total			14620	100.00		2200	100.00
Calc'd Head		0.731			0.1		

COMMENTS :

1. NaCN addition : 0.75 (Kg/t)
2. NaCN consum'n : 0.25 (Kg/t)
3. Lime consum'n : 0.35 (Kg/t)
4. Perth tap water : 1.000 (SG)
5. Grind Size P 80 : 150 (µm)
6. Leach test conducted in mechanically stirred vat.
7. Evaporation losses made up prior to sampling at each period.



APPENDIX II

CIP KINETICS AND EQUILIBRIUM CARBON LOADING

DETAILS AND RESULTS

TEST No.	: HS 13918			
SAMPLE IDENTITY	: **MASTER COMPOSITE "TAM"**			
CARBON TYPE	: HAYCARB YAO 6x12			
CARBON WEIGHT (g)	:	5.5		
SLURRY % SOLIDS (%)	:	40.0		
SOLUTION WEIGHT (g)	:	4500.0 (PER CONTACT)	Eqv Vol (ml) :	4500.0
SLURRY SAMPLE VOLUME (mls)	:	80.0	Eqv Vol (ml) :	64.2
ORE SG	:	2.7		
SOLUTION SG	:	1.000		

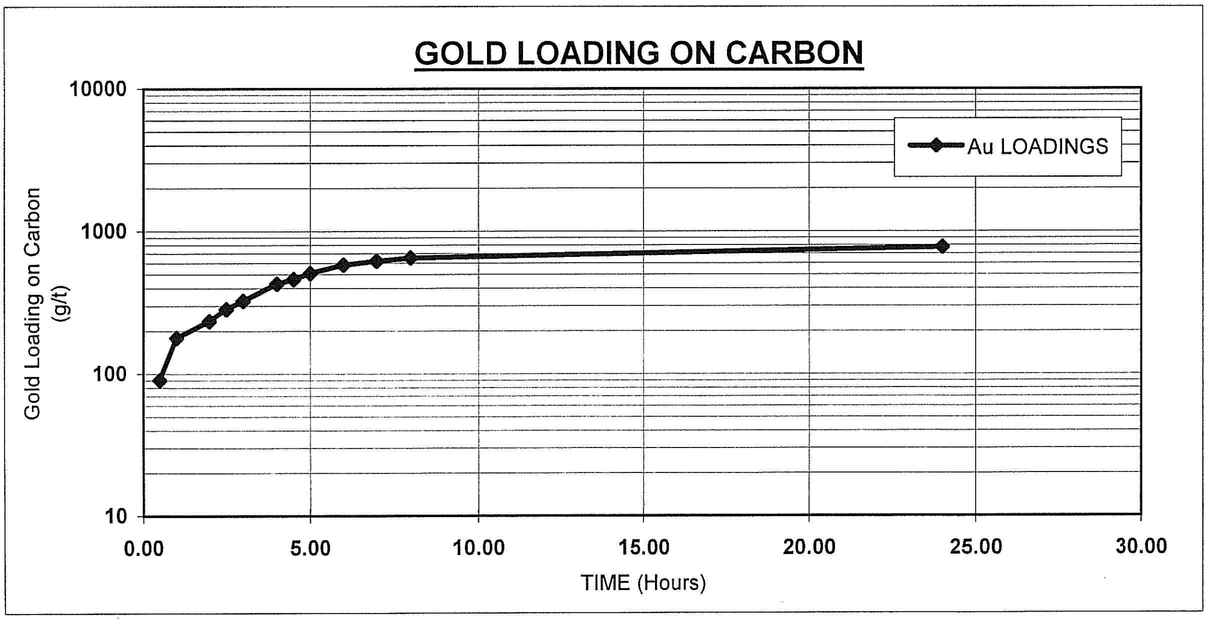
SEQUENTIAL BATCH CIP TEST : HS 13918 : ***GOLD RESULTS***

TEST RESULTS

CYCLE	SOLUTION VOLUME (mls)	ELAPSED TIME Cycle (Hours)	ELAPSED TIME Cumulative (Hours)	SOLUTION GOLD Au (ppm)	CARBON CALC'd LOADING Incremental Au (ppm)	CARBON CALC'd LOADING Cumulative Au (ppm)	
1	4500	0.00	0.00	0.46	0	0	
	4436	0.50	0.50	0.35	90	90	
	4372	1.00	1.00	0.24	89	179	
	4308	2.00	2.00	0.17	56	234	
2	4500	0.00	2.00	0.46	0	234	
	4436	0.50	2.50	0.40	49	283	
	4372	1.00	3.00	0.35	40	324	
	4308	2.00	4.00	0.22	103	427	
3	4500	0.00	4.00	0.46	0	427	
	4436	0.50	4.50	0.42	33	460	
	4372	1.00	5.00	0.36	48	508	
	4308	2.00	6.00	0.27	72	580	
	4243	3.00	7.00	0.22	39	619	
	4179	4.00	8.00	0.18	30	649	
	4115	20.00	24.00	0.02	122	771	

FLEMING KINETIC CONSTANTS, REGRESSION OVER FIRST 6 HOURS

Fleming k (hr^{-1}) : 222.82 **Fleming n : 0.721**



TEST No.	: HS 13918			
SAMPLE IDENTITY	: **MASTER COMPOSITE "TAM"**			
CARBON TYPE	: HAYCARB YAO 6x12			
CARBON WEIGHT (g)	: 5.5			
SLURRY % SOLIDS (%)	: 40.0			
SOLUTION WEIGHT (g)	: 4500.0	(PER CONTACT)	Eqv Vol (ml) :	4500
SLURRY SAMPLE VOLUME (mls)	: 80.0		Eqv Vol (ml) :	64.2
ORE SG	: 2.7			
SOLUTION SG	: 1.000			

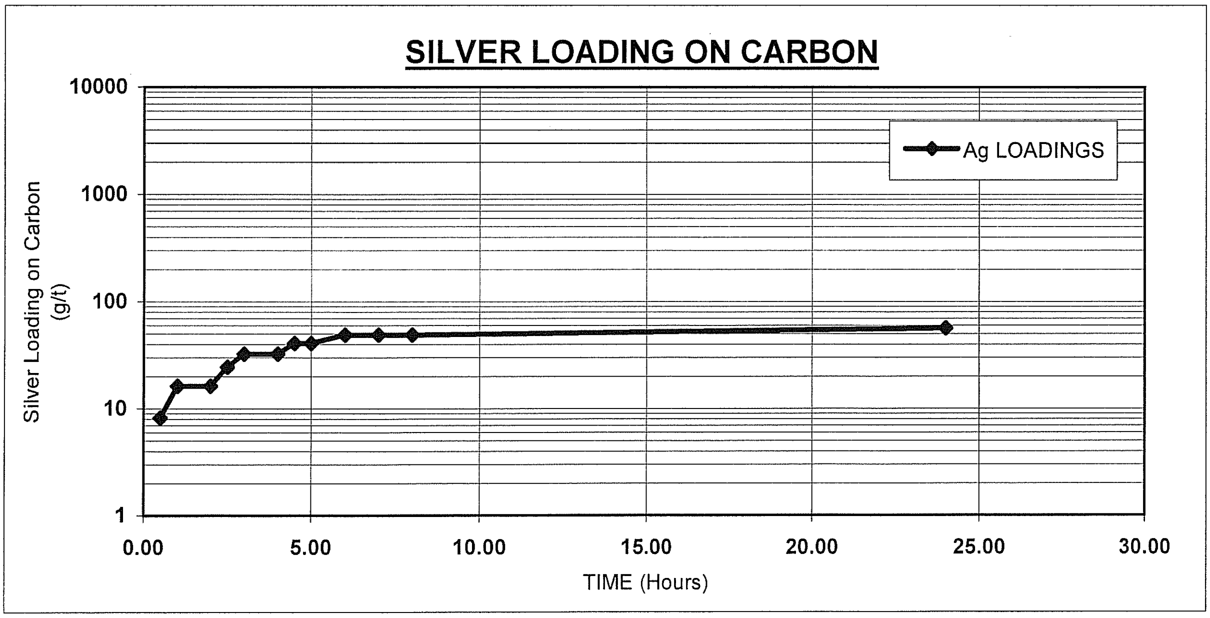
SEQUENTIAL BATCH CIP TEST : HS 13918 : ***SILVER RESULTS***

TEST RESULTS

CYCLE	SOLUTION VOLUME (mls)	ELAPSED TIME Cycle (Hours)	ELAPSED TIME Cumulative (Hours)	SOLUTION SILVER Ag (ppm)	CARBON CALC'd LOADING Incremental Ag (ppm)	CARBON CALC'd LOADING Cumulative Ag (ppm)	
1	4500	0.00	0.00	0.05	0	0	
	4436	0.50	0.50	0.04	8	8	
	4372	1.00	1.00	0.03	8	16	
	4308	2.00	2.00	0.03	0	16	
2	4500	0.00	2.00	0.05	0	16	
	4436	0.50	2.50	0.04	8	24	
	4372	1.00	3.00	0.03	8	32	
	4308	2.00	4.00	0.03	0	32	
3	4500	0.00	4.00	0.05	0	32	
	4436	0.50	4.50	0.04	8	41	
	4372	1.00	5.00	0.04	0	41	
	4308	2.00	6.00	0.03	8	49	
	4243	3.00	7.00	0.03	0	49	
	4179	4.00	8.00	0.03	0	49	
	4115	20.00	24.00	0.02	8	56	

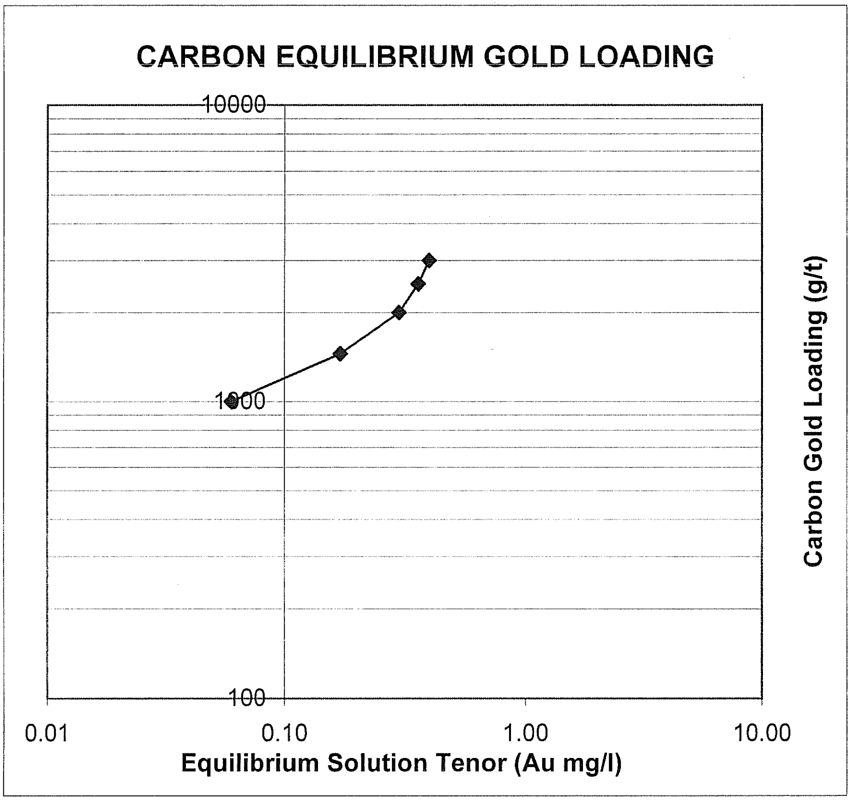
FLEMING KINETIC CONSTANTS, REGRESSION OVER FIRST 6 HOURS

Fleming k (hr^{-1}) : 175.92 **Fleming n :** 0.688



TEST HS 13918
EQUILIBRIUM LOADING TEST FOR HAYCARB YAO (6 x 12) CARBON : *GOLD DATA*

Test No.	Carbon Concentration g/l	Carbon Added grams	Solution mls	Initial Au mg/l	Final Solution Assay Au mg/l	Loading Au g/t (calc)		Loading Au g/t (assay)
1	0.02	0.04	2000	0.46	0.40	3000		
2	0.04	0.08	2000	0.46	0.36	2500		
3	0.08	0.16	2000	0.46	0.30	2000		
4	0.20	0.40	2000	0.46	0.17	1450		1504
5	0.40	0.80	2000	0.46	0.06	1000		1029



Log(soln)	Log(assay load)
-0.398	3.477
-0.444	3.398
-0.523	3.301
-0.770	3.161
-1.222	3.000

3.631 intercept
0.966 correl
0.541 slope

Log (X/M) = Slope * log C + Intercept

For 0.10 mg/l solution:
Log (X/M) = 3.0895
X/M = 1229

For 0.20 mg/l solution:
Log (X/M) = 3.2525
X/M = 1788

For 0.50 mg/l solution:
Log (X/M) = 3.4678
X/M = 2936

Carbon Loading Capacity

log (X/M) = m log C + log K

EQUILIBRIUM LOADING : Au g/t

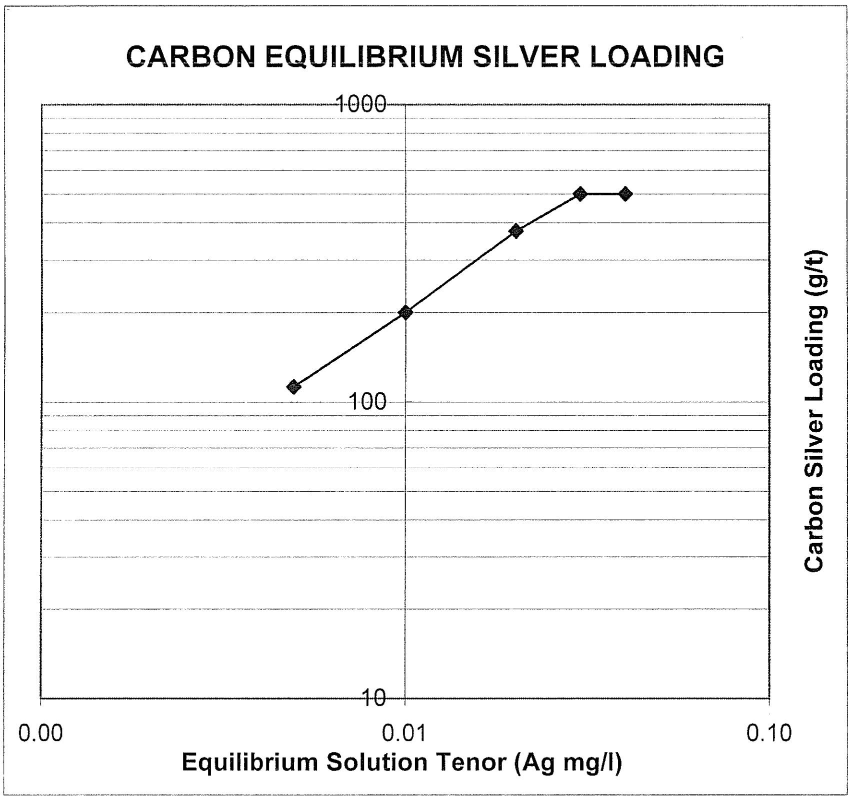
2936 at 0.50 mg/l
1788 at 0.20 mg/l
1229 at 0.10 mg/l

Where X/M = mg of gold adsorbed per gram of carbon at equilibrium.
C = mg/l of gold remaining in solution.
K, m = constants.

TEST HS 13918

EQUILIBRIUM LOADING TEST FOR HAYCARB YAO (6 x 12) CARBON - *SILVER DATA*

Test No.	Carbon Concentration g/l	Carbon Added grams	Solution mls	Initial Ag mg/l	Final Solution Assay Ag mg/l	Loading Ag g/t (calc)		
1	0.02	0.04	2000	0.05	0.04	500		
2	0.04	0.08	2000	0.05	0.03	500		
3	0.08	0.16	2000	0.05	0.02	375		
4	0.20	0.40	2000	0.05	0.01	200		
5	0.40	0.80	2000	0.05	0.01	113		



Log(soln)	Log(assay load)
-1.398	2.699
-1.523	2.699
-1.699	2.574
-2.000	2.301
-2.301	2.051

3.824 intercept
0.989 correl
0.762 slope

Log (X/M) = Slope * log C + Intercept

For 0.01 mg/l solution:
Log (X/M) = 2.3004
X/M = 200

For 0.05 mg/l solution:
Log (X/M) = 2.8328
X/M = 680

For 0.10 mg/l solution:
Log (X/M) = 3.0621
X/M = 1154

Carbon Loading Capacity

$$\log (X/M) = m \log C + \log K$$

EQUILIBRIUM LOADING : Ag g/t

1154	**at 0.10 mg/l**
680	**at 0.05 mg/l**
200	**at 0.01 mg/l**

Where X/M = mg of silver adsorbed per gram of carbon at equilibrium.
C = mg/l of silver remaining in solution.
K, m = constants.

APPENDIX III

SLURRY VISCOSITY

DETAILS AND RESULTS

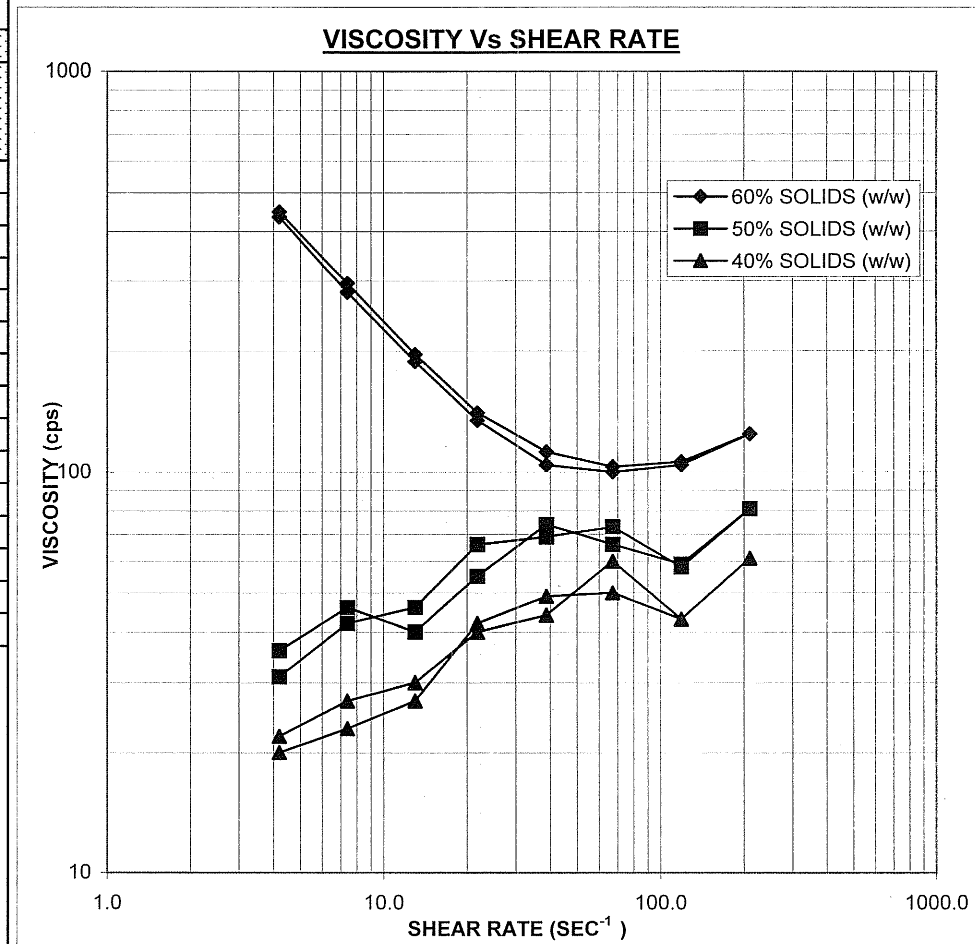
ATLANTIC GOLD EXPLORATION PTY LTD : TOUQUOY GOLD PROJECT

SLURRY RHEOLOGY TESTWORK : VISCOSITY Vs PULP DENSITY @ pH 8.5

Composite Identity	Grind Size P80 (µm)	Pulp pH	Pulp Temp.	Pulp Density % Solids (w/w)	Bohlin Visco 88] Viscosity @ Shear Rate (Sec^{-1}) 4.2 (cps)	7.4 (cps)	13.0 (cps)	21.8 (cps)	38.7 (cps)	67.1 (cps)	118.7 (cps)	209.9 (cps)	118.7 (cps)	67.1 (cps)	38.7 (cps)	21.8 (cps)	13.0 (cps)	7.4 (cps)	4.2 (cps)
Master Composite "TAM"	150 [As is]	8.5 [Lime]	Ambient	60	435	281	188	134	104	100	104	124	106	103	112	140	196	296	448
				50	31	42	46	66	69	73	58	81	59	66	74	55	40	46	36
				40	20	23	27	42	49	50	43	61	43	60	44	40	30	27	22

Shear Rate (sec-1)	60% solids (w/w) Viscosity (Pas)	60% Viscosity (cps)	60% Shear Stress (Pa)	50% solids (w/w) Viscosity (Pa)	50% Viscosity (cps)	50% Shear Stress (Pa)	40% solids (w/w) Viscosity (Pa)	40% Viscosity (cps)	40% Shear Stress (Pa)
4.2	0.435	435	1.8	0.031	31	Low	0.020	20	Low
7.4	0.281	281	2.0	0.042	42	Low	0.023	23	Low
13.0	0.188	188	2.6	0.046	46	Low	0.027	27	Low
21.8	0.134	134	3.0	0.066	66	Low	0.042	42	Low
38.7	0.104	104	4.1	0.069	69	Low	0.049	49	Low
67.1	0.100	100	6.9	0.073	73	4.9	0.050	50	0.7
118.7	0.104	104	12.4	0.058	58	6.8	0.043	43	5.2
209.9	0.124	124	25.4	0.081	81	16.7	0.061	61	13.0
118.7	0.106	106	12.6	0.059	59	7.0	0.043	43	5.2
67.1	0.103	103	7.1	0.066	66	3.8	0.060	60	3.9
38.7	0.112	112	4.4	0.074	74	Low	0.044	44	Low
21.8	0.140	140	3.1	0.055	55	Low	0.040	40	Low
13.0	0.196	196	2.6	0.040	40	Low	0.030	30	Low
7.4	0.296	296	3.0	0.046	46	Low	0.027	27	Low
4.2	0.448	448	1.9	0.036	36	Low	0.022	22	Low

NOTES : 1] Perth tap water was used to generate slurry from the supplied milled samples.



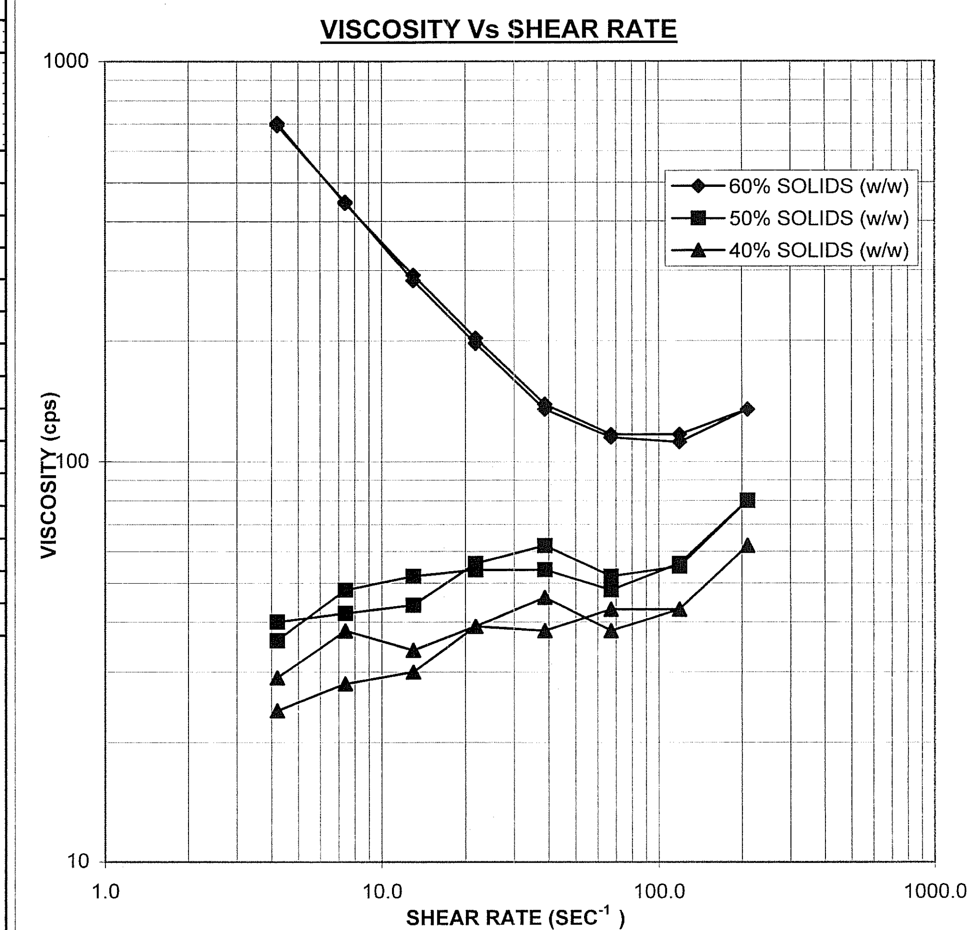
ATLANTIC GOLD EXPLORATION PTY LTD : TOUQUOY GOLD PROJECT

SLURRY RHEOLOGY TESTWORK : VISCOSITY Vs PULP DENSITY @ pH 10.5

Composite Identity	Grind Size P80 (µm)	Pulp pH	Pulp Temp.	Pulp Density % Solids (w/w)	Bohlin Visco 88] Viscosity @ Shear Rate (Sec^{-1}) 4.2 (cps)	7.4 (cps)	13.0 (cps)	21.8 (cps)	38.7 (cps)	67.1 (cps)	118.7 (cps)	209.9 (cps)	118.7 (cps)	67.1 (cps)	38.7 (cps)	21.8 (cps)	13.0 (cps)	7.4 (cps)	4.2 (cps)
Master Composite "TAM"	150 [As is]	10.5 [Lime]	Ambient	60	694	447	283	197	135	115	112	135	117	117	139	203	292	444	703
				50	36	48	52	54	54	48	56	80	55	52	62	56	44	42	40
				40	24	28	30	39	46	38	43	62	43	43	38	39	34	38	29

Shear Rate (sec-1)	60% solids (w/w) Viscosity (Pas)	60% Viscosity (cps)	60% Shear Stress (Pa)	50% solids (w/w) Viscosity (Pa)	50% Viscosity (cps)	50% Shear Stress (Pa)	40% solids (w/w) Viscosity (Pa)	40% Viscosity (cps)	40% Shear Stress (Pa)
4.2	0.694	694	2.8	0.036	36	Low	0.024	24	Low
7.4	0.447	447	3.3	0.048	48	Low	0.028	28	Low
13.0	0.283	283	3.8	0.052	52	Low	0.030	30	Low
21.8	0.197	197	4.4	0.054	54	Low	0.039	39	Low
38.7	0.135	135	5.4	0.054	54	Low	0.046	46	Low
67.1	0.115	115	7.9	0.048	48	3.3	0.038	38	2.6
118.7	0.112	112	13.5	0.056	56	6.6	0.043	43	5.0
209.9	0.135	135	28.5	0.080	80	17.0	0.062	62	13.0
118.7	0.117	117	13.9	0.055	55	6.5	0.043	43	5.1
67.1	0.117	117	7.9	0.052	52	3.4	0.043	43	2.5
38.7	0.139	139	5.5	0.062	62	Low	0.038	38	Low
21.8	0.203	203	4.5	0.056	56	Low	0.039	39	Low
13.0	0.292	292	3.8	0.044	44	Low	0.034	34	Low
7.4	0.444	444	3.3	0.042	42	Low	0.038	38	Low
4.2	0.703	703	2.9	0.040	40	Low	0.029	29	Low

NOTES : 1] Perth tap water was used to generate slurry from the supplied milled samples.



APPENDIX IV

CYANIDATION DETOXIFICATION

DETAILS AND RESULTS

TABLE
SO_2/Air Cyanide Detoxification Test D1

Operating Conditions

Sample: Leach Tail Slurry (ex HS13936)
Client: Atlantic Gold
Project: Tourquoy

Date: 10 May 2006
Test: A10174 D1

Time	pH	KG	Temp	D.O	Meta	Cu	Feed	Lime	CN load	SO2 Ratio	CuSO4.5H2O Ratio	$Ca(OH)_2$	Ret Time	Solution
min		mV	°C	ppm	mL/hr.	mL/hr.	mL/hr.	mL/hr.	g/hr.	gSO2/gCN	ppm	$gCa(OH)_2/gSO2$	min	Lit/hr.
0	9.05	-47	25	7.8	9.0	10.0	350	50.0	0.04	4.10	77	2.76	71.60	0.27
30	9.07	16		7.6	9.0	10.0	350	50.0	0.04	4.10	77	2.76	71.60	0.27
60	9.20	1		7.8	9.0	10.0	350	50.0	0.04	4.10	77	2.76	71.60	0.27
90	9.01	7		7.6	10.0	9.0	310	0.0	0.04	5.14	78	0.00	91.19	0.24
120	9.11	2		7.5	10.0	9.0	310	0.0	0.04	5.14	78	0.00	91.19	0.24
150	9.06	0		7.8	8.0	9.0	340	0.0	0.04	3.75	71	0.00	84.03	0.26
180	9.03	-3		7.4	8.0	9.0	340	0.0	0.04	3.75	71	0.00	84.03	0.26
210	9.04	3		7.6	10.0	9.0	300	0.0	0.04	5.31	81	0.00	94.04	0.23
240	9.01	10		7.5	10.0	9.0	300	0.0	0.04	5.31	81	0.00	94.04	0.23
270	9.04	12		7.4	12.0	12.0	400	50.0	0.05	4.78	81	2.07	63.29	0.31
AVG	9.06	0	25.0	7.6	9.50	9.60	335	20.00	0.04	4.52	77	1.05	80.19	0.26

Reactor Size	500	COMMENTS:
CuSO4.5H2O Conc (gpl)	2.08	Feed, Meta, Copper and Lime flowrates determined from hourly average.
Meta Conc (gpl)	29.85	29.85 g/l Na2S2O5
$Ca(OH)_2$ (gpl)	10.00	10.0 g/l Lime (60% CaO)
Agitator (rpm)	1000	
Air Flow (L/min/L)	1.00	
Solids (S.G.)	2.80	Estimated solids s.g
Solids (% wt)	44.84	
Soln (S.G.)	1.000	
Slurry (S.G.)	1.405	

Sample	Time	CN_{FREE}	CNp	Cu	Ni	Fe	Zn	Calculated CN total	COMMENTS
	min	ppm	ppm	ppm	ppm	ppm	ppm		
FEED	0	158	163	3.23	0.45	2.61	1.07	170	
DISP 1	0-90	N/a	0.73	0.10	0.02	0.49	0.06	2.08	
DISP 2	90-180	N/a	0.79	0.15	0.04	0.89	0.01	3.24	Zn <0.02 ppm reported as 0.01 ppm
DISP 3	180-270	N/a	0.72	0.16	0.02	0.78	0.01	2.87	
AVERAGE SOLN ASSAYS			0.75	0.14	0.03	0.72	0.03	2.73	

TABLE
SO_2/Air Cyanide Detoxification Test D2

Operating Conditions

Sample: Leach Tail Slurry (ex HS13936)
Client: Atlantic Gold
Project: Tourquoy

Date: 11 May 2006
Test: A10174 D2

Time	pH	KG	Temp	D.O	Meta	Cu	Feed	Lime	CN load	SO2 Ratio	CuSO4.5H2O Ratio	$Ca(OH)_2$	Ret Time	Solution
min		mV	°C	ppm	mL/hr.	mL/hr.	mL/hr.	mL/hr.	g/hr.	gSO2/gCN	ppm	$gCa(OH)_2/gSO2$	min	Lit/hr.
0	9.22	-4	25	7.4	10.0	10.0	300	0.0	0.04	2.94	92	0.00	93.75	0.23
30	9.10	-3		7.6	10.0	10.0	300	0.0	0.04	2.94	92	0.00	93.75	0.23
60	9.03	-5		7.4	10.0	10.0	300	0.0	0.04	2.94	92	0.00	93.75	0.23
90	9.04	4		7.7	10.0	10.0	310	0.0	0.04	2.85	89	0.00	90.91	0.24
120	9.01	7		7.6	10.0	10.0	310	50.0	0.04	2.85	89	4.47	78.95	0.24
150	9.03	8		7.5	11.0	10.0	340	50.0	0.04	2.86	81	4.06	72.99	0.26
180	9.11	10		7.6	11.0	10.0	340	0.0	0.04	2.86	81	0.00	83.10	0.26
210	9.17	10		7.7	9.0	10.0	330	0.0	0.04	2.41	83	0.00	85.96	0.26
240	9.20	7		7.8	9.0	10.0	330	0.0	0.04	2.41	83	0.00	85.96	0.26
270	9.11	10		7.7	10.0	10.0	340	0.0	0.04	2.60	81	0.00	83.33	0.26
AVG	9.10	4	25.0	7.6	10.00	10.00	320	10.00	0.04	2.76	86	0.89	85.71	0.25

Reactor Size	500		COMMENTS:
CuSO4.5H2O Conc (gpl)	2.14		Feed, Meta, Copper and Lime flowrates determined from hourly average.
Meta Conc (gpl)	16.60		16.60 g/l Na2S2O5
$Ca(OH)_2$ (gpl)	10.00		10.0 g/l Lime (60% CaO)
Agitator (rpm)	1000		
Air Flow (L/min/L)	1.00		
Solids (S.G.)	2.80		Estimated solids s.g
Solids (% wt)	44.36		
Soln (S.G.)	1.000		
Slurry (S.G.)	1.399		

Sample	Time	CN_{FREE}	CNp	Cu	Ni	Fe	Zn	Calculated CN total	COMMENTS
	min	ppm	ppm	ppm	ppm	ppm	ppm		
FEED	0	158	163	3.23	0.45	2.61	1.07	170	
DISP 1	0-90	N/a	0.72	0.16	0.02	0.95	0.01	3.33	
DISP 2	90-180	N/a	0.36	0.17	0.01	1.20	0.01	3.66	Ni & Zn <0.02 ppm reported as 0.01 ppm
DISP 3	180-270	N/a	0.43	0.19	0.02	1.51	0.01	4.58	
AVERAGE SOLN ASSAYS			0.50	0.17	0.02	1.22	0.01	3.86	

TABLE
SO_2/Air Cyanide Detoxification Test D3

Operating Conditions

Sample: Leach Tail Slurry (ex HS13936)
Client: Atlantic Gold
Project: Tourquoy

Date: 12 May 2006
Test: A10174 D3

Time	pH	KG	Temp	D.O	Meta	Cu	Feed	Lime	CN load	SO2 Ratio	CuSO4.5H2O Ratio	$Ca(OH)_2$	Ret Time	Solution
min		mV	°C	ppm	mL/hr.	mL/hr.	mL/hr.	mL/hr.	g/hr.	gSO2/gCN	ppm	$gCa(OH)_2/gSO2$	min	Lit/hr.
0	8.12	-12	25	7.4	11.0	11.0	325	25.0	0.04	3.06	96	2.09	80.65	0.24
30	8.06	-28		7.4	11.0	11.0	325	25.0	0.04	3.06	96	2.09	80.65	0.24
60	8.17	-13		7.5	11.0	11.0	325	25.0	0.04	3.06	96	2.09	80.65	0.24
90	8.35	3		7.2	9.0	9.0	325	0.0	0.04	2.50	78	0.00	87.46	0.24
120	8.35	-37		7.6	9.0	9.0	325	0.0	0.04	2.50	78	0.00	87.46	0.24
150	8.14	-20		7.2	10.0	10.0	350	0.0	0.04	2.58	81	0.00	81.08	0.26
180	8.17	-20		7.6	10.0	10.0	350	0.0	0.04	2.58	81	0.00	81.08	0.26
210	8.09	-18		7.3	10.0	10.0	350	0.0	0.04	2.58	81	0.00	81.08	0.26
240	8.19	-20		7.8	10.0	10.0	350	0.0	0.04	2.58	81	0.00	81.08	0.26
270	8.12	-17		7.6	10.0	10.0	300	0.0	0.04	3.02	94	0.00	93.75	0.22
AVG	8.18	-18	25.0	7.5	10.10	10.10	333	7.50	0.04	2.75	86	0.68	83.29	0.25

Reactor Size	500	COMMENTS:
CuSO4.5H2O Conc (gpl)	2.08	Feed, Meta, Copper and Lime flowrates determined from hourly average.
Meta Conc (gpl)	16.10	16.10 g/l Na2S2O5
$Ca(OH)_2$ (gpl)	10.00	10.0 g/l Lime (60% CaO)
Agitator (rpm)	1000	
Air Flow (L/min/L)	1.00	
Solids (S.G.)	2.80	Estimated solids s.g
Solids (% wt)	50.00	
Soln (S.G.)	1.000	
Slurry (S.G.)	1.474	

Sample	Time	CN_{FREE}	CNp	Cu	Ni	Fe	Zn	Calculated CN total	COMMENTS
	min	ppm	ppm	ppm	ppm	ppm	ppm		
FEED	0	158	163	3.23	0.45	2.61	1.07	170	
DISP 1	0-90	N/a	1.02	0.73	0.08	0.07	0.05	1.21	
DISP 2	90-180	N/a	1.50	1.31	0.15	0.06	0.03	1.67	
DISP 3	180-270	N/a	1.00	1.06	0.11	0.06	0.02	1.17	
AVERAGE SOLN ASSAYS			1.17	1.03	0.11	0.06	0.03	1.35	

APPENDIX V

DETOXIFICATION ANALYTICAL REPORTS

Report of Examination

58602
05E1743; 3.1.1
Jenny McGuire

Ammtec
6 MacAdam Place
Balcatta
WA 6021

Attention : Holland,M

Report On:
2 samples received on 31/05/2006

CCWA ID	**Material**	**Client Description**
05E1743 / 001	solution	A10174 HS13936 Detox Feed
05E1743 / 002	solution	D2 solution

CCWA ID		05E1743/001	05E1743/002
Client ID		A10174 HS13936	D2 solution
Sampled			
Analyte	**Unit**		
CN_Free	mg/L	150	<5
CN_WAD	mg/L	160	0.40
CN_total	mg/L	180	19
CNO	mg/L	0.9	81
SCN	mg/L	24	29
Ag_CN	mg/L	<0.5	<0.5
Au_CN	mg/L	<0.5	<0.5
Co_CN	mg/L	<0.1	<0.1
Cr_CN	mg/L	<0.5	<0.5
Cu_CN	mg/L	3.6	0.2
Fe2+_CN	mg/L	2	1.3
Fe3+_CN	mg/L	<0.05	<0.05
Ni_CN	mg/L	<0.2	<0.2

Analyte	**Method**	**Description**
Ag_CN	iCNSP1WSL	Silver cyanide complex expressed as Ag mg/L.
Au_CN	iCNSP1WSL	Gold cyanide complex expressed as Au mg/L.
CNO	iCNO1WAIC	Cyanate
CN_Free	iCNF1WATI	Free cyanide by AgNO3 titration.
CN_total	iCNT1WTAA	Cyanide, total including thiocyanate

Chemistry Centre of Western Australia
Environmental Chemistry Section
Report of Examination

Analyte	Method	Description
CN_WAD	iCNW1WAAA	Cyanide, weak acid dissociable.
Co_CN	iCNSP1WSL	Cobalt cyanide complex expressed as Co mg/L.
Cr_CN	iCNSP1WSL	Chromium cyanide complex expressed as Cr mg/L.
Cu_CN	iCNSP1WSL	Copper cyanide complex expressed as Cu mg/L.
Fe2+_CN	iCNSP1WSL	Iron 2+ cyanide complex expressed as Fe2+ mg/L.
Fe3+_CN	iCNSP1WSL	Iron 3+ cyanide complex expressed as Fe3+ mg/L.
Ni_CN	iCNSP1WSL	Nickel cyanide complex expressed as Ni mg/L.
SCN	iCNSP1WSL	Thiocyanate

These results apply only to the sample(s) as received. Unless arrangements are made to the contrary, these samples will be disposed of after 60 days of the issue of this report.
This report may only be reproduced in full.

Jenny McGuire
Principal Chemist
Environmental Chemistry Section

27/06/2006

TABLE

TOURQUOY CYANIDE DETOXIFICATION TESTWORK : SOLUTION ASSAYS

ELEMENT	UNITS	DETOX FEED (Soln ex HS13936)	DETOXIFIED SOLN (From Test D2)
Ag	mg/l	<0.02	<0.02
Al	mg/l	0.60	0.2
As	mg/l	1.50	1.56
Ba	mg/l	<0.05	0.10
Bi	mg/l	<0.1	<0.1
Ca	mg/l	6.05	98.8
Cd	mg/l	<0.05	<0.05
Co	mg/l	0.27	0.25
Cr	mg/l	<0.1	<0.1
Cu	mg/l	4.20	0.10
Fe	mg/l	2.54	1.40
K	mg/l	14.8	20.3
Li	mg/l	<0.05	<0.05
Mg	mg/l	0.60	4.10
Mn	mg/l	<0.05	<0.05
Mo	mg/l	<0.05	<0.05
Na	mg/l	394	474
Ni	mg/l	0.5	<0.05
P	mg/l	<1	<1
Pb	mg/l	<0.05	<0.05
Sr	mg/l	0.1	0.54
Ti	mg/l	<0.1	<0.1
V	mg/l	<0.02	<0.02
Y	mg/l	<0.01	<0.01
Zn	mg/l	1.09	<0.02
Zr	mg/l	<0.05	<0.05
SO4	g/l	0.31	0.97

TABLE

TOURQUOY CYANIDE DETOXIFICATION TESTWORK : SOLUTION ASSAYS

ELEMENT	UNITS	DETOX FEED (Soln ex HS13936)	DETOXIFIED SOLN (From Test D1)	DETOXIFIED SOLN (From Test D2)	DETOXIFIED SOLN (From Test D3)
Hg	mg/l	0.576	0.032	<0.001	0.126
Hg (Rpt)	mg/l	0.723	0.034	-	0.134

APPENDIX B

CYANIDE INFORMATION

INFORMATION ABOUT CYANIDE

Cyanide use in Canada

Cyanidation is the most effective and conventional means of extracting gold from gold ores, and it has been used commercially for over a century. Today 90% of the world's gold production from about 460 mining operations involves the use of cyanide. All of the fifteen major gold mining operations in Canada use cyanide as the main processing method. There have been no documented accidental human deaths due to cyanide poisoning in North American (or Australian) mining industries in the last 100 years. Table 1 presents the Touquoy Gold Project as comparable to major successfully operating gold mine processing plants elsewhere in Canada.

Table 1. Canadian Gold Mining Operations

Operation	Operator	Location	Mine Type	tpd	Process	Effluent treatment
Campbell	Goldcorp	Balmertown, Ont	UG	1,850	Gravity/float pressure ox/CIP	SO_2-air
Red Lake Complex	Goldcorp	Balmertown, Ont	UG	800	Gravity/CIL/float	Inco air-SO_2
Dome (Porcupine JV)	Goldcorp/Kinross	Timmins, Ont	OP	12,500	Gravity/CIL	Inco air-SO_2
Musselwhite	Goldcorp/Kinross	Thunder Bay, Ont	UG	3,000	Gravity/CIP	Wash, then Inco air-SO_2
Williams	Barrick/Teck	Hemlo, Ont	UG/OP	9,600	Gravity/CIL	Natural degradation, ferric.
David Bell	Barrick/Teck	Hemlo, Ont	UG	1,370	Milled at Williams	
Doyon	Iamgold	Preissac	UG	2,300	CIP/CIL	H_2O_2 or natural degradation
Sleeping Giant	Iamgold	Val d'Or/Amos, PQ	UG	910	CIL	H_2O_2
Holt McDermott	St Andrew Goldfields	Matheson, Ont	UG	3,000	CIL	Natural degradation
Holloway	St Andrew Goldfields	Matheson, Ont	UG	1,500	Milled at Holt McDermott	.
Stock Mill	St Andrew Goldfields	Timmins, Ont	UG/OP	1,500	Gravity/CIL	Inco air-SO_2
Macassa	Kirkland Lake Gold	Kirkland Lake, Ont	UG	1,600	CIP	Natural degradation, ferric.
Eagle River	Wesdome Gold Mines	Wawa, Ont	UG	1,000	Gravity/Merrill Crowe	H_2O_2
Kiena Mill	Wesdome Gold Mines	Dubuisson, PQ		2,000	CIP	H_2O_2
Seabee	Claude Resources	La Ronge, Sask.	UG	1,100	CIP	Natural degradation
Sigma-Lamaque	Century Mining	Val d'Or, PQ	OP	5,000	Gravity/CIL	Natural degradation
Casa Berardi	Aurizon Mines	Casa Berardi, PQ	UG	2,200	Gravity/CIP	Inco air-SO_2
Touquoy	DDV Gold	Moose River	OP	4,500	Gravity/CIL	Inco air-SO_2

Previous use of cyanide by the Proponent

As noted elsewhere, the principals of Atlantic Gold Ltd are former directors and executives of Plutonic Resources Ltd, which through the 1990s was one of the largest gold mining companies in Australia. During 1989 to 1998, before its takeover by US-based Homestake Mining Company, Plutonic Resources owned, developed and operated six gold mines, each with its own dedicated processing plant, in Western Australia with a combined annual production of about 500,000 ounces gold.

All six processing plants incorporated a gravity circuit and a cyanidation circuit (carbon-in-leach or carbon-in-pulp) similar to that proposed at Touquoy. Destruction of residual cyanide in the tailings effluent was effected by natural degradation within the tailings dams. Tailings dams were constructed with sufficient freeboard to accommodate precipitation from annual cyclonic storm events. No adverse incidents relating to the use of cyanide at these mines arose during Plutonic Resources' operation at these sites.

Instances of cyanide mismanagement involving mining/processing

There have been relatively few, but well publicised, adverse events relating to mismanagement of cyanide elsewhere in the gold mining industry. These can be ascribed to four main factors:

- Operations in jurisdictions with poorly developed legislation and management controls
- Poorly controlled heap-leach type processing
- Untreated tailings discharged to tailings dam
- Poorly constructed tailings dam, and without contingency for adverse climatic events.

The Proponent will comply with all relevant Canadian federal legislation controlling the transportation, handling and use of cyanide (and dangerous goods generally) which is comprehensive and strict.

To avoid these situations at the Touquoy Gold Project, Cyanide will be safety and effectively managed in the following ways:

- There will be no heap-leach type processing. All process is physically contained.
- Residual cyanide in the tailings will be destroyed in a dedicated circuit prior to discharge to the tailings dam to the extent that initial cyanide levels in the tailings dam, prior to the effect of natural degradation, will be <10ppm.
- The tailings management facility is being designed and engineered by globally reputable experts (Golder Associates) with monitoring and mitigation protocols established.

Breakdown Products of Cyanide

The following text is from "Process and Environmental Chemistry of Cyanidation" by Jurgen Lorosch, 2001, Chapter 7, pp 337-350.

All effluent associated with processing of the ore will be treated through a dedicated cyanide destruction circuit, which will destroy about 95% of the residual cyanide, prior to direction to the tailings pond. The breakdown product of cyanide from this operation is cyanate which results from the oxidation of cyanide via the following reaction:

$CN^- + 0.5O_2 = OCN^-$

The cyanate ion in turn hydrolyses in the Tailings Management Facility (TMF) to ammonium and carbon dioxide. Ammonium is on-used by plants as a source of nitrogen.

The approximately 5% of residual cyanide not destroyed in the cyanide destruction process will comprise metal-cyanide complexes (notably ferrocyanide) and CN_{WAD} (weak-acid dissociable cyanide). These products will further attenuate in the TMF through a variety of processes:

(1) Thiocyanate Formation

$S_x^- + CN^- = S_{x-1}^{-2} + SCN^-$

$S_2O_3^{-2} + CN^- = SO_3^{-2} + SCN^-$

Free cyanide forms stable thiocyanate by combining with sulphur from sulphide minerals in the ore.

(2) Base Metal Complexation

$M(CN)4^{-2} = M^{+2} + 4CN^-$

Free cyanide readily complexes with base metals, principally iron, zinc and copper. These cyanide complexes are relatively stable and non-toxic.

Complexes with iron are called ferrocyanides and are considerably more stable than their zinc and copper counterparts. Ferrocyanides do break down when subjected to UV radiation, however, when this occurs in the tailings pond the resulting free cyanide is volatilized to HCN.

$Fe(CN)_6^{-4} + H_2O = [\ Fe(CN)_5\ (H_2O)]^{-3} + CN^-$

Ferrocyanides form a number of highly stable, insoluble compounds with other cations which precipitate at pHs from 2-11. Complexation is only an intermediate step in the attenuation of cyanide which is typically completed through precipitation, adsorption, oxidation and volatilization.

(3) Oxidation to Cyanate

$CN^- + 0.5O_2 = OCN^-$

This is a continuation of the process principle applied in the cyanide destruction circuit, but in the natural environment it occurs only slowly.

As noted above cyanate does not represent a final fate of cyanide in the natural environment. Cyanate undergoes hydrolysis and decomposes quickly to ammonium/ammonia and carbon dioxide.

$OCN^- + 2H_2O = NH_4^+ + CO_3^{-2}$

(4) Adsorption

In the deposited tailings, free cyanide and all base metal cyanide complexes exist in the form of anions. Minerals such as clay, chlorite, feldspar, and aluminum and iron oxides which act as anion exchangers and organic and carbonaceous material all adsorb cyanide and cyanide complexes binding them in the tailings sediments.

(5) Biodegradation

Plants and microorganisms in the soil degrade cyanide though it is recognized that biodegradation is more effective in unsaturated conditions.

(6) Volatilization

$CN^- + H_2O = HCN + OH^-$

The hydrolysis of free cyanide results in the formation of hydrogen cyanide gas. The reaction is pH dependent with the reaction occurring more readily at lower pH.

Given the instantly effective air dilution, levels of HCN directly above the tailings pond would be expected to be below normal detection limits of a typical HCN gas detector of 1ppm.

Studies using more precise accumulative measurement methods in the case of non-detoxified tailings, indicate that HCN concentrations one meter above a tailings pond drop to < 0.1 ppm or two orders of magnitude below the typical workplace threshold limit value of 10 ppm. On this basis, air dilution of naturally volatilized hydrogen cyanide is very effective in reducing HCN concentrations to levels which are harmless to people, animals, or plants.

<u>Products from Cyanide Destruction</u>

The following text is from "Process and Environmental Chemistry of Cyanidation" by Jurgen Lorosch, 2001, Chapter 9, pp 434-440

The SO_2/Air cyanide destruction reaction occurs in the following way:

$CN^-_{Free} + SO_2 + O_2 + H_2O = OCN^- + H_2SO_4$

or

$Me(CN)_4^{-2} + 4SO_2 + 4O_2 + 4H_2O = 4OCN^- + 4H_2SO_4 + Me^{+2}$

Where Me = Zn, Ni, Cd, or Cu

The cyanide is oxidized to cyanate by sulfur dioxide provided by sodium meta-bisulphite and oxygen and catalyzed by the presence of copper. The cyanate decomposes rapidly in the tailings pond into ammonium and carbon dioxide.

The reaction is immediate and little affected by temperature. Optimum pH is 8-10. Sulphuric acid is produced in the reaction and this is neutralized in the alkalic tailings stream.

Hydrogen Cyanide in the Atmosphere

The following text is from "Process and Environmental Chemistry of Cyanidation" by Jurgen Lorosch, 2001, Chapter 7, pp 367).

Only exceedingly low concentrations of HCN gas will be emitted to the atmosphere from the Touquoy operation – from the leach tanks and from the TMF.

HCN release from the leach tanks is negligible because the pH of the solution in the leach tanks will be purposefully maintained at high levels (around 10.5) through the addition of lime to ensure HCN is kept in solution to maximise its leaching efficiency. Any HCN available to volatilize into the air above the leach tanks will be instantly and effectively diluted to levels below the normal detection limits of a typical HCN gas detector, which is 1ppm.

HCN release from the TMF will also be negligible, even though the pH of the tailings will be lower. This is because almost all of the residual cyanide in the tailings will be firstly destroyed in the cyanide destruction circuit prior to discharge of tailings to the TMF. The resultant concentration of CN_{WAD}, the only potential source of HCN, will be <10ppm. CN_{WAD} will then further effectively attenuate in the tailings dam through a variety of mechanisms: formation of thiocyanate, complexation with base metals, further oxidation to cyanate, precipitation of ferrocyanides, biodegradation and absorption by organic matter. Any remaining free cyanide, now <<10ppm, will be available to volatilize into the air above the tailings pond. Given the instantly effective air dilution levels of HCN directly above the tailings pond would be expected to be below normal detection limits of a typical HCN gas detector of 1ppm.

Studies using more precise accumulative measurement methods in the case of non-detoxified tailings, indicate that HCN concentrations one meter above a tailings pond drop to < 0.1 ppm or two orders of magnitude below the typical workplace threshold limit value of 10 ppm. On this basis, air dilution of naturally volatilized hydrogen cyanide is very effective in reducing HCN concentrations to levels which are harmless to people, animals, or plants.

Notwithstanding the insignificant contribution of HCN to the atmosphere from the Touquoy TMF it may be informative to consider the fate of HCN in the atmosphere. Natural emissions of hydrogen cyanide from the burning of biomass and volcanic eruptions generate more than one million tones per year of HCN, about ten times the amount applied (not emitted) by the mining industry annually. Atmospheric studies show that the amount of HCN in the atmosphere is only a fraction of total annual emissions. These low atmospheric concentrations of HCN are known to be constant over time, and unaffected by altitude and location

Mechanisms for attenuation of HCN in the atmosphere include oxidation by ozone and hydroxyl, and "rainout", however neither fully explain the low levels of HCN found in the atmosphere. It is thought that not yet understood processes active in the low atmosphere, perhaps uptake by the oceans, are responsible for the removal of the majority of hydrogen cyanide. The result is that HCN emissions account for less than 1% of all nitrogen in global NOx. In addition, due to overlaps with other infrared absorbers, HCN does not contribute to the greenhouse effect.

APPENDIX C

GOLDER REPORT - STATIC TESTING OF WASTE ROCK

DRAFT
REPORT ON

RESULTS OF STAGE I GEOCHEMICAL STUDY
STATIC TESTING OF WASTE ROCK
TOUQUOY PROJECT
NOVA SCOTIA, CANADA

Submitted to:

Atlantic Gold NS.
Suite 701, 220 Pacific Highway
Crows Nest
NSW 2065 Australia

DISTRIBUTION:

2 Copies	-	Atlantic Gold NS
2 Copies	-	Golder Associates Ltd.

December, 2006 06-1118-041c

EXECUTIVE SUMMARY

A geochemical characterization program was undertaken for Atlantic Gold NL (Atlantic) for the Touquoy Project. This project is a Gold deposit that will be extracted by open pit. The Touquoy site is located in Moose River Gold Mines region of Halifax County in the central part of Nova Scotia, Canada, approximately 140 km northeast of Halifax.

After a background review and a site visit that included consultation with the site geologist and review of the core, 83 waste rock samples and 11 marginal ore samples were collected. These were taken from the major lithologies identified and include:

- Argillite (<5% greywacke)
- Argillite (5-49% greywacke interbeds)
- Greywacke (<20% argillite interbeds)
- Greywacke (20-50% argillite interbeds)
- Minor quartz veining.

Although a reasonable number of samples have been collected from each of the major lithologies, the western portion of the pit is under-represented due limitations with respect to available drill core at the time of sampling.

Based on the test program completed the key conclusions and recommendations are as follows:

- Concentrations of sulphide control the acid generating potential of a sample since the neutralizing potential is generally similar among the various waste rock types. The sulphide content typically decreases with increasing greywacke content. Mineralogy and solids analysis indicate that calcite is the dominant control on buffering capacity.
- Based on acid-base accounting results received to date, waste rock and marginal ore units on the whole are considered to be non acid generating, however the tailings have some potential to generate acidity
- Arsenic is elevated in all of the units relative to typical crustal abundances with an overall average of 1000 ppm and an overall median of 160 ppm. The maximum arsenic concentration of 15000 ppm was observed in the Argillite (<5% greywacke interbeds) unit.
- Compared to the waste rock and marginal ore units, the tailings sample had bulk chemistry similar to the host rocks; however, it is enriched in various trace metals including: chromium, copper, manganese and molybdenum relative to the host rocks. The presence of these trace metals is likely associated with gold mineralization.

- Short term leach testing on waste rock and tailings indicate that cyanide, arsenic, aluminum, lead, iron and zinc warrant further investigation relative to the overall site water quality:

Based on the results and conclusions, key recommendations are as follows:

- Additional supplemental samples from the western portion of the pit should be collected and analyzed to ensure that the current samples set is representative of this material. It is our understanding that infill drilling will be commencing in the near future and geochemical samples could be collected as part of this drilling campaign and tested.

- Areas of high sulphide waste need to be considered in terms of the waste rock management plan. Sulphide concentrations can be included in the block model and a tonnage of expected acid-generating waste can be estimated through developing a sulphide cut-off once the carbonate reactivity from the humidity cell testing has been established.

- Although some parameters exceed the CCME guidelines in the short-term leach testing, supernatant aging tests and in the tailings humidity cell, this water will not be discharged directly to the environment. A detailed water quality assessment in the context of the site wide water balance is required to develop a meaningful water quality assessment for the Touquoy site and the uncertainty in several variables must be evaluated.

- It is expected that under oxidizing conditions, dissolved concentrations (particularly arsenic) could exceed those observed in the short-term leach testing and this water may need to be treated before it is discharged to the environment. The leachability of the arsenic under oxidizing conditions needs to be quantified and the resulting concentrations will need to be assessed in the context of the overall site water quality. The expected reaction and loading rates from the pile need to be determined when sufficient humidity cell data becomes available.

- The natural degradation of cyanide needs to be assessed relative to the site specific characteristics and relative to the site water quality for the Touquoy project. It is important to note that in the current testwork, the tailings sample was detoxified down to CN-wad <1 ppm. Based on recent discussions (pers comm., 2006) Atlantic is expecting to be able to detoxify cyanide to <10 ppm. To ensure the above results remain valid, it is recommended that additional tailings testing be conducted in the future when a decision has been reached regarding the process specifics of the Touquoy project.

- Suspended solids contribution to site water quality needs to be assessed in the context of the current data, mine plan and water balance.

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NOTE: APPENDIX B AND C NOT INCLUDED AS THEY CONTAINED PROPRIETARY INFORMATION

1.0 INTRODUCTION

This report provides information regarding the geochemical characterization of the Touquoy Gold deposit in the Moose River Gold Mines district of Nova Scotia, Canada. Golder Associates (Golder) was retained by Atlantic Gold NL (Atlantic) to provide a geochemical characterization of the anticipated mine waste materials at the Touquoy property in support of Feasibility Studies, currently in progress.

In mining operations, the natural weathering of soils and rock typically is accelerated as these materials are disturbed and exposed to the atmosphere. This enhanced weathering may result in impacts to water resources (i.e., groundwater, surface water). It is therefore necessary to evaluate the quantity and composition of possible runoff and leachate from the disturbed material to assess the potential implications to mine design and the environment. The results may influence the mine plan and may have ramifications with respect to the overall acceptance by the appropriate regulatory agencies. If a potential problem is identified, mitigation measures can often be developed to prevent, reduce or eliminate the impact.

Environmental impacts of most concern commonly are those associated with the presence of reactive sulphide minerals. When sulphides are exposed to the atmosphere, they have the potential to react with oxygen and water to produce acid rock drainage (ARD). The resulting acidity may then be neutralized by minerals that contain buffering capacity. Carbonate minerals generally are the most effective in counteracting acidic conditions, but other minerals (e.g., silicates) may contribute as well. If insufficient buffering minerals are present, significant quantities of acidity, sulphate and metals may be released from the mine wastes. However, it should be noted that metal leaching (ML) can also occur in the absence of reactive sulphides under non-acidic conditions due to dissolution of soluble mineral phases. In addition, release of nutrients (e.g., ammonia, nitrate) may take place due to the presence of residual explosives. Therefore, the geochemical characterization program needs to be comprehensive and not just focus on the generation of acid rock drainage.

1.1 Scope of Work - Geochemistry

The primary objective of the geochemical characterization program is to provide sufficient data for chemical stability evaluation of the various materials expected to be produced in mining and mineral processing. This evaluation will allow for comparisons to be made with existing environmental conditions such that the potential for environmental impacts can be evaluated.

Other specific objectives of the baseline geochemistry program include:

- Development of a defensible geochemical database sufficient for mine planning and decision making purposes;

- Development of estimates of the potential for ARD and metal leaching for use in site water quality assessments; and,

- Development of appropriate data to support decisions related to environmental management strategies, material handling strategies or mitigation measures, as required.

The testing program described in this report was designed to evaluate the metal leaching potential and acid generating capacity of the waste rock, marginal ore and tailings that may be deposited on site. The characterization of the mine wastes was completed using representative samples that not only evaluate specific rock types, but also evaluate the deposit characteristics on a scale that is relevant to the proposed mining operations (e.g. in addition to specific rock-type samples, composite samples over the expected open pit bench height intervals are used in the assessment).

The Phase I geochemistry test work includes both short term (static) and long-term (kinetic) tests to determine the chemical stability of these materials. The implications of these results with respect to the Touquoy Project are discussed, as are possible mitigation measures and follow-up work that should be considered as the project progresses into operations.

2.0 BACKGROUND GEOLOGY AND PROJECT DEVELOPMENT

2.1 Project Overview

The Touquoy Gold deposit is located approximately 140 km northeast of Halifax in the Moose River Gold Mines district in the Halifax County, Nova Scotia, Canada. The proposed site will occupy an approximate footprint of 320 ha. The Touquoy site is mainly characterized by low-relief and hummocky topography. The site is located inland, sheltered from the immediate effects of the Atlantic Ocean, such that climate conditions are characterized by warmer summers and cooler winters (Atlantic, 2006). A Meteorological Service of Canada climate station (ID#8203535) is located approximately 15 kilometers from the site location near Middle Musquodoboit. A 35 year climate record from 1968-2003 indicated monthly temperatures vary from -6.2°C in January to 18.4°C in July and average monthly precipitation varies from 97 mm in June to approximately 138 mm in December (Atlantic, 2006).

Based on the current project description (Atlantic, 2006), ore will be extracted through an open pit operation with an anticipated mine life of 5 to 7 years and a mill capacity of 4,000 – 5,000 tpd. Currently, the Touquoy property has an estimated total resource of approximately 9.76 Mt at a grade of 1.8 g/t and is expected to yield approximately 554,500 oz gold (Atlantic, 2006). The ore is disseminated throughout the sedimentary host rocks and is visually indistinguishable from waste materials. During operations, the ore will have to be delineated through grade control drilling for each bench as the pit evolves (Atlantic, 2006).

The project description indicates that gold will be removed from the ore in a process involving the following two stages: gravity concentration and carbon-in-leach (CIL) procedure (Atlantic, 2006). Tailings produced during process with be detoxified using the INCO SO_2/Air procedure before being deposited as a slurry at approximately 50% solids into the tailings management facility (TMF).

2.2 Background Geology

The Touquoy deposit is formed in the Meguma Group sediments of Nova Scotia. These are defined as a series of greywacke and argillite sedimentary rocks underlying approximately half of the province of Nova Scotia. Two main lithological units occur at the Touquoy Project: argillite and greywacke. Varying degrees of interbedding occur within these two units and the above can be further subdivided as follows:

- Argillite (<5% greywacke interbeds)
- Argillite (5-49% greywacke interbeds)
- Greywacke (<20% argillite interbeds)

- Greywacke (20-50% argillite interbeds)

Minor quartz veining is also present in the Touquoy deposit; however, unlike the majority of gold deposits in Meguma sediments, mineralization at Touquoy is found disseminated throughout the sediments and is not associated with quartz veining (Atlantic, 2006).

The bedrock geology is overlain by approximately 3 metres of glacial till. The overlying sediments are mainly composed of quartzite with drumlins composed of local and foreign materials. The quartzite is described by Atlantic (2006) as bluish-grey, loose, cobbly silt-sand till which grades into a sandier, coarser till with occasional clay inclusions.

Topsoil at the Touquoy site is part of the Danesville and Wolfville series and primarily consists of loams to sandy loams and sandy clay loams with some gravely and stony areas (Atlantic, 2006).

Table 1 outlines the initial percentages of each material expected to be encountered (Carter, 2006). These tonnages formed the basis of waste rock distribution. It should be noted that the percentages of each lithology are based on the estimated distribution of ore among the various lithologies and the waste rock to be extracted during operations is also considered to be distributed in the same proportion (Carter, 2006).

2.3 Rock/Overburden Use

All rock types are anticipated to be directed towards the waste rock storage facility (WRSF) unless designated as ore. Topsoil will be stockpiled for later use in site reclamation activities or used in the construction of an annular safety berm approximately 30m outwards from the open pit. The underlying till will also be used in the construction of the safety berm and in the construction of other site infrastructure such as tailings dam embankments and for site levelling.

3.0 METHODS

Sample selection methods and test methods are summarized below.

3.1 Sample Selection

Waste Rock

Waste rock sample selection was conducted to meet the following objectives:

- Identify the major waste rock units and those units that will potentially be exposed on the open pit surface and in the waste rock disposal area(s); and
- Collect samples from these units that are spatially and compositionally representative of each rock type.

During the site visit, a review of the background data (geologic and design information) was conducted to develop an understanding of site components and lithologic units/alteration types that might affect the overall geochemistry of the site. Consultation with site personnel in addition to reviewing logs, cross sections and core made available, aided in the identification of major lithologies. The following prevalent lithologies types were identified:

- Argillite (<5% greywacke interbeds)
- Argillite (5-49% greywacke interbeds)
- Greywacke (<20% argillite interbeds)
- Greywacke (20-50% argillite interbeds)
- Massive quartz veins
- Argillite and greywacke composites.

The massive quartz vein is defined as an individual unit when it present for at least 50% of a one meter drill interval (Diamond Ventures NL, 2004). The argillite and greywacke composites represent sections of core where the lithology was too variable over the sample interval that no one lithological classification could be used. Composite samples were collected in areas of the pit where the composite lithologies are expected to contribute significantly to the waste rock.

In order to obtain samples of the different rock types to be encountered, Golder used the available cross-sections to evaluate rock type distribution. Samples were targeted within a preliminary pit outline (Mining Solutions Consultancy Pty Ltd., 2006) available as a trace on the cross-sections. There were some limitations with respect to developing a spatially representative sample set resulting from core availability at the time of sample selection, since some of the core had been used for metal assays, particularly in the western zone of the pit.

The sample list was generated based on cross-sections from the central portion of the pit and the margins of the pit. A visual estimate of the lithology from the cross-sections was used as a guide to collect samples in proportion to the distribution of the various lithologies. Once a final mining sequence plan is made available, these proportions will be checked for representativeness.

In addition to ensuring lithological representativeness, samples were also selected across the length and depth of the intended pit to obtain spatial variability to the extent possible using available core. Drillholes selected from the cross-section were sampled at length from near surface to near the pit bottom to provide a depth distribution. In general, samples were comprised of 10-m intervals of core. This interval length was chosen to mirror a typical bench height used during open pit excavations.

Marginal Ore

In addition to waste rock sampling, marginal ore samples were also collected on site for geochemical characterization of a marginal ore stockpile. It was determined on site by Atlantic personnel that marginal ore would be defined by grades ranging from 0.7 to 0.9 g/t (Atlantic pers comm., 2006). The geologic sections were reviewed to target continuous sections of core with grades in the range of 0.7 to 0.9 g/t trying to maintain an average grade of approximately 0.7 to 0.8 g/t. Occasionally, rock with grades >0.9g/t or <0.7g/t were included in some of the targeted lengths since it is expected that this material may also end up in the marginal ore pile. Marginal ore samples were identified over the longest possible interval to maintain the desired gold grade average.

Tailings

A master-composite head sample provided by Atlantic was leached and detoxified by SGS Lakefield in Ontario, Canada, under the direction of Atlantic's metallurgist, Sydney-based Peter Lewis and Associates to produce a tailings sample reported to be representative of the expected process byproduct at the Touquoy site (Lewis, 2006). Due to the expected homogeneity of the Touquoy deposit, only one tailings sample was prepared to represent the tailings materials that will be produced during operations (Lewis, 2006). Additional tailings preparation and analysis is to be completed.

3.1.1 Sample Collection

Waste Rock & Marginal Ore

Once a final list of samples was assembled, lengths of core from the identified boreholes were retrieved from storage and laid out. Golder personnel then reviewed the core to evaluate the sample lithology visually relative to the core record. Waste rock samples were collected over approximately 10-m intervals. Some intervals were shorter, depending on the overall condition of the core and core recovery.

Two to three kilogram samples were collected comprising several smaller subsamples (approximately 10-cm lengths) collected at regular intervals (approximately at each metre) across the length of each sample. The sub-samples were visually representative of the sub-interval from which they originated. Samples were placed in bags with and were clearly labelled with a unique sample number in indelible marker. The bags were sealed and samples were then gathered into larger bags and labelled with shipment details. As samples were removed from the core, the core box was marked to indicate where the sample was removed. All samples were shipped from site to the analytical laboratory in Lakefield, Ontario (SGS Lakefield).

A total of 83 waste rock and 11 marginal ore samples were collected. Initially 84 waste rock samples were targeted, but based on a review of the average gold grades in the sample suggests that one waste rock sample (06-008) was more representative of material that may end up in the marginal ore stockpile. This sample had grades ranging from 0.012 to 2.01 g/t with an average of 0.62 g/t. Table 2 provides a summary of waste rock and marginal ore samples collected from the site.

Tailings

A wet head sample to be leached and detoxified was shipped directly by Metcon Laboratories in Australia to the analytical laboratory, SGS Lakefield, in Lakefield, Ontario, Canada. Table 2 summarizes the details of this sample.

3.2 Laboratory Testing Methods

Selected samples were submitted for static testing, and the tailings sample was submitted for longer-term kinetic testing. These tests are summarized below. Additional details on these test procedures are provided in Price (1997) and in ASTM (2001). The geochemical testing was conducted by SGS Lakefield Research in Lakefield, Ontario.

3.2.1 Static Testing

Static tests are "one-time" analyses to determine the general geochemical characteristics of a sample and are typically the first step in the assessment and prediction of acidic drainage and metal leaching. For an individual sample this testing might comprise a combination of the following:

- Modified Acid Base Accounting (Modified ABA) – used to develop estimates of the potential for acid generation based on the balance between acid producing and acid buffering minerals;
- Elemental Analysis on Solids and/or Whole Rock Analyses – used to determine the total amount of metals in the solid phase of the rock samples;
- Short-Term Leach Testing – used to develop initial estimates of metal leaching from weathered materials; and
- Mineralogy – used to identify mineral assemblages as they have a large influence on acid generating and buffering reactions.

<u>Modified ABA</u>

Acid-base accounting (ABA) was conducted to determine the acid generation potential of the waste rock and tailings. ABA testing included the following parameters:

- Paste pH;
- Sulphur species (including total sulphur, sulphide sulphur and sulphate);
- Neutralization potential (NP) by the modified Sobek method;
- Carbonate NP (CaNP) by carbon dioxide analysis; and
- Calculation of acid potential (AP), net neutralization potential (NNP), neutralization potential ratio (NPR, or NP/AP), and carbonate neutralization potential ratio (CaNP/AP).

ABA is used to determine the balance between the acid-generating potential (AP) and acid neutralizing potential (NP) of a particular material. There are a number of standard protocols used for the determination of ABA as summarized in Price (1997). For this characterization, a modified Sobek method was used (based on Sobek et al., 1978). Rather than calculating an AP based on total sulphur, the AP is calculated using sulphide-sulphur. This assumes that all the sulphide sulphur is present as pyrite and that each mole of pyrite generates four moles of hydrogen ions upon oxidation. Using sulphide sulphur instead of total sulphur values avoids the over-estimation of the AP that may occur by incorporating other oxidized, non-reactive forms of sulphur.

The NP is generally determined by sample acidification with sulphuric acid and back-titration to identify acid consumption as described in Sobek et al. (1978). A common alternative method for the estimation of NP makes use of carbonate analysis. On the assumption that all carbonate represents calcite [$CaCO_3$] a conversion is performed to calculate the amount of calcite. This form of NP is thus referred to as carbonate neutralization potential (CaNP). Use of CaNP is considered to be a more conservative measure of available neutralizing potential than the "bulk" NP Sobek methods. In many cases, the Sobek method has been shown to overestimate available neutralizing capacity due to the dissolution and subsequent acid consumption by silicate minerals during the test. However, under ambient conditions, dissolution of silicate minerals generally is too slow to provide effective buffering capacity, and only the readily-available CaNP is released.

Paste pH is a test to measure the pH that a sample generates upon contact with water. The pH is measured in a paste formed by mixing water and a crushed rock sample (Steffen et al., 1989). This test is a qualitative indicator of the capacity of the sample for the immediate dissolution of calcium carbonate as well as the presence of stored acidity.

A number of criteria have been proposed for assigning an ARD potential to a material using ABA results. The most common approaches are those based on the use of the neutralization potential ratio (NPR = NP/AP). For several reasons, no single ratio of NPR values has been identified to have universal applicability with respect to acid generation prediction. The actual threshold values for a particular solid are material specific, and depend on factors including the amounts and type of acid generating and neutralizing materials, morphology, crystallinity, grain size, chemical composition, paragenesis, texture and site-specific exposure conditions.

For the purpose of this study, acid generation potential (AP) was calculated using sulphide-sulphur (modified Sobek method). Sulphide sulphur is used for this purpose, as it is considered to represent the reactive sulphur component. NPR guidelines suggested by Price (1997) are summarized below:

Potential for ARD	**Criteria**	**Comments**
Likely	NPR <1	Likely acid generating, unless sulphide minerals are non-reactive.
Uncertain	1< NPR <2	Possibly acid generating if NP is insufficiently reactive or is depleted at a rate faster than sulphides.
Low	2< NPR <4	Not potentially acid generating unless significant preferential exposure of sulphides along fractures planes, or extremely reactive sulphides in combination with insufficiently reactive NP.
Unlikely	NPR >4	Not expected to generate acidity

In addition, the relationship between paste pH and sulphide sulphur content was considered. Materials with a sulphide sulphur content of less than 0.3 wt.% and a paste pH greater than 5.5 may be classified as non-acid generating (Price, 1997) except where the rock matrix consists of base poor minerals (e.g., quartz), or where the sulphide minerals contain metals that may leach under weakly acidic to alkaline conditions.

Elemental Analysis

Elemental analysis was performed to determine the solid-phase content of most metals in a material or the reservoir of an element in the material, to characterize the chemical composition of the rock samples. Two analytical methods were used. XRF was used to quantify the major oxide content of the rock and ICP was used to quantify trace metals.

The elemental composition provides a basis for comparison between and within lithologies. In addition, if necessary, element data can be used in conjunction with results from leach tests to develop predictive, quantitative relationships between metal content and leaching rate. Results were also compared to average crustal abundances as presented in Price (1997).

Short-Term Leach (Modified SWEP) Testing

Short-term leach tests are primarily used as a screening tool for qualitative identification of elements of potential environmental concern and to evaluate the extent of weathering of the core. The results of this type of testing do not translate directly to the expected environmental behaviour of the rock because of the small size of the test, the reduced grain size of the materials, the short duration, and the enhanced contact between liquid and the solid test charge during the test.

The short-term leach test utilized in this characterization program was a modified version of the U.S. EPA Method 1312 Synthetic Precipitation Leach Procedure (SPLP) (U.S.EPA, 1998). The modification involved use of a water to rock ratio of 4:1 (by weight) rather than the standard ratio of 20:1. This was done to reduce the possibility of inadvertently diluting solutes to concentrations below their respective detection limits. A 100 g of solid sample was mixed with 400 mL of a dilute sulphuric/nitric acid solution at a pH of 5. The sample container was then rotated end-over-end in an agitator for 18 hours after which, the leachate samples were collected, filtered and analyzed using ICP-MS.

Results of short-term leach tests are very sensitive to the methodology used and can therefore exhibit considerable variability related to the specific test methodology used. As such, the SPLP test does not represent field conditions. In particular, the solid to solution ratio can have a profound effect on leachate composition, and anticipated relationships between the degree of dilution and leachate quality are rarely observed. In addition, the SPLP simulates metals leaching by simple dissolution of readily-soluble mineral phases in response to a single, natural precipitation event (e.g., a "first flush" event). The test is therefore not intended to simulate transient conditions and reactions, such as sulphide oxidation. To assess reaction rates and long term conditions, results from the laboratory kinetic tests are typically used.

Despite these limitations, results from the SPLP test are useful in that they provide a first indication of elements of potential environmental concern. However, since the leachate compositions cannot be directly related to full-scale, ambient operational or post-closure conditions they should not be quantitatively compared to water quality guidelines.

Mineralogy

Mineralogy is a controlling factor in the geochemical behaviour of a material. For example, iron identified in the trace metal analysis may occur in acid generating pyrite, or acid neutralizing calcium-iron carbonate, or some other form of oxide. Mineralogy testing is performed to better understand the composition of the material.

3.2.2 Kinetic Testing

Kinetic tests are repetitive leach tests on a representative sample designed to evaluate potential material reactivity, mass loading and/or leachate water quality of the sample over time.

Laboratory Humidity Cell Tests

A humidity cell is a weathering chamber designed to provide simple control over air, temperature and moisture, while allowing for the removal of weathering products (principally oxidation products) in solution. For the laboratory testing a standard humidity cell procedure as described in ASTM D5744-96 Standard Test Method for Accelerated Weathering of Solid Materials Using a Modified Humidity Cell (ASTM, 2001) is used. This type of laboratory testing also provides the fundamental data necessary to complete a preliminary evaluation of reaction rates for acid generating minerals, reaction rates for neutralizing minerals, metal leaching rates, mass loading rates and possible water quality implications.

The standard humidity cell test requires approximately 1 kg of sample (ASTM, 2001). Prior to placement in the test cell, the sample is wetted, flushed, and rinsed. This is followed by a weekly cycle of dry air, humid air, and flushing. The flushing takes place by adding 500 mL of the lixiviant to the top of the cell and allowing it to soak the samples for a specified period. The leachate resulting from the flushing is filtered and analyzed for a limited set of standard parameters on a weekly basis, as well as for a more comprehensive suite of analytes at greater time intervals.

A humidity cell has been initiated for the tailings sample and waste rock humidity cells have been selected and initiated.

4.0 RESULTS

This section presents the results of the static test analyses for the Touquoy deposit. Detailed results from static testing are provided in Appendix A.

4.1 XRF and Trace Metals

The composition of the samples as determined by the XRF results and trace metals analyses are summarized in Tables 3 and 4. Histograms showing the distribution of results for each rock type are presented in Figure 1 and 2. The dots on the figures represent static test results from the samples selected for short-term leach and kinetic testing.

Average elemental compositions of the principle rock types are similar as is expected in turbidite depositional sequences such as the Meguma Formation. This is supported in the varying degrees of interbedding of sandstone/argillite in the argillite and sandstone units. The elemental similarity between the rock units at the Touquoy site suggests lithologies differ in grain size and are likely derived from similar host rocks.

Elemental compositions were also compared to the average crustal abundances for clastic sedimentary rocks (Price, 1997). It is important to note that the average crustal abundances provide a basis of comparison and elements elevated relative to these values does not necessarily mean it will be an environmental concern. The average crustal abundances provide a starting point to identify elements that require additional investigation relative to the overall site water quality.

Compared to the average elemental compositions for clastic sedimentary rocks (Price, 1997), arsenic concentrations are elevated in all of the principle rock units. The overall arsenic average was 990 ppm for the samples collected from the Touquoy site. Arsenic concentrations were observed to be highest in the argillite (<5% greywacke interbeds) with an average of 1625 ppm and a maximum of 15,000 ppm. Although the maximum concentration skews the average in this unit, the median value of 990 ppm also remains elevated over the average crustal abundance of 13 ppm. The argillite (5-49% greywacke interbeds), greywacke (<20% argillite interbeds), greywacke (20-50% argillite interbeds), composite sample and the quartz vein units had average arsenic concentrations of 740 ppm, 900 ppm, 910 ppm, 220 ppm and 250 ppm respectively. Arsenic concentrations in the marginal ore and the tailings sample were 615 ppm and 160 ppm respectively.

The average concentrations of silver and selenium were also observed to be elevated relative to the average crustal abundances for clastic sedimentary rocks. Maximum average concentrations of silver (0.73 ppm) and selenium (2.3 ppm) occurred in the quartz vein and the marginal ore units respectively. Maximum concentrations of silver (1.1 ppm) and selenium (7.0 ppm) were observed in the argillite (<5% greywacke interbeds). The leachability of these metals will be assessed during the Phase II kinetic testwork.

4.2 Acid Generating Potential and Metal Leaching Static Testing

ABA and short term leach testing was performed on waste rock and marginal ore to quantify the acid generating and metal leaching potential of these materials. The tailings sample was also submitted for ABA testing to characterize the tailings acid producing potential. Humidity cell testing has commenced for the tailings sample to quantify the expected leachability of the solids and subsequently, an aging test was completed on the supernatant to characterize the water quality of the process water.

Results of the ABA testing are summarized in Table 5 and in Figures 3 through 6. Short term leach test results are summarized in Table 6 and are provided graphically in Figure 7. It is important to note that short-term leach analyses are aggressive leaching tests that generally produce elevated dissolved elemental concentrations that are not representative of what would occur under ambient conditions. Comparisons relative to environmental guidelines are applied here to identify elements that need to be investigated further. Appendix B graphically shows the sample locations.

The above static test results are discussed below for each of the major lithologies, followed by a more general discussion of the relationship of the results, including a discussion of the remaining lithologies that occur in minor amounts.

4.2.1 Argillite (<5% greywacke interbeds)

The argillite (<5% greywacke interbeds) unit, referred to here as the "argillite unit", is expected to comprise 88% of the waste rock (Carter, 2006) and as such, represents the majority of the sample population. Of the ore, 88% is also expected to occur in the argillite unit. In total, 39 samples were collected from the argillite. Of the 39 samples, 11 were from the Western portion, 18 were from the Central portion and 10 were from the Eastern portion relative to the current open pit design. ABA results also exist for four samples previously collected by Atlantic and were included into the static results database.

Acid-Base Accounting

Results of the ABA testing for the argillite unit are presented in Table 5 and in Figures 3 through 6. Total sulphur and sulphide content was elevated in the argillite compared to the overall waste rock. The total sulphur content of the argillite samples reach a maximum of 1.6% with an overall average of 0.4% and a median value of 0.25%. As presented in Figure 3, the majority of this sulphur occurs as sulphide for samples containing lower total sulphur concentrations (e.g. <0.3%). As the total sulphur concentration increases, more of the sulphur is attributed to sulphate. The argillite unit has the lowest carbonate concentration compared to the principle rock types with and average concentration of 1.58%. This is slightly below the overall average of 1.83 %.

As can be seen in Figure 4, only a weak correlation exists between the bulk neutralizing potential (NP) and the carbonate neutralizing potential (CaNP), indicating the neutralizing source varies in the argillite unit. Comparing the NP to the acid producing potential (AP) is provides an indication of the potential for a sample to generate acidity. CaNP/AP ratios provide a conservative estimate of the acid producing potential of a sample since it excludes the bulk NP component. Based on the CaNP/AP ratios calculated for the argillite unit and employing the criteria of Price (1997), 18 samples have some potential to produce acidity (Figure 5) whereas only 12 are identified as having some acid potential using NP/AP ratios (Figure 6). Of the 18 samples that are described as having some potential to produce acidity (i.e. CaNP/AP < 4), two are likely acid generating, three are possibly acid generating and the remaining 13 have low acid producing potentials.

It is important to note that for some of the argillite samples, the CaNP is greater than the bulk-NP (Figure 4). This can be attributed to the difference in the determination methods of the two parameters. As described in Section 3.2.1 the bulk-NP is acidified and back titrated to determine the amount of acid consumed whereas the CaNP is based on a theoretical stoichiometric conversion assuming all of the carbonate is in the form of calcite. Mineralogical analyses on two argillite samples (06-049 and 06-073) indicate that although the majority of the carbonates take the form of calcite, dolomite (maximum 11.8%) and ankerite (maximum 22.4%) are also present in the samples. Since dolomite is less soluble and iron and manganese ankerites produce no net neutralizing potential (Price, 1997), the CaNP could be overestimated on the basis of the stoichiometric conversion. NP consumptions rates and sulphide production rates will have to be further assessed when sufficient humidity cell data becomes available.

Short Term Leach Testing

Leach testing was done on a subset of 17 argillite samples and results of this testing are presented in Table 6 and Figure 7a. Based on the test results, average aluminum (0.4 mg/L) and arsenic (0.2 mg/L) and maximum concentrations of iron (0.4 mg/L), lead (0.0012 mg/L) and zinc (0.08 mg/L) exceeded CCME (1999) guideline values. The maximum concentration of arsenic (1.3 mg/L) exceeded the MMER (2002) guideline value of 0.5 mg/L. All of these parameters require further consideration with respect to site water quality.

4.2.2 Greywacke (<20% argillite interbeds)

The greywacke (<20% argillite interbeds) unit, referred to here as the "greywacke unit", is expected to account for 2% of the waste rock and ore (Carter, 2006) in the current pit model. Ten samples in total were collected from this unit. All of the samples were collected from the Western portion of the current open pit design. Five existing samples collected by Atlantic were included in the greywacke unit statistical calculations.

Acid-Base Accounting

Results of the ABA testing for the greywacke unit are presented in Table 5 and in Figures 3 through 6. The total sulphur content of the greywacke samples reach a maximum of 0.6% with an overall average of 0.15%. Sulphide concentrations range from 0.03 to 0.6% and although a positive correlation exists between sulphide and total sulphur, sulphate concentrations also contribute a significant component to the total sulphur and range from 0.002 to 0.3% (Figure 3).

Carbonate concentrations in the greywacke unit range from 1.3 to 2.9% and contribute the majority of the bulk-NP (Figure 4). Compared to the acid producing potential of the greywacke unit (Figures 5 and 6), the greywacke contains sufficient neutralizing potential to buffer acid production and all of the samples are classified as unlikely to produce acidity using the criteria of Price (1997).

Short Term Leach Testing

Leach testing was done on a subset of three greywacke samples and results of this testing are presented in Table 6 and Figure 7c. Based on the test results, average aluminum (0.5 mg/L) and arsenic (0.09 mg/L) and maximum concentrations of lead (0.0013 mg/L) and zinc (0.05 mg/L) exceeded CCME guideline values. All of these parameters require further consideration with respect to site water quality.

4.2.3 Mixed Units

Mixed units at the Touquoy site collectively account for approximately 10% of the waste rock and ore that will be extracted from the open pit during operations (Carter, 2006). For discussion purposes, the following are considered as mixed units: argillite (5-49% greywacke interbeds), greywacke (20-50% argillite interbeds) and composite samples. As the names suggest, the mixed argillite (5-49% greywacke interbeds) contains a higher proportion of greywacke and vice versa for the greywacke (20-50% argillite interbeds). Composite samples of the argillite, greywacke and interbedded units were collected in areas where the variability of these units was too high to be considered as one unit but are considered to provide a significant proportion of rock to the waste pile over that bench interval. The static test results of the three mixed units are discussed individually below.

4.2.4 Argillite (5-49% greywacke interbeds)

In total, six samples were collected from the argillite (<5% greywacke interbeds) unit, referred to here as the "argillite/greywacke unit". Of the six samples, one was from the Western portion, three were from the Central portion and two were from the Eastern portion relative to the current open pit design. One existing sample collected by Atlantic was included into the argillite/greywacke unit statistical calculations.

Acid-Base Accounting

Results of the ABA testing for the argillite/greywacke unit are presented in Table 5 and in Figures 3 through 6. The total sulphur content of the argillite/greywacke samples reach a maximum of 0.7% with an overall average of 0.2%. Similar to the argillite unit, there is a stronger correlation between total sulphur and sulphide sulphur for samples with total sulphur concentrations less than 0.3% (Figure 3). Two argillite samples with total sulphur concentrations greater than 0.3% have an increased component of sulphate sulphur. Carbonate concentrations in the argillite/greywacke unit range from 1.3 to 2.9%.

On average, the argillite/greywacke unit has sufficient carbonate concentrations, which provide the majority of the neutralizing potential (Figure 4), to neutralize acid production as a result of sulphide oxidation. Using the Price (1997) classification system, none of the samples have the potential to generate acidity based on the CaNP/AP ratio (Figure 5); however, one of the samples was classified as having a low potential to generate acidity (i.e. 2<NP/AP<4) relative to the available bulk NP (Figure 6). This particular sample has an elevated CaNP relative to the bulk-NP. It is likely that the CaNP is overestimated for this sample due to the presence of unreactive carbonates. This sample should therefore be recognized as having a low potential to produce acidity.

Short Term Leach Testing

Leach testing was done on a subset of three argillite/greywacke samples and results of this testing are presented in Table 6 and Figure 7b. Based on the test results, average aluminum (0.2 mg/L) and arsenic (0.06 mg/L) concentrations have the potential to exceed the CCME guideline values of 100 μg/L and 5 μg/L respectively. Maximum zinc concentrations also exceeded the CCME guideline value of 30 μg/L. All of these parameters require further consideration with respect to site water quality.

4.2.5 Greywacke (20-50% argillite interbeds)

In total, twelve samples were collected from the greywacke (20-50% argillite interbeds) unit, referred to here as the "greywacke/argillite unit". Eleven of the samples were collected from the Central portion and one was collected from the Western portion of the current open pit design. One sample was previously collected by Atlantic and was included in the greywacke/argillite database.

Acid-Base Accounting

Results of the ABA testing for the greywacke/argillite unit are presented in Table 5 and in Figures 3 through 6. The total sulphur content of the greywacke/argillite samples reach a maximum of 0.6% with an overall average of 0.2%. In general, the majority of the total sulphur can be attributed to sulphide (Figure 3). The average sulphate concentrations in the greywacke/argillite unit are 0.05% with a maximum of 0.14%.

Carbonate concentrations in the greywacke/argillite unit range from 1.68 to 3.62%. Although the majority of carbonate concentrations in the greywacke/argillite provide a significant proportion of the bulk-NP (Figure 4), sulphide concentrations were high enough in three of the samples (06-001, 06-039 & DA0472) to produce CaNP/AP ratios less than four; however, since most of the buffering is from carbonate minerals, it is still expected that the samples will not generate acidity. Compared to the acid producing potential, the bulk-NP of only one sample (06-039) in the greywacke/argillite unit is classified as possibly acid generating ($1<NP/AP<2$).

Three samples (06-002, 06-026 & 06-039) in this unit were observed to have CaNP values greater than bulk-NP (Figure 4). The CaNP of these samples are likely overestimated due to non-reactive carbonate minerals.

Short Term Leach Testing

Leach testing was done on a subset of two greywacke/argillite samples and results of this testing are presented in Table 6 and Figure 7d. Based on the test results, average aluminum (0.3 mg/L) and arsenic (0.2 mg/L) were found elevated to the CCME guideline values 100 µg/L and 5 µg/L respectively. The maximum concentration of lead (0.0012 mg/L) was marginally above the CCME guideline value of 0.001 mg/L. All of these parameters require further consideration with respect to site water quality.

4.2.6 Composite Samples

In total, fifteen composite waste rock samples were collected from the Touquoy site. Seven of these were from the Western portion, five from the Central portion and three from the Eastern portion of the current open pit design.

Acid-Base Accounting

Results of the ABA testing for the composite samples are presented in Table 5 and in Figures 3 through 6. The total sulphur content of the composite samples reach a maximum of 0.5% with an overall average of 0.2% which is lower compared to the other principal lithologies. The majority of the total sulphur can be attributed to sulphide (Figure 3). Similar to other units, samples with total sulphur concentrations greater than 0.3% have a higher preponderance of sulphate. The average sulphate concentration in the composite samples is 0.05% with a maximum of 0.21%.

On average, the composite samples had sufficient carbonate concentrations, which provide the majority of the neutralizing potential (Figure 4), to neutralize acid production as a result of sulphide oxidation. Using the Price (1997) classification system (See Section 3.2.1), only one sample (06-070) of the fifteen is classified as possibly having the potential to generate acidity based on the CaNP/AP ratio (Figure 5) and relative to the bulk NP (Figure 6). The remaining samples were classified as non-acid generating with average CaNP/AP and NP/AP values of 7.6 and 9.1 respectively.

Short Term Leach Testing

Leach testing was done on a subset of five composite samples and results of this testing are presented in Table 6 and Figure 7e. Based on the test results, average aluminum (0.3 mg/L) and arsenic (0.06 mg/L) were found elevated to the CCME guideline values of 100 μg/L and 5 μg/L respectively. The maximum concentration of lead (0.0015 mg/L) was marginally above the CCME guideline value of 0.001 mg/L. All of these parameters require further consideration with respect to site water quality.

4.2.7 Marginal Ore

It is expected that a marginal ore stockpile will be present on site. Eleven marginal ore samples were collected to quantify the acid producing potential of these materials. The samples were selected over intervals that were dictated by the average grade and were collected where they were available and not according to lithology or location. However, nine of the eleven samples were collected from the argillite unit since this unit host the majority of the ore (approximately 88%). The remaining two samples are composite samples.

Acid-Base Accounting

Results of the ABA testing for the marginal ore samples are presented in Table 5 and in Figures 3 through 6. The total sulphur content of the marginal ore reached a maximum of 0.6% with an overall average of 0.4%. Sulphide concentrations range from 0.08 to 0.42% and although a positive correlation exists between sulphide and total sulphur, sulphate concentrations also contribute a significant component to the total sulphur and range from 0.04 to 0.36% (Figure 3).

Carbonate concentrations in the marginal ore range from 0.7 to 2.3% and contribute the majority of the bulk-NP (Figure 4). Based on the CaNP/AP ratios calculated for the marginal ore samples and employing the criteria of Price (1997), five samples have some potential to produce acidity (Figure 5) whereas only four are identified as having some acid potential using NP/AP ratios (Figure 6). Of the five samples that are described as having some potential to produce acidity (i.e. CaNP/AP < 4), on is possibly acid generating and the remaining four have low acid producing potentials.

One marginal ore sample (06-088) was observed to have a CaNP value greater than bulk-NP value (Figure 4). The CaNP of this sample is likely overestimated and the due to non-reactive carbonate minerals.

Short Term Leach Testing

Leach testing was done on a subset of three marginal ore samples and results of this testing are presented in Table 6 and Figure 7f. Based on the test results, average aluminum (0.6 mg/L) and arsenic (0.06 mg/L) and maximum concentrations of iron (0.6 mg/L) and zinc (0.07 mg/L) exceeded CCME guideline values. All of these parameters require further consideration with respect to site water quality.

4.2.8 Ore

Nine ore samples were previously collected by Atlantic and their acid generating potential was assessed based on ABA testing. Results of this testing are presented in Table 5 and in Figures 3 through 6. Total sulphur concentrations ranged from 0.14 to 0.98% with and average value of 0.48%. Most of the total sulphur was in the form of sulphide (Figure 3). Carbon concentrations in the ore range from 0.8 to 3.27% and account for approximately half of the bulk-NP (Figure 4). Based on the CaNP/AP ratios calculated for the ore samples and employing the criteria of Price (1997), all samples with the exception of one have some potential to produce acidity (Figure 5) whereas only six of the nine are identified as having some acid potential using NP/AP ratios (Figure 6).

4.2.9 Tailings

One tailings sample was leached and detoxified (using the Inco Air/SO2 process) by SGS Lakefield based on the procedures provided by Atlantic. The tailings solids were retained and submitted for the ABA and solid chemistry analysis. A humidity cell was also initiated to quantify the leachability of the tailings over time. The tailings supernatant water was also retained and aging analyses were performed to quantify the natural attention of selected parameters.

Results of the elemental analyses for the tailings sample are presented in Tables 3 and 4. XRF analyses indicate that the bulk chemistry of the tailings sample is analogous to the waste rock samples. This is expected since the ore is disseminated throughout the sedimentary rock as opposed to being associated with post-depositional veining (Atlantic, 2006). ICP trace element analyses indicate that the tailings arsenic concentration (160 ppm) is depleted relative to the overall average of 1000 ppm but is similar to the median concentration. The tailings arsenic concentration is also elevated relative to the average crustal abundances for clastic sedimentary rocks (Price, 1997). The following metals were also elevated in the tailings sample relative to the overall sample averages and compared to the average crustal abundances: chromium, copper, manganese and molybdenum.

Acid-Base Accounting

Results of the ABA testing for the tailings sample are presented in Table 5 and in Figures 3 through 6. The total sulphur content of the tailings was 0.17% with the majority being in the form of sulphide (Figure 4). The tailings sample had a sufficient carbonate concentration (1.22%), which provided the majority of the neutralizing potential (Figure 4), to neutralize acid production as a result of sulphide oxidation. Using the Price (1997) classification system, the tailings did not have acid producing potential based on the CaNP/AP (Figure 5) and NP/AP ratios.

Supernatant Aging Results

Tailings supernatant water, generated during leaching and detoxification of the ore head sample, was retained and scanned on the following days: 0, 3, 7, 14, 31 and 45 for selected parameters. Results of this testing are presented in Table 7. The purpose of the aging test analyses was to describe the natural attenuation of various parameters through time and to quantify the water quality of the process water being discharged to the tailings management facility. It appears that on day 31 several of the parameter concentrations and instrument detection limits increased. The cause of these increases is being investigated and at present they are considered to be an analytical or reporting error. Results from day 31 are therefore not included in the following discussion. Although the process water will not be discharged directly to the environment, for discussion purposes, aging test results were compared to the MMER effluent guidelines and CCME freshwater receiving water guidelines for the protection of aquatic life.

Weak acid dissociable cyanide (CN-wad) concentrations in the tailings sample were detoxified to <1 ppm. This is less than the MMER guideline value of 1.0 mg/L for total cyanide (CN-tot). Therefore, concentrations of CN-tot in the tailings supernatant water never exceeded this limit during the test period. As opposed to the MMER guideline, the CCME guideline of 0.005 mg/L governs the maximum allowable concentration of free cyanide (CN-free). In the analysis of the tailings supernatant water, a CN-free detection limit of <0.03 to <0.05 mg/L was used. Since CN-free concentrations remained below detection throughout the test period, for comparison purposes, CN-wad was compared to the CCME guideline value. CN-wad ranged from 0.03 to 0.04 mg/L, which is above the maximum allowable concentration. The proportion of CN-free in the CN-wad will need to be determined and both of these parameters will need to be assessed in the context of the overall site water quality.

All of the measured parameters met the MMER effluent guidelines with the exception of dissolved arsenic on day 0. The value of 0.53 mg/L marginally exceeds the compliance concentration of 0.5 mg/L. The total concentration of arsenic for this sampling round was 0.47 mg/L which is marginally below the MMER guideline. Although the total concentration of arsenic is slightly less than the dissolved component, the concentrations are very similar and the difference is likely a result of analytical uncertainty.

Several parameters have the potential to exceed the CCME freshwater receiving water guidelines for the protection of aquatic life. Total concentrations of aluminum, arsenic, chromium, iron and lead all exceeded the CCME guidelines. Mercury (0.0002 mg/L) was detected to be marginally above the CCME guideline (0.0001 mg/L) on day 45 of the aging test and silver (0.0003 mg/L) and selenium (0.004 mg/L) were marginally above their guideline values of 0.0001 mg/L and 0.001 mg/L respectively on day 0.

Dissolved concentrations of silver (0.0002 mg/L) and aluminum (0.2 mg/L) exceeded the CCME guideline values of 0.0001 mg/L and 0.1 mg/L respectively on day 0. Selenium concentrations ranged from 0.003 mg/L to 0.004 mg/L and marginally exceeded the maximum permissible concentration of 0.001 mg/L on days 0, 3 and 7. Arsenic was the only dissolved metal to be consistently above the CCME guideline value of 0.005 mg/L with a maximum concentration of 0.53 mg/L.

All of the total and dissolved parameters exceeding the CCME and MMER guidelines need to be considered further with respect to the overall site water quality.

Humidity Cell Testing

Only five weeks of data exists for the tailings humidity cell and it is possible that analyte concentrations may not have stabilized and could change. Preliminary humidity cell results are presented in Table 8. For discussion purposes, the results are compared to the MMER effluent guidelines and CCME freshwater receiving water guidelines for the protection of aquatic life.

The first five weeks of data indicate the following:

- pH in the tailings humidity cell has remained neutral;
- Sulphate concentrations initially increased to 100 mg/L during week two but have since decreased to 18 mg/L;
- No metal concentrations exceeded the MMER effluent guidelines;
- Dissolved arsenic concentrations were consistently elevated relative to the CCME guideline of 0.005 mg/L;
- Copper exceeded the CCME maximum permissible concentration during the initial flush (week 0) of the humidity cell testing but has since decreased; and
- During week five, dissolved concentrations of the major ions, such as calcium, magnesium, potassium and sodium have significantly decreased.

4.2.10 Minor Units

Quartz veining occurs randomly within waste rock materials. One sample of the quartz vein was collected to characterize the acid producing potential of this material. Since this is considered to be a minor unit relative to the other lithologies, only ABA testing was done and no leach testing was done on this sample to assess the acid generating potential of the sample. Results of this testing are provided in Table 5 and Figures 3 through 6 and are summarized as follows.

The total sulphur content of the quartz vein was 0.4%, of which 0.3% was attributed to sulphide and the remaining 0.1% to sulphate (Figure 3) reached a maximum of 0.6% with an overall average of 0.4%. Sulphide concentrations range from 0.08 to 0.42% and although a positive correlation exists between sulphide and total sulphur, sulphate concentrations also contribute a significant component to the total sulphur and range from 0.04 to 0.36% (Figure 3). The carbonate concentration of the quartz sample was 1.1% and accounts for the majority of the bulk-NP (Figure 4). When the neutralizing potentials of this sample are compared to the acid producing potential, the CaNP/AP ratio (1.9) indicates this sample is possibly acid generating (Figure 5) whereas the NP/AP ratio (2.8) indicates the quartz vein has low acid producing potential (Figure 6).

4.2.11 Mineralogy

Five samples were selected to quantify the mineralogical characteristics of the waste rock; mainly the sulphide and carbonate species as these have the greatest influence on the acid generating/neutralization potential of the sample. The selected samples are summarized in the following table:

Sample #	Hole #	From (m)	To	Lithology	Lithological Description
06-034	MR-05-091	10	20	G/A	Greywacke (20-50% argillite interbeds)
06-049	MR-05-122	10	20	AR	Argillite (<5% greywacke interbeds)
06-073	MR-05-094	12	22	AR	Argillite (<5% greywacke interbeds)
06-066	MR-05-084	65	72	GW	Greywacke (<20% argillite interbeds)
06-070	MR-05-083	68	75	Comp	Composite (greywacke and argillite)

Note:
Based on data from Lakefield (2006).

Based on Lakefield's mineralogical report (2006) (Appendix C), the three main sulphide species are pyrite, pyrrhotite and arsenopyrite. Examination of the textural associations of these minerals indicate that 50-80% of the pyrite and 50-100% of the pyrrhotite occurs locked within the silicate particles and may not be readily available to produce acidity. Only a minor proportion of arsenopyrite (0-26%) occurs locked among silicate particles. Therefore, sulphide speciation in the waste rock materials will influence the acid producing potential of the samples. The following table presents the five samples selected for mineralogical analyses and the percentages of the predominant sulphides.

Sample	Lithology	Predominant Sulphides
06-034	Greywacke (20-50% argillite interbeds)	Arsenopyrite (87%)
06-049	Argillite (<5% greywacke interbeds)	Pyrrhotite (40%) & Arsenopyrite (36%)
06-073	Argillite (<5% greywacke interbeds)	Pyrite (44%) & Arsenopyrite (42%)
06-066	Greywacke (<20% argillite interbeds)	Arsenopyrite (58%)
06-070	Composite (greywacke and argillite)	Pyrite (98%)

Note: Based on data from Lakefield (2006).

Availability and the type of carbonate minerals will also influence the available neutralization potential of the samples. The predominant carbonate minerals present in the five samples submitted for mineralogical analyses are calcite, dolomite and ankerite. The distribution of the carbonate species is presented in the following table:

Mineral	Sample Formula	06-034		06-049		06-066		06-070		06-073	
		wt. %	Dist'n %	wt. %	Dist'n %	wt. %	Dist'n %	wt. %	Dist'n %	wt. %	Dist'n %
Calcite	$CaCO_3$	4.49	99.8	3.24	78.7	3.38	78.9	3.17	68.3	5.26	68.8
Dolomite	$CaMg(CO_3)_2$	0.0	0.1	0.48	11.8	0.83	19.5	1.46	31.4	0.66	8.6
Ankerite	$Ca(Fe,Mg,Mn)(CO_3)_2$	0.0	0.1	0.39	9.4	0.06	1.5	0.01	0.2	1.71	22.4
Siderite	$FeCO_3$	0.001	0.0	0.01	0.1	0.01	0.1	0.002	0.1	0.02	0.2
Total		**4.5**	**100**	**4.1**	**100**	**4.3**	**100**	**4.6**	**100**	**7.7**	**100**

Note:
Based on data from Lakefield (2006).

Although the textural relationship of the carbonate minerals suggests that approximately 53% to 78% are either liberated or exposed and are amenable to dissolution and neutralization (Lakefield, 2006), the carbonate species will influence the effectiveness of the neutralization potential. For example, calcite is readily soluble and is an effective neutralizing mineral; however, manganese and iron carbonates create acidity when they dissolve and no net alkalinity is produced (Price, 1997). Therefore, the predominant cation available in the ankerite carbonates during hydrolysis will influence the neutralization potential of this mineral.

Several of the waste rock lithologies had carbonate neutralization potentials greater than the bulk neutralization potential (Figure 4). It is possible that the overestimation of the carbonate neutralization is a result of the presence of iron and manganese ankerites. Humidity cell testing will provide an indication of the sulphide oxidation and neutralization rates under oxidizing conditions. The effectiveness of the neutralization potential will be assessed when the data becomes available.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

A review of the expected waste rock tonnages in Table 1 relative to the distribution of selected samples show the lithological distribution to be representative of the respective rock types and tonnages anticipated to be encountered in the pit. When the spatial distribution of the samples is examined on the drill core sections (Appendix B), the selected samples are representative of the expected waste rock types to be encountered in the Eastern and Central portion of the pit but gaps exist in the Western portion of the pit as a result of sample availability. Although 30 of the 83 waste rock samples were collected from this area, the majority of the samples are along the walls of the proposed pit boundary. The majority of the holes in the centre of the pit were drilled previous to 1990 and sample was unavailable from this drill core.

The current sample list was generated based on a preliminary pit design (Mining Solutions Consultancy Ltd., 2006) present on the cross-sections. If the pit design changes, the sample set and analytical results can be reviewed to determine if supplementary collection and geochemical characterization of samples is required.

5.1.1 Waste Rock

The following conclusions can be drawn from the static testing of the waste rock and the marginal ore:

- Based on the XRF and ICP results, the various waste rock units have similar solid chemistries and the geochemical behaviour of the units is expected to be similar. The units are therefore, only distinguished based on grain size and the greywacke and argillite of the Touquoy deposit are likely derived from similar host rocks.

- Compared to the waste rock and marginal ore units, the tailings sample had bulk chemistry similar to the host rocks; however, it is enriched in various trace metals including: chromium, copper, manganese and molybdenum. The presence of these trace metals is likely associated with gold mineralization.

- Based on the trace metal analyses, arsenic is the main parameter of concern for the Touquoy project. Solid concentrations reached a maximum of 15000 ppm and average approximately 1000 ppm.

- On average, the acid generating potential of the waste rock and marginal ore units is classified as unlikely to generate acidity using the guidelines outlined in Price (1997). Based on the ABA results the potential for acid generation is more commonly associated with the argillite and marginal ore units and decreases with increasing greywacke content.

- Concentrations of sulphide control the acid generating potential of a sample since neutralizing potential is generally similar among the various waste rock types.

- Mineralogy and solids analysis indicate that calcite is the dominant control on buffering capacity. This suggests that even at NPR's between 2 and 4, net neutral conditions will likely be realized since calcite is quite effective at providing neutralizing capacity.

- Compared to the MMER and CCME guidelines, short-term leach results have identified several metals that warrant further investigation relative to the overall site water quality. These include: arsenic, aluminum, lead, iron and zinc.

- Arsenic is the main parameter of concern at the Touquoy project and has the potential to exceed both the MMER guideline value of 0.5 mg/L and the CCME guideline values of 0.005 mg/L (Figure 8).

Figure 8 is a plot of the solid arsenic component versus the dissolved concentrations derived from the short-term leach testing. This figure indicates that the MMER guideline value is exceeded for two argillite samples with solid concentrations above 8600 ppm. It is important to understand that leach testing occurs under limited oxidization potential and only the readily available arsenic will be leached. The Lakefield (2006) mineralogy report indicates that arsenopyrite is a significant sulphide component in the Touquoy waste rock materials and is mainly liberated or exposed. Therefore, the majority of arsenopyrite is readily available to be oxidized and during this process additional arsenic may be released under oxidizing conditions. The humidity cell testing will provide a better understanding of the liberation of arsenic under oxidizing conditions.

5.1.2 Tailings

The majority of the ore samples previously tested by Atlantic are acid generating whereas, the tailings sample generated using a head ore sample provided by Atlantic was not acid generating. Relative to the previously analysed ore samples, the tailings sample sulphide concentration (0.11%) was within the lower range of sulphide concentrations as observed in the ore samples (0.13 to 0.96%). The carbonate neutralizing potential of the tailings sample (20 t CaCO3/1000) is within the range of carbonate neutralizing potentials of the ore samples (13.4 to 54.5 t CaCO3/1000t). Therefore, the tailings sample is considered to be a low sulphide sample and based on the results from the ore samples, tailings are expected to be acid generating.

The following conclusions can be drawn from the static and kinetic testing of the tailings sample:

- Aging test results of the tailings indicate there are several total and dissolved parameters that warrant further investigation in the context of the overall site water quality. These include: cyanide, aluminum, arsenic, chromium, iron, lead and selenium. Concentrations of silver and mercury marginally exceeded the CCME guideline on one occasion and also need to be investigated further with respect to the site water balance.

- Based on recent discussions, cyanide concentrations as tested are lower than currently anticipated to be discharged to the tailings impoundment. For the sample as provided, CN-tot concentrations naturally attenuated from 0.32 mg/L to 0.17 mg/L during the 45 day test period. Under laboratory conditions, this attenuation is likely the result of hydrolysis since the sample is not exposed to biological activity or sunlight. It is expected that under ambient conditions, the natural degradation will be accelerated.

- Based on the first five weeks of kinetic data, concentrations of arsenic in this humidity cell are lower than those observed in the short-term leach testing but were consistently above the CCME guideline value of 0.005 mg/L and copper (0.004 mg/L) was elevated during the initial flush relative to the CCME guideline value of 0.002 mg/L but below the MMER effluent standard of 0.2 mg/L.

5.2 Recommendations

Samples in the western portion of the pit are not representative of waste rock as a whole that will be extracted from this region. Golder recommends that additional samples be collected for additional static testing to ensure that the current samples from this portion (i.e. along the walls of the pit) are representative of materials that will be extracted from the pit as a whole. It is our understanding that infill drilling will be commencing in the near future and geochemical samples could be collected as part of this drilling campaign and tested.

Based on the results of the acid-base accounting (ABA), it appears as though the acid-generating potential of the waste rock and marginal ore is a function of the sulphide concentration since the carbonate concentrations are similar among the various waste rock materials. Areas of high sulphide waste need to be considered in terms of the waste rock management plan. Sulphide concentrations can be included in the block model and a tonnage of expected acid-generating waste can be estimated through developing a sulphide cut-off once the carbonate reactivity from the humidity cell testing has been established.

Although some parameters exceed the CCME guidelines in the short-term leach testing, supernatant aging tests and in the tailings humidity cell, this water will not be discharged directly to the environment. A detailed water quality assessment in the context of the site wide water balance is required to develop a meaningful water quality assessment for the Touquoy site and the uncertainty in several variables must be evaluated.

It is expected that under oxidizing conditions, dissolved concentrations (particularly arsenic) could exceed those observed in the short-term leach testing and this water may need to be treated before it is discharged to the environment. The leachability of the arsenic under oxidizing conditions needs to be quantified and the resulting concentrations will need to be assessed in the context of the overall site water quality. The expected reaction and loading rates from the pile need to be determined when sufficient humidity cell data becomes available.

The natural degradation of cyanide needs to be assessed relative to the site specific characteristics and relative to the site water quality for the Touquoy project. It is important to note that in the current testwork, the tailings sample was detoxified down to CN-wad <1 ppm. Based on recent discussions (pers comm., 2006) Atlantic is expecting to be able to detoxify cyanide to <10 ppm. To ensure the above results remain valid, it is recommended that additional tailings testing be conducted in the future when a decision has been reached regarding the process specifics of the Touquoy project.

Suspended solids contribution to site water quality needs to be assessed in the context of the current data, min plan and water balance.

GOLDER ASSOCIATES LTD.

DRAFT

Michael K. Herrell, M.Sc.
Project Scientist

DRAFT

Ken DeVos, M.Sc., P.Geo
Associate, Hydrogeochemist

MKH/KJD/co

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TABLES

Table 1
Summary of Ore and Waste Rock Tonnages

Lithology	Expected Rock Tonnages	Tonnage		Percentage		Number of Samples Collected					Waste Rock and Tailings Testing Analysis						
		Ore	Waste	Ore	Waste	Individual Samples			Atlantic Gold Samples	Total	Modified ABA	Trace Metals (ICP)	Whole Rock (XRF)	Short-Term Leach	Mineralogy	Supernatant Aging	Humidity Cells
						Western	Central	Eastern									
Argillite (<5% greywacke interbeds)	21,208,000	6,688,000	14,520,000	88%	88%	11	18	10	4	43	43	39	39	17	2	-	-
Argillite (5-49% greywacke interbeds)						1	3	2	1	7	7	6	6	3	-	-	-
Greywacke (20-50% argillite interbeds)	2,410,000	760,000	1,650,000	10%	10%	1	11	-	1	13	13	12	12	2	1	-	-
Composite Samples						7	5	3	-	15	15	15	15	5	1	-	-
Greywacke (<20% argillite interbeds)	482,000	152,000	330,000	2%	2%	10	-	-	5	15	15	10	10	3	1	-	-
Massive Quartz Vein	-	-	-	-	-	-	1	-	-	1	1	1	1	-	-	-	-
Marginal Ore	-	-	-	-	-	-	-	-	-	11	11	11	11	3	-	-	-
Ore	7,600,000	7,600,000	-	100%	0%	-	-	-	9	9	9	-	-	-	-	-	-
Tailings	-	-	-	-	-	-	-	-	-	1	1	1	1	-	-	1	1
Total	24,100,000	7,600,000	16,500,000	100%	100%	30	38	15	20	115	115	95	95	33	5	1	1

Note:

Expected ore and waste tonnages provided by Atlantic (2006).

Summary of Samples Collected for Geochemical Testing

Sample #	Hole #	Section	Location	From (m)	To	Lithology	Lithological Description
ARGILLITE (5-49%) GREYWACKE							
06-012	MR-04-039	21900 East	Central Pit	14	17	A/G	Argillite with 5-49% greywacke interbeds
06-016	MR-04-039	21900 East	Central Pit	50	59	A/G	Argillite with 5-49% greywacke interbeds
06-021	MR-05-101	21900 East	Central Pit	12	15	A/G	Argillite with 5-49% greywacke interbeds
06-040	MR-05-125	22075 East	Eastern Pit	11	15	A/G	Argillite with 5-49% greywacke interbeds
06-042	MR-03-018	22075 East	Eastern Pit	15	25	A/G	Argillite with 5-49% greywacke interbeds
06-082	MR-03-002	21650 East	Western Pit	15	19	A/G	Argillite with 5-49% greywacke interbeds
ARGILLITE (<5% GREYWACKE)							
06-004	MR-05-114	21975 East	Central Pit	10	20	AR	Argillite (<5% Greywacke)
06-005	MR-05-105	21975 East	Central Pit	35	45	AR	Argillite (<5% Greywacke)
06-006	MR-05-106	21975 East	Central Pit	15	25	AR	Argillite (<5% Greywacke)
06-009	MR-05-071	21975 East	Central Pit	20	30	AR	Argillite (<5% Greywacke)
06-010	MR-05-071	21975 East	Central Pit	40	50	AR	Argillite (<5% Greywacke)
06-014	MR-04-039	21900 East	Central Pit	26	35	AR	Argillite (<5% Greywacke)
06-017	MR-05-102	21900 East	Central Pit	10	20	AR	Argillite (<5% Greywacke)
06-019	MR-05-102	21900 East	Central Pit	48	58	AR	Argillite (<5% Greywacke)
06-022	MR-05-101	21900 East	Central Pit	15	21	AR	Argillite (<5% Greywacke)
06-025	MR-05-100	21900 East	Central Pit	12.5	20	AR	Argillite (<5% Greywacke)
06-028	MR-05-100	21900 East	Central Pit	58	68	AR	Argillite (<5% Greywacke)
06-029	MR-05-103	21900 East	Central Pit	5	15	AR	Argillite (<5% Greywacke)
06-030	MR-05-103	21900 East	Central Pit	30	40	AR	Argillite (<5% Greywacke)
06-031	MR-05-093	21900 East	Central Pit	11	21	AR	Argillite (<5% Greywacke)
06-032	MR-05-092	21900 East	Central Pit	20	30	AR	Argillite (<5% Greywacke)
06-033	MR-05-092	21900 East	Central Pit	30	40	AR	Argillite (<5% Greywacke)
06-036	MR-05-091	21900 East	Central Pit	39	44	AR	Argillite (<5% Greywacke)
06-038	MR-05-091	21900 East	Central Pit	49	59	AR	Argillite (<5% Greywacke)
06-041	MR-05-125	22075 East	Eastern Pit	15	25	AR	Argillite (<5% Greywacke)
06-043	MR-03-018	22075 East	Eastern Pit	33	42	AR	Argillite (<5% Greywacke)
06-044	MR-03-018	22075 East	Eastern Pit	60	70	AR	Argillite (<5% Greywacke)
06-046	MR-05-120	22075 East	Eastern Pit	25	35	AR	Argillite (<5% Greywacke)
06-047	MR-03-019	22075 East	Eastern Pit	17	23	AR	Argillite (<5% Greywacke)
06-048	MR-03-021	22075 East	Eastern Pit	20	28	AR	Argillite (<5% Greywacke)
06-049	MR-05-122	22075 East	Eastern Pit	10	20	AR	Argillite (<5% Greywacke)
06-050	MR-05-122	22075 East	Eastern Pit	25	35	AR	Argillite (<5% Greywacke)
06-053	MR-03-024	22075 East	Eastern Pit	14	23	AR	Argillite (<5% Greywacke)
06-054	MR-05-124	22075 East	Eastern Pit	15	25	AR	Argillite (<5% Greywacke)
06-067	MR-05-084	21650 East	Western Pit	125	130	AR	Argillite (<5% Greywacke)
06-071	MR-05-083	21675 East	Western Pit	91	98	AR	Argillite (<5% Greywacke)
06-073	MR-05-094	21625 East	Western Pit	12	22	AR	Argillite (<5% Greywacke)
06-074	MR-05-094	21625 East	Western Pit	45	55	AR	Argillite (<5% Greywacke)
06-076	MR-05-094	21625 East	Western Pit	100	105	AR	Argillite (<5% Greywacke)
06-077	MR-03-001	21650 East	Western Pit	11	20	AR	Argillite (<5% Greywacke)
06-078	MR-03-001	21650 East	Western Pit	32	40	AR	Argillite (<5% Greywacke)
06-079	MR-03-001	21650 East	Western Pit	50	59	AR	Argillite (<5% Greywacke)
06-080	MR-03-001	21650 East	Western Pit	59	65	AR	Argillite (<5% Greywacke)
06-083	MR-03-002	21650 East	Western Pit	32	37	AR	39.08-40=GW
06-084	MR-03-002	21650 East	Western Pit	59	65	AR	Argillite (<5% Greywacke)
COMPOSITE							
06-007	MR-05-107	21975 East	Central Pit	12	22	composite	Composite of Greywacke and Argillite
06-018	MR-05-102	21900 East	Central Pit	27	37	composite	Composite of Greywacke and Argillite
06-023	MR-05-101	21900 East	Central Pit	27	36	composite	Composite of Greywacke and Argillite
06-027	MR-05-100	21900 East	Central Pit	25	35	composite	Composite of Greywacke and Argillite
06-035	MR-05-091	21900 East	Central Pit	22	28	composite	Composite of Greywacke and Argillite
06-045	MR-05-120	22075 East	Eastern Pit	11	20	composite	Composite of Greywacke and Argillite
06-051	MR-03-023	22075 East	Eastern Pit	11	21	composite	Composite of Greywacke and Argillite
06-052	MR-05-123	22075 East	Eastern Pit	12	22	composite	Composite of Greywacke and Argillite
06-055	MR-05-085	21650 East	Western Pit	3	11	composite	Composite of Greywacke and Argillite
06-058	MR-05-085	21650 East	Western Pit	28	38	composite	Composite of Greywacke and Argillite
06-059	MR-05-085	21650 East	Western Pit	61	67	composite	Composite of Greywacke and Argillite
06-062	MR-05-084	21650 East	Western Pit	3	13	composite	Composite of Greywacke and Argillite
06-064	MR-05-084	21650 East	Western Pit	32	42	composite	Composite of Greywacke and Argillite
06-069	MR-05-083	21675 East	Western Pit	30	40	composite	Composite of Greywacke and Argillite
06-070	MR-05-083	21675 East	Western Pit	68	74.5	composite	Composite of Greywacke and Argillite

Summary of Samples Collected for Geochemical Testing

Sample #	Hole #	Section	Location	From (m)	To (m)	Lithology	Statistics
GREYWACKE (20%-50% ARGILLITE INTERBEDS)							
06-001	MR-05-128	21975 East	Central Pit	7	17	G/A	Greywacke with 20-50% argillite interbeds
06-002	MR-05-128	21975 East	Central Pit	23	33	G/A	Greywacke with 20-50% argillite interbeds
06-003	MR-05-128	21975 East	Central Pit	35	45	G/A	Greywacke with 20-50% argillite interbeds
06-011	MR-04-039	21900 East	Central Pit	6	14	G/A	Greywacke with 20-50% argillite interbeds
06-013	MR-04-039	21900 East	Central Pit	17	24	G/A	Greywacke with 20-50% argillite interbeds
06-015	MR-04-039	21900 East	Central Pit	35	40	G/A	Greywacke with 20-50% argillite interbeds
06-020	MR-05-101	21900 East	Central Pit	4	9	G/A	Greywacke with 20-50% argillite interbeds
06-024	MR-05-100	21900 East	Central Pit	6	10	G/A	Greywacke with 20-50% argillite interbeds
06-026	MR-05-100	21900 East	Central Pit	20	24	G/A	Greywacke with 20-50% argillite interbeds
06-034	MR-05-091	21900 East	Central Pit	10	20	G/A	Greywacke with 20-50% argillite interbeds
06-039	MR-04-049	21850 East	Central Pit	10	20	G/A	Greywacke with 20-50% argillite interbeds
06-057	MR-05-085	21650 East	Western Pit	20	28	G/A	Greywacke with 20-50% argillite interbeds
GREYWACKE (<20% ARGILLITE INTERBEDS)							
06-056	MR-05-085	21650 East	Western Pit	11	19	GW	Greywacke with <20% argillite interbeds
06-060	MR-05-085	21650 East	Western Pit	75	85	GW	Greywacke with <20% argillite interbeds
06-061	MR-05-085	21650 East	Western Pit	90	100	GW	Greywacke with <20% argillite interbeds
06-063	MR-05-084	21650 East	Western Pit	14	24	GW	Greywacke with <20% argillite interbeds
06-065	MR-05-084	21650 East	Western Pit	42	52	GW	Greywacke with <20% argillite interbeds
06-066	MR-05-084	21650 East	Western Pit	65	72	GW	Greywacke with <20% argillite interbeds
06-068	MR-05-083	21675 East	Western Pit	5	15	GW	Greywacke with <20% argillite interbeds
06-072	MR-05-083	21675 East	Western Pit	100	110	GW	Greywacke with <20% argillite interbeds
06-075	MR-05-094	21625 East	Western Pit	85	95	GW	Greywacke with <20% argillite interbeds
06-081	MR-03-002	21650 East	Western Pit	5	15	GW	Greywacke with <20% argillite interbeds
MARGINAL ORE							
06-008	MR-05-071	21975 East	Marginal Ore	3	13	AR	Argillite (<5% Greywacke) - marginal ore
06-085	MR-05-107	21975 East	Marginal Ore	45	50	AR	Argillite (<5% Greywacke)
06-086	MR-05-118	22150 East	Marginal Ore	32	36	AR	Argillite (<5% Greywacke)
06-087	MR-05-092	21900 East	Marginal Ore	9	13	AR	Argillite (<5% Greywacke)
06-088	MR-05-080	21725 East	Marginal Ore	34	42	AR	Argillite (<5% Greywacke)
06-089	MR-04-054	21775 East	Marginal Ore	12	16	composite	Composite of Greywacke and Argillite
06-090	MR-03-019	22075 East	Marginal Ore	42	45	AR	Argillite (<5% Greywacke)
06-091	MR-05-121	22075 East	Marginal Ore	17	19	AR	Argillite (<5% Greywacke)
06-092	MR-05-116	22150 East	Marginal Ore	39	48	AR	Argillite (<5% Greywacke)
06-093	MR-05-083	21775 East	Marginal Ore	111	115	AR	Argillite (<5% Greywacke)
06-094	MR-04-058	21775 East	Marginal Ore	13	17	composite	Composite of Greywacke and Argillite
QUARTZ VEIN							
06-037	MR-05-091	21900 East	Central Pit	44	47	QV	Massive Quartz Vein (>50% of interval)
TAILINGS							
CND 2 Treated Solids	-	-	-	-	-	-	Generated by SGS Lakefield using TAM master composite provided by Atlantic Gold. (Composite of TWT, TWM. TWB. TET & TEB)

Notes:

TAM - Master Argillite Composite containing equal amounts of the following:
TWT - Argillite location composite - western section top.
TWM - Argillite location composite - western section middle.
TWB - Argillite location composite - western section bottom.
TET - Argillite location composite - eastern section top.
TEB - Argillite location composite - eastern section bottom.
AR - Argillite (<5% Greywacke)
A/G - Argillite with 5-49% greywacke interbeds
GW - Greywacke with <20% argillite interbeds
G/A - Greywacke with 20-50% argillite interbeds
QV - Massive Quartz Vein (>50% of interval)

Table 3.
Summary of Whole Rock Results

Sample #	Statistics	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	TiO_2 (%)	P_2O_5 (%)	MnO (%)	Cr_2O_3 (%)	V_2O_5 (%)	LOI (%)	Sum (%)
ARGILLITE (5-49%) GREYWACKE															
	Minimum	57.10	15.20	6.90	1.86	0.87	1.06	2.87	0.77	0.10	0.10	0.01	0.01	4.26	98.20
	Maximum	63.00	19.50	8.38	2.51	2.57	2.07	4.16	1.06	0.15	0.14	0.02	0.03	5.27	99.40
	Average	59.63	17.03	7.47	2.21	1.92	1.50	3.38	0.90	0.12	0.12	0.01	0.02	4.56	98.87
	Standard Deviation	2.35	1.67	0.53	0.23	0.64	0.37	0.53	0.11	0.02	0.01	0.00	0.01	0.40	0.47
	Median	59.15	17.15	7.33	2.23	2.01	1.51	3.22	0.88	0.12	0.11	0.01	0.01	4.38	99.00
	Count	6	6	6	6	6	6	6	6	6	6	6	6	6	6
ARGILLITE (<5% GREYWACKE)															
	Minimum	52.50	16.10	7.10	2.07	0.30	0.11	3.10	0.74	0.09	0.06	0.01	0.01	3.68	97.10
	Maximum	63.00	20.10	9.40	3.32	2.77	1.58	5.06	1.04	0.13	0.15	0.04	0.03	5.65	99.70
	Average	57.44	18.33	8.30	2.54	1.39	0.75	4.17	0.93	0.11	0.11	0.01	0.02	4.46	98.54
	Standard Deviation	2.15	0.99	0.58	0.26	0.49	0.28	0.36	0.06	0.01	0.02	0.01	0.01	0.41	0.58
	Median	57.40	18.40	8.21	2.49	1.33	0.79	4.12	0.93	0.11	0.10	0.01	0.02	4.43	98.60
	Count	39	39	39	39	39	39	39	39	39	39	39	39	39	39
COMPOSITE															
	Minimum	56.90	14.40	5.08	1.91	0.50	1.00	2.57	0.72	0.09	0.09	0.01	0.01	3.62	98.30
	Maximum	65.10	18.30	8.17	2.48	6.68	2.32	3.97	1.00	0.16	0.21	0.03	0.03	7.29	100.00
	Average	59.81	17.09	7.10	2.16	2.19	1.52	3.46	0.92	0.12	0.12	0.01	0.02	4.53	99.05
	Standard Deviation	2.03	1.22	0.81	0.18	1.50	0.32	0.37	0.08	0.02	0.03	0.01	0.01	0.93	0.46
	Median	59.20	17.30	7.37	2.21	1.71	1.50	3.51	0.94	0.12	0.12	0.01	0.01	4.39	98.90
	Count	15	15	15	15	15	15	15	15	15	15	15	15	15	15
GREYWACKE (20%-50% ARGILLITE INTERBEDS)															
	Minimum	55.50	11.70	3.85	0.95	1.18	0.87	1.68	0.74	0.08	0.09	0.01	0.01	3.41	98.40
	Maximum	70.80	19.60	9.06	2.57	3.89	2.77	4.23	0.99	0.14	0.15	0.02	0.03	4.92	99.70
	Average	63.44	15.26	6.17	1.79	2.19	1.93	2.86	0.87	0.11	0.11	0.01	0.02	4.09	98.86
	Standard Deviation	4.25	2.30	1.40	0.43	0.82	0.56	0.76	0.09	0.02	0.02	0.00	0.01	0.51	0.41
	Median	63.70	15.05	6.22	1.74	1.89	2.11	2.79	0.88	0.10	0.11	0.01	0.02	4.04	98.80
	Count	12	12	12	12	12	12	12	12	12	12	12	12	12	12
GREYWACKE (<20% ARGILLITE INTERBEDS)															
	Minimum	63.10	11.60	3.87	1.08	1.21	0.05	1.31	0.58	0.07	0.08	0.01	0.01	2.63	97.20
	Maximum	71.00	15.30	5.88	2.33	4.08	3.14	3.38	0.89	0.15	0.13	0.02	0.02	4.51	100.30
	Average	67.82	13.29	4.67	1.56	2.33	2.42	2.16	0.74	0.11	0.10	0.01	0.01	3.65	98.88
	Standard Deviation	2.49	1.10	0.68	0.38	0.97	0.89	0.65	0.11	0.03	0.02	0.00	0.00	0.65	0.89
	Median	68.30	13.00	4.54	1.55	2.06	2.63	2.10	0.73	0.12	0.10	0.01	0.01	3.65	98.85
	Count	10	10	10	10	10	10	10	10	10	10	10	10	10	10
MARGINAL ORE															
	Minimum	55.80	15.70	5.41	1.46	0.68	0.18	3.14	0.80	0.09	0.08	0.01	0.01	3.58	97.70
	Maximum	65.30	18.70	9.06	2.85	2.24	1.94	4.51	0.92	0.13	0.11	0.03	0.03	4.58	99.80
	Average	58.84	17.81	7.76	2.39	1.56	0.79	4.06	0.89	0.11	0.10	0.01	0.02	4.16	98.47
	Standard Deviation	2.64	0.83	0.94	0.36	0.46	0.45	0.40	0.03	0.01	0.01	0.01	0.01	0.29	0.63
	Median	58.20	18.00	7.94	2.37	1.61	0.71	4.15	0.89	0.11	0.10	0.01	0.02	4.16	98.20
	Count	11	11	11	11	11	11	11	11	11	11	11	11	11	11
QUARTZ VEIN															
06-037	Massive Quartz Vein (>50% of interval)	92.00	0.53	1.46	0.13	1.44	0.05	0.12	0.02	0.02	0.05	0.01	0.01	1.23	97.00
TAILINGS															
	Cnd 2 Treated Solids	56.90	19.70	7.70	2.60	1.16	0.57	4.80	0.54	0.11	0.08	0.03	0.02	4.47	98.70
OVERALL SAMPLES															
	Overall Minimum	52.50	0.53	1.46	0.13	0.30	0.05	0.12	0.02	0.02	0.05	0.01	0.01	1.23	97.00
	Overall Maximum	92.00	20.10	9.40	3.32	6.68	3.14	5.06	1.06	0.16	0.21	0.04	0.03	7.29	100.30
	Overall Average	60.36	16.88	7.25	2.21	1.77	1.26	3.57	0.88	0.11	0.11	0.01	0.02	4.27	98.70
	Overall Standard Deviation	5.22	2.64	1.51	0.49	0.87	0.75	0.89	0.13	0.02	0.02	0.01	0.01	0.66	0.61
	Overall Median	58.80	17.80	7.66	2.34	1.61	0.98	3.83	0.91	0.11	0.11	0.01	0.01	4.36	98.80
	Overall Count	95	95	95	95	95	95	95	95	95	95	95	95	95	95

Note:
A value equal to the instrument detection limit was used in statistical calculations when a non-detect value was encountered.

Table 4.
Summary of ICP Results

Sample #	Statistics	Ag (µg/g)	Al (%)	As (µg/g)	Ba (µg/g)	Be (µg/g)	Bi (µg/g)	Ca (%)	Cd (µg/g)	Co (µg/g)	Cr (µg/g)	Cu (µg/g)	Fe (%)	K (%)
ARGILLITE (5-49%) GREYWACKE														
	Minimum	0.13	6.60	35	360	1.4	0.17	0.65	0.04	14	54	27	4.80	2.2
	Maximum	0.76	10.00	3800	750	2.6	0.72	1.90	0.31	19	65	95	6.10	3.9
	Average	0.31	6.18	737	560	1.97	0.40	1.36	0.13	16	59	59	5.38	3.05
	Standard Deviation	0.23	1.47	1505	141	0.43	0.19	0.46	0.10	2	4	24	0.57	0.66
	Median	0.21	7.85	101.5	530	1.9	0.36	1.35	0.09	16	61	60	5.25	3
	Count	6	6	6	6	6	6	6	6	6	6	6	6	6
ARGILLITE (<5% GREYWACKE)														
	Minimum	0.12	6.50	25	480	1.5	0.10	0.18	0.03	13	45	27	3.90	2.7
	Maximum	1.10	11.00	15000	870	3.1	1.80	2.00	0.44	22	72	130	7.30	4.5
	Average	0.35	8.50	1623	650	2.15	0.49	0.95	0.14	17	60	56	5.72	3.55
	Standard Deviation	0.21	1.00	3334	87	0.29	0.43	0.37	0.09	3	6	23	0.80	0.44
	Median	0.28	8.70	340	640	2.1	0.33	0.94	0.12	17	59	55	5.70	3.5
	Count	39	39	39	39	39	39	39	39	39	39	39	39	39
COMPOSITE														
	Minimum	0.11	6.50	25	390	1.4	0.09	0.33	0.03	11	40	20	3.40	2.2
	Maximum	0.31	9.40	850	680	2.5	0.42	4.80	0.18	18	74	78	6.10	3.5
	Average	0.21	8.33	222	564	1.89	0.23	1.54	0.09	14	55	41	4.90	3.09
	Standard Deviation	0.05	0.93	278	85	0.30	0.09	1.12	0.05	2	8	19	0.73	0.41
	Median	0.20	8.80	71	590	1.9	0.21	1.20	0.08	13	56	34	5.00	3.2
	Count	15	15	15	15	15	15	15	15	15	15	15	15	15
GREYWACKE (20%-50% ARGILLITE INTERBEDS)														
	Minimum	0.12	5.80	32	270	1.1	0.13	0.81	0.03	9	41	18	2.60	1.5
	Maximum	0.46	8.80	7000	680	2.2	1.20	2.80	0.19	26	69	69	6.20	3.7
	Average	0.25	7.52	910	466	1.63	0.32	1.61	0.09	14	56	45	4.36	2.56
	Standard Deviation	0.11	1.05	2023	112	0.33	0.30	0.68	0.05	5	9	17	1.01	0.64
	Median	0.24	7.55	69.5	500	1.7	0.23	1.35	0.07	14	59	45.5	4.60	2.5
	Count	12	12	12	12	12	12	12	12	12	12	12	12	12
GREYWACKE (<20% ARGILLITE INTERBEDS)														
	Minimum	0.13	5.90	19	220	0.9	0.09	0.70	0.03	7	24	9.9	2.60	1.3
	Maximum	0.33	8.10	5200	430	1.5	0.54	2.90	0.23	12	49	36	3.90	2.6
	Average	0.23	6.66	896	305	1.14	0.18	1.54	0.11	9	40	19	3.13	1.90
	Standard Deviation	0.07	0.69	1771	71	0.21	0.14	0.78	0.07	2	9	7	0.45	0.46
	Median	0.22	6.55	52.5	295	1.1	0.12	1.35	0.07	9	41	18	3.00	1.85
	Count	10	10	10	10	10	10	10	10	10	10	10	10	10
MARGINAL ORE														
	Minimum	0.03	6.70	8	430	1.6	0.06	0.42	0.03	9	50	16	3.90	2.6
	Maximum	0.61	9.40	2200	660	2.3	0.45	1.30	0.25	17	66	74	6.10	3.9
	Average	0.20	8.26	613	545	2.01	0.19	0.93	0.13	14	60	46	5.32	3.14
	Standard Deviation	0.15	0.70	743	64	0.20	0.10	0.28	0.07	3	6	17	0.62	0.34
	Median	0.16	8.40	330	550	2.0	0.17	0.96	0.12	15	62	47	5.20	3.1
	Count	11	11	11	11	11	11	11	11	11	11	11	11	11
QUARTZ VEIN														
06-037	Massive Quartz Vein (>50% of interval)	0.73	1.30	250	33	0.1	2.30	1.10	0.03	4	32	39	1.10	0.2
TAILINGS														
	CND 2 Treated Solids	0.35	7.00	180	400	0.34	0.40	0.63	0.10	9.1	120	109	5.00	1.2
OVERALL SAMPLES														
	Overall Minimum	0.03	1.30	8	33	0.14	0.06	0.18	0.03	3.6	24	9.9	1.10	0.2
	Overall Maximum	1.10	11.00	15000	870	3.1	2.30	4.80	0.44	26	120	130	7.30	4.5
	Overall Average	0.28	8.01	981	548	1.86	0.36	1.21	0.12	15	57	48	5.01	3.03
	Overall Standard Deviation	0.17	1.28	2336	147	0.48	0.37	0.66	0.07	4	11	23	1.15	0.77
	Overall Median	0.23	8.20	160	570	2	0.24	1.00	0.10	15	59	42	5.10	3.2
	Overall Count	95	95	95	95	95	95	95	95	95	95	95	95	95

Sample #	Statistics	Li (µg/g)	Mg (%)	Mn (µg/g)	Mo (µg/g)	Na (%)	Ni (µg/g)	Pb (µg/g)	Sb (µg/g)	Se (µg/g)	Sn (µg/g)	Sr (µg/g)	Ti (µg/g)	Tl (µg/g)	U (µg/g)	V (µg/g)	Y (µg/g)	Zn (µg/g)	Hg (µg/g)
ARGILLITE (5-49%) GREYWACKE																			
	Minimum	28	1.10	820	1.7	1.10	26	9.3	0.1	2	1.8	96	1000	0.4	1.40	81	6.3	95	0.1
	Maximum	43	1.80	1100	3.0	3.70	36	44.0	2.3	3	2.7	140	2100	2.9	1.80	140	9.5	130	0.1
	Average	33	1.45	953	2.30	2.10	31	22.38	0.52	2	2.15	118	1533	1.03	1.57	114	7.60	106	0.10
	Standard Deviation	5	0.27	97	0.57	1.04	4	12.28	0.88	0	0.37	16	418	0.93	0.15	21	1.24	13	0.00
	Median	31	1.45	960	2.2	1.85	31	19	0.15	2	2.0	120	1500	0.7	1.5	115	7.2	100	0.1
	Count	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
ARGILLITE (<5% GREYWACKE)																			
	Minimum	27	1.20	410	0.1	0.11	27	4.3	0.1	2	1.7	35	1100	0.5	1.40	89	4.3	68	0.1
	Maximum	49	2.10	1100	4.1	2.90	42	48.0	6.2	7	11.0	140	3500	1.2	2.00	160	19.0	140	0.1
	Average	35	1.57	803	1.11	1.11	33	18.39	1.16	2	2.80	83	2085	0.75	1.63	116	7.45	111	0.10
	Standard Deviation	5	0.23	141	0.76	0.79	3	10.26	1.45	1	1.41	21	728	0.12	0.14	15	2.40	15	0.00
	Median	35	1.50	800	0.9	0.70	34	15	0.4	2	2.6	85	1800	0.7	1.6	110	7.0	110	0.1
	Count	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39
COMPOSITE																			
	Minimum	19	1.10	600	0.8	0.89	21	8.9	0.1	2	2.0	70	760	0.5	1.40	80	6.7	64	0.1
	Maximum	42	1.70	1400	3.6	2.70	33	40.0	1.4	3	2.8	210	2700	0.8	2.30	130	15.0	120	0.1
	Average	31	1.43	887	1.92	1.59	28	17.53	0.48	2	2.34	114	1924	0.63	1.68	106	9.47	92	0.10
	Standard Deviation	5	0.19	197	0.73	0.67	3	9.45	0.42	0	0.30	42	604	0.09	0.23	15	1.98	17	0.00
	Median	33	1.40	820	1.8	1.30	28	14	0.2	2	2.3	110	2100	0.6	1.7	110	9.5	90	0.1
	Count	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
GREYWACKE (20%-50% ARGILLITE INTERBEDS)																			
	Minimum	12	0.69	700	1.1	0.65	15	8.4	0.1	2	1.1	95	770	0.4	1.30	75	5.2	50	0.1
	Maximum	37	1.70	1200	3.8	3.70	40	33.0	3	2	3.2	180	3100	1.5	1.90	120	11.0	110	0.1
	Average	24	1.18	871	2.14	2.24	25	16.78	0.70	2	2.02	127	1586	0.62	1.63	98	8.47	79	0.10
	Standard Deviation	7	0.25	121	0.79	1.00	7	7.67	0.86	0	0.62	22	727	0.32	0.18	16	2.18	18	0.00
	Median	25	1.20	855	2.1	2.00	23	14	0.4	2	1.9	125	1350	0.55	1.7	104	9.0	79.5	0.1
	Count	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
GREYWACKE (<20% ARGILLITE INTERBEDS)																			
	Minimum	12	0.70	560	1.4	0.09	14	9.2	0.1	2	1.5	42	710	0.2	1.20	60	8.2	41	0.1
	Maximum	26	1.20	910	4.3	2.50	29	27.0	2.7	3	2.0	140	2300	0.8	1.80	86	11.0	66	0.1
	Average	16	0.95	724	2.54	1.83	21	14.11	0.58	2	1.76	101	1255	0.41	1.55	71	10.05	52	0.10
	Standard Deviation	4	0.16	107	0.79	0.65	4	5.20	0.87	0	0.18	26	591	0.16	0.21	9	1.14	8	0.00
	Median	16	1.00	730	2.5	1.95	20.5	13.0	0.2	2	1.8	100	1100	0.4	1.55	70.5	10.5	52.5	0.1
	Count	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
MARGINAL ORE																			
	Minimum	19	0.98	580	0.3	0.18	22	6.1	0.1	2	1.9	46	1400	0.6	1.50	92	6.0	66	0.1
	Maximum	38	1.70	860	1.4	1.40	39	22.0	2.3	4	3.2	110	2200	0.9	1.90	110	8.8	120	0.1
	Average	30	1.40	734	0.77	0.60	33	12.07	0.92	2	2.53	74	1709	0.73	1.66	101	7.20	99	0.10
	Standard Deviation	5	0.22	82	0.39	0.30	5	4.86	0.72	1	0.38	16	274	0.08	0.14	6	1.09	15	0.00
	Median	30	1.30	740	0.6	0.55	32	12	0.8	2	2.5	73	1600	0.7	1.7	100	7.2	100	0.1
	Count	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
QUARTZ VEIN																			
06-037	Massive Quartz Vein (>50% of interval)	3	0.10	500	11.0	2.80	15	70	0.1	2	0.2	15	94	0.9	0.18	6	2.2	11	0.1
TAILINGS																			
	CND 2 Treated Solids	60	1.40	3800	5.2	0.35	44	19	2.1	< 1	3.2	62	2500	0.8	1.70	130	7.2	34	< 0.1
OVERALL SAMPLES																			
	Overall Minimum	3	0.10	410	0.05	0.09	14	4.3	0.1	2	0.2	15	94	0.2	0.18	5.8	2.2	11	0.1
	Overall Maximum	60	2.10	3800	11	3.70	44	70	6.2	7	11	210	3500	2.9	2.30	160	19	140	0.1
	Overall Average	30	1.38	845	1.70	1.41	30	17.47	0.83	2	2.41	96	1800	0.69	1.62	105	8.11	94	0.10
	Overall Standard Deviation	9	0.31	332	1.35	0.89	6	10.29	1.06	1	1.01	31	690	0.29	0.22	22	2.24	26	0.00
	Overall Median	31	1.40	800	1.5	1.20	31	14	0.4	2	2.4	92	1700	0.7	1.6	110	7.8	100	0.1
	Overall Count	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95

Notes:
A value equal to the instrument detection limit was used in statistical calculations when a non-detect value was encountered.

Table 5
Summary of Acid-Base Accounting Results

Sample	Statistics	Paste pH	NP	AP	Net NP	NP/AP	S	Acid Leachable SO4-S	Sulphide-S	C	Carbonate	TIC	Carb-NP	Carb-NP/AP
#		units	t CaCO3/1000t	t CaCO3/1000 t	t CaCO3/1000 t	ratio	%	%	%	%	%	%	t CaCO3/1000 t	ratio
ARGILLITE (5-49%) GREYWACKE														
	Minimum	8.65	21.20	0.9	18.0	3.5	0.048	0.01	0.03	0.41	1.31	0.26	21.8	4.1
	Maximum	9.37	115.07	11.9	111.6	49.8	0.662	0.28	0.38	6.11	2.92	0.58	101.9	40.0
	Average	8.92	49.77	4.7	45.1	10.7	0.234	0.09	0.15	1.39	2.10	0.42	44.6	9.6
	Standard Deviation	N/A	30.02	3.7	30.6	17.2	0.212	0.11	0.12	2.08	0.53	0.11	26.6	13.8
	Median	8.84	41.90	3.5	38.2	9.9	0.127	0.03	0.10	0.61	2.05	0.41	36.0	8.5
	Count	7	7	7	7	7	7	7	7	7	6	6	7	7
ARGILLITE (<5% GREYWACKE)														
	Minimum	7.65	7.10	0.9	-13.3	0.4	0.028	0.00	0.03	0.10	0.30	0.06	5.0	0.2
	Maximum	9.67	73.43	26.2	68.8	25.6	1.620	0.78	0.84	2.43	3.75	0.75	62.5	25.7
	Average	8.87	30.13	6.8	23.3	4.4	0.375	0.16	0.22	0.54	1.58	0.32	26.6	3.9
	Standard Deviation	N/A	11.71	6.1	13.4	5.6	0.378	0.21	0.20	0.46	0.68	0.14	11.2	5.3
	Median	9.37	30.10	4.7	24.7	6.3	0.251	0.07	0.15	0.42	1.51	0.30	25.4	4.6
	Count	43	43	43	43	43	43	43	43	43	39	39	43	43
COMPOSITE														
	Minimum	9.09	8.80	1.2	7.5	2.4	0.057	0.01	0.04	0.13	0.45	0.09	7.5	1.8
	Maximum	9.61	120.00	11.6	118.0	63.7	0.451	0.21	0.37	1.44	6.64	1.33	110.7	58.3
	Average	9.33	39.90	4.4	35.5	9.1	0.191	0.05	0.14	0.51	2.01	0.40	33.6	7.6
	Standard Deviation	N/A	26.79	2.6	26.8	14.6	0.108	0.06	0.08	0.33	1.53	0.31	25.5	13.5
	Median	9.36	30.60	4.1	27.8	7.7	0.168	0.03	0.13	0.41	1.49	0.30	24.9	6.6
	Count	15	15	15	15	15	15	15	15	15	15	15	15	15
GREYWACKE (20%-50% ARGILLITE INTERBEDS)														
	Minimum	7.40	28.20	0.6	17.4	2.1	0.073	0.01	0.02	0.44	1.68	0.34	16.4	2.7
	Maximum	9.66	67.50	15.3	65.0	61.4	0.578	0.14	0.49	0.99	3.62	0.73	60.4	57.0
	Average	8.46	43.10	4.8	38.3	9.0	0.200	0.05	0.15	0.63	2.32	0.47	37.0	7.7
	Standard Deviation	N/A	11.10	4.0	12.8	15.6	0.140	0.04	0.13	0.16	0.63	0.13	11.8	14.7
	Median	9.38	40.80	2.8	36.2	11.1	0.155	0.04	0.09	0.59	2.08	0.42	34.5	12.3
	Count	13	13	13	13	13	13	13	13	13	12	12	13	13
GREYWACKE (<20% ARGILLITE INTERBEDS)														
	Minimum	8.30	21.80	0.9	18.4	5.0	0.041	0.00	0.03	0.31	1.05	0.21	17.5	4.1
	Maximum	9.71	133.12	19.2	113.9	67.4	0.615	0.24	0.61	7.33	3.77	0.75	122.3	62.6
	Average	8.99	50.96	3.7	47.2	13.7	0.159	0.04	0.12	1.35	2.22	0.44	41.3	11.1
	Standard Deviation	N/A	27.01	4.7	23.9	18.3	0.173	0.06	0.15	1.79	0.93	0.19	25.9	16.7
	Median	9.53	44.63	2.4	41.1	22.6	0.081	0.02	0.07	0.68	1.96	0.39	34.5	16.6
	Count	15	15	15	15	15	15	15	15	15	10	10	15	15
MARGINAL ORE														
	Minimum	8.83	16.30	2.5	13.3	2.4	0.122	0.04	0.08	0.21	0.73	0.15	12.2	1.7
	Maximum	9.65	39.40	13.1	28.8	12.3	0.570	0.36	0.42	0.59	2.30	0.46	38.4	10.7
	Average	9.31	27.96	6.1	21.8	4.6	0.386	0.19	0.20	0.38	1.51	0.30	25.2	4.1
	Standard Deviation	N/A	6.42	3.4	5.2	2.8	0.170	0.12	0.11	0.11	0.45	0.09	7.5	3.0
	Median	9.51	29.60	5.0	21.8	6.3	0.480	0.20	0.16	0.37	1.58	0.32	26.4	4.9
	Count	11	11	11	11	11	11	11	11	11	11	11	11	11
QUARTZ VEIN														
06-037	Massive Quartz Vein (>50% of interval)	8.71	27.50	10.0	17.5	2.8	0.416	0.10	0.32	0.33	1.11	0.22	18.5	1.9
TAILINGS														
	CND 2 Treated Solids	9.29	21.5	3.4	18.1	6.3	0.170	< 0.4	0.11	0.38	1.22	-	20.3	5.9
ORE														
DA 0087		8.20	46.08	17.3	28.8	2.7	0.554	0.01	0.55	1.21	-	-	20.2	1.2
DA 0351		7.95	50.74	16.8	33.9	3.0	0.539	0.00	0.54	1.39	-	-	23.2	1.4
DA 0398		7.25	13.85	11.8	2.1	1.2	0.377	0.02	0.36	1.03	-	-	17.2	1.5
DA 0402		7.55	52.72	13.9	38.8	3.8	0.444	0.01	0.43	2.46	-	-	41.1	3.0
DA 0577		8.75	60.50	30.7	29.8	2.0	0.982	0.02	0.96	1.79	-	-	29.9	1.0
DA 7399		8.55	45.16	17.2	28.0	2.6	0.550	0.01	0.54	1.57	-	-	26.2	1.5
DA 7278		8.90	83.47	17.2	66.3	4.9	0.550	0.00	0.55	3.27	-	-	54.5	3.2
DA 0898		7.85	65.37	4.3	61.1	15.4	0.136	0.00	0.13	2.33	-	-	38.8	9.1
DA 8157		8.70	30.51	7.2	23.3	4.2	0.231	0.01	0.22	0.81	-	-	13.4	1.9
OVERALL STATISTICS (WASTE ROCK, MARGINAL ORE, AND TAILINGS SAMPLES)														
	Overall Minimum	7.40	7.10	0.6	-13.3	0.4	0.028	0.00	0.02	0.10	0.30	0.06	5.0	0.2
	Overall Maximum	9.71	133.12	26.2	118.0	67.4	1.620	0.78	0.84	7.33	6.64	1.33	122.3	62.6
	Overall Average	9.02	36.98	5.5	31.5	12.0	0.283	0.11	0.17	0.69	1.82	0.37	31.8	10.2
	Overall Standard Deviation	N/A	19.33	4.8	19.9	12.6	0.277	0.15	0.15	0.92	0.87	0.18	17.8	11.2
	Overall Median	9.36	31.80	4.1	27.4	7.3	0.178	0.05	0.13	0.46	1.68	0.34	28.4	6.2
	Overall Count	115	115	115	115	115	115	115	115	115	115	115	115	115

Note:
A value equal to the instrument detection limit was used in statistical calculations when a non-detect value was encountered.
0.4 Indicates an NP/AP or CaNP/AP ratio <4

Table 6
Summary of Short Term Leach Results

Sample #	Statistics	pH (units)	Alkalinity (mg/L as CaCO3)	Acidity (mg/L as CaCO3)	SO_4 (mg/L)	Cl (mg/L)	Hg (mg/L)	Al (mg/L)	As (mg/L)	Ag (mg/L)
ARGILLITE (6-45%) GREYWACKE										
	Minimum	7.58	35	2	11.0	2.0	0.0001	0.07	0.01	0.0001
	Maximum	8.33	45	2	110.0	2.1	0.0001	0.32	0.10	0.0001
	Average	7.80	38	2	47.7	2.0	0.0001	0.17	0.08	0.0001
	Standard Deviation	N/A	6	0	54.3	0.1	0.0000	0.13	0.05	0.0000
	Median	7.79	35	2	22.0	2.0	0.0001	0.12	0.09	0.0001
	Count	3	3	3	3	3	3	3	3	3
ARGILLITE (<5% GREYWACKE)										
	Minimum	7.36	28	2	6.5	2.0	0.0001	0.03	0.01	0.0001
	Maximum	8.30	56	2	100.0	3.5	0.0001	0.64	1.25	0.0001
	Average	7.78	36	2	28.3	2.3	0.0001	0.41	0.22	0.0001
	Standard Deviation	N/A	7	0	30.6	0.5	0.0000	0.20	0.37	0.0000
	Median	7.84	33	2	15.0	2.0	0.0001	0.40	0.06	0.0001
	Count	17	17	17	17	17	17	17	17	17
COMPOSITE										
	Minimum	7.85	29	2	8.4	2.0	0.0001	0.20	0.02	0.0001
	Maximum	8.03	39	2	46.0	2.3	0.0001	0.37	0.10	0.0001
	Average	7.75	32	2	30.5	2.2	0.0001	0.28	0.06	0.0001
	Standard Deviation	N/A	4	0	14.1	0.2	0.0000	0.08	0.03	0.0000
	Median	7.73	31	2	35.0	2.2	0.0001	0.23	0.05	0.0001
	Count	5	5	5	5	5	5	5	5	5
GREYWACKE (20%-60% ARGILLITE INTERBEDS)										
	Minimum	8.05	35	2	6.0	2.0	0.0001	0.24	0.00	0.0001
	Maximum	8.05	56	2	66.0	2.8	0.0001	0.31	0.35	0.0001
	Average	8.05	46	2	36.0	2.4	0.0001	0.28	0.18	0.0001
	Standard Deviation	N/A	15	0	42.4	0.6	0.0000	0.05	0.25	0.0000
	Median	8.05	46	2	36.0	2.4	0.0001	0.28	0.18	0.0001
	Count	2	2	2	2	2	2	2	2	2
GREYWACKE (<20% ARGILLITE INTERBEDS)										
	Minimum	7.59	38	2	8.0	2.0	0.0001	0.39	0.03	0.0001
	Maximum	8.16	40	2	28.0	3.6	0.0001	0.68	0.21	0.0001
	Average	7.80	39	2	14.9	2.8	0.0001	0.52	0.09	0.0001
	Standard Deviation	N/A	1	0	11.4	0.8	0.0000	0.15	0.10	0.0000
	Median	7.83	38	2	8.7	2.8	0.0001	0.49	0.04	0.0001
	Count	3	3	3	3	3	3	3	3	3
MARGINAL ORE										
	Minimum	7.65	27	2	9.0	2.0	0.0001	0.17	0.04	0.0001
	Maximum	7.91	42	2	67.0	2.0	0.0001	1.28	0.08	0.0001
	Average	7.76	35	2	28.7	2.0	0.0001	0.59	0.06	0.0001
	Standard Deviation	N/A	8	0	33.2	0.0	0.0000	0.59	0.02	0.0000
	Median	7.75	37	2	10.0	2.0	0.0001	0.32	0.06	0.0001
	Count	3	3	3	3	3	3	3	3	3
OVERALL SAMPLES										
	Overall Minimum	7.36	27	2	6.0	2.0	0.0001	0.03	0.00	0.0001
	Overall Maximum	8.33	56	2	110.0	3.6	0.0001	1.28	1.25	0.0001
	Overall Average	7.79	36	2	28.8	2.3	0.0001	0.37	0.14	0.0001
	Overall Standard Deviation	N/A	7	0	27.7	0.4	0.0000	0.23	0.26	0.0000
	Overall Median	7.83	35	2	16.0	2.0	0.0001	0.38	0.06	0.0001
	Overall Count	33	33	33	33	33	33	33	33	33
MMER Guidelines (Max. Authorized Monthly Mean Conc.)		-	-	-	-	-	-	-	0.50	-
CCME Guidelines (Protection of freshwater aquatic life)		6.5-9.0	-	-	-	-	0.0001	0.005-0.1	0.01	0.0001

Statistics	Ba (mg/L)	Be (mg/L)	Bi (mg/L)	Ca (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Li (mg/L)	K (mg/L)	Mg (mg/L)	Mn (mg/L)
ARGILLITE (6-45%) GREYWACKE													
Minimum	0.14	0.0004	0.0000	8.26	0.00006	0.00004	0.001	0.0002	0.01	0.002	8.60	1.66	0.0030
Maximum	0.31	0.0004	0.0000	42	0.00006	0.00011	0.001	0.0007	0.06	2.050	13.10	6.21	0.0808
Average	0.24	0.0004	0.0000	20.62	0.00006	0.00006	0.001	0.0004	0.03	0.685	10.36	3.46	0.0350
Standard Deviation	0.08	0.0000	0.0000	18.4479	0.00000	0.00004	0.000	0.0003	0.03	1.182	2.40	2.42	0.0485
Median	0.26	0.0004	0.0000	12.2	0.00006	0.00005	0.001	0.0004	0.03	0.002	9.39	2.51	0.0113
Count	3	3	3	3	3	3	3	3	3	3	3	3	3
ARGILLITE (<5% GREYWACKE)													
Minimum	0.10	0.0004	0.0000	6.07	0.00006	0.00001	0.001	0.0002	0.01	0.002	7.68	0.89	0.0011
Maximum	0.57	0.0004	0.0001	39.7	0.00006	0.00048	0.005	0.0010	0.43	0.002	16.70	8.37	0.1260
Average	0.30	0.0004	0.0000	13.95058	0.00006	0.00009	0.001	0.0005	0.12	0.002	11.42	2.66	0.0204
Standard Deviation	0.10	0.0000	0.0000	9.618743	0.00000	0.00011	0.001	0.0002	0.12	0.000	3.04	2.05	0.0340
Median	0.31	0.0004	0.0000	9.6	0.00006	0.00007	0.001	0.0005	0.05	0.002	10.50	1.89	0.0059
Count	17	17	17	17	17	17	17	17	17	17	17	17	17
COMPOSITE													
Minimum	0.14	0.0004	0.0000	7.73	0.00006	0.00001	0.001	0.0002	0.01	0.002	7.69	1.28	0.0018
Maximum	0.34	0.0004	0.0000	21.9	0.00006	0.00017	0.001	0.0005	0.13	0.002	12.90	2.81	0.0124
Average	0.22	0.0004	0.0000	14.726	0.00006	0.00006	0.001	0.0003	0.04	0.002	9.40	2.06	0.0071
Standard Deviation	0.08	0.0000	0.0000	5.386586	0.00000	0.00006	0.000	0.0001	0.05	0.000	2.16	0.55	0.0047
Median	0.22	0.0004	0.0000	15.3	0.00006	0.00004	0.001	0.0003	0.02	0.002	8.62	2.03	0.0060
Count	5	5	5	5	5	5	5	5	5	5	5	5	5
GREYWACKE (20%-60% ARGILLITE INTERBEDS)													
Minimum	0.26	0.0004	0.0000	7.77	0.00006	0.00001	0.001	0.0002	0.03	0.002	7.01	0.87	0.0016
Maximum	0.35	0.0004	0.0000	10.3	0.00006	0.00001	0.001	0.0008	0.04	0.002	8.75	2.36	0.0105
Average	0.30	0.0004	0.0000	9.035	0.00006	0.00001	0.001	0.0005	0.03	0.002	7.88	1.62	0.0060
Standard Deviation	0.07	0.0000	0.0000	1.78898	0.00000	0.00000	0.000	0.0004	0.01	0.000	1.23	1.06	0.0063
Median	0.30	0.0004	0.0000	9.035	0.00006	0.00001	0.001	0.0005	0.03	0.002	7.88	1.62	0.0060
Count	2	2	2	2	2	2	2	2	2	2	2	2	2
GREYWACKE (<20% ARGILLITE INTERBEDS)													
Minimum	0.27	0.0004	0.0000	6.86	0.00006	0.00002	0.001	0.0001	0.02	0.002	6.63	1.00	0.0019
Maximum	0.49	0.0004	0.0000	13.7	0.00006	0.00020	0.001	0.0006	0.24	0.002	11.50	2.62	0.0112
Average	0.35	0.0004	0.0000	9.706667	0.00006	0.00010	0.001	0.0004	0.12	0.002	9.25	1.69	0.0064
Standard Deviation	0.12	0.0000	0.0000	3.561254	0.00000	0.00009	0.000	0.0003	0.11	0.000	2.46	0.83	0.0047
Median	0.30	0.0004	0.0000	8.58	0.00006	0.00007	0.001	0.0004	0.11	0.002	9.61	1.46	0.0062
Count	3	3	3	3	3	3	3	3	3	3	3	3	3
MARGINAL ORE													
Minimum	0.13	0.0004	0.0000	8.61	0.00006	0.00001	0.001	0.0002	0.01	0.002	9.08	1.24	0.0011
Maximum	0.49	0.0004	0.0000	26.4	0.00006	0.00028	0.001	0.0005	0.57	0.002	10.40	3.44	0.0629
Average	0.31	0.0004	0.0000	14.65667	0.00006	0.00011	0.001	0.0004	0.20	0.002	9.64	2.04	0.0238
Standard Deviation	0.18	0.0000	0.0000	10.17153	0.00000	0.00015	0.000	0.0002	0.32	0.000	0.68	1.22	0.0340
Median	0.30	0.0004	0.0000	8.96	0.00006	0.00004	0.001	0.0004	0.01	0.002	9.44	1.44	0.0074
Count	3	3	3	3	3	3	3	3	3	3	3	3	3
OVERALL SAMPLES													
Overall Minimum	0.10	0.0004	0.0000	6.07	0.00006	0.00001	0.001	0.0001	0.01	0.002	6.63	0.87	0.0011
Overall Maximum	0.57	0.0004	0.0001	42	0.00006	0.00048	0.005	0.0010	0.57	2.050	16.70	8.37	0.1260
Overall Average	0.29	0.0004	0.0000	13.66066	0.00006	0.00008	0.001	0.0004	0.09	0.056	10.28	2.36	0.0165
Overall Standard Deviation	0.10	0.0000	0.0000	8.753184	0.00000	0.00009	0.001	0.0002	0.13	0.332	2.57	1.61	0.0278
Overall Median	0.30	0.0004	0.0000	10.3	0.00006	0.00005	0.001	0.0004	0.04	0.002	9.71	1.87	0.0062
Overall Count	33	33	33	33	33	33	33	33	33	33	33	33	33
MMER Guidelines (Max. Authorized Monthly Mean Conc.)	-	-	-	-	-	-	-	0.3000	-	-	-	-	-
CCME Guidelines (Protection of freshwater aquatic life)	-	-	-	-	0.00002	-	-	0.002-0.004	0.30	-	-	-	-

Statistics	Mo (mg/L)	Na (mg/L)	Ni (mg/L)	Pb (mg/L)	P (mg/L)	Sb (mg/L)	S (mg/L)	Se (mg/L)	Sr (mg/L)	Ti (mg/L)	V (mg/L)	W (mg/L)	Zn (mg/L)
ARGILLITE (6-45%) GREYWACKE													
Minimum	0.0012	5.85	0.0010	0.0005	0.01	0.0014	4.54	0.003	0.0309	0.0006	0.0003	0.0002	0.0054
Maximum	0.0060	9.87	0.0029	0.0007	0.73	0.3000	47.00	0.003	0.0695	0.0024	0.0013	0.0046	0.0398
Average	0.0035	7.62	0.0019	0.0006	0.25	0.1016	20.30	0.003	0.0449	0.0016	0.0007	0.0019	0.0178
Standard Deviation	0.0039	2.05	0.0010	0.0001	0.42	0.1718	23.25	0.000	0.0214	0.0009	0.0006	0.0023	0.0189
Median	0.0013	7.14	0.0017	0.0005	0.01	0.0034	9.35	0.003	0.0342	0.0017	0.0004	0.0010	0.0085
Count	3	3	3	3	3	3	3	3	3	3	3	3	3
ARGILLITE (<5% GREYWACKE)													
Minimum	0.0003	3.98	0.0007	0.0005	0.01	0.0010	2.50	0.003	0.0191	0.0002	0.0001	0.0002	0.0050
Maximum	0.0092	9.25	0.0060	0.0012	0.02	0.0272	42.40	0.003	0.1130	0.0090	0.0022	0.0019	0.0753
Average	0.0012	6.73	0.0021	0.0008	0.01	0.0040	12.79	0.003	0.0357	0.0036	0.0010	0.0008	0.0268
Standard Deviation	0.0021	1.38	0.0014	0.0002	0.00	0.0062	11.75	0.000	0.0275	0.0027	0.0006	0.0006	0.0260
Median	0.0008	6.48	0.0017	0.0007	0.01	0.0019	7.22	0.003	0.0255	0.0026	0.0010	0.0004	0.0067
Count	17	17	17	17	17	17	17	17	17	17	17	17	17
COMPOSITE													
Minimum	0.0004	5.69	0.0009	0.0004	0.01	0.0009	3.81	0.003	0.0262	0.0006	0.0003	0.0003	0.0080
Maximum	0.0013	9.98	0.0024	0.0015	0.03	0.0038	21.10	0.003	0.0584	0.0056	0.0012	0.0005	0.0524
Average	0.0008	7.58	0.0014	0.0009	0.01	0.0024	13.56	0.003	0.0404	0.0022	0.0008	0.0004	0.0157
Standard Deviation	0.0004	1.86	0.0006	0.0004	0.01	0.0011	6.24	0.000	0.0158	0.0020	0.0004	0.0001	0.0206
Median	0.0007	6.77	0.0013	0.0007	0.01	0.0028	14.80	0.003	0.0310	0.0013	0.0007	0.0003	0.0070
Count	5	5	5	5	5	5	5	5	5	5	5	5	5
GREYWACKE (20%-60% ARGILLITE INTERBEDS)													
Minimum	0.0009	6.81	0.0007	0.0008	0.01	0.0011	3.22	0.003	0.0299	0.0009	0.0005	0.0003	0.0046
Maximum	0.0011	8.13	0.0008	0.0012	0.01	0.0017	9.79	0.003	0.0308	0.0035	0.0023	0.0006	0.0066
Average	0.0010	7.47	0.0007	0.0010	0.01	0.0014	6.50	0.003	0.0303	0.0022	0.0014	0.0004	0.0056
Standard Deviation	0.0002	0.93	0.0001	0.0003	0.00	0.0004	4.65	0.000	0.0008	0.0018	0.0013	0.0002	0.0014
Median	0.0010	7.47	0.0007	0.0010	0.01	0.0014	6.50	0.003	0.0303	0.0022	0.0014	0.0004	0.0056
Count	2	2	2	2	2	2	2	2	2	2	2	2	2
GREYWACKE (<20% ARGILLITE INTERBEDS)													
Minimum	0.0004	6.85	0.0007	0.0005	0.01	0.0013	3.27	0.003	0.0270	0.0012	0.0014	0.0006	0.0060
Maximum	0.0014	11.80	0.0007	0.0013	0.01	0.0032	14.00	0.003	0.0352	0.0189	0.0035	0.0013	0.0849
Average	0.0008	8.82	0.0007	0.0008	0.01	0.0020	7.14	0.003	0.0306	0.0086	0.0025	0.0010	0.0507
Standard Deviation	0.0005	2.62	0.0000	0.0004	0.00	0.0010	5.85	0.000	0.0041	0.0092	0.0010	0.0003	0.0405
Median	0.0006	10.80	0.0007	0.0007	0.01	0.0015	4.16	0.003	0.0301	0.0057	0.0025	0.0010	0.0612
Count	3	3	3	3	3	3	3	3	3	3	3	3	3
MARGINAL ORE													
Minimum	0.0003	3.96	0.0007	0.0005	0.01	0.0010	4.77	0.003	0.0206	0.0005	0.0003	0.0003	0.0034
Maximum	0.0006	7.88	0.0036	0.0008	0.01	0.0013	28.30	0.003	0.0437	0.0308	0.0022	0.0005	0.0695
Average	0.0004	6.45	0.0018	0.0006	0.01	0.0011	12.76	0.003	0.0292	0.0108	0.0010	0.0004	0.0268
Standard Deviation	0.0001	2.17	0.0015	0.0001	0.00	0.0002	13.46	0.000	0.0127	0.0173	0.0010	0.0001	0.0370
Median	0.0004	7.52	0.0012	0.0006	0.01	0.0011	5.21	0.003	0.0232	0.0011	0.0007	0.0004	0.0076
Count	3	3	3	3	3	3	3	3	3	3	3	3	3
OVERALL SAMPLES													
Overall Minimum	0.0003	3.96	0.0007	0.0004	0.01	0.0009	2.50	0.003	0.0191	0.0002	0.0001	0.0002	0.0034
Overall Maximum	0.0092	11.80	0.0060	0.0015	0.73	0.3000	47.00	0.003	0.1130	0.0308	0.0035	0.0046	0.0849
Overall Average	0.0012	7.30	0.0017	0.0008	0.03	0.0107	12.12	0.003	0.0351	0.0040	0.0011	0.0008	0.0242
Overall Standard Deviation	0.0018	1.78	0.0012	0.0002	0.12	0.0484	10.89	0.000	0.0202	0.0058	0.0008	0.0008	0.0281
Overall Median	0.0006	6.85	0.0013	0.0007	0.01	0.0018	9.36	0.003	0.0299	0.0020	0.0010	0.0004	0.0070
Overall Count	33	33	33	33	33	33	33	33	33	33	33	33	33
MMER Guidelines (Max. Authorized Monthly Mean Conc.)	-	-	0.5000	0.2000	-	-	-	-	-	-	-	-	0.5000
CCME Guidelines (Protection of freshwater aquatic life)	0.0730	-	0.025-0.15	0.001-0.007	-	-	-	0.001	-	-	-	-	0.0300

Note:

A value equal to the instrument detection limit was used in statistical calculations when a non-detect value was encountered.

0.57	Indicates a value elevated relative to CCME guideline value.
1.25	Indicates a value elevated relative to MMER and CCME guideline values.

CCME and MMER values provided only as basis of comparison, values above guidelines require further evaluation

Table 7
Summary of Tailings Supernatant Water Aging Results

Parameter	Units	MMER Guidelines (mg/L)	CCME	Day 0	Day 3	Day 7	Day 14	Day 45
General Parameters								
Temperature Upon	Receipt °C	-	-	21	20.5	18.5	18	20.5
Total Suspended Solids	mg/L	15.00	-	***116***	***136***	***29 UAL***	***32 UAL***	***42***
Conductivity	uS/cm	-	-	2200	2520	2440	2480	2620
pH	units	-	6.5-9	7.97	7.76	7.79	7.92	8.03
Alkalinity	mg/L as CaCO3	-	-	65	56	63	73	118
Cl	mg/L	-	-	13	13	13	13	14
SO4	mg/L	-	-	970	1100	1100	1200	1100
Nutrients								
NO2	as N mg/L	-	0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.6
NO3	as N mg/L	-	-	0.05	0.06	0.06	< 0.05	< 0.5
NH3+NH4	as N mg/L	-	-	29.3	45.8	3.1	26.5	37.3
Total Metals								
Hg	mg/L	-	0.0001	< 0.0001	< 0.0001	< 0.0001	0.0001	0.0002
Ag	mg/L	-	0.0001	0.00032	< 0.00003	< 0.00003	< 0.00003	0.00005
Al	mg/L	-	0.1	2.14	1.68	0.496	0.63	0.758
As	mg/L	0.50	0.005	0.469	0.448	0.353	0.242	0.219
B	mg/L	-	-	0.026	0.029	0.051	0.035	< 0.05
Ba	mg/L	-	-	0.0268	0.0409	0.0339	0.0362	0.0376
Be	mg/L	-	-	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Bi	mg/L	-	-	0.00006	< 0.00002	< 0.00002	< 0.00002	0.00003
Ca	mg/L	-	-	136	183	185	187	159
Cd	mg/L	-	0.000017	< 0.00006	< 0.00006	< 0.00006	0.00006	< 0.00006
Co	mg/L	-	-	0.2	0.216	0.25	0.22	0.186
Cr	mg/L	-	0.001	0.0059	0.0062	0.0055	0.0026	0.0021
Cu	mg/L	0.30	-	0.0474	0.0522	0.0397	0.0253	0.0249
Fe	mg/L	-	0.3	3.66	3.52	0.84	1.24	1.66
K	mg/L	-	-	22.5	22.3	21.3	21.3	27.1
Li	mg/L	-	-	0.0057	0.0062	0.0137	0.0062	0.0089
Mg	mg/L	-	-	5.05	6.22	6.92	7.68	13.4
Mn	mg/L	-	-	0.0773	0.0924	0.104	0.109	0.0739
Mo	mg/L	-	0.073	0.0231	0.024	0.0301	0.0262	0.0292
Na	mg/L	-	-	337	402	405	401	412
Ni	mg/L	0.50	0.025	0.0079	0.0087	0.0047	0.0047	0.0045
Pb	mg/L	0.20	0.001	0.00165	0.00184	0.00185	0.00104	0.00088
Sb	mg/L	-	-	0.016	0.0162	0.013	0.0133	0.0104
Se	mg/L	-	0.001	0.004	< 0.003	< 0.003	< 0.003	< 0.003
Sn	mg/L	-	-	< 0.0003	0.0017	0.002	< 0.002	0.0041
Sr	mg/L	-	-	0.279	0.343	0.366	0.373	0.41
Ti	mg/L	-	-	0.0088	0.0085	0.0027	0.0041	0.0044
Tl	mg/L	-	0.0008	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
U	mg/L	-	-	0.00486	0.00479	0.0053	0.00496	0.00605
V	mg/L	-	-	0.00258	0.00212	0.00142	0.00061	0.0012
W	mg/L	-	-	0.0346	0.031	0.0337	0.0335	0.0286
Y	mg/L	-	-	0.000547	0.000428	0.00014	0.000203	0.000186
Zn	mg/L	0.50	0.03	0.0077	0.0156	0.0146	0.0092	0.0053

Summary of Tailings Supernatant Water Aging Results

Parameter	Units	MMER Guidelines (mg/L)	CCME	Day 0	Day 3	Day 7	Day 14	Day 45
Dissolved Metals								
Hg	mg/L	-	0.0001	< 0.0001	< 0.0001	0.0003	< 0.0001	0.0001
Ag	mg/L	-	0.0001	0.00015	0.00015	< 0.00003	< 0.00003	< 0.00003
Al	mg/L	-	0.1	0.158	0.0788	0.0847	0.0725	0.0982
As	mg/L	0.50	0.005	***0.532***	0.366	0.335	0.307	0.227
B	mg/L	-	-	0.03	0.032	0.027	0.027	< 0.05
Ba	mg/L	-	-	0.0259	0.036	0.0332	0.0347	0.0359
Be	mg/L	-	-	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Bi	mg/L	-	-	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Ca	mg/L	-	-	135	163	144	196	144
Cd	mg/L	-	0.000017	< 0.00006	< 0.00006	< 0.00006	< 0.00006	< 0.00006
Co	mg/L	-	-	0.183	0.186	0.218	0.205	0.182
Cr	mg/L	-	0.001	0.0031	0.0032	0.003	0.0025	0.0012
Cu	mg/L	0.30	-	0.0337	0.0335	0.0293	0.0252	0.0194
Fe	mg/L	-	0.3	0.08	0.11	0.08	0.07	0.11
K	mg/L	-	-	17.7	22	18.6	21.6	23.7
Li	mg/L	-	-	0.0038	0.0058	0.0054	0.0051	0.0049
Mg	mg/L	-	-	4.16	5.25	5.93	7.76	11.6
Mn	mg/L	-	-	0.0238	0.046	0.0615	0.105	0.0567
Mo	mg/L	-	0.073	0.0222	0.0237	0.0224	0.0234	0.0277
Na	mg/L	-	-	378	368	376	401	377
Ni	mg/L	0.50	0.025	0.0063	0.0038	0.0037	0.0048	0.0035
Pb	mg/L	0.20	0.001	0.00003	0.00015	0.00025	0.00011	0.00022
Sb	mg/L	-	-	0.0178	0.0163	0.014	0.014	0.0103
Se	mg/L	-	0.001	0.004	0.003	0.003	< 0.003	< 0.003
Sn	mg/L	-	-	< 0.0003	0.0017	0.0068	< 0.002	0.0037
Sr	mg/L	-	-	0.301	0.319	0.331	0.372	0.379
Ti	mg/L	-	-	0.0008	< 0.0002	0.0007	0.0005	0.0099
Tl	mg/L	-	0.0008	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
U	mg/L	-	-	0.00437	0.0045	0.00481	0.00487	0.00549
V	mg/L	-	-	0.00114	0.00084	0.00065	0.00072	0.0007
W	mg/L	-	-	0.0303	0.0306	0.0322	0.0264	0.0253
Y	mg/L	-	-	0.00001	0.000018	0.000013	0.000033	0.000028
Zn	mg/L	0.50	0.03	0.0041	0.0052	0.0062	0.0079	0.0023
Other Parameters								
Thiosalts	as S2O3 mg/L	-	-	< 10	< 10	< 10	< 20	< 10
CN(T)	mg/L	1.00	-	0.32	0.32	0.2	0.18	0.17
CN(F)	mg/L	-	0.005	< 0.03	< 0.05	< 0.04	< 0.04	< 0.04
CNWAD	mg/L	-	-	0.03	0.04	0.03	0.04	0.04

Notes:

1.0	Indicates a value that is elevated relative to the CCME guideline.
1.0	Indicates a value that is elevated relative to the MMER and CCME (if present) guideline values.

CCME and MMER values provided only as basis of comparison, values above guidelines require further evaluation.

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TABLE 8
HUMIDITY CELL RESULTS FOR CND2 Treated Solids

Weeks Date	#	MMER Guidelines	CCME Guidelines	0 23-Oct-06	1 30-Oct-06	2 8-Nov-06	3 14-Nov-06	4 22-Nov-06	5 27-Nov-06
Leachate	mL	-	-	833	993	985	987	984	976
pH	pH	-	6.5-9.0	7.77	7.33	7.43	7.32	7.05	7.3
Acidity as CaCO3	mg CaCO3/L	-	-	< 2	< 2	< 2	< 2	< 2	< 2
Alkalinity as CaCO3	mg CaCO3/L	-	-	15	16	38	13	14	12
Conductivity	umhos/cm	-	-	228	154	349	99	94	74
Sulphate (SO4)	mg/L	-	-	63	42	100	25	24	18
NH_3+NH_4 as N	mg/L	-	-	8.2	1.5	3.8	0.7	0.4	0.3
NO_2 as N	mg/L	-	0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Aluminium (Al)	mg/L	-	0.1	0.0569	0.0234	0.057	-	-	0.0374
Antmony (Sb)	mg/L	-	-	0.0024	< 0.0002	0.0027	-	-	0.0006
Arsenic (As)	mg/L	0.50	0.005	0.0538	0.0218	0.0573	-	-	0.0106
Barium (Ba)	mg/L	-	-	0.00112	0.00098	0.00265	-	-	0.00052
Beryllium (Be)	mg/L	-	-	< 0.00004	< 0.00004	0.00011	-	-	< 0.00004
Bismuth (Bi)	mg/L	-	-	< 0.00002	< 0.00002	< 0.00002	-	-	< 0.00002
Boron (B)	mg/L	-	-	0.01	0.003	0.009	-	-	0.018
Cadmium (Cd)	mg/L	-	0.000017	< 0.00006	< 0.00006	< 0.00006	-	-	< 0.00006
Calcium (Ca)	mg/L	-		12.8	10.3	22.4	7.61	7.94	2.82
Chromium (Cr)	mg/L	-	0.001	< 0.0003	0.001	0.0004	-	-	0.0007
Cobalt (Co)	mg/L	-	-	0.0123	0.00748	0.0187	-	-	0.00211
Copper (Cu)	mg/L	0.30	-	0.0043	0.0017	0.002	-	-	0.0009
Iron (Fe)	mg/L	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Lead (Pb)	mg/L	0.20	0.001	0.00003	0.00011	0.00007	-	-	0.00035
Lithium (Li)	mg/L	-	-	0.002	< 0.002	< 0.002	-	-	< 0.002
Magnesium (Mg)	mg/L	-	-	1.06	0.956	2.64	-	-	0.342
Manganese (Mn)	mg/L	-	-	0.032	0.0546	0.0787	-	-	0.0504
Molybdenum (Mo)	mg/L	-	0.073	0.00561	0.00251	0.00388	-	-	0.00091
Nickel (Ni)	mg/L	0.50	0.025	0.0008	< 0.0007	< 0.0007	-	-	< 0.0007
Phosphorus (P)	mg/L	-	-	0.02	0.02	0.02	-	-	0.02
Potassium (K)	mg/L	-	0.3	2.78	1.68	5.15	-	-	0.52
Selenium (Se)	mg/L	-	0.001	< 0.003	< 0.003	< 0.003	-	-	< 0.003
Silver (Ag)	mg/L	-	0.0001	< 0.00003	< 0.00003	< 0.00003	-	-	< 0.00003
Sodium (Na)	mg/L	-	-	26.2	14.8	34.3	-	-	5.72
Strontium (Sr)	mg/L	-	-	0.0242	0.0229	0.0501	-	-	0.0136
Thallium (Tl)	mg/L	-	0.0008	< 0.0001	< 0.0001	< 0.0001	-	-	< 0.0001
Tin (Sn)	mg/L	-	-	0.0103	0.0062	0.0026	-	-	0.0016
Titanium (Ti)	mg/L	-	-	0.0007	0.0008	0.0003	-	-	0.0006
Urnaium (U)	mg/L	-	-	0.00012	0.00012	0.00048	-	-	0.00005
Vanadium (V)	mg/L	-	-	0.00028	< 0.00006	0.00028	-	-	< 0.00006
Yttrium (Y)	mg/L	-	-	< 0.000005	0.00001	0.000018	-	-	0.00001
Tungsten (W)	mg/L	-	-	0.00192	0.0011	0.00426	-	-	0.00041
Zinc (Zn)	mg/L	0.50	0.03	0.0021	0.0013	0.0015	-	-	0.0022

FIGURES

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Figure 1a. Summary of Major Element Distribution (ICP) for Argillite Samples
Touquoy Site
Halifax

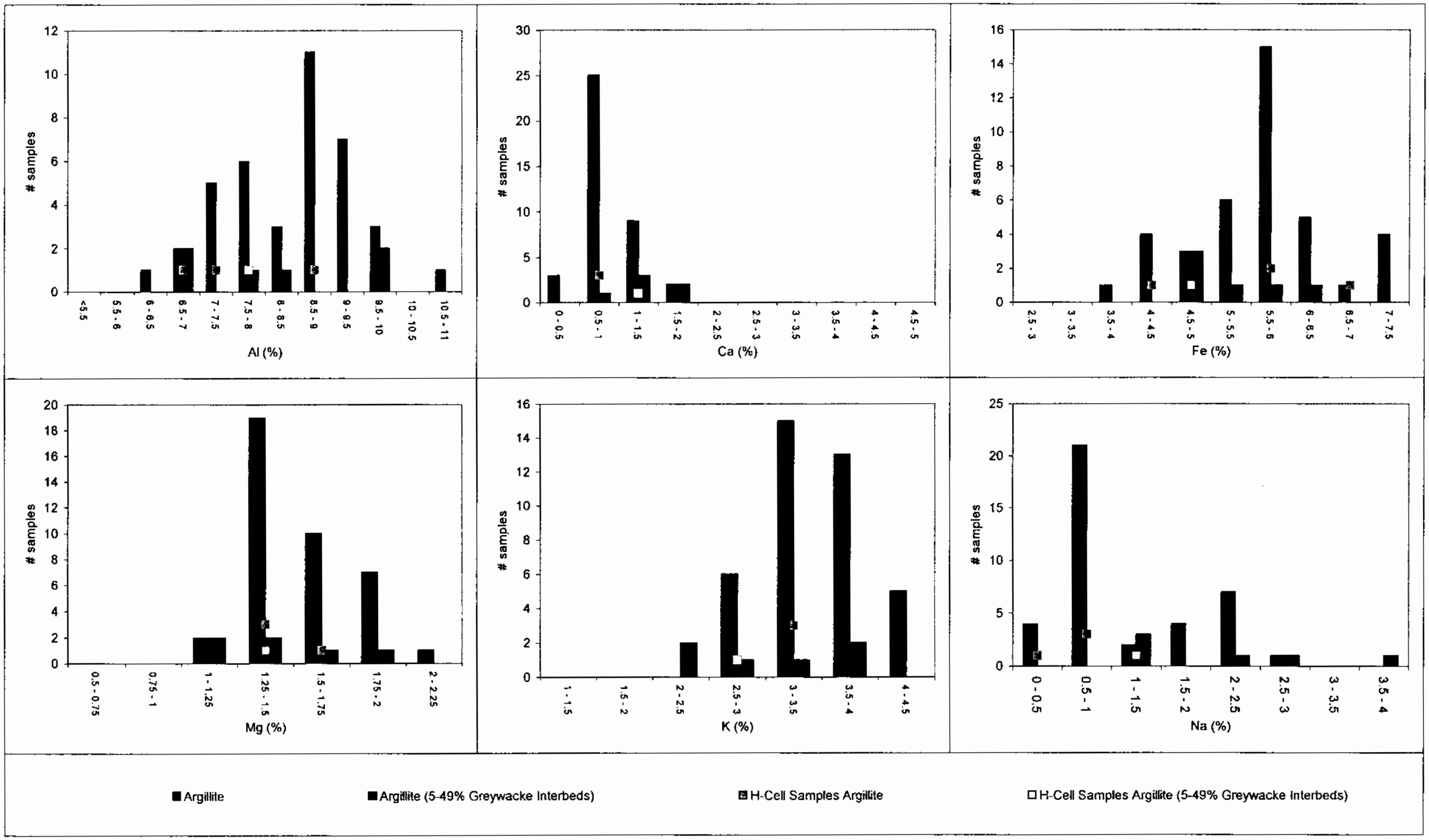

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Figure 1b. Summary of Major Element Distribution (ICP) for Greywacke Samples
Touquoy Site
Halifax

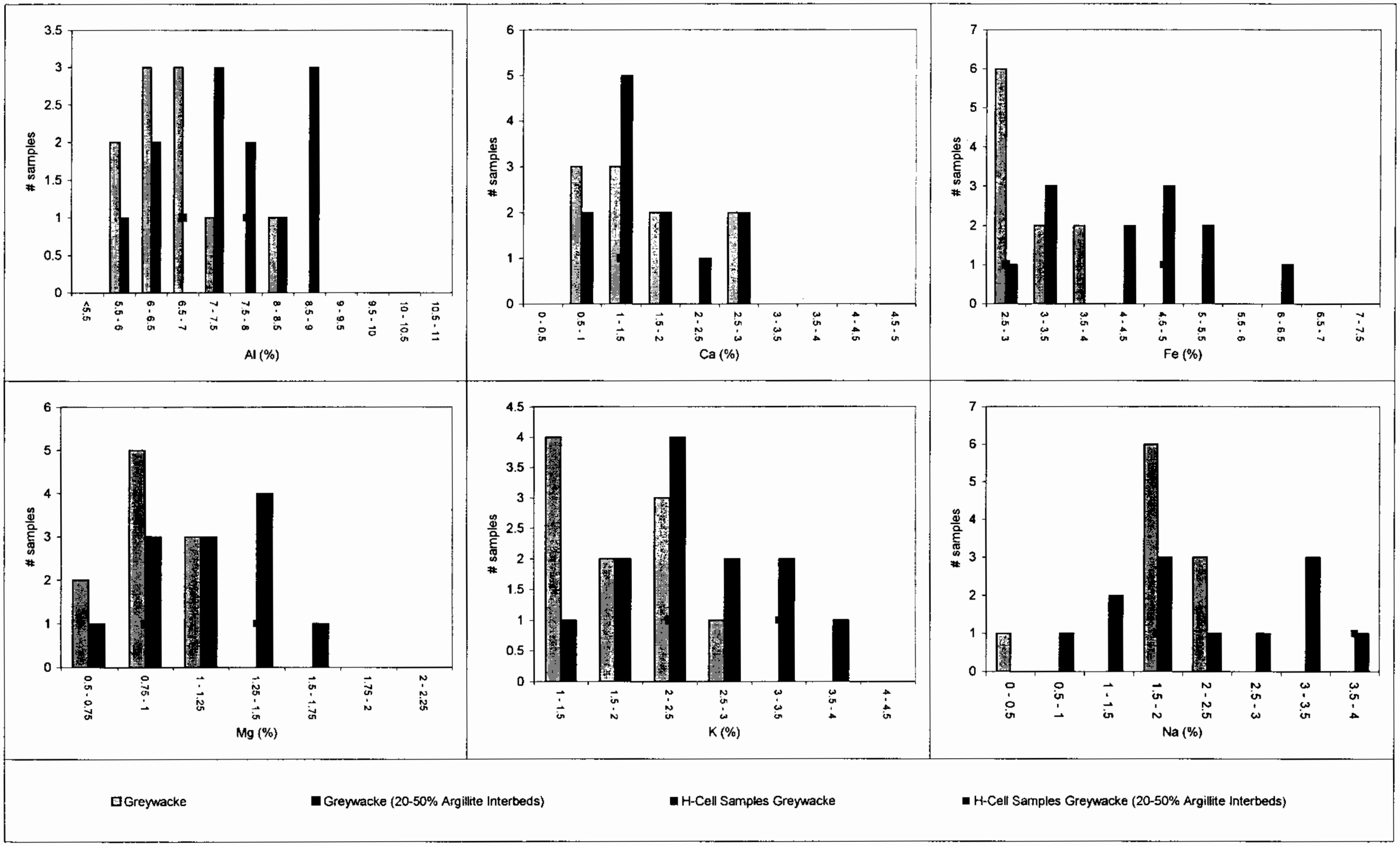

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Figure 1c. Summary of Major Element Distribution (ICP) for Composite and Marginal Ore Samples
Touquoy Site
Halifax

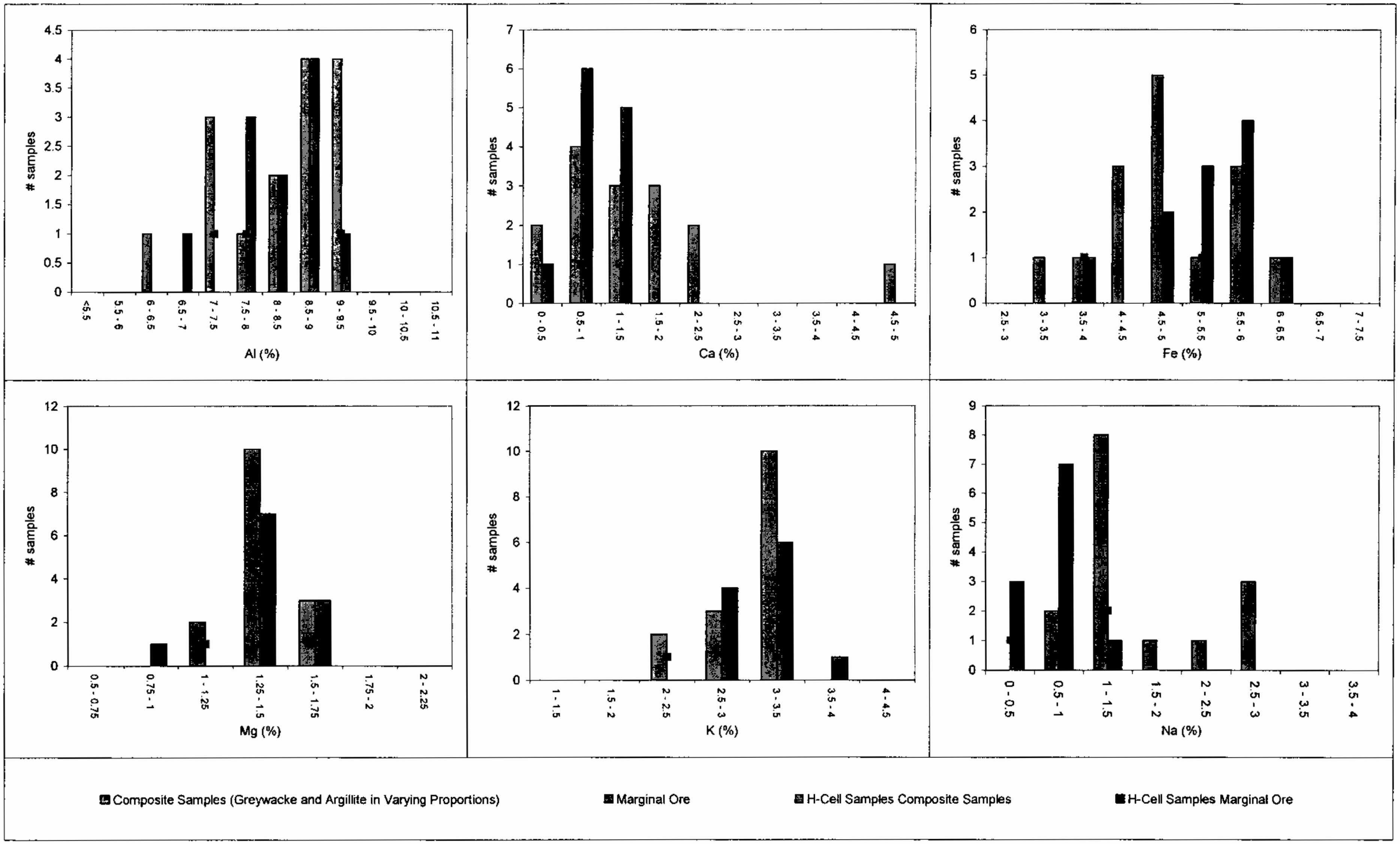

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Figure 2a. Summary of Sulphide and ICP Trace Metal Distributions for Argillite Samples
Touquoy Site
Halifax

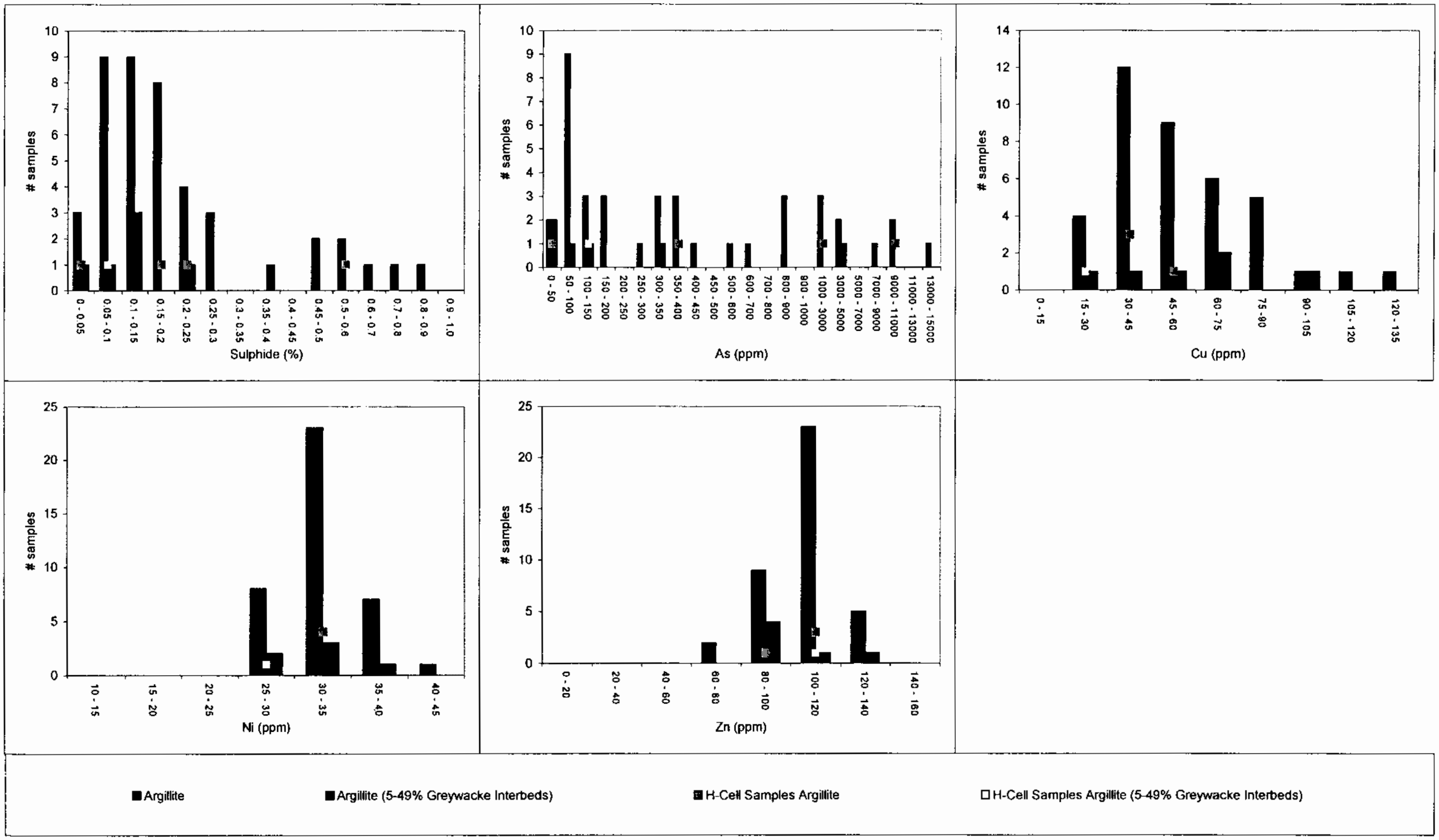

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Figure 2b. Summary of Sulphide and Trace Metal Distributions for Greywacke Samples
Touquoy Site
Halifax

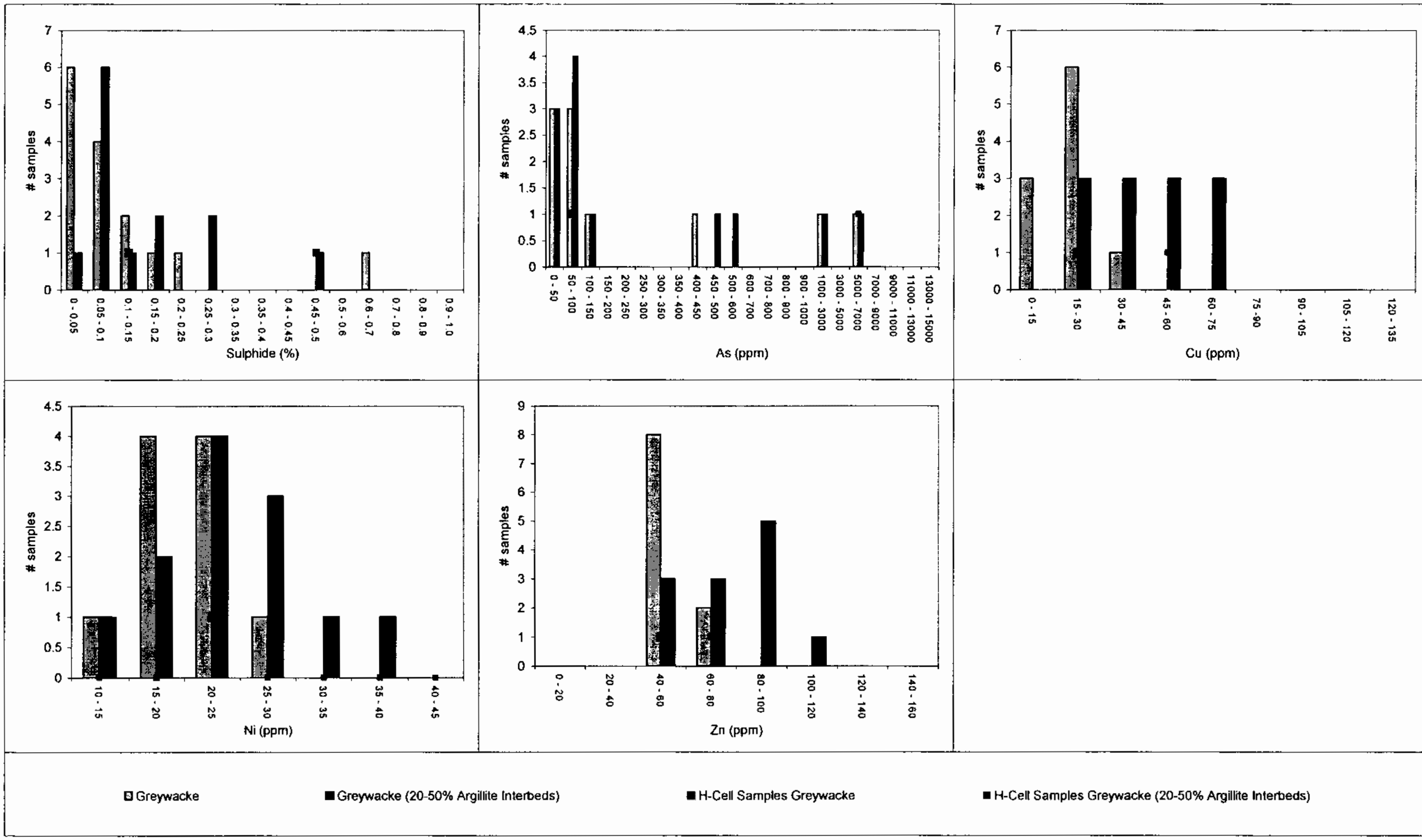

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Figure 2c. Summary of Sulphide and ICP Trace Metal Distributions for Composite and Marginal Ore Samples
Touquoy Site
Halifax

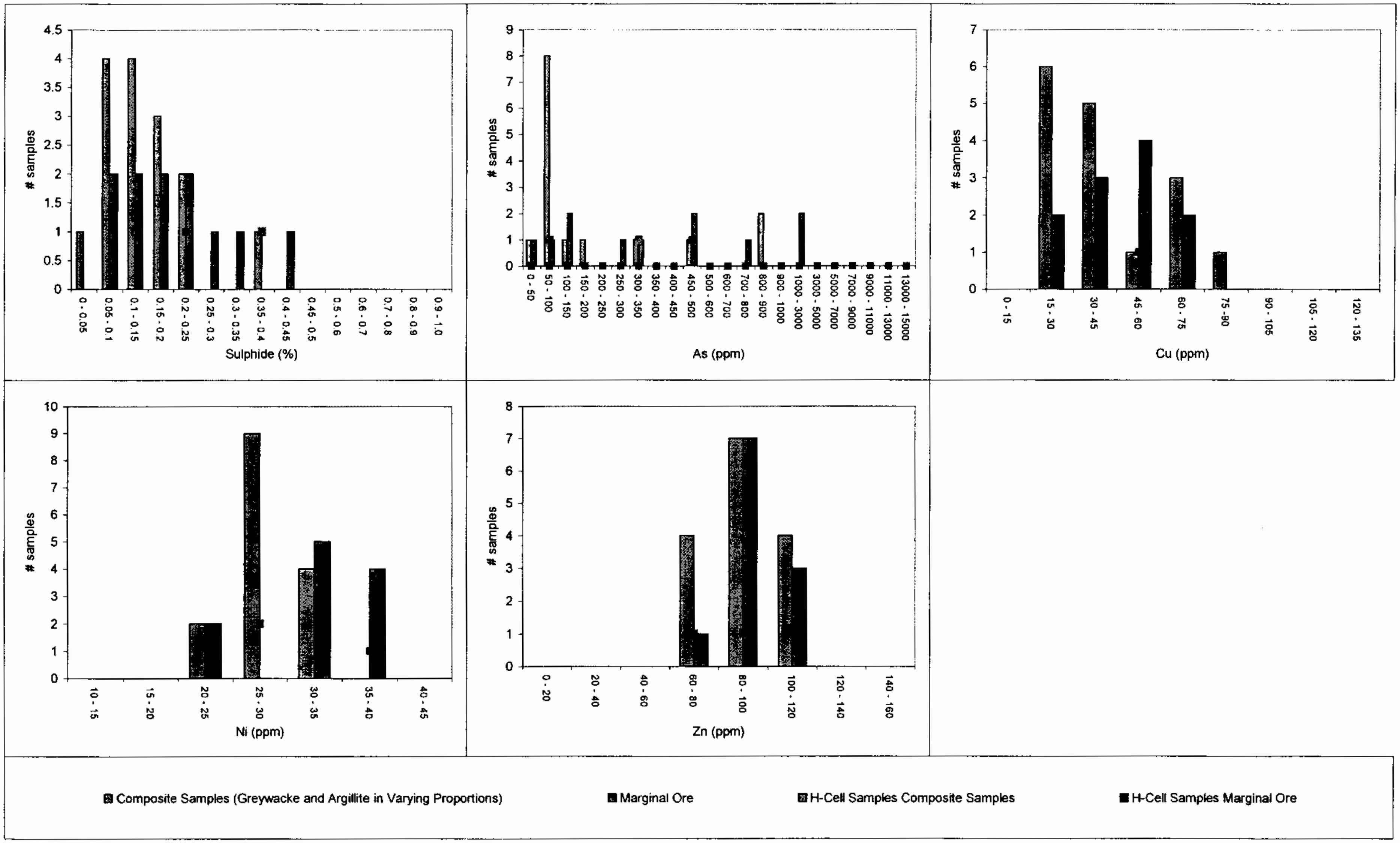

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Figure 3.
Sulphide Sulphur vs. Total Sulphur by Lithology

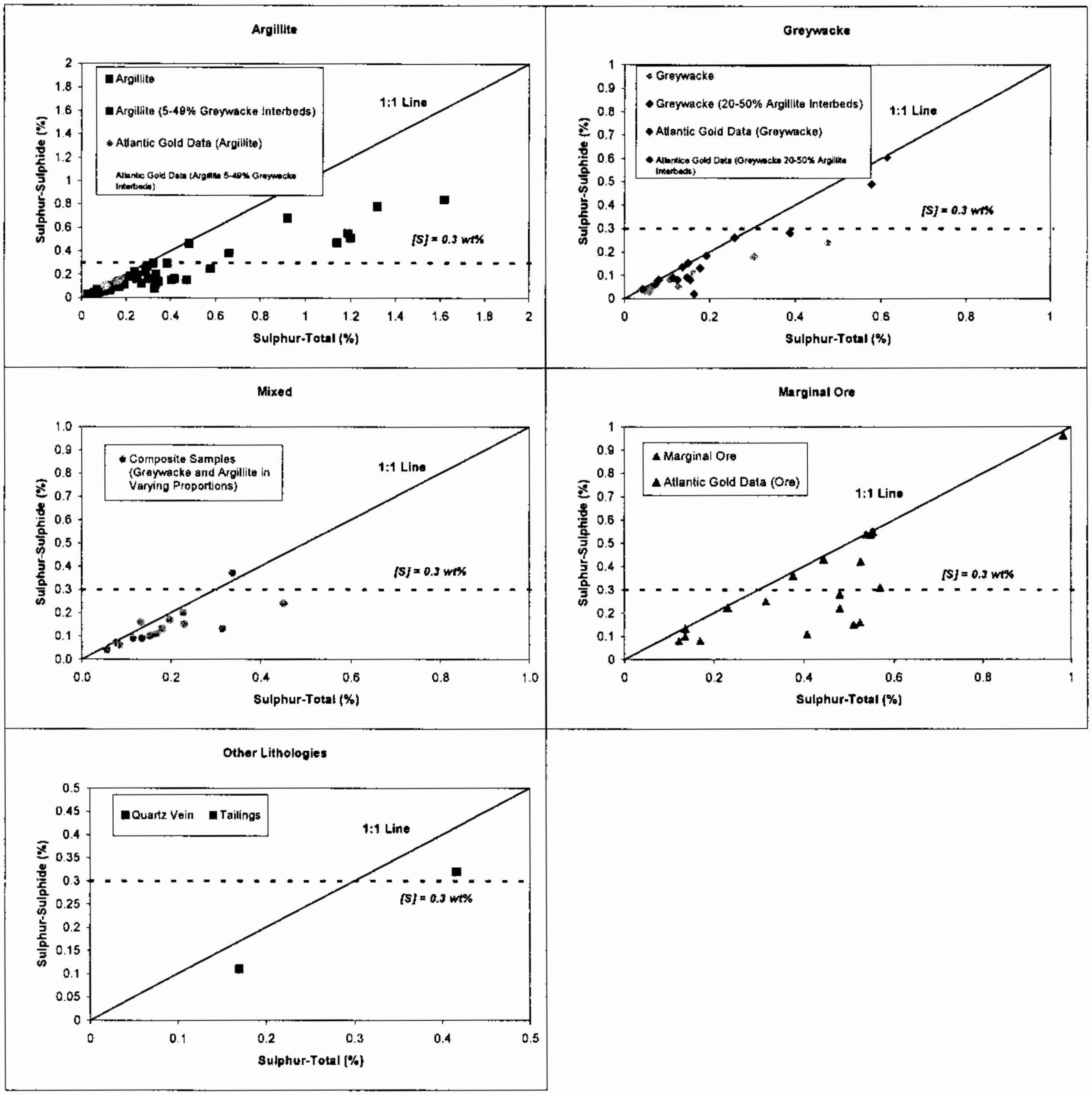

Figure 4.
Bulk Neutralization Potential vs. Carbonate Neutralization Potential

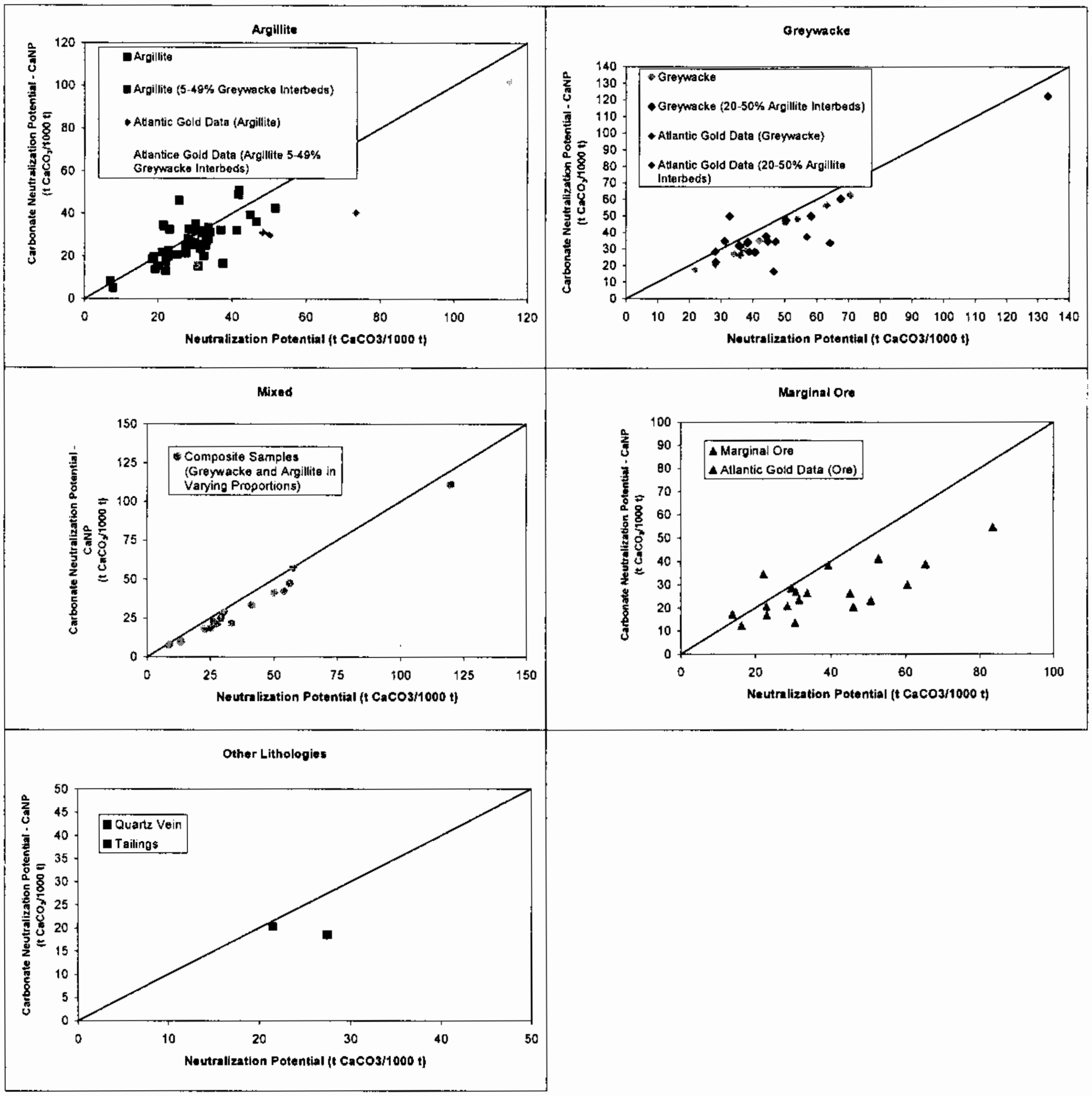

Figure 5.

Potential for Acid Rock Drainage (Acid Potential vs. Carbonate Neutralization Potential) by Lithology

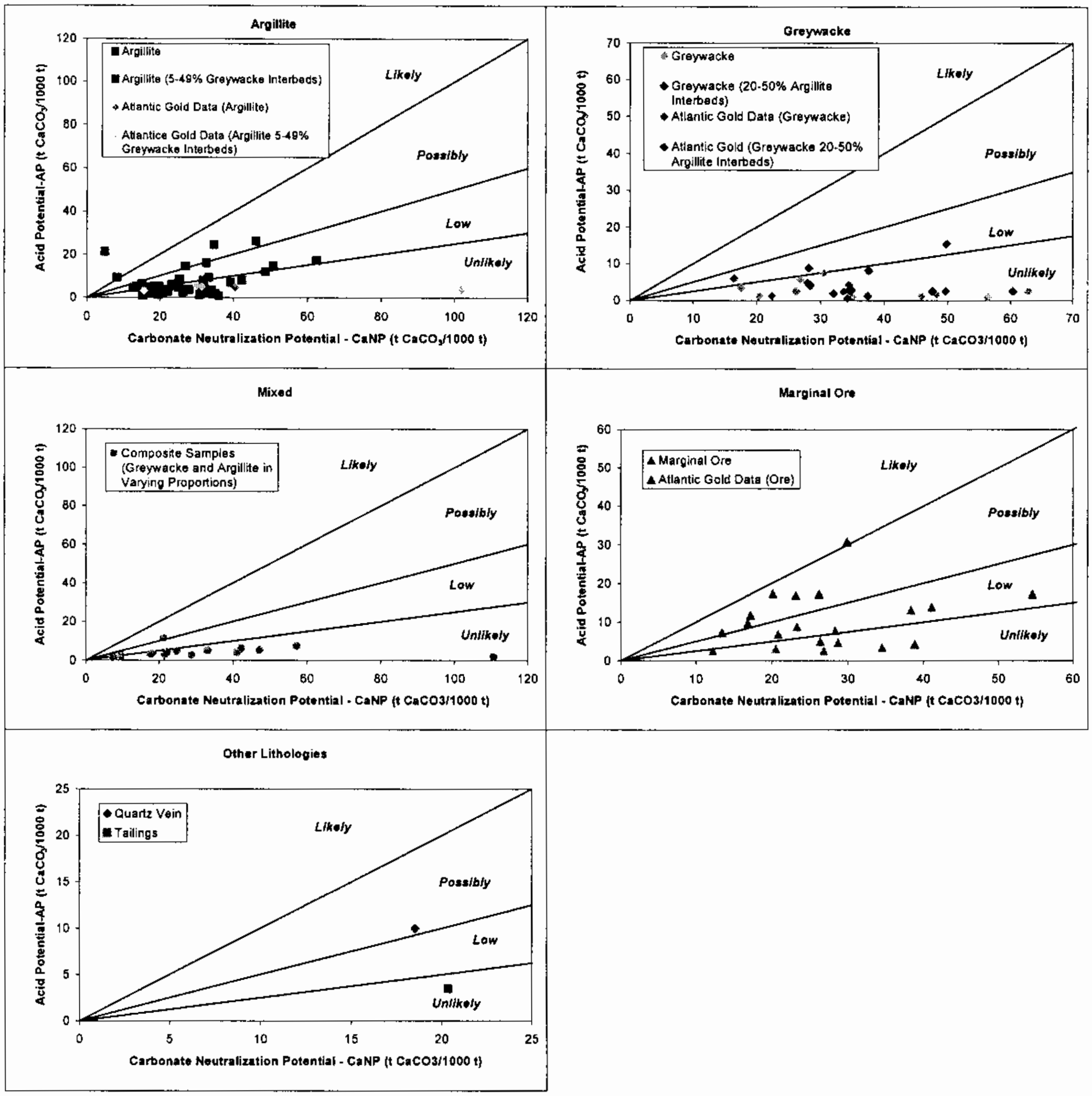

Figure 6.
Potential for Acid Rock Drainage (Acid Potential vs. Bulk Neutralization Potential) by Lithology

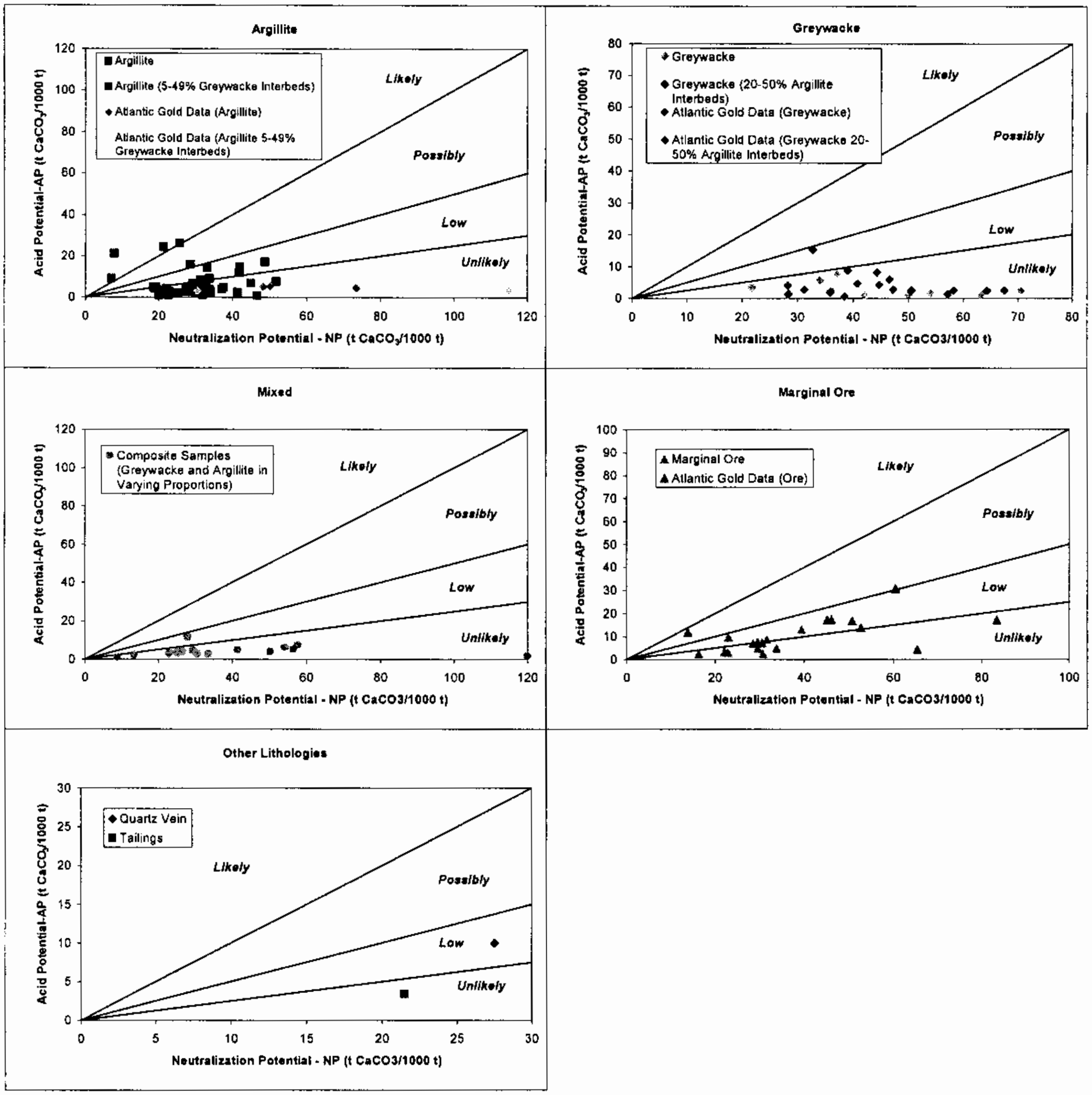

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Figure 7a. Summary of Short Term Leach Results for Argillite Samples
Touquoy Site
Halifax

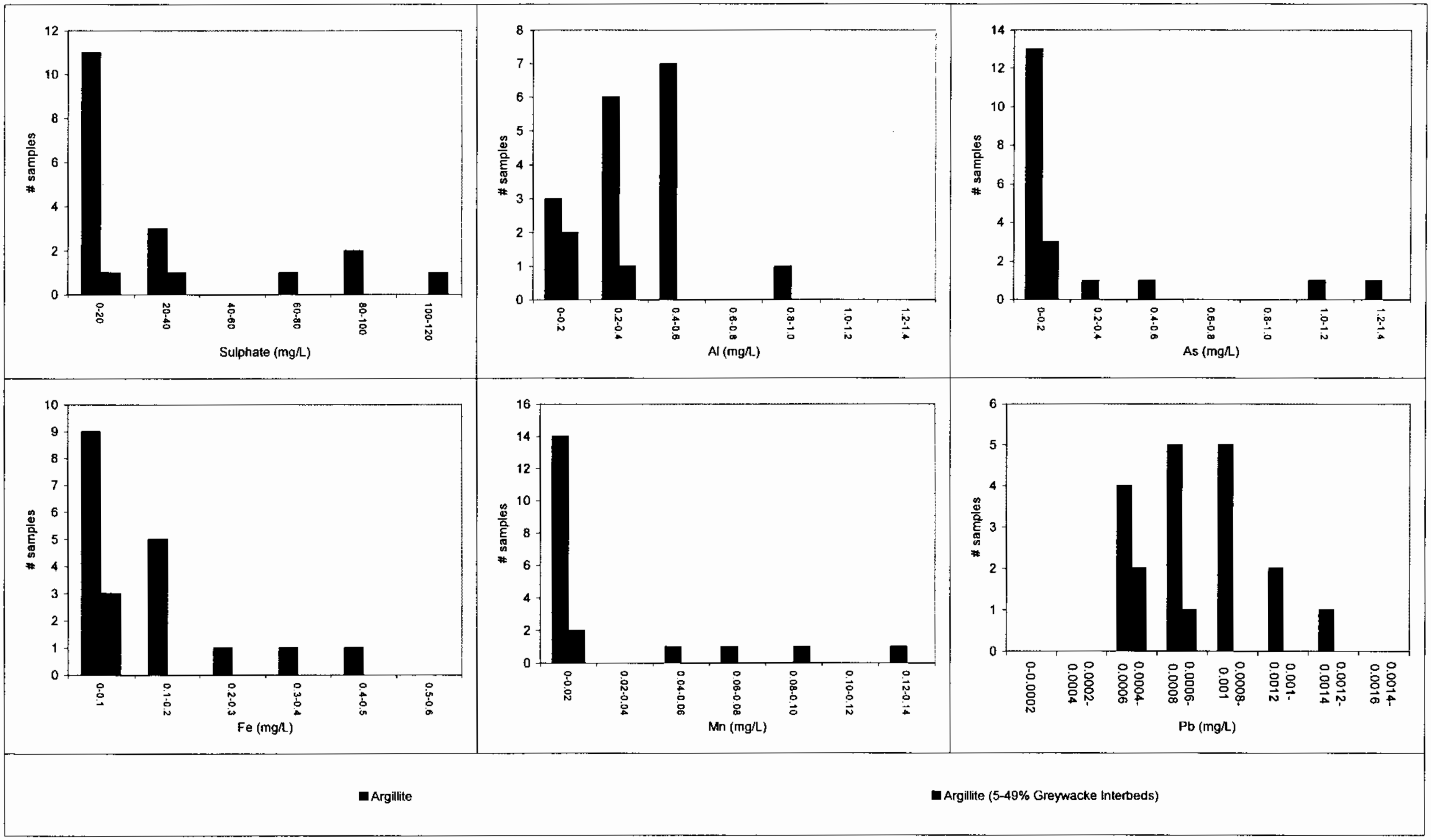

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Figure 7b. Summary of Short Term Leach Results for Greywacke Samples
Touquoy Site
Halifax

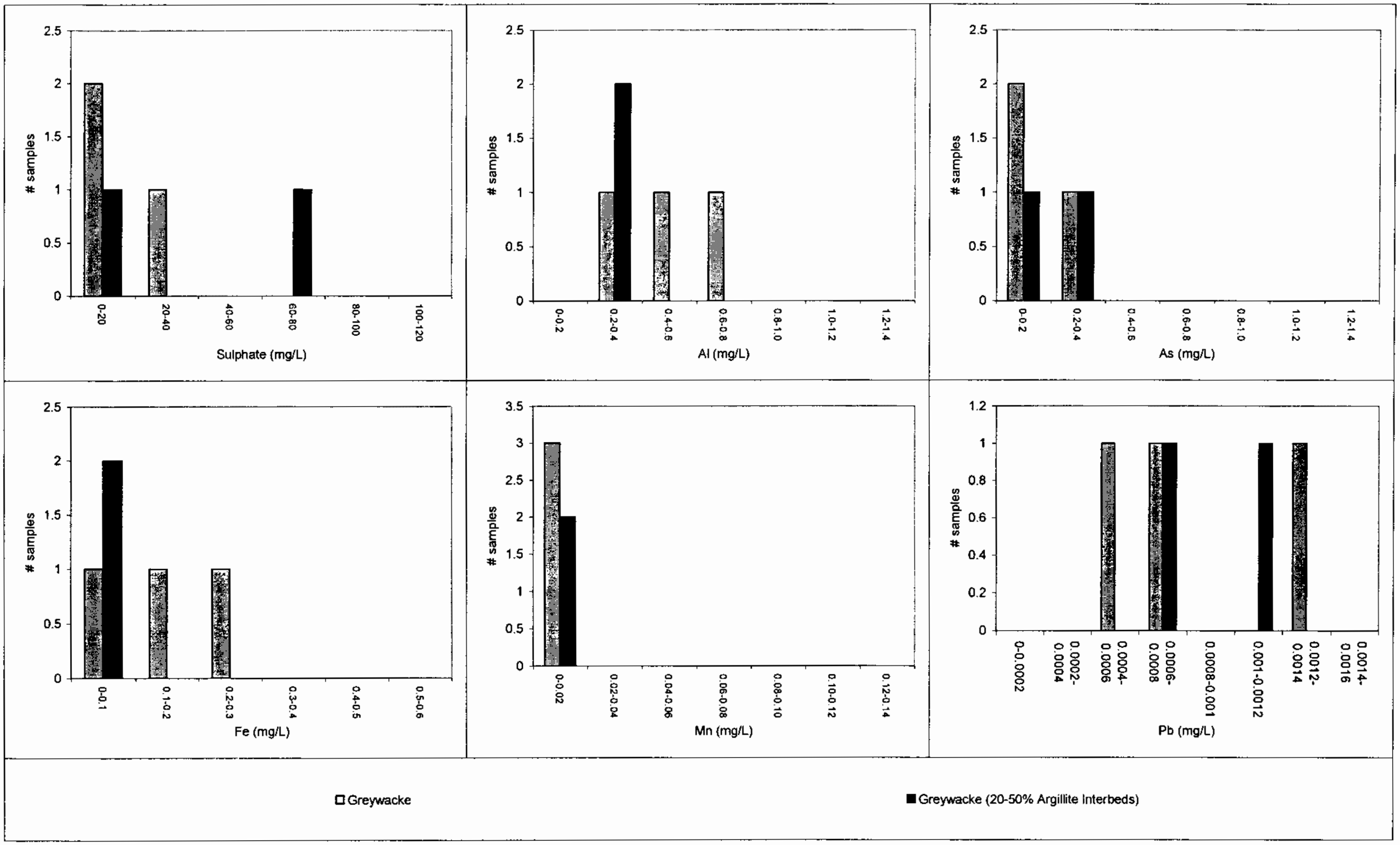

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Figure 7c. Summary of Short Term Leach Results for Composite and Marginal Ore Samples
Touquoy Site
Halifax

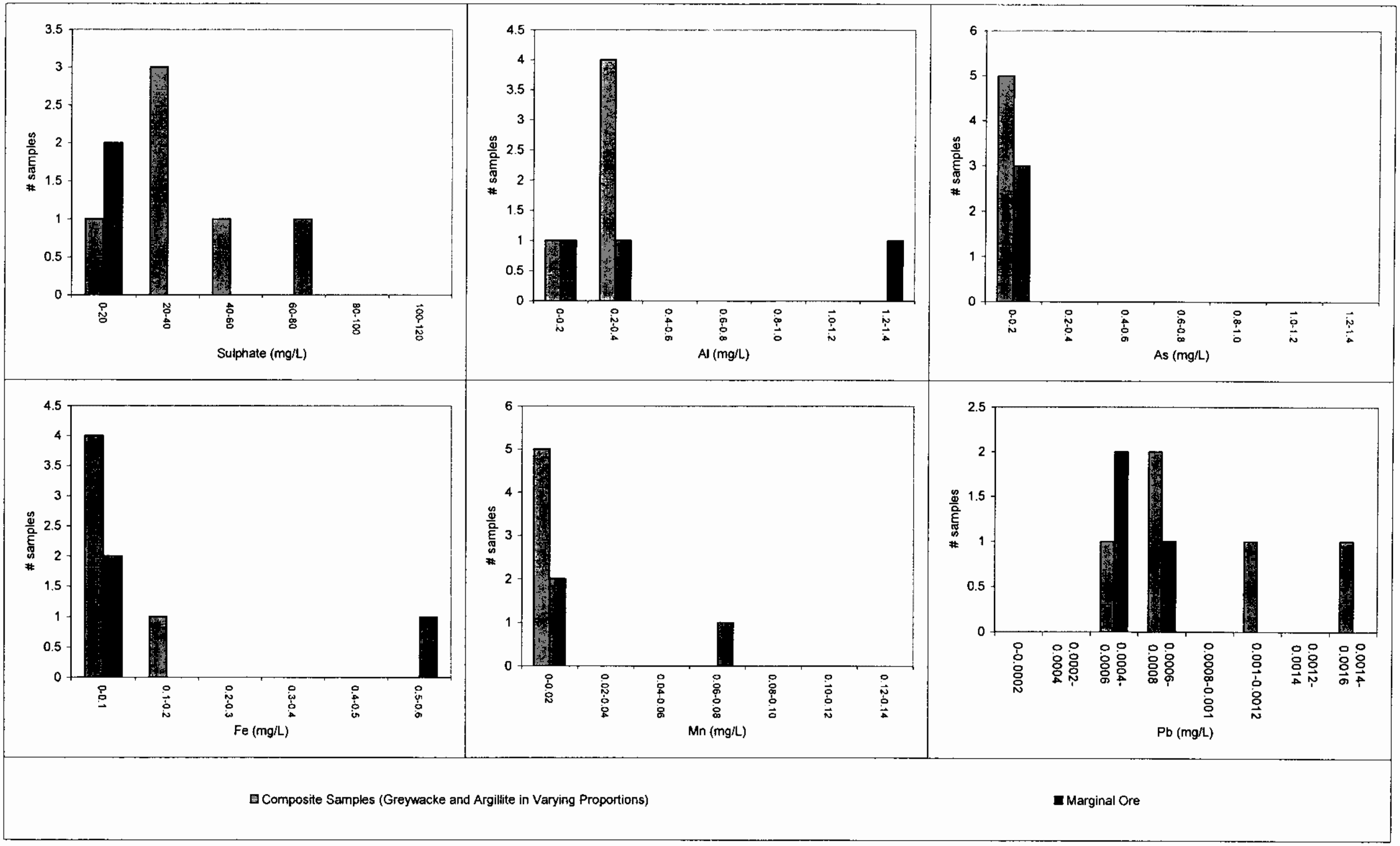

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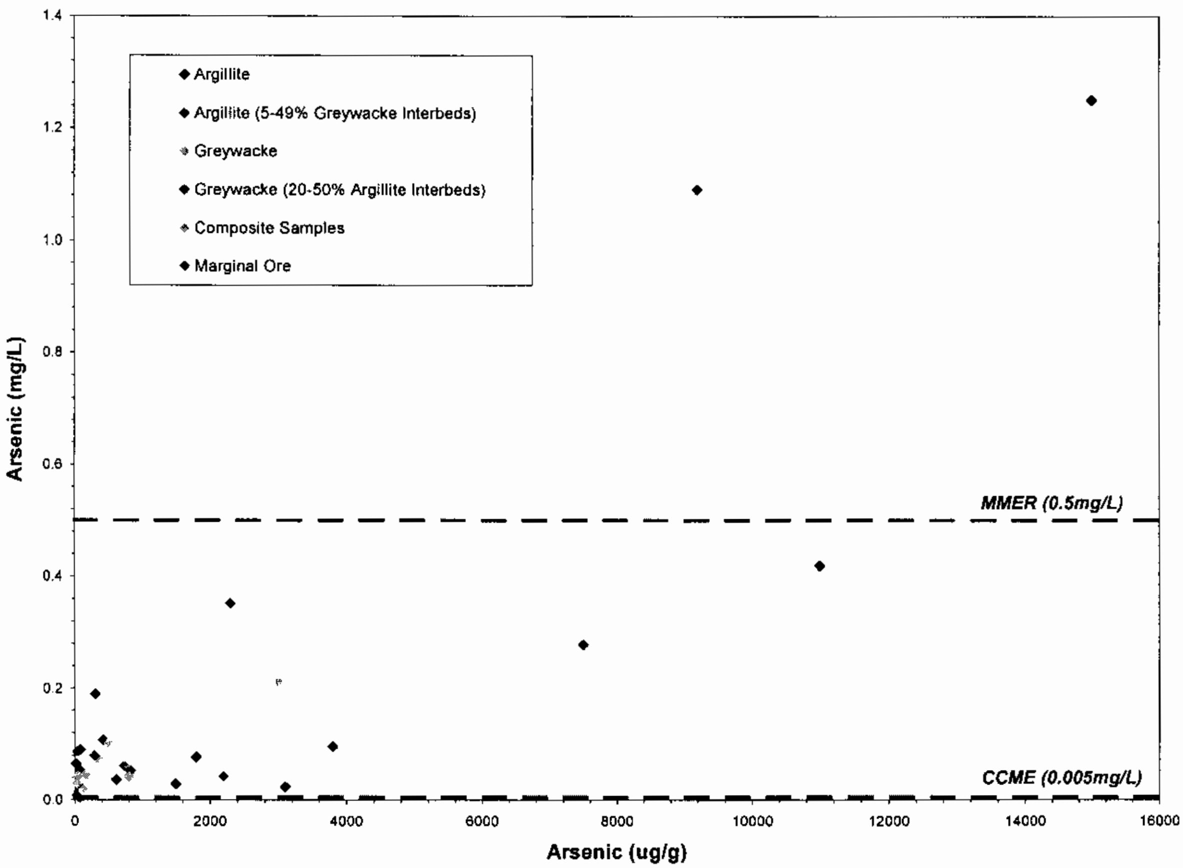
Figure 8.
Dissolved Arsenic Concentrations vs. Solid Arsenic Concentrations



APPENDIX A

STATIC TEST RESULTS

Sample #	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	MgO (%)	CaO (%)	Na_2O (%)	K_2O (%)	TiO_2 (%)	P_2O_5 (%)	MnO (%)	Cr_2O_3 (%)	V_2O_5 (%)	LOI (%)	Sum (%)
ARGILLITE (5-49%) GREYWACKE														
06-012	58.10	17.40	7.23	2.30	1.72	2.07	3.27	1.06	0.12	0.12	0.01	0.01	4.78	98.20
06-016	63.00	15.20	6.90	1.86	2.43	1.45	2.87	0.81	0.10	0.12	0.01	0.02	4.33	99.10
06-021	57.80	18.00	7.42	2.06	2.57	1.06	3.89	0.89	0.12	0.11	0.01	0.03	5.27	99.20
06-040	57.10	19.50	8.38	2.51	0.87	1.14	4.16	1.01	0.15	0.10	0.02	< 0.01	4.43	99.40
06-042	60.20	16.90	7.77	2.16	1.66	1.70	3.16	0.88	0.12	0.11	< 0.01	0.02	4.26	98.90
06-082	61.60	15.20	7.13	2.35	2.30	1.57	2.94	0.77	0.12	0.14	0.01	< 0.01	4.29	98.40
ARGILLITE (<5% GREYWACKE)														
06-004	58.20	18.80	8.21	2.49	1.06	0.87	3.98	0.89	0.12	0.09	< 0.01	0.01	4.44	99.10
06-005	57.90	18.80	9.12	2.62	1.04	0.72	4.08	0.98	0.09	0.09	< 0.01	< 0.01	4.18	99.70
06-006	57.50	18.00	8.67	2.53	1.75	0.80	3.96	0.93	0.10	0.11	< 0.01	0.03	4.37	98.80
06-009	58.90	18.00	7.64	2.40	1.69	0.74	4.18	0.90	0.10	0.10	< 0.01	0.03	4.40	99.00
06-010	55.70	18.80	7.24	2.20	2.77	0.94	4.48	0.93	0.12	0.14	0.01	0.02	5.15	98.50
06-014	55.60	19.40	8.64	2.52	1.39	1.21	4.29	1.00	0.12	0.12	0.01	0.03	4.79	99.10
06-017	57.80	18.30	9.40	2.53	1.07	0.61	3.76	0.89	0.13	0.10	< 0.01	0.02	4.39	99.00
06-019	56.80	18.40	8.46	2.47	1.45	0.57	4.13	0.92	0.10	0.10	< 0.01	0.02	4.73	98.10
06-022	56.90	18.90	9.38	2.64	1.28	0.79	3.86	0.95	0.12	0.11	0.02	0.01	4.42	99.40
06-025	56.20	19.50	8.83	2.48	1.15	0.70	4.26	1.00	0.13	0.11	< 0.01	< 0.01	4.52	98.80
06-028	54.90	20.10	9.21	2.57	0.96	0.32	4.76	1.01	0.10	0.09	0.02	0.03	4.57	98.70
06-029	62.30	16.10	7.10	2.07	1.70	0.53	3.79	0.83	0.09	0.09	0.01	0.02	3.94	98.60
06-030	56.90	18.70	8.66	2.65	1.19	0.59	4.20	0.97	0.11	0.08	0.01	0.02	4.46	98.60
06-031	56.60	18.80	7.53	2.34	2.20	0.79	4.45	0.94	0.11	0.10	0.02	0.03	4.46	98.30
06-032	58.00	18.60	7.94	2.38	1.15	0.87	4.29	0.96	0.12	0.10	0.04	0.01	4.04	98.50
06-033	58.80	17.30	8.11	2.45	1.91	0.98	3.63	0.94	0.12	0.11	0.03	< 0.01	4.36	98.80
06-036	53.40	19.40	8.60	2.83	1.64	0.54	4.92	1.04	0.12	0.12	0.01	0.01	5.10	97.70
06-038	59.00	17.30	7.82	2.46	1.12	0.66	4.12	0.87	0.10	0.10	< 0.01	0.02	4.38	97.90
06-041	55.80	19.70	9.17	2.74	0.93	0.94	4.11	0.97	0.13	0.10	< 0.01	0.02	4.61	99.20
06-043	58.00	18.40	7.98	2.51	1.33	0.96	3.78	0.89	0.12	0.11	< 0.01	0.03	4.55	98.70
06-044	56.50	19.10	8.14	2.47	1.06	0.76	4.43	0.93	0.13	0.11	< 0.01	0.02	4.62	98.30
06-046	58.20	19.00	7.88	2.53	1.02	0.84	4.30	0.92	0.11	0.10	< 0.01	< 0.01	4.30	99.20
06-047	58.40	18.40	8.04	2.47	1.38	0.74	4.03	0.92	0.11	0.11	< 0.01	< 0.01	4.43	99.00
06-048	57.90	18.00	7.77	2.43	1.97	0.86	4.00	0.91	0.11	0.11	< 0.01	0.02	4.75	98.60
06-049	58.30	18.00	7.93	2.51	1.52	0.79	4.03	0.86	0.11	0.12	< 0.01	0.02	4.24	98.40
06-050	57.40	18.20	8.30	2.44	1.77	0.87	4.01	0.97	0.11	0.12	< 0.01	0.01	4.44	98.70
06-053	57.00	18.80	8.58	2.37	1.60	1.16	3.99	0.94	0.10	0.11	< 0.01	0.02	4.21	98.90
06-054	58.90	16.90	8.11	2.67	2.10	1.58	3.10	0.94	0.11	0.15	0.01	< 0.01	4.66	99.30
06-067	62.80	16.10	7.32	2.09	0.31	0.16	3.73	0.74	0.12	0.06	< 0.01	0.01	3.80	97.30
06-071	59.20	16.60	8.20	2.72	1.61	0.11	4.08	0.89	0.13	0.15	0.02	< 0.01	4.37	98.10
06-073	54.80	18.30	8.46	2.75	2.17	0.87	4.42	0.93	0.11	0.13	< 0.01	< 0.01	4.77	97.70
06-074	56.20	18.80	8.56	2.45	1.56	0.84	4.43	0.99	0.11	0.11	< 0.01	0.02	4.18	98.20
06-076	63.00	16.20	7.84	2.24	0.30	0.15	3.99	0.86	0.10	0.07	< 0.01	0.01	3.68	98.30
06-077	56.90	19.00	8.72	2.48	1.03	0.63	4.53	0.95	0.11	0.09	0.01	0.03	3.94	98.30
06-078	58.70	18.20	7.89	2.27	1.70	1.06	4.12	0.97	0.12	0.10	< 0.01	< 0.01	3.94	99.10
06-079	56.00	17.70	8.49	3.21	1.18	0.68	4.36	0.90	0.10	0.09	0.02	< 0.01	4.93	97.70
06-080	55.70	17.80	8.05	3.17	0.85	0.51	4.58	0.87	0.09	0.09	0.01	0.02	5.37	97.10
06-083	52.50	19.60	8.99	3.32	1.11	0.57	5.06	0.98	0.09	0.11	0.02	0.02	5.65	98.00
06-084	56.60	19.00	8.75	2.51	1.01	0.86	4.40	0.97	0.11	0.10	< 0.01	< 0.01	3.92	98.30
COMPOSITE														
06-007	56.90	17.90	7.26	2.25	2.93	1.20	3.78	0.91	0.11	0.12	0.01	0.01	5.07	98.40
06-018	58.60	17.20	7.47	2.02	2.81	1.21	3.45	0.94	0.12	0.12	< 0.01	0.02	5.05	99.00
06-023	59.20	16.70	8.17	2.38	2.16	1.00	3.43	0.90	0.12	0.13	< 0.01	< 0.01	4.76	98.90
06-027	59.50	17.40	7.60	2.27	1.74	1.23	3.51	0.95	0.13	0.10	< 0.01	0.01	4.39	98.90
06-035	59.20	16.80	6.20	1.92	3.24	1.56	3.26	0.90	0.10	0.12	0.03	0.03	4.94	98.30
06-045	58.40	18.30	7.54	2.30	1.65	1.28	3.83	0.96	0.11	0.10	< 0.01	0.01	4.45	98.90
06-051	58.00	18.10	7.96	2.48	1.71	1.53	3.57	1.00	0.12	0.12	< 0.01	< 0.01	4.29	98.90
06-052	62.00	17.20	7.13	2.21	1.51	1.73	3.35	0.90	0.12	0.10	< 0.01	0.03	3.71	100.00
06-055	60.30	18.30	7.37	2.17	0.50	1.44	3.97	0.95	0.11	0.11	< 0.01	< 0.01	3.69	98.90
06-058	61.80	17.30	6.72	2.04	1.30	1.76	3.66	0.99	0.10	0.09	< 0.01	0.03	3.88	99.70
06-059	58.00	14.40	5.08	1.93	6.68	2.32	2.57	0.72	0.16	0.21	0.02	< 0.01	7.29	99.40
06-062	60.60	18.20	7.47	2.27	0.74	1.50	3.80	0.97	0.12	0.09	< 0.01	0.01	3.86	99.60
06-064	59.10	17.90	7.66	2.29	1.35	1.64	3.69	0.99	0.10	0.13	0.03	0.02	3.98	98.90
06-069	60.40	15.90	6.69	2.01	3.20	1.50	3.19	0.91	0.13	0.15	< 0.01	0.01	5.02	99.10
06-070	65.10	14.80	6.13	1.91	1.40	1.84	2.91	0.79	0.09	0.12	< 0.01	0.01	3.62	98.80
GREYWACKE (20%-50% ARGILLITE INTERBEDS)														
06-001	60.30	16.80	7.34	2.14	1.55	1.67	3.40	0.90	0.10	0.11	0.02	0.03	4.07	98.40
06-002	55.50	19.60	9.06	2.57	1.18	0.87	4.23	0.99	0.11	0.11	< 0.01	0.01	4.61	98.80
06-003	59.90	17.10	7.40	2.07	1.84	1.41	3.53	0.93	0.12	0.13	0.01	0.02	4.55	99.00
06-011	63.40	15.50	6.22	1.86	1.66	2.15	2.89	0.98	0.14	0.12	< 0.01	0.03	4.00	98.90
06-013	70.80	11.70	3.85	0.95	2.55	2.77	1.68	0.78	0.10	0.09	0.01	< 0.01	3.44	98.80
06-015	68.40	12.90	4.97	1.56	1.54	2.46	2.04	0.77	0.09	0.12	0.02	< 0.01	3.41	98.40
06-020	64.90	13.40	6.22	1.56	3.33	1.56	2.33	0.74	0.09	0.15	< 0.01	0.02	4.65	99.00
06-024	66.20	14.60	5.83	1.59	2.05	2.07	2.51	0.76	0.10	0.09	0.01	0.02	3.63	99.50
06-026	60.80	17.20	6.80	1.89	1.80	1.31	3.56	0.98	0.14	0.09	< 0.01	0.02	4.22	98.80
06-034	66.50	13.10	5.04	1.62	2.92	2.33	2.16	0.84	0.09	0.10	0.01	0.01	3.69	98.40
06-039	60.60	16.80	6.42	2.22	1.94	2.28	3.28	0.91	0.12	0.10	< 0.01	0.02	3.87	98.60
06-057	64.00	14.40	4.93	1.40	3.89	2.32	2.68	0.86	0.08	0.15	0.01	0.01	4.92	99.70
GREYWACKE (<20% ARGILLITE INTERBEDS)														
06-056	68.50	12.60	3.95	1.11	4.08	2.59	2.02	0.71	0.07	0.13	< 0.01	0.02	4.51	100.30
06-060	66.80	12.40	4.53	1.65	3.59	2.83	1.58	0.64	0.14	0.11	< 0.01	< 0.01	4.39	98.70
06-061	70.70	11.60	3.94	1.45	2.13	3.14	1.31	0.60	0.14	0.11	< 0.01	0.02	3.16	98.30
06-063	68.60	12.90	3.87	1.08	2.86	2.52	2.18	0.75	0.08	0.10	< 0.01	< 0.01	3.85	98.80
06-065	63.10	14.40	5.44	1.64	2.76	1.99	2.51	0.89	0.13	0.12	< 0.01	0.02	4.21	97.20
06-066	64.70	15.30	5.26	1.79	1.80	2.88	2.91	0.87	0.12	0.10	0.01	0.01	3.45	99.00
06-068	68.10	13.80	4.46	1.28	1.98	2.51	2.36	0.84	0.07	0.08	0.01	0.01	3.38	98.90
06-072	71.00	12.70	4.54	1.84	1.30	3.14	1.56	0.58	0.14	0.09	0.01	0.01	2.85	99.80
06-075	67.20	14.10	5.88	2.33	1.57	< 0.05	3.38	0.69	0.15	0.10	0.02	0.01	4.07	99.60
06-081	69.50	13.10	4.83	1.42	1.21	2.70	1.79	0.81	0.10	0.08	< 0.01	0.01	2.83	98.20
MARGINAL ORE														
06-008	56.80	18.70	7.32	2.34	1.98	0.67	4.51	0.91	0.12	0.10	0.01	0.02	4.56	98.10
06-085	58.20	18.30	7.70	2.34	1.54	0.51	4.43	0.89	0.09	0.10	0.02	0.01	4.07	98.20
06-086	58.00	18.00	7.94	2.32	1.78	0.76	4.15	0.87	0.10	0.10	0.01	0.03	4.16	98.20
06-087	56.70	18.10	8.24	2.41	1.85	0.67	4.28	0.91	0.13	0.11	< 0.01	0.02	4.15	97.70
06-088	55.80	18.00	9.06	2.53	2.24	0.48	4.13	0.92	0.10	0.11	< 0.01	0.02	4.42	97.80
06-089	59.50	17.30	7.63	2.31	1.61	0.98	3.99	0.91	0.11	0.10	< 0.01	< 0.01	3.92	98.30
06-090	60.50	17.70	7.24	2.37	1.77	0.99	3.86	0.88	0.12	0.09	< 0.01	0.02	4.22	99.80
06-091	60.40	17.40	8.27	2.72	0.68	0.77	3.64	0.89	0.13	0.08	< 0.01	< 0.01	3.87	98.80
06-092	57.10	18.70	8.26	2.61	1.19	0.71	4.15	0.91	0.11	0.10	0.01	0.03	4.35	98.20
06-093	58.90	18.00	8.31	2.85	0.92	0.18	4.43	0.86	0.11	0.11	0.01	0.01	4.41	99.00
06-094	65.30	15.70	5.41	1.46	1.58	1.94	3.14	0.80	0.10	0.09	0.03	< 0.01	3.58	99.10
QUARTZ VEIN														
06-037	92.00	0.53	1.46	0.13	1.44	< 0.05	0.12	0.02	0.02	0.05	< 0.01	< 0.01	1.23	97.00
TAILINGS														
Cnd 2 Treated Solids	56.90	19.70	7.70	2.60	1.18	0.57	4.80	0.54	0.11	0.08	0.03	0.02	4.47	98.70

Sample #	Ag (µg/g)	Al (µg/g)	As (µg/g)	Ba (µg/g)	Be (µg/g)	Bi (µg/g)	Ca (µg/g)	Cd (µg/g)	Co (µg/g)	Cr (µg/g)	Cu (µg/g)	Fe (µg/g)	K (µg/g)	Li (µg/g)	Mg (µg/g)	Mn (µg/g)	Mo (µg/g)	Na (µg/g)	Ni (µg/g)	Pb (µg/g)	Sb (µg/g)	Se (µg/g)	Sn (µg/g)	Sr (µg/g)	Ti (µg/g)	Tl (µg/g)	U (µg/g)	V (µg/g)	Y (µg/g)	Zn (µg/g)	Hg (µg/g)
ARGILLITE (5-49%) GREYWACKE																															
06-012	0.13	76000	150	550	2.0	0.17	13000	0.08	17	61	27	49000	29000	31	14000	970	1.80	15000	26	9.3	0.2	< 2	2.7	130	1600	0.7	1.8	130	7.4	110	< 0.1
06-016	0.19	66000	42	500	1.8	0.35	16000	0.04	16	54	74	48000	25000	30	11000	1100	3.00	11000	34	28.0	0.3	< 2	1.9	120	1400	0.6	1.5	110	8.7	100	< 0.1
06-021	0.19	99000	53	690	2.3	0.38	19000	0.09	14	65	57	55000	37000	34	15000	950	1.70	22000	29	44.0	< 0.1	< 2	1.8	140	1200	0.9	1.5	120	9.5	100	< 0.1
06-040	0.76	81000	340	750	2.6	0.49	6500	0.05	19	61	63	61000	39000	43	18000	820	2.60	29000	31	21.0	< 0.1	< 2	2.5	100	1900	0.7	1.7	140	6.3	130	< 0.1
06-042	0.38	100000	35	510	1.7	0.28	11000	0.31	15	54	95	60000	31000	31	17000	880	2.80	37000	31	16.0	< 0.1	< 2	1.8	120	2100	2.9	1.5	100	7.0	95	< 0.1
06-082	0.23	69000	3800	360	1.4	0.72	14000	0.18	15	61	40	50000	22000	28	12000	1000	1.90	12000	36	16.0	2.3	3	2.1	98	1000	0.4	1.4	81	6.7	99	< 0.1
ARGILLITE (<5% GREYWACKE)																															
06-004	0.29	72000	160	630	2.1	0.14	6700	0.06	16	69	42	56000	35000	35	15000	710	0.97	7400	34	12.0	0.4	7	3.0	92	3100	0.7	1.7	110	4.3	120	< 0.1
06-005	0.15	65000	120	590	2.0	0.10	6100	0.05	18	59	56	62000	35000	36	15000	730	1.10	5300	36	10.0	0.4	< 2	2.8	53	2700	0.7	1.6	120	5.1	120	< 0.1
06-006	0.20	70000	360	590	1.9	0.16	11000	0.12	18	62	51	60000	34000	34	15000	870	0.73	6100	34	7.9	0.4	< 2	2.8	75	3200	0.7	1.8	110	6.8	110	< 0.1
06-009	0.23	73000	830	630	2.1	0.56	11000	0.10	21	65	42	54000	36000	32	14000	770	0.92	5800	32	15.0	0.5	< 2	2.9	67	1600	0.7	1.6	110	6.5	100	< 0.1
06-010	0.34	84000	380	710	2.2	0.43	20000	0.28	14	60	40	50000	39000	31	14000	1000	1.10	6900	27	13.0	1.3	< 2	3.2	86	2300	0.9	1.7	130	9.4	120	< 0.1
06-014	0.23	93000	130	760	2.5	0.33	10000	0.17	18	59	52	60000	38000	37	17000	990	1.20	9200	35	11.0	0.4	< 2	3.0	110	2500	0.9	1.6	140	8.6	130	< 0.1
06-017	0.43	79000	48	610	2.0	0.23	7300	0.03	18	63	45	67000	34000	42	16000	830	0.69	4700	35	4.3	0.2	< 2	2.4	88	1200	0.7	1.6	120	8.7	120	< 0.1
06-019	0.22	91000	110	690	2.2	0.53	10000	0.08	18	59	91	65000	42000	36	19000	750	1.50	20000	39	24.0	< 0.1	< 2	2.1	110	1500	0.8	1.5	120	7.2	110	< 0.1
06-022	0.22	88000	25	680	2.3	0.24	9400	< 0.03	18	59	55	71000	36000	45	19000	810	< 0.05	23000	35	13.0	0.2	< 2	1.9	100	1200	0.6	1.5	120	7.8	130	< 0.1
06-025	0.12	100000	80	700	2.3	0.24	8300	0.09	20	67	56	72000	43000	42	20000	840	0.92	20000	31	30.0	0.3	< 2	2.3	85	1300	0.8	1.6	130	8.1	120	< 0.1
06-028	0.22	110000	430	870	2.9	0.26	8000	< 0.03	22	64	110	71000	45000	49	20000	800	0.53	15000	35	15.0	0.3	< 2	3.0	85	1600	0.8	1.6	160	6.8	140	< 0.1
06-029	0.23	84000	2100	640	2.1	0.76	13000	0.13	16	59	84	50000	34000	33	14000	820	4.10	21000	28	37.0	2.5	< 2	2.0	74	1200	0.7	1.5	110	8.4	100	< 0.1
06-030	0.35	90000	340	740	2.5	0.46	9000	0.20	18	61	68	59000	38000	44	18000	710	0.90	16000	37	30.0	< 0.1	< 2	2.1	78	1500	0.7	1.6	140	8.6	130	< 0.1
06-031	0.35	94000	600	770	2.5	0.27	17000	0.05	19	59	65	52000	39000	35	16000	890	< 0.05	20000	34	10.0	0.3	< 2	11.0	80	1600	0.7	1.7	130	7.2	120	< 0.1
06-032	0.28	77000	72	730	2.4	0.19	8400	0.19	15	59	80	58000	40000	39	17000	680	0.49	22000	29	7.2	0.9	< 2	2.4	71	2500	1.2	1.6	140	6.3	110	< 0.1
06-033	0.29	78000	900	650	2.1	0.32	14000	0.14	21	68	66	57000	35000	37	16000	850	1.70	23000	34	14.0	2.5	< 2	2.2	82	1800	0.6	1.6	120	7.5	120	< 0.1
06-036	0.85	99000	3100	850	3.1	1.20	14000	0.19	22	72	130	64000	43000	40	19000	1000	1.70	22000	33	40.0	3.0	< 2	3.1	100	1700	0.8	1.8	140	7.1	130	< 0.1
06-038	0.80	92000	890	750	2.1	0.64	8400	0.19	14	54	78	57000	39000	32	17000	760	0.85	22000	29	17.0	0.6	< 2	2.2	81	1800	0.6	1.4	110	6.4	120	< 0.1
06-041	0.30	92000	100	700	2.4	0.19	6600	0.09	19	61	88	73000	42000	46	21000	760	1.20	25000	35	10.0	< 0.1	< 2	2.5	92	2200	0.6	1.5	130	5.5	120	< 0.1
06-043	0.17	90000	100	660	2.1	0.18	10000	0.20	18	56	62	58000	36000	37	17000	840	1.80	29000	31	10.0	0.2	< 2	1.7	110	2500	0.6	1.7	110	5.4	110	< 0.1
06-044	0.25	78000	60	710	2.2	0.24	7600	< 0.03	14	55	27	45000	32000	36	13000	800	0.49	5300	28	15.0	0.4	< 2	3.2	86	3500	0.8	1.8	120	7.0	120	< 0.1
06-046	0.19	74000	94	660	2.1	0.17	6900	0.11	16	59	28	44000	32000	35	13000	680	0.91	5700	32	11.0	0.2	< 2	2.7	91	1700	0.7	1.6	110	6.0	110	< 0.1
06-047	0.16	76000	390	680	2.1	0.13	10000	0.06	13	47	32	44000	30000	35	14000	780	0.26	5600	30	8.3	0.4	< 2	2.6	98	2600	0.7	1.6	110	6.8	110	< 0.1
06-048	0.26	68000	160	660	2.1	0.18	14000	0.13	17	58	27	39000	27000	33	12000	860	0.64	5300	32	15.0	0.3	< 2	2.6	98	3100	0.7	2	110	10.0	110	< 0.1
06-049	0.28	74000	1500	630	1.9	0.67	10000	0.10	14	59	44	44000	30000	31	13000	780	0.82	5800	31	18.0	2.0	< 2	2.5	87	2100	0.6	1.4	97	9.5	110	< 0.1
06-050	0.30	94000	66	630	1.9	0.35	12000	0.11	15	57	31	57000	36000	34	17000	830	0.68	7000	31	20.0	< 0.1	< 2	2.4	91	3000	0.7	1.6	110	9.0	120	< 0.1
06-053	0.27	88000	59	630	1.9	0.18	10000	0.08	16	53	40	59000	35000	34	15000	760	0.90	8900	34	11.0	0.2	< 2	2.4	100	2500	0.6	1.7	100	8.2	100	< 0.1
06-054	0.18	88000	76	490	1.5	0.21	13000	0.05	17	45	31	58000	27000	35	18000	1100	1.00	12000	34	19.0	0.2	< 2	2.0	110	2700	0.5	1.7	89	19.0	98	< 0.1
06-067	0.27	87000	620	550	1.9	0.33	1900	0.09	15	47	79	54000	39000	29	15000	410	3.20	1200	32	13.0	2.8	< 2	2.4	35	1100	0.8	1.4	90	7.0	68	< 0.1
06-071	0.38	79000	3800	580	2.0	0.45	9500	0.26	20	55	58	55000	30000	32	15000	1100	1.40	1400	38	48.0	6.2	3	2.2	45	1100	0.7	1.6	95	11.0	110	< 0.1
06-073	0.64	100000	7500	690	2.3	1.40	15000	0.44	22	67	54	66000	39000	29	16000	1100	1.20	8200	42	27.0	2.7	3	3.2	140	1800	0.8	2	120	7.6	120	< 0.1
06-074	0.52	90000	160	600	2.0	0.47	9200	0.18	15	60	38	56000	33000	31	14000	810	0.82	5700	34	20.0	0.3	< 2	2.6	75	2700	0.8	1.7	120	6.9	100	< 0.1
06-076	0.26	72000	1800	480	1.9	0.65	1800	0.04	14	57	78	50000	29000	35	12000	510	1.60	1100	29	8.5	3.8	4	2.2	40	1100	0.9	1.5	93	8.0	72	< 0.1
06-077	0.50	89000	290	580	2.0	0.28	5400	0.15	17	62	58	59000	34000	31	14000	700	0.36	5100	38	14.0	0.4	2	2.5	80	3100	0.8	1.6	110	5.6	98	< 0.1
06-078	0.72	86000	310	530	1.8	0.47	9600	0.22	13	63	29	52000	31000	28	13000	760	1.60	7700	30	17.0	0.2	2	2.6	80	2700	0.8	1.6	110	7.0	91	< 0.1
06-079	0.46	89000	9200	560	2.1	1.50	6900	0.16	14	62	31	59000	34000	31	15000	760	1.50	5200	34	34.0	3.2	< 2	3.0	73	1800	0.8	1.5	100	5.6	100	< 0.1
06-080	1.10	83000	15000	550	2.2	1.50	5000	0.24	15	64	84	55000	34000	27	14000	620	1.70	5300	33	27.0	2.6	< 2	3.1	72	1100	0.8	1.6	110	5.0	93	< 0.1
06-083	0.38	93000	11000	620	2.1	1.60	6500	0.22	19	63	71	63000	37000	30	16000	810	0.97	5300	38	34.0	4.0	2	3.3	89	1400	0.8	1.6	120	5.2	110	< 0.1
06-084	0.19	86000	350	560	2.0	0.52	5800	0.18	14	67	42	60000	33000	34	15000	740	0.57	6400	36	27.0	0.4	< 2	3.0	64	3100	0.8	1.9	120	6.3	110	< 0.1
COMPOSITE																															
06-007	0.11	74000	53	620	2.2	0.14	20000	0.12	15	63	40	50000	33000	33	14000	960	1.50	10000	27	12.0	0.2	< 2	2.7	120	2400	0.7	1.7	110	7.2	97	< 0.1
06-018	0.31	83000	73	640	2.1	0.33	23000	0.08	14	60	78	58000	34000	35	15000	1100	2.10	27000	26	20.0	0.2	< 2	2.0	130	1400	0.6	1.6	120	8.4	110	< 0.1
06-023	0.18	94000	850	630	2.2	0.36	17000	0.17	17	56	69	61000	34000	42	17000	1000	3.80	26000	32	17.0	0.9	< 2	2.0	160	1500	0.7	1.4	120	8.7	110	< 0.1
06-027	0.18	88000	500	610	2.1	0.20	12000	0.11	17	74	54	58000	35000	36	17000	820	2.10	25000	30	38.0	0.7	< 2	2.0	120	1600	0.6	1.5	120	7.3	110	< 0.1
06-035	0.22	91000	120	680	2.5	0.28	25000	0.15	12	60	75	45000	32000	31	13000	1000	1.90	27000	21	10.0	0.5	< 2	2.4	180	2700	0.6	1.8	130	9.5	100	< 0.1
06-045	0.18	78000	66	590	1.9	0.25	11000	0.05	12	61	31	44000	30000	33	13000	810	0.75	8900	27	17.0	0.2	< 2	2.5	110	2100	0.6	1.6	110	6.7	100	< 0.1
06-051	0.15	94000	61	570	2.0	0.24	12000	0.18	12	53	40	56000	32000	36	17000	850	1.30	12000	29	14.0	< 0.1	< 2	2.2	110	2000	0.6	2.3	110	9.9	120	< 0.1
06-052	0.21	82000	810	500	1.7	0.42	10000	< 0.03	18	50	34	47000	28000	28	14000	750	1.70	14000	32	21.0	1.2	< 2	2.2	110	2400	0.5	1.8	94	9.1	90	< 0.1
06-055	0.24	90000	60	610	1.9	0.17	3300	0.08	13	52	27	50000	35000	34	15000	760	1.30	11000	27	11.0	0.1	< 2	2.8	70	2700	0.7	1.7	110	9.3	87	< 0.1
06-058	0.25	89000	25	590	1.8	0.09	8700	0.08	11	59	20	46000	33000	30	14000	680	2.90	13000	22	8.9	1.4	< 2	2.8	77	2300	0.8	1.9	120	9.7	80	< 0.1
06-059	0.22	71000	170	400	1.4	0.23	48000	0.10	13	40	26	34000	23000	19	13000	1400	1.50	17000	30	14.0	0.7	< 2	2.1	210	1100	0.5	1.4	81	15.0	66	< 0.1
06-062	0.26	91000	71	580	1.8	0.16	4400	0.05	13	56	29	50000	33000	33	15000	600	2.20	11000	28	10.0	0.2	< 2	2.5	70	2300	0.7	1.8	100	9.8	87	< 0.1
06-064	0.19	88000	68	560	1.8	0.21	8400	0.11	17	51	25	52000	32000	31	15000	790	1.40	12000	31	17.0	0.2	< 2	2.6	81	2300	0.7	1.7	100	11.0	85	< 0.1
06-069	0.19	65000	62	480	1.5	0.21	20000	< 0.03	13	48	40	44000	27000	25	11000	1000	1.80	12000	33	13.0	< 0.1	< 2	2.3	90	1300	0.5	1.6	80	11.0	76	< 0.1
06-070	0.20	72000	340	390	1.5	0.17	8000	0.05	11	46	30	40000	22000	26	11000	780	2.80	13000	27	40.0	0.5	3	2.0	73	760	0.6	1.4	80	9.5	64	< 0.1
GREYWACKE (20%-50% ARGILLITE INTERBEDS)																															
06-001	0.16	65000	69	520	1.8	0.28	10000	0.12	16	69	67	51000	30000	25	12000	840	1.80	13000	40	17.0	0.3	< 2	2.6	110	2100	0.6	1.8	110	5.2	92	< 0.1
06-002	0.24	88000	62	680	2.2	0.31	8100	0.05	16	62	47	62000	37000	37	17000	890	1.10	6500	33	13.0	0.3	< 2	3.2	95	2500	0.8	1.6	120	5.7	110	< 0.1
06-003	0.37	73000	150	540	1.8	0.32	12000	0.07	18	61	44	51000	31000	25	13000	930	1.90	11000	28	16.0	0.4	< 2	2.8	120	2200	0.6	1.7	110	5.5	94	< 0.1
06-011	0.16	78000	32	500	1.7	0.21	12000	0.05	14	47	38	43000	25000	24	13000	850	2.20	17000	28	12.0	0.4	< 2	2.3	130	1500	0.6	1.9	110	8.7	82	< 0.1
06-013	0.27	56000	590	270	1.1	0.14	19000	0.13	9	61	23	28000	15000	12	8900	820	3.80	21000	18	14.0	0.4	< 2	1.7	120	870	0.4	1.6	75	9.4	50	< 0.1
06-015	0.12	61000	42	340	1.3	0.15	11000	0.05	10	45	30	33000	18000	14	10000	880	2.30	19000	23	12.0	0.2	< 2	1.6	110	1300	0.4	1.7	79	7.3	57	< 0.1
06-020	0.12	82000	65	400	1.5	0.25	28000	0.09	14	41	68	48000	23000	29	12000	1200	3.40	32000	26	8.4	0.7	< 2	1.1	140	770	0.4	1.3	83	9.9	78	< 0.1
06-024	0.28	86000	70	510	1.7	0.19	16000	< 0.03	12	67	53	45000	25000	26	12000	780	1.20	31000	22	26.0	< 0.1	< 2	1.4	150	1100	0.8	1.3	97	7.6	81	< 0.1
06-026	0.25	88000	500	560	2.0	0.55	14000	0.13	26	59	88	49000	29000	29	13000	790	2.30	28000	23	27.0	0.7	< 2	1.6	130	890	1.5	1.7	110	9.3	99	< 0.1
06-034	0.46	73000	2300	380	1.4	0.13	22000	0.19	9	50	31	35000	19000	20	10000	860	1.70	35000	15	11.0	3.0	< 2	1.7	180	3100	0.4	1.7	90	11.0	74	< 0.1
06-039	0.38	80000	7000	500	1.6	1.20	13000	0.08	14	59	50	47000	31000	26	13000	700	2.30	37000	22	33.0	1.8	< 2	2.3	130	1200	0.5	1.7	110	11.0	74	< 0.1
06-057	0.16	72000	37	390	1.2	0.13	28000	0.06	11	47	18	33000	23000	17	9500	910	1.70	18000	18	12.0	0.1	< 2	2.0	110	1400	0.4	1.5	81	11.0	57	< 0.1
GREYWACKE (<20% ARGILLITE INTERBEDS)																															
06-056	0.16	59000	19	290	1.0	0.15	29000	< 0.03	8	40	19	27000	18000	13	7000	910	2.40	29000	19	12.0	0.1	< 2	1.8	87	1300	0.4	1.6	60	11.0	43	< 0.1
06-060	0.13	63000	110	260	1.0	0.13	27000	< 0.03	9	32	21	30000	15000	16	11000	760	2.50	23000	25	9.9	0.3	< 2	1.5	120	750	0.3	1.3	66	11.0	50	< 0.1
06-061	0.33	62000	28	220	0.9	0.09	14000	0.07	7	24	10	27000	13000	12	10000	780	2.60	25000	19	15.0	0.1	< 2	1.5	100	730	0.2	1.4	61	11.0	41	< 0.1
06-063	0.19	65000	51	330	1.0	0.09	18000	0.07	7	37	11	26000	19000	13	7400	700	2.00	19000	14	9.2	0.1	< 2	1.9	100	1700	0.4	1.5	70	9.9	42	< 0.1
06-065	0.27	74000	53	390	1.2	0.10	19000	0.15	12	48	18	35000	23000	17	10000	830	1.40	17000	23	12.0	0.1	< 2	1.9	140	2300	0.4	1.8	86	11.0	61	< 0.1
06-066	0.17	81000	3000	430	1.5	0.18	11000	0.23	10	48	36	37000	26000	16	10000	780	4.30	21000	21	27.0	1.8	< 2	2.0	120	1000	0.5	1.8	81	10.0	66	< 0.1
06-068	0.14	70000	52	360	1.2	0.12	13000	0.08	10	41	18	30000	21000	18	8400	590	3.20	18000	20	10.0	< 0.1	< 2	1.8	100	1200	0.4	1.7	79	11.0	54	< 0.1
06-072	0.32	59000	26	230	1.1	0.12	7200	0.18	8	30	15	29000	15000	17	11000	700	2.20	20000	20	14.0	0.3	< 2	1.9	100	710	0.3	1.2	62	6.5	56	< 0.1
06-075	0.25	67000	5200	300	1.5	0.54	9000	0.17	11	49	17	39000	25000	26	12000	650	2.80	900	29	17.0	2.7	3	1.7	42	760	0.6	1.5	78	8.9	51	< 0.1
06-081	0.28	66000	420	240	1.0	0.24	7000	0.05	11	46	24	33000	15000	13	8500	560	2.00	19000	21	15.0	0.4	< 2	1.6	88	2100	0.4	1.7	71	6.2	57	< 0.1
MARGINAL ORE																															
06-008	0.26	67000	2200	660	2.2	0.45	13000	0.09	16	60	47	50000	39000	27	13000	780	0.85	5800	31	13.0	0.9	< 2	3.0	87	1600	0.8	1.7	110	6.0	100	< 0.1
06-085	0.23	77000	460	570	2.2	0.30	8600	< 0.03	16	65	53	52000	33000	30	13000	720	1.40	4600	39	22.0	2.0	< 2	3.2	69	1500	0.9	1.7	100	6.2	98	< 0.1
06-086	0.21	86000	470	580	2.1	0.13	11000	0.23	17	60	74	52000	31000	29	13000	740	0.65	5500	38	10.0	1.4	< 2	2.6	72	1600	0.8	1.7	98	8.8	94	< 0.1
06-087	0.15	87000	330	550	2.0	0.15	11000	0.12	15	62	50	58000	31000	31	14000	760	0.41	5400	32	9.5	0.6	2	2.3	65	1500	0.7	1.5	100	8.2	100	< 0.1
06-088	0.22	86000	290	550	2.0	0.21	13000	0.17	16	64	67	61000	31000	33	15000	820	0.59	4000	38	12.0	0.4	4	2.5	78	2000	0.7	1.9	110	7.8	100	< 0.1
06-089	0.12	80000	1900	500	1.9	0.19	9100	0.14	12	55	41	51000	29000	26	13000	700	0.61	8600	32	6.7	2.3	< 2	2.5	74	2200	0.7	1.5	92	7.8	85	< 0.1
06-090	0.10	79000	740	480	1.8	0.11	9900	0.09	11	50	16	49000	29000	29	13000	740	0.69	7300	25	7.5	1.0	< 2	2.4	73	2100	0.6	1.5	100	6.1	95	< 0.1
06-091	0.16	84000	8	500	1.9	0.06	4200	0.06	9	62	36	58000	29000	38	17000	610	0.40	5600	35	6.1	< 0.1	3	2.1	63	1600	0.7	1.9	100	6.0	120	< 0.1
06-092	0.61	94000	130	560	2.1	0.18	7100	0.15	16	62	30	59000	33000	35	16000	760	0.31	5200	31	16.0	0.4	< 2	2.9	74	1500	0.7	1.7	110	7.2	110	< 0.1
06-093	0.14	87000	89	610	2.3	0.16	5500	0.25	15	66	59	58000	34000	36	17000	660	1.20	1800	36	17.0	0.8	2	2.4	46	1400	0.7	1.6	100	8.6	120	< 0.1
06-094	< 0.03	82000	130	430	1.6	0.17	9600	0.06	11	50	32	39000	26000	19	9600	580	1.40	14000	22	13.0	0.2	< 2	1.9	110	1800	0.7	1.6	94	6.5	86	< 0.1
QUARTZ VEIN																															
06-037	0.73	13000	250	33	0.1	2.30	11000	< 0.03	4	32	39	11000	2000	< 3	1000	500	11.00	26000	15	70.0	0.1	< 2	0.2	15	94	0.9	0.18	6	2.2	11	< 0.1
TAILINGS																															
CND 2 Treated Solids	0.35	70000	160	400	0.34	0.40	6300	0.10	9.1	120	109	50000	12000	60	14000	3800	5.20	3500	44	19.0	2.1	< 1	3.2	62	2500	0.8	1.7	130	7.2	34	< 0.1

Appendix A-3
Acid-Base Accounting Results

Sample	Paste pH	NP	AP	Net NP	NP/AP	S	Acid Leachable SO4-S	Sulphide-S	C	Carbonate	TIC	Carb-NP	Carb-NP/AP
#	units	t CaCO3/1000t	t CaCO3/1000 t	t CaCO3/1000 t	ratio	%	%	%	%	%	%	t CaCO3/1000 t	ratio
ARGILLITE (5-49%) GREYWACKE													
06-012	9.3	41.40	2.5	38.9	16.6	0.11	0.03	0.08	0.59	1.92	0.38	32.0	12.8
06-016	9.3	45.00	6.9	38.2	6.6	0.24	0.02	0.22	0.61	2.35	0.47	39.2	5.7
06-021	9.4	46.70	0.9	45.8	49.8	0.05	0.02	0.03	0.62	2.16	0.43	36.0	40.0
06-040	8.8	21.20	3.1	18.0	6.8	0.13	0.03	0.10	0.41	1.31	0.26	21.8	7.0
06-042	8.8	37.10	3.8	33.4	9.9	0.34	0.22	0.12	0.57	1.93	0.39	32.2	8.5
06-082	8.6	41.90	11.9	30.0	3.5	0.66	0.28	0.38	0.86	2.92	0.58	48.7	4.1
DA 7357	8.8	115.07	3.5	111.6	32.9	0.11	0.01	0.10	6.11	-	-	101.9	29.1
ARGILLITE (<5% GREYWACKE)													
06-004	9.4	25.30	2.2	23.1	11.5	0.07	< 0.01	0.07	0.34	1.24	0.25	20.7	9.4
06-005	9.4	22.10	4.4	17.7	5.0	0.17	0.03	0.14	0.23	0.77	0.15	12.8	2.9
06-006	9.4	33.00	5.6	27.4	5.9	0.22	0.04	0.18	0.38	1.48	0.30	24.7	4.4
06-009	9.4	31.40	8.4	22.9	3.7	0.30	0.03	0.27	0.42	1.52	0.30	25.4	3.0
06-010	9.3	51.80	7.8	44.0	6.6	0.29	0.04	0.25	0.65	2.54	0.51	42.4	5.4
06-014	9.2	33.80	9.1	24.8	3.7	0.32	0.04	0.29	0.49	2.00	0.40	33.4	3.7
06-017	9.4	20.10	0.9	19.1	21.4	0.03	< 0.01	0.03	0.24	0.92	0.19	15.3	17.0
06-019	9.4	31.60	5.9	25.7	5.3	0.25	0.06	0.19	0.40	1.40	0.28	23.4	4.0
06-022	9.4	22.80	1.2	21.6	18.3	0.07	0.03	0.04	0.28	1.18	0.24	19.7	16.4
06-025	9.2	22.30	1.6	20.7	14.3	0.10	0.05	0.05	0.28	1.06	0.21	17.7	11.0
06-028	9.3	18.60	5.0	13.6	3.7	0.30	0.14	0.16	0.25	1.12	0.22	18.7	3.7
06-029	9.3	31.00	6.2	24.8	5.0	0.34	0.14	0.20	0.48	0.91	0.18	15.2	2.4
06-030	9.3	23.20	2.2	21.0	10.6	0.10	0.03	0.07	0.27	1.95	0.39	32.5	14.8
06-031	9.4	37.70	4.7	33.0	8.0	0.40	0.25	0.15	0.48	0.99	0.20	16.5	3.5
06-032	9.6	21.70	3.4	18.2	6.3	0.19	0.08	0.11	0.28	2.04	0.41	34.0	10.0
06-033	9.5	33.80	3.8	30.1	9.0	0.27	0.15	0.12	0.43	1.67	0.34	27.9	7.3
06-036	9.0	42.00	14.7	27.4	2.9	1.14	0.67	0.47	0.71	3.05	0.61	50.9	3.5
06-038	9.4	32.50	7.8	24.7	4.2	0.58	0.33	0.25	0.51	1.91	0.38	31.9	4.1
06-041	8.9	22.30	3.8	18.6	6.0	0.16	0.04	0.12	0.32	1.04	0.21	17.3	4.6
06-043	8.8	30.30	1.9	28.4	16.2	0.13	0.07	0.06	0.48	2.10	0.42	35.0	18.4
06-044	9.4	27.70	2.8	24.9	9.9	0.17	0.08	0.09	0.40	1.28	0.26	21.3	7.6
06-046	9.4	22.90	2.8	20.1	8.1	0.16	0.07	0.09	0.34	1.34	0.27	22.3	8.0
06-047	9.3	28.20	3.4	24.8	8.2	0.18	0.07	0.11	0.38	1.68	0.34	28.0	8.2
06-048	9.4	34.20	2.5	31.7	13.7	0.13	0.05	0.08	0.43	1.87	0.37	31.2	12.5
06-049	9.4	29.20	6.9	22.3	4.2	0.29	0.07	0.22	0.36	1.51	0.30	25.2	3.7
06-050	9.5	30.60	4.4	26.2	7.0	0.19	0.05	0.14	0.46	1.91	0.38	31.9	7.2
06-053	9.6	32.50	5.0	27.5	6.5	0.25	0.09	0.16	0.31	1.19	0.24	19.8	4.0
06-054	9.6	32.00	1.2	30.8	25.8	0.06	0.02	0.04	0.42	1.85	0.37	30.9	25.7
06-067	8.9	7.90	21.2	-13.3	0.4	0.92	0.24	0.68	0.10	0.30	0.06	5.0	0.2
06-071	9.4	33.20	14.4	18.8	2.3	0.48	0.02	0.46	0.39	1.62	0.32	27.0	1.9
06-073	9.2	48.80	17.2	31.6	2.8	1.19	0.64	0.55	0.97	3.75	0.75	62.5	3.6
06-074	9.5	27.50	4.7	22.8	5.9	0.47	0.32	0.15	0.46	1.50	0.30	25.0	5.3
06-076	9.0	7.10	9.1	-2.0	0.8	0.39	0.10	0.29	0.17	0.50	0.10	8.3	0.9
06-077	9.4	19.30	5.0	14.3	3.9	0.42	0.28	0.16	0.24	0.82	0.17	13.7	2.7
06-078	9.6	30.10	2.5	27.6	12.0	0.33	0.25	0.08	0.47	1.58	0.32	26.4	10.5
06-079	9.4	28.60	15.9	12.7	1.8	1.20	0.69	0.51	0.49	1.96	0.39	32.7	2.1
06-080	9.3	21.40	24.4	-3.0	0.9	1.32	0.54	0.78	0.62	2.08	0.42	34.7	1.4
06-083	9.0	25.80	26.2	-0.4	1.0	1.62	0.78	0.84	0.73	2.77	0.56	46.2	1.8
06-084	9.7	19.00	4.4	14.6	4.3	0.35	0.21	0.14	0.37	1.18	0.24	19.7	4.5
DA 0423	8.0	73.43	4.7	68.8	15.8	0.149	0.01	0.14	2.43	-	-	40.5	8.7
DA 0562	7.7	50.24	5.5	44.8	9.2	0.175	0.02	0.16	1.80	-	-	30.0	5.5
DA 1693	8.8	30.46	3.2	27.3	9.7	0.101	0.00	0.10	0.94	-	-	15.7	5.0
DA 8107	8.7	48.31	5.1	43.3	9.5	0.162	0.02	0.14	1.88	-	-	31.3	6.2
COMPOSITE													
06-007	9.4	54.20	6.2	48.0	8.7	0.23	0.03	0.20	0.65	2.53	0.51	42.2	6.8
06-018	9.3	50.20	4.1	46.2	12.4	0.18	0.05	0.13	0.66	2.47	0.50	41.2	10.0
06-023	9.3	41.50	5.0	36.5	8.3	0.13	< 0.01	0.16	0.48	1.99	0.40	33.2	6.6
06-027	9.4	33.50	2.8	30.7	11.9	0.12	0.02	0.09	0.38	1.29	0.26	21.5	7.7
06-035	9.2	57.70	7.5	50.2	7.7	0.45	0.21	0.24	0.87	3.43	0.69	57.2	7.6
06-045	9.4	30.60	2.8	27.8	10.9	0.14	0.04	0.09	0.46	1.73	0.35	28.9	10.3
06-051	9.2	29.30	4.7	24.6	6.3	0.23	0.08	0.15	0.41	1.49	0.30	24.9	5.3
06-052	9.6	26.50	4.1	22.4	6.5	0.31	0.18	0.13	0.37	1.33	0.27	22.2	5.4
06-055	9.1	8.80	1.2	7.5	7.0	0.06	0.02	0.04	0.13	0.45	0.09	7.5	6.3
06-058	9.5	23.00	3.1	19.9	7.4	0.15	0.05	0.10	0.31	1.06	0.21	17.7	5.7
06-059	9.4	120.00	1.9	118.0	63.7	0.09	0.02	0.06	1.44	6.64	1.33	110.7	58.3
06-062	9.2	13.50	2.2	11.3	6.1	0.08	< 0.01	0.07	0.18	0.58	0.12	9.7	4.4
06-064	9.3	25.30	3.4	21.8	7.3	0.17	0.06	0.11	0.31	1.10	0.22	18.3	5.4
06-069	9.5	56.50	5.3	51.2	10.6	0.20	0.03	0.17	0.67	2.83	0.57	47.2	8.9
06-070	9.5	27.90	11.6	16.3	2.4	0.34	< 0.01	0.37	0.36	1.27	0.25	21.2	1.8
GREYWACKE (20%-60% ARGILLITE INTERBEDS)													
06-001	9.3	39.00	8.8	30.3	4.4	0.39	0.11	0.28	0.59	1.69	0.34	28.2	3.2
06-002	9.4	28.20	4.1	24.2	6.9	0.18	0.05	0.13	0.44	1.70	0.34	28.4	6.9
06-003	9.4	44.30	8.1	36.2	5.5	0.26	< 0.01	0.26	0.73	2.25	0.45	37.5	4.6
06-011	9.3	38.40	0.6	37.8	61.4	0.16	0.14	0.02	0.52	2.05	0.41	34.2	57.0
06-013	8.4	47.20	2.8	44.4	16.8	0.11	0.02	0.09	0.55	2.07	0.41	34.5	12.3
06-015	9.5	40.80	4.7	36.2	8.7	0.15	< 0.01	0.15	0.50	1.68	0.34	28.0	6.0
06-020	9.3	58.20	2.5	55.7	23.3	0.08	< 0.01	0.08	0.71	2.98	0.60	49.7	19.9
06-024	9.4	35.80	1.9	33.9	19.1	0.07	0.01	0.06	0.44	1.92	0.38	32.0	16.9
06-026	9.4	31.20	2.8	28.4	11.1	0.15	0.06	0.09	0.51	2.09	0.42	34.9	12.4
06-034	9.7	50.50	2.5	48.0	20.2	0.16	0.08	0.08	0.67	2.85	0.57	47.5	19.0
06-039	9.3	32.70	15.3	17.4	2.1	0.58	0.09	0.49	0.76	2.99	0.60	49.9	3.3
06-057	9.5	67.50	2.5	65.0	27.0	0.12	0.04	0.08	0.83	3.62	0.73	60.4	24.2
DA 0472	7.4	46.53	6.0	40.5	7.8	0.19	0.01	0.18	0.99	-	-	16.4	2.7
GREYWACKE (<20% ARGILLITE INTERBEDS)													
06-056	9.6	70.60	2.5	68.1	28.2	0.11	0.03	0.08	0.82	3.77	0.75	62.9	25.2
06-060	9.5	63.20	0.9	62.3	67.4	0.06	0.03	0.03	0.72	3.38	0.68	56.4	62.6
06-061	9.6	42.00	0.9	41.1	44.8	0.05	0.02	0.03	0.45	2.10	0.42	35.0	38.9
06-063	9.6	50.00	1.2	48.8	40.0	0.06	0.02	0.04	0.60	2.75	0.55	45.9	38.2
06-065	9.7	54.00	1.6	52.4	34.6	0.13	0.08	0.05	0.68	2.89	0.58	48.2	30.1
06-066	9.6	37.10	7.5	29.6	5.0	0.48	0.24	0.24	0.46	1.83	0.37	30.5	4.1
06-068	9.7	36.00	2.5	33.5	14.4	0.08	< 0.01	0.08	0.41	1.57	0.31	26.2	10.5
06-072	9.7	28.20	1.2	27.0	22.6	0.04	< 0.01	0.04	0.32	1.22	0.24	20.3	17.0
06-075	9.4	34.00	5.6	28.4	6.0	0.30	0.12	0.18	0.42	1.61	0.32	26.9	4.8
06-081	8.9	21.80	3.4	18.4	6.3	0.16	0.05	0.11	0.31	1.05	0.21	17.5	5.2
DA 0070	8.7	28.35	1.3	27.0	21.1	0.04	0.00	0.04	1.34	-	-	22.3	16.6
DA 1151	9.0	64.31	2.4	61.9	26.4	0.08	0.00	0.07	2.02	-	-	33.6	13.8
DA 1154	9.0	57.03	1.3	55.7	44.5	0.04	0.00	0.04	2.24	-	-	37.4	29.2
DA 0879	8.3	44.63	4.3	40.4	10.5	0.14	0.00	0.13	2.07	-	-	34.5	8.1
DA 8413	8.6	133.12	19.2	113.9	6.9	0.62	0.01	0.61	7.33	-	-	122.3	6.4
MARGINAL ORE													
06-008	9.1	39.40	13.1	26.3	3.0	0.53	0.11	0.42	0.59	2.30	0.46	38.4	2.9
06-085	9.6	28.50	6.9	21.7	4.2	0.48	0.26	0.22	0.35	1.25	0.25	20.8	3.0
06-086	9.5	31.60	8.8	22.8	3.6	0.48	0.20	0.28	0.37	1.40	0.28	23.4	2.7
06-087	9.4	33.80	5.0	28.8	6.8	0.52	0.36	0.16	0.39	1.58	0.32	26.4	5.3
06-088	9.5	22.10	3.4	18.6	6.4	0.41	0.30	0.11	0.52	2.07	0.41	34.5	10.2
06-089	9.5	29.60	4.7	24.9	6.3	0.51	0.36	0.15	0.39	1.72	0.34	28.7	6.1
06-090	9.6	30.80	2.5	28.3	12.3	0.12	0.04	0.08	0.36	1.61	0.32	26.9	10.7
06-091	9.5	16.30	2.5	13.8	6.5	0.17	0.09	0.08	0.21	0.73	0.15	12.2	4.9
06-092	9.5	22.90	3.1	19.8	7.3	0.14	0.04	0.10	0.32	1.23	0.25	20.5	6.6
06-093	8.8	23.00	9.7	13.3	2.4	0.57	0.26	0.31	0.28	1.01	0.20	16.8	1.7
06-094	9.1	29.60	7.8	21.8	3.8	0.32	0.07	0.25	0.43	1.70	0.34	28.4	3.6
QUARTZ VEIN													
06-037	8.7	27.50	10.0	17.5	2.8	0.42	0.10	0.32	0.33	1.11	0.22	18.5	1.9
TAILINGS													
CND 2 Treated Solids	9.3	21.5	3.4375	18.0625	6.3	0.17	< 0.4	0.11	0.38	1.22	-	20.3	5.9
ORE													
DA 0087	8.2	46.08	17.3	28.8	2.7	0.55	0.01	0.55	1.21	-	-	20.2	1.2
DA 0351	8.0	50.74	16.8	33.9	3.0	0.54	0.00	0.54	1.39	-	-	23.2	1.4
DA 0398	7.3	13.85	11.8	2.1	1.2	0.38	0.02	0.36	1.03	-	-	17.2	1.5
DA 0402	7.6	52.72	13.9	38.8	3.8	0.44	0.01	0.43	2.46	-	-	41.1	3.0
DA 0577	8.6	60.50	30.7	29.8	2.0	0.98	0.02	0.96	1.79	-	-	29.8	1.0
DA 7399	8.6	45.16	17.2	28.0	2.6	0.55	0.01	0.54	1.57	-	-	26.2	1.5
DA 7278	8.9	83.47	17.2	66.3	4.9	0.55	0.00	0.55	3.27	-	-	54.5	3.2
DA 0898	7.9	65.37	4.3	61.1	15.4	0.14	0.00	0.13	2.33	-	-	38.8	9.1
DA 8157	8.7	30.51	7.2	23.3	4.2	0.23	0.01	0.22	0.81	-	-	13.4	1.9

Sample	pH	Alkalinity	Acidity	SO_4	Cl	Hg	Al	As	Ag	Ba
#	units	mg/L as CaCO3	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ARGILLITE (5-49%) GREYWACKE										
06-016	8.33	35	< 2	11.0	< 2	< 0.0001	0.32	0.09	< 0.0001	0.31
06-042	7.79	35	< 2	22.0	< 2	< 0.0001	0.12	0.01	< 0.0001	0.26
06-082	7.58	45	< 2	110.0	2.1	< 0.0001	0.07	0.10	< 0.0001	0.14
ARGILLITE (<5% GREYWACKE)										
06-009	7.71	28	< 2	19.0	< 2	< 0.0001	0.33	0.05	< 0.0001	0.24
06-022	7.75	33	< 2	6.5	3.5	< 0.0001	0.54	0.06	< 0.0001	0.37
06-025	8.3	32	< 2	11.0	2.5	< 0.0001	0.55	0.09	< 0.0001	0.33
06-028	7.87	31	< 2	9.0	2.2	< 0.0001	0.53	0.11	< 0.0001	0.35
06-032	7.84	30	< 2	15.0	2.1	< 0.0001	0.33	0.05	< 0.0001	0.28
06-036	7.83	30	< 2	100.0	< 2	< 0.0001	0.13	0.02	< 0.0001	0.10
06-044	8.06	35	< 2	8.8	< 2	< 0.0001	0.51	0.01	< 0.0001	0.36
06-049	7.93	33	< 2	16.0	3.1	< 0.0001	0.80	0.03	< 0.0001	0.27
06-050	7.88	31	< 2	13.0	< 2	< 0.0001	0.49	0.01	< 0.0001	0.31
06-054	7.96	34	< 2	7.9	< 2	< 0.0001	0.40	0.02	< 0.0001	0.31
06-067	7.53	35	< 2	100.0	< 2	< 0.0001	0.03	0.04	< 0.0001	0.16
06-073	8.09	56	< 2	25.0	2.9	< 0.0001	0.36	0.28	< 0.0001	0.31
06-076	7.79	33	< 2	87.0	3	< 0.0001	0.13	0.08	< 0.0001	0.20
06-078	7.79	44	< 2	8.1	< 2	< 0.0001	0.84	0.19	< 0.0001	0.57
06-079	7.89	46	< 2	15.0	< 2	< 0.0001	0.52	1.09	< 0.0001	0.43
06-080	7.36	41	< 2	26.0	< 2	< 0.0001	0.37	1.25	< 0.0001	0.32
06-083	7.64	40	< 2	34.0	< 2	< 0.0001	0.27	0.42	< 0.0001	0.26
COMPOSITE										
06-027	7.78	32	< 2	8.4	2.2	< 0.0001	0.37	0.10	< 0.0001	0.34
06-035	7.65	30	< 2	46.0	2.3	< 0.0001	0.20	0.02	< 0.0001	0.14
06-052	7.65	31	< 2	27.0	< 2	< 0.0001	0.23	0.04	< 0.0001	0.22
06-059	8.03	29	< 2	36.0	< 2	< 0.0001	0.23	0.05	< 0.0001	0.15
06-070	7.73	39	< 2	35.0	2.3	< 0.0001	0.37	0.07	< 0.0001	0.26
GREYWACKE (20%-50% ARGILLITE INTERBEDS)										
06-001	8.05	56	< 2	68.0	< 2	< 0.0001	0.24	0.00	< 0.0001	0.26
06-034	8.05	35	< 2	6.0	2.8	< 0.0001	0.31	0.35	< 0.0001	0.35
GREYWACKE (<20% ARGILLITE INTERBEDS)										
06-061	7.83	40	< 2	8.7	3.6	< 0.0001	0.68	0.03	< 0.0001	0.49
06-065	8.16	38	< 2	8.0	< 2	< 0.0001	0.49	0.04	< 0.0001	0.27
06-066	7.59	38	< 2	28.0	2.8	< 0.0001	0.39	0.21	< 0.0001	0.30
MARGINAL ORE										
06-008	7.65	27	< 2	67.0	< 2	< 0.0001	0.17	0.04	< 0.0001	0.13
06-088	7.75	37	< 2	9.0	< 2	< 0.0001	0.32	0.06	< 0.0001	0.30
06-090	7.91	42	< 2	10.0	< 2	< 0.0001	1.26	0.06	< 0.0001	0.49

Sample	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Li	K	Mg	Mn
#	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ARGILLITE (5-49%) GREYWACKE												
06-016	< 0.0004	< 0.00002	8.26	< 0.00006	0.00004	< 0.001	0.0007	0.06	< 0.002	9.39	1.66	0.0030
06-042	< 0.0004	< 0.00002	12.20	< 0.00006	0.00005	< 0.001	0.0004	0.03	< 0.002	8.60	2.51	0.0113
06-082	< 0.0004	< 0.00002	42.00	< 0.00006	0.00011	< 0.001	0.0002	< 0.01	2.05	13.10	5.21	0.0906
ARGILLITE (<5% GREYWACKE)												
06-009	< 0.0004	< 0.00002	11.10	< 0.00006	0.00001	< 0.001	0.0004	0.03	< 0.002	7.69	1.63	0.0038
06-022	< 0.0004	0.00	6.07	< 0.00006	0.00012	< 0.001	0.0004	0.17	< 0.002	10.00	1.05	0.0031
06-025	< 0.0004	0.00	7.42	< 0.00006	0.00012	< 0.001	0.0006	0.13	< 0.002	8.33	0.89	0.0050
06-028	< 0.0004	< 0.00002	7.36	< 0.00006	0.00007	< 0.001	0.0005	0.12	< 0.002	8.37	1.26	0.0024
06-032	< 0.0004	< 0.00002	9.60	< 0.00006	0.00005	< 0.001	0.0003	0.04	< 0.002	10.40	1.49	0.0013
06-036	< 0.0004	< 0.00002	39.70	< 0.00006	0.00007	< 0.001	0.0002	< 0.01	< 0.002	9.71	6.39	0.0744
06-044	< 0.0004	< 0.00002	8.02	< 0.00006	0.00006	< 0.001	0.0003	0.10	< 0.002	10.50	1.87	0.0040
06-049	< 0.0004	< 0.00002	8.82	< 0.00006	0.00012	< 0.001	0.0010	0.43	< 0.002	10.70	1.69	0.0087
06-050	< 0.0004	< 0.00002	8.24	< 0.00006	0.00003	< 0.001	0.0003	0.04	< 0.002	8.43	1.13	0.0022
06-054	< 0.0004	< 0.00002	6.84	< 0.00006	0.00001	< 0.001	0.0005	0.02	< 0.002	7.76	1.41	0.0011
06-067	< 0.0004	< 0.00002	32.70	< 0.00006	0.00048	0.005	0.0005	0.03	< 0.002	13.60	8.37	0.1260
06-073	< 0.0004	< 0.00002	15.50	< 0.00006	0.00003	< 0.001	0.0003	0.05	< 0.002	16.70	2.94	0.0102
06-076	< 0.0004	< 0.00002	24.50	< 0.00006	0.00013	< 0.001	0.0007	0.03	< 0.002	16.10	4.10	0.0171
06-078	< 0.0004	0.00	9.09	< 0.00006	0.00009	< 0.001	0.0007	0.38	< 0.002	13.50	1.29	0.0059
06-079	< 0.0004	0.00	11.90	< 0.00006	0.00003	< 0.001	0.0005	0.22	< 0.002	12.30	2.91	0.0093
06-080	< 0.0004	< 0.00002	14.30	< 0.00006	0.00004	< 0.001	0.0006	0.13	< 0.002	14.80	3.15	0.0167
06-083	< 0.0004	< 0.00002	16.00	< 0.00006	0.00003	< 0.001	0.0003	0.05	< 0.002	15.20	3.59	0.0566
COMPOSITE												
06-027	< 0.0004	< 0.00002	7.73	< 0.00006	0.00005	< 0.001	0.0003	0.05	< 0.002	7.69	1.26	0.0018
06-035	< 0.0004	< 0.00002	21.90	< 0.00006	0.00001	< 0.001	0.0003	< 0.01	< 0.002	8.62	2.03	0.0124
06-052	< 0.0004	< 0.00002	11.60	< 0.00006	0.00004	< 0.001	0.0004	0.02	< 0.002	10.00	1.95	0.0037
06-059	< 0.0004	< 0.00002	17.10	< 0.00006	0.00004	< 0.001	0.0002	< 0.01	< 0.002	7.80	2.22	0.0060
06-070	< 0.0004	< 0.00002	15.30	< 0.00006	0.00017	< 0.001	0.0005	0.13	< 0.002	12.90	2.81	0.0115
GREYWACKE (20%-50% ARGILLITE INTERBEDS)												
06-001	< 0.0004	< 0.00002	10.30	< 0.00006	0.00001	< 0.001	0.0008	0.03	< 0.002	8.75	2.36	0.0105
06-034	< 0.0004	< 0.00002	7.77	< 0.00006	0.00001	< 0.001	0.0002	0.04	< 0.002	7.01	0.87	0.0016
GREYWACKE (<20% ARGILLITE INTERBEDS)												
06-061	< 0.0004	< 0.00002	6.86	< 0.00006	0.00020	< 0.001	0.0006	0.24	< 0.002	6.63	1.46	0.0062
06-065	< 0.0004	< 0.00002	8.56	< 0.00006	0.00002	< 0.001	0.0001	0.02	< 0.002	9.61	1.00	0.0019
06-066	< 0.0004	< 0.00002	13.70	< 0.00006	0.00007	< 0.001	0.0004	0.11	< 0.002	11.50	2.62	0.0112
MARGINAL ORE												
06-008	< 0.0004	< 0.00002	26.40	< 0.00006	0.00004	< 0.001	0.0005	< 0.01	< 0.002	9.44	3.44	0.0629
06-088	< 0.0004	< 0.00002	8.96	< 0.00006	< 0.000007	< 0.001	0.0002	0.01	< 0.002	9.08	1.44	0.0011
06-090	< 0.0004	< 0.00002	8.61	< 0.00006	0.00028	< 0.001	0.0004	0.57	< 0.002	10.40	1.24	0.0074

Sample	Mo	Na	Ni	Pb	P	Sb	S	Se	Sr	Ti	V	W	Zn
#	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
ARGILLITE (5-49%) GREYWACKE													
06-016	0.0013	5.85	0.0017	0.0007	< 0.01	0.0034	4.54	< 0.003	0.0309	0.0024	0.0013	0.0002	0.0054
06-042	0.0060	7.14	0.0010	0.0005	0.01	0.0014	9.35	< 0.003	0.0342	0.0006	0.0004	0.0046	0.0065
06-082	0.0012	9.87	0.0029	0.0005	0.73	0.3000	47.00	< 0.003	0.0695	0.0017	0.0003	0.0010	0.0396
ARGILLITE (<5% GREYWACKE)													
06-009	0.0005	5.63	0.0045	0.0010	< 0.01	0.0010	9.69	< 0.003	0.0239	0.0014	0.0006	0.0003	0.0063
06-022	0.0006	6.93	0.0016	0.0006	< 0.01	0.0032	2.50	< 0.003	0.0203	0.0061	0.0013	0.0002	0.0060
06-025	0.0010	6.97	0.0032	0.0009	< 0.01	0.0037	5.72	< 0.003	0.0191	0.0066	0.0015	0.0003	0.0062
06-028	0.0006	5.98	0.0023	0.0008	< 0.01	0.0055	4.13	< 0.003	0.0193	0.0044	0.0014	0.0003	0.0057
06-032	0.0016	5.62	0.0029	0.0006	< 0.01	0.0015	7.21	< 0.003	0.0229	0.0020	0.0011	0.0006	0.0057
06-036	0.0004	5.51	0.0014	0.0005	< 0.01	0.0010	42.40	< 0.003	0.0558	< 0.0002	0.0001	0.0004	0.0085
06-044	0.0007	3.98	0.0008	0.0007	< 0.01	0.0025	3.99	< 0.003	0.0196	0.0043	0.0008	0.0005	0.0060
06-049	0.0004	6.48	0.0020	0.0010	0.02	0.0012	7.22	< 0.003	0.0255	0.0051	0.0006	0.0004	0.0067
06-050	0.0005	5.78	0.0017	0.0012	< 0.01	0.0010	5.93	< 0.003	0.0239	0.0026	0.0009	0.0003	0.0066
06-054	0.0004	6.79	< 0.0007	0.0007	< 0.01	0.0011	3.19	< 0.003	0.0193	0.0019	0.0011	0.0002	0.0050
06-067	0.0092	5.78	0.0029	0.0006	< 0.01	0.0070	35.30	< 0.003	0.1130	0.0004	0.0001	0.0004	0.0528
06-073	0.0004	9.25	0.0012	0.0009	< 0.01	0.0018	16.30	< 0.003	0.0324	0.0018	0.0007	0.0019	0.0483
06-076	0.0026	8.23	0.0080	0.0005	< 0.01	0.0272	26.20	< 0.003	0.0961	0.0007	0.0005	0.0017	0.0515
06-078	0.0008	7.73	0.0017	0.0009	< 0.01	0.0017	4.61	< 0.003	0.0259	0.0090	0.0022	0.0010	0.0753
06-079	0.0006	7.84	0.0013	0.0011	< 0.01	0.0044	9.54	< 0.003	0.0299	0.0077	0.0016	0.0016	0.0487
06-080	0.0003	7.45	< 0.0007	0.0009	0.01	0.0019	15.40	< 0.003	0.0301	0.0053	0.0017	0.0016	0.0640
06-083	0.0006	6.42	< 0.0007	0.0007	< 0.01	0.0022	18.10	< 0.003	0.0306	0.0017	0.0010	0.0013	0.0523
COMPOSITE													
06-027	0.0007	6.77	0.0013	0.0010	0.03	0.0038	3.81	< 0.003	0.0262	0.0025	0.0012	0.0003	0.0061
06-035	0.0005	8.34	0.0010	0.0004	< 0.01	0.0009	21.10	< 0.003	0.0566	0.0006	0.0003	0.0004	0.0070
06-052	0.0013	9.12	0.0015	0.0007	< 0.01	0.0028	13.10	< 0.003	0.0310	0.0013	0.0007	0.0003	0.0071
06-059	0.0004	5.69	0.0009	0.0007	< 0.01	0.0018	15.20	< 0.003	0.0584	0.0009	0.0006	0.0003	0.0060
06-070	0.0010	9.98	0.0024	0.0015	< 0.01	0.0029	14.80	< 0.003	0.0296	0.0055	0.0011	0.0005	0.0524
GREYWACKE (20%-50% ARGILLITE INTERBEDS)													
06-001	0.0009	6.81	0.0008	0.0012	0.01	0.0011	9.79	< 0.003	0.0308	0.0009	0.0005	0.0003	0.0046
06-034	0.0011	8.13	< 0.0007	0.0008	< 0.01	0.0017	3.22	< 0.003	0.0298	0.0035	0.0023	0.0006	0.0066
GREYWACKE (<20% ARGILLITE INTERBEDS)													
06-061	0.0004	11.8	< 0.0007	0.0013	< 0.01	0.0013	3.27	< 0.003	0.0270	0.0189	0.0035	0.0013	0.0849
06-065	0.0006	6.85	< 0.0007	0.0005	< 0.01	0.0015	4.16	< 0.003	0.0301	0.0012	0.0025	0.0006	0.0060
06-066	0.0014	10.8	0.0007	0.0007	< 0.01	0.0032	14.00	< 0.003	0.0352	0.0057	0.0014	0.0010	0.0612
MARGINAL ORE													
06-008	0.0004	7.52	0.0035	0.0005	< 0.01	0.0010	28.30	< 0.003	0.0437	0.0011	0.0003	0.0004	0.0076
06-088	0.0006	3.96	< 0.0007	0.0006	< 0.01	0.0011	5.21	< 0.003	0.0232	0.0005	0.0007	0.0003	0.0034
06-090	0.0003	7.88	0.0012	0.0008	< 0.01	0.0013	4.77	< 0.003	0.0206	0.0308	0.0022	0.0005	0.0695

APPENDIX D

MSDS SHEETS

Envirotrol Inc.®
P.O. Box 61
432 Green St.
Sewickley, PA 15143
Phone: 412.741.2030 Fax: 412.741.2670

Emergency Phone Number:
724.827.8181

MSDS Date: 5/14/2003

Material Safety Data Sheet

Section 1 – Product Identification

Chemical Name:	Carbon	Trade Name:	Activated/Reactivated Carbon (Granular, Pelletized or Powdered)
Formula:	C	Common Name:	Carbon
CAS Number:	7440-44-0	Chemical Family:	Element, Group IV-A

Section 2 – Ingredients (Typical Values)

Carbon	90-100%
Inert Ingredients	0-10%

Section 3 - Physical And Chemical Data

Boiling Point:	8721° F, 4827° C (Approx.)	Vapor Pressure:	N/A
Vapor Density:	N/A	Solubility in Water:	Insoluble
Specific Gravity:	0.2 – 0.75	Percent, Volatile by Volume:	N/A
Appearance:	Black, Odorless, Pelletized, Powder	Evaporation Rate:	N/A

Section 4 - Fire And Explosion Hazard Data

- Flash Point: N/A
- Ignition Point: 500-800° F
- Extinguishing Media: Dry Chemical, Water Fog, Foam
- Special Fire Fighting Procedures: Wear positive pressure self-contained breathing apparatus if fire occurs in enclosed space. Oxygen starved fires may result in the release of carbon monoxide.
- Unusual Fires And Explosion Hazards: Avoid producing suspensions of dust during handling, and avoid exposure of suspensions to sources of ignition. Suspensions of -40 mesh powdered activated carbon may explode if exposed to strong sources of ignition

Section 5 - Health Hazard Data

- Eye: Carbon particles may cause physical irritation if not removed.
- Skin Contact: Constant prolonged exposure may cause dryness or chapping of exposed area
- Skin Adsorption: Not adsorbed by skin.
- Ingestion: No adverse affect unless quantity ingested causes physical discomfort.
- Inhalation: No toxic affect caused by dust. As with any dust, excessive exposure should be avoided. OSHA "Nuisance Dust" limitations should be observed
- Systemic And Other Effects: None

Section 5 - Health Hazard Data *(continued)*

• Eyes:	Irrigate with water immediately. Repeat as needed to flush particle from eye. If irritation persists, consult medical personnel.
• Skin:	Wash with soap and water to avoid skin drying or chapping.
• Ingestion:	N/A
• Inhalation:	N/A

Section 6 - Reactivity Data Compatibility Data

• Stability:	Avoid contact with strong oxidizing chemicals, such as ozone, perchloric acid, permanganate, sodium chlorite, etc. Exposure to hydrocarbons and vegetable oils may cause slow oxidation until ignition point is reached--contact should be avoided.
• Incompatibility:	Strong oxidizing materials.
• Hazardous Decomposition Products:	Oxygen starved combustion may yield carbon monoxide.
• Hazardous Polymerization:	Will not occur.

Section 7 - Storage Handling And Use

• Action To Take For Spills:	Shovel and sweep material into appropriate container. If necessary wash area with water.
• Disposal Method:	Reactivation, landfill or incineration, in accordance with applicable regulations.

Section 8 - Personnel Protection

• Ventilation:	Local exhaust recommended minimizing dust exposure.
• Respiratory Protection:	Approved "nuisance dust" dust masks should be worn in dust exposure areas.
• Protective Clothing:	Protective gloves can be worn.
• Eye Protection:	Safety glasses with side shields should be worn and eye wash capabilities should be available.

Section 9 - Special Precautions And Additional Information

Precautions to be taken in handling and storage: keep dry; wet carbon will adsorb oxygen and may reduce oxygen levels in confined spaces to dangerous levels. Adequate ventilation and precautions should be employed whenever closed tanks, receptacles or other enclosed spaces containing carbon are accessed. Suspensions of dust should be avoided and exposure of suspensions of dust to sources of ignition should be avoided.

COPPER SULFATE $CuSO_4 \cdot 5H_2O$

IDENTIFICATION

Common Synonyms

BLUESTONE
CUPRIC SULFATE
BLUE VITRIOL
ROMAN VITRIOL
COPPER 2 SULFATE PENTAHYDRATE
COPPER SULFATE PENTAHYDRATE

Observable Characteristics

Whitish-blue to greenish-blue powder or crystals. Odourless.

Manufacturers

Canadian Copper Refiners Ltd., Montreal, Que.
Cominco Limited, Kimberley, B.C.
Canadian Metafina, Vancouver, B.C.

Transportation and Storage Information

Shipping State: Solid.
Classification: Not regulated.
Inert Atmosphere: No requirement.
Venting: Open.
Label(s): None. Class 9.2, Group I.
Storage Temperature: Ambient.
Grades or Purity: Technical.
Containers and Materials: Multiwall paper and poly bags, drums; steel.

Physical and Chemical Characteristics

Physical State (20°C, 1 atm): Solid.
Solubility (Water): 31.6 g/100 mL (0°C); 203.3 g/100 mL (100°C).
Molecular Weight: 249.7
Vapour Pressure: No information.
Boiling Point: Loses $4H_2O$ at 110°C; loses $5H_2O$ at 150°C.
Floatability (Water): Sinks and mixes.
Odour: Odourless.
Flash Point: Not flammable.
Vapour Density: No information.
Specific Gravity: 2.28 (20°C).
Colour: Whitish-blue to greenish-blue.
Explosive Limits: Not flammable.
Melting Point: Loses $4H_2O$ at 110°C; loses $5H_2O$ at 150°C.

HAZARD DATA

Human Health

Symptoms: Contact: irritation of eyes and skin, as well as congestion of nasal mucous membranes. Ingestion: vomiting, gastric pain, hemorrhagic gastritis, diarrhea, convulsions and collapse. Inhalation: sore throat, coughing, shortness of breath.
Toxicology: Moderately toxic by ingestion and inhalation.
TLV® (inhalation) 0.2 mg/m^3 (as fume Cu); 1 mg/m^3 (dust, mist Cu).
Short-term Inhalation Limits - 2 mg/m^3 for 15 min (as Cu, dust and mist).
LC_{50} - No information.
Delayed Toxicity - No information.
LD_{50} - Oral: rat= 0.3 g/kg

Fire

Fire Extinguishing Agents: Not combustible. Most fire extinguishing agents may be used on fires involving copper sulfate.
Behaviour in Fire: Not combustible. When heated above 400°C can release toxic SO_x fumes. Closed containers may rupture when heated above 110°C due to loss of water vapour and expansion.
Ignition Temperature: Not combustible.
Burning Rate: Not combustible.

Reactivity

With Water: No reaction, soluble.
With Common Materials: Can react with hydroxylamine and magnesium.
Stability: Stable.

Environment

Water: Prevent entry into water intakes and waterways. Harmful to aquatic life in low concentrations. Fish toxicity: 0.15 mg/L/48 h/rainbow trout/TLm/freshwater; 3.8 ppm/24 h/rainbow trout/TLm/freshwater; 1.0 mg/L/24 h/Daphnia magna/LC_{100}/freshwater; BOD: None.
Land-Air: LD_{Lo} - wild bird = 0.3 g/kg
Food Chain Concentration Potential: No information.

EMERGENCY MEASURES

Special Hazards

Immediate Responses

Keep non-involved people away from spill site. Avoid contact and inhalation. Stop or reduce discharge if safe to do so. Contain spill by diking. Notify manufacturer or supplier. Notify environmental authorities.

Protective Clothing and Equipment

In fires and confined spaces - Respiratory protection - self-contained breathing apparatus. Otherwise, Gloves - rubber or plastic. Goggles - (mono), tight fitting. Rubber boots (pants worn outside boots).

Fire and Explosion

Not combustible. Most fire extinguishing agents may be use on fires involving copper sulfate.

First Aid

Move victim out of spill area to fresh air. Call for medical assistance, but start first aid at once. Contact: remove contaminated clothing, wash eyes and affected skin with plenty of water. Keep warm and quiet. Ingestion: give milk or water to conscious victim to drink. Induce vomiting. If medical assistance is not immediately available, transport victim to hospital, doctor or clinic.

ENVIRONMENTAL PROTECTION MEASURES

Response

Water
1. Stop or reduce discharge if safe to do so.
2. Contact manufacturer or supplier for advice.
3. If possible, contain discharge by damming or water diversion.
4. Dredge or vacuum pump to remove contaminants, liquids and contaminated bottom sediments.
5. Notify environmental authorities to discuss disposal and cleanup of contaminated materials.

Land-Air
1. Stop or reduce discharge if safe to do so.
2. Contact manufacturer or supplier for advice.
3. Dike to prevent runoff from rainwater or water application.
4. Remove material by manual or mechanical means.
5. Recover undamaged containers.
6. Notify environmental authorities to discuss disposal and cleanup of contaminated materials.

Disposal

1. Contact manufacturer or supplier for advice on disposal.
2. Contact environmental authorities for advice on disposal.

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product information

Trade name	:	CyPlus® Sodium Cyanide, Bricks 98/99 %
Use of the Substance / Preparation	:	Raw material for industrial use
Function		Electroplating agent Gold mining
Supplier	:	CyPlus Canada Inc. 3612 Poirier Blvd St. Laurent,QC H4R 2J5 Canada
Telephone	:	514-337-2421
Telefax	:	514-337-9057
CANADA: CANUTEC EMERGENCY NUMBER	:	613-996-6666
Product Regulatory Services	:	905-451-3810

2. COMPOSITION/INFORMATION ON INGREDIENTS

Information on ingredients / Hazardous components

Sodium cyanide

CAS-No.	143-33-9	Percent (Wt./ Wt.)	>= 60 - <= 100 %

3. HAZARDS IDENTIFICATION

***** EMERGENCY OVERVIEW *****

Form*-solid* ***Colour****-white* **Odour***-distinct, similar to bitter almond*

Very toxic by inhalation, in contact with skin and if swallowed.
Contact with acids liberates very toxic gas.
Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
Under the action of acids (as well as carbon dioxide !) hydrocyanic acid is released which is combustible and may react with air to explosive gas mixtures.
Hydrocyanic acid may cause all degrees of poisoning.

Avoid contact with acids, air humidity, water.

Causes severe eye burns.

Eye contact

Corrosive. May cause burns resulting in permanent damage.

Skin Contact

Highly toxic. May be fatal if absorbed through the skin.

Inhalation

Highly toxic. May be fatal if inhaled.

Ingestion

Highly toxic. May be fatal if swallowed.

4. FIRST AID MEASURES

General advice

The following recommendations in respect of first aid and therapy should be made available to all First Aid Officers and Doctors, who could be called upon to render first aid, before work with cyanide/hydrocyanic acid is started.

Observe self-protection

If signs of poisoning occur, consult a doctor immediately.

Possible signs of poisoning: headache, dizziness, drowsiness, nausea, seizures, unconciousness, respiratory disturbance, cessation of breathing, cardiac arrest.

Move out of dangerous area.

Remove contaminated or saturated clothing immediately and dispose of safely.
Do not leave affected persons unattended.

In case of difficulties in breathing, supply oxygen. Employ artificial respiration if breathing ceases.

No artificial respiration, mouth-to-mouth or mouth to nose. Use suitable instruments/apparatus.

Keep warm and in a quiet place.

Place person on side in stable position if unconscious.

Inhalation

In case of difficulties in breathing, supply oxygen.
Employ artificial respiration if breathing ceases.

Skin contact

After contact with skin, wash immediately with plenty of water.

Eye contact

With eye held open, thoroughly rinse immediately with plenty of water for at least 10 minutes.
In case of persistent discomfort: Consult an ophthalmologist.

Ingestion

Call emergency doctor immediately (alarm report: cyanide / hydro-cyanic acid poisoning).

Do not induce vomiting.

Only when patient fully conscious:
Have the mouth rinsed with water.

Notes to physician

Possible signs of poisoning:
Discrimination in 2 stages seems appropriate:
1. mild poisoning: Patient concious.
2. very serious poisoning: Patient unconscious.
The following symptoms are not sufficient to ensure correct prognosis:
symptoms of the central nervous system:
Early stage
headache, dizziness, somnolence (drowsiness), nausea.
advanced stage: seizures, coma.
Pulmonary symptoms:
Early stage: dyspnea, tachypnea.
advanced stage:
hypoventilation, Cheyne-Stokes respiration, apnea
Cardiovascular symptoms:
Early stage
hypertension, sinus arrhythmia, atrioventricular arrhythmia, bradycardia.
advanced stage:
tachycardia, complex arrhythmias, cardiac arrest.
Skin symptoms:
Early stage: rosy skin colour.
advanced stage: cyanosis.
Effect on the metabolism:
Lactate acidosis up to pH 7,1 and lactate level of 17 mmol/l are described.
Treatment:
Prevention of absorption and checking of vital functions only in the absence of risk to selfprotection !
Rapid treatment with antidotes can save lives and has priority over removal of poison !
Antidote treatment:
Warning! Dosage level relevant for adults weighing 70 kg.
In case of slight poisoning or danger of reabsorption (intake method: skin, gastro-intestinal tract):
Possible administration of sodium thiosulphate (12,5 g i.v.) depending on the clinical symptoms.
In the event of severe poisoning, administration of an antidote necessary.
Observe national methods of treatment.
Information about licensing of antidotes in different countries not available.
Common antidote combinations:
Dicobalt edetate/sodium thiosulphate: 300 mg (1 vial) dicobalt edetate i.v., combination with sodium thiosulphate possible.
Antidote in the event of false diagnosis or overdosage: sodium calcium edetate.
Hydroxocobalamin/sodium thiosulphate: 4 g hydroxocobalamin by slow infusion; then 8 g sodium thiosulphate by infusion.
The hydroxocobalamin dosage can be raised if necessary.
Amyl nitrite/sodium nitrite/sodium thiosulphate: amyl nitrite every 15 to 30 seconds by inhalation, then 300 - 600 mg sodium nitrite i.v., then 12,5 g sodium thiosulphate by infusion.
Antidote in the event of false diagnosis or overdosage (methemoglobinemia > 30 %): toluidine blue, methylene blue.
4-dimethylaminophenol, 4-DMAP/sodium thiosulphate: 250 mg (1 vial) 4-DMAP i.v., then 12,5 g sodium thiosulphate by infusion.
Antidote in the event of false diagnosis or overdosage (methemoglobinemia > 30 %): toluidine blue, methylene blue.
Symptomatic therapy:
administration of oxygen, artificial respiration, treatment of arrhythmias, treatment of spasmodic fit, correction of acid-base balance.
Follow-up of patient, if reabsorption possible (after oral intake, after skin absorption).

Following skin contact, eye contact, swallowing of cyanide salt or cyanide salt solution: consider cauterisaton as well as the effect of the poison!
If substance has been swallowed:
Only when patient fully conscious:
Rinse mouth.
First administrate antidote, if necessary.
Early endoscopy in order to assess mucosa lesions in the oesophagus and stomach which may appear.
The administration of activated charcoal is disputed.

5. FIRE-FIGHTING MEASURES

Flash point	Not combustible.
Autoignition temperature	Not applicable.

Suitable extinguishing media

alkali powder quenching agent

Extinguishing media which must not be used for safety reasons

water foam acidic quenching agents acidic powder quenching agents; carbon dioxide (CO_2)

Specific hazards during fire fighting

May be released in case of fire: Hydro-cyanic acid

Special protective equipment for fire-fighters

In the case of fire, wear respiratory protective equipment independent of surrounding air and chemical protective suit.

Further information

Water used to extinguish fire should not enter drainage systems, soil or stretches of water. Ensure there are sufficient retaining facilities for water used to extinguish fire. Contaminated fire-extinguishing water must be disposed of in accordance with the regulations issued by the appropriate local authorities. Fire residues should be disposed of in accordance with the regulations.
As in any fire, wear self-contained positive-pressure breathing apparatus, (MSHA/NIOSH approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Wear personal protective equipment.
Keep out unprotected persons.
Keep unauthorised persons away.

Avoid dust formation.

Ensure sufficient ventilation. Avoid skin contact because of the danger of skin absorption.

Environmental precautions

Do not allow the product into the following compartments:
stretches of water
drainage systems
soil

Cyanide-containing sewage water and solutions must be decontaminated before entering a public canal network or stretch of water.

Methods for cleaning up

1. solid:
Pick up mechanically. Collect in suitable containers.
Reuse or eliminate absorbed material according to the regulations in force.

2. solution:

Absorb with liquid-binding material, e. g.: inert absorbent, diatomaceous earth or acid neutralizer

Pick up mechanically. Collect in suitable containers.

Reuse or eliminate absorbed material according to the regulations in force.

Waste to be packed like clean product and to be marked. Identification label on packages not to be removed until recycling.

7. HANDLING AND STORAGE

Handling

Safe handling advice

Store under lock and key or in a way that only skilled persons have access to it.
Ensure ventilation when opening container. Traces of HCN may adhere to product.
Seal container hermetically immediately after use.

Be careful when opening the package, since toxic and caustic gases and vapours may escape.

Advice on protection against fire and explosion

The product is not combustible.
see section 5.

In case of release hydrocyanic acid:

Formation of flammable or explosive dust/air mixtures possible.

Storage

Requirements for storage areas and containers

clean, dry, lockable.
Keep container tightly sealed and store in a dry, well-ventilated place.
Unsuitable materials aluminium

Advice on common storage

Do not store together with: acid and acidic salts.
Keep away from food, drink and animal feedingstuffs.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Product occupational exposure guidelines

- **Sodium cyanide**

CAS-No. 143-33-9 EC-No. 205-599-4

Control parameters

5 mg/m3 as CN	Time Weighted Average (TWA):(OEL (QUE))	
as CN	Skin designation:(OEL (QUE))	Can be absorbed through the skin.
5 mg/m3 as CN	Time Weighted Average (TWA):(CAD AB OEL)	
10 mg/m3 as CN	Short Term Exposure Limit (STEL):(CAD AB OEL)	
as CN	Skin designation:(CAD AB OEL)	Can be absorbed through the skin.
5 mg/m3 as CN	Ceiling Limit Value:(CAD BC OEL)	
as CN	Skin designation:(CAD BC OEL)	Can be absorbed through the skin.
10 mg/m3	Time Weighted Average (TWA):(OEL (QUE))	Total dust.
10 mg/m3	Time Weighted Average (TWA):(CAD AB OEL)	Total dust.
5 mg/m3	Time Weighted Average (TWA):(CAD AB OEL)	Respirable dust.
10 mg/m3	Time Weighted Average (TWA):(CAD BC OEL)	Total dust.
3 mg/m3	Time Weighted Average (TWA):(CAD BC OEL)	Respirable dust.
5 mg/m3 as CN	Ceiling Limit Value:(CAD ON OEL)	
as CN	Skin designation:(CAD ON OEL)	Can be absorbed through the skin.
5 mg/m3 as CN	Ceiling Limit Value:(CAD AB OEL)	
as CN	Skin designation:(CAD AB OEL)	Can be absorbed through the skin.
5 mg/m3 as CN	Ceiling Limit Value:(CAD BC OEL)	
as CN	Skin designation:(CAD BC OEL)	Can be absorbed through the skin.
10 ppm 11 mg/m3 as CN	Ceiling Limit Value:(OEL (QUE))	
as CN	(OEL (QUE))	Recirculation prohibited

Component occupational exposure guidelines

- **Hydrogen cyanide**

CAS-No. 74-90-8

Control parameters

	(OEL (QUE))	Listed.
10 ppm 11 mg/m3	Ceiling Limit Value:(OEL (QUE))	
	Skin designation:(OEL (QUE))	Can be absorbed through the skin.
	(OEL (QUE))	Recirculation prohibited
as CN	(CAD AB OEL)	Listed.
4.7 ppm 5.2 mg/m3 as CN	Ceiling Limit Value:(CAD AB OEL)	
as CN	Skin designation:(CAD AB OEL)	Can be absorbed through the skin.
4.7 ppm as CN	Ceiling Limit Value:(CAD BC OEL)	
as CN	Skin designation:(CAD BC OEL)	Can be absorbed through the skin.
as CN	(CAD BC OEL)	Listed.
4.7 ppm as CN	Ceiling Limit Value:(CAD ON OEL)	
as CN	Skin designation:(CAD ON OEL)	Can be absorbed through the skin.
as CN	(CAD ON OEL)	Listed.

Other information

Suitable measuring processes are:

Sodium cyanide

OSHA method ID 120
NIOSH method 7904

Hydro-cyanic acid

OSHA method ID 120

Engineering measures

Ensure suitable suction/aeration at the work place and with operational machinery.
see also section 7.
Provide adequate ventilation.
Local exhaust and mechanical ventilation required.

Personal protective equipment

Respiratory protection

A respiratory protection program that meets OSHA 1910.134 and ANSI Z88.2 or applicable federal/provincial requirements must be followed whenever workplace conditions warrant respirator use. NIOSH's "Respirator Decision Logic" may be useful in determining the suitability of various types of respirators.

Hand protection

Glove material	Natural rubber (NR), for example, Cama Clean 708, Kächele-Cama Latex GmbH (KCL), Germany
Material thickness	0.5 mm
Break through time	>= 480 min
Method	DIN EN 374
Glove material	Nitrile, for example, Dermatril 740, Kächele-Cama Latex GmbH (KCL), Germany
Material thickness	0.11 mm
Break through time	>= 480 min
Method	DIN EN 374
Glove material	Nitrile, for example, Camatril (735), Kächele-Cama Latex GmbH (KCL), Germany
Material thickness	0.33 mm
Break through time	>= 480 min
Method	DIN EN 374
Glove material	Polychloroprene with natural-latex liner., for example, Camapren 722, Kächele-Cama Latex GmbH (KCL), Germany
Material thickness	0.6 mm
Break through time	>= 480 min
Method	DIN EN 374

The above mentioned hand protection is based on knowledge of the chemistry and anticipated uses of this product but it may not be appropriate for all workplaces. A hazard assessment should be conducted prior to use to ensure suitability of gloves for specific work environments and processes prior to use.

Eye protection

wear basket-shaped glasses

Skin and body protection

Wear chemical protective suit.
During cleaning work: rubber or plastic boots.

To identify additional Personal Protective Equipment (PPE) requirements, it is recommended that a hazard assessment in accordance with the OSHA PPE Standard (29CFR1910.132) be conducted before using this product.

A safety shower and eye wash fountain must be readily available.
Wash contaminated clothing before re-use.

Hygiene measures

Avoid contact with skin.
After contact with skin, wash immediately with plenty of water.

No eating, drinking, smoking, or snuffing tobacco at work. Wash face and/or hands before break and end of work.

preventive skin protection

Keep working clothes separately.

Avoid contaminating clothes with product.
Immediately change moistened and saturated work clothes.
Immediately rinse contaminated or saturated clothing with water.

Protective measures

The work-place related airborne concentrations have to be kept below of the indicated exposure limits. If the limits at the workplace are exceeded and/or larger amounts are released (leakage, spilling, dust) the indicated respiratory protection should be used.
All precautionary measures indicated have to be observed.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	solid
Colour	white
Odour	distinct, similar to bitter almond

Safety data

pH	ca. 11 - 12 (20 g/l) Medium: water
Melting point/range	562 °C
Boiling point/range	1497 °C
Flash point	Not combustible.
Flammability	not flammable
Autoignition temperature:	Not applicable.
Autoinflammability	no
Vapour pressure	100 Pa (800 °C)
Density	ca. 1.6 g/cm3 (20 °C)
Bulk density	ca. 750 - 950 kg/m3 (powder) (granulate) (compacts)
Water solubility	ca. 370 g/l (20 °C)
	ca. 450 g/l (> 35 °C)
Partition coefficient (n-octanol/water)	log Pow: -0.44 Method: (calculated)
Viscosity, dynamic	not applicable
Viscosity, kinematic	not applicable

10. STABILITY AND REACTIVITY

Conditions to avoid	Hydrogen cyanide forms if heated above 300 °C.
Materials to avoid	Under the action of acids (as well as carbon dioxide !) hydrocyanic acid is released which is combustible and may react with air to explosive gas mixtures., Keep away from acidic salts.
Hazardous decomposition products	HCN: Hydrogen cyanide (hydrocyanic acid)

11. TOXICOLOGICAL INFORMATION

Product Acute oral toxicity	LD50 Rat: 5 mg/kg Method: literature
Product Acute dermal toxicity	LD50 Rabbit(female): 11.8 mg/kg Method: literature
Product Skin irritation	Due to acute dermal toxicity, the irritative effect on the skin cannot be determined.
Product Eye irritation	Rabbit irritating Method: literature Test substance: solid product
Product Repeated dose toxicity	Oral Rat Testing period: 11.5 month NOEL: 75 mg/kg target organ/effect: thyroid., brain Feeding experiments chronic related to substance: Potassium cyanide Oral Rat Testing period: 90 d NOAEL: ca. 0.3 mg/kg target organ/effect: reproductive syste drinking water analysis Subchronic toxicity related to substance: Potassium cyanide Oral mouse NOAEL: ca. 16.2 mg/kg target organ/effect: reproductive syste drinking water analysis Subchronic toxicity related to substance: Potassium cyanide

Product Gentoxicity in vitro	Ames test Salmonella typhimurium negative Method: literature mammalian cells negative Method: literature
Product Human experience	Inhaling of (at already approx. 200 ppm HCN in the air breathed) or swallowing (approx. 200 - 300 mg KCN) can result in immediate unconsciousness and death. Can be absorbed through the skin. Following long-term exposition (15 ppm) individual cases of thyroid dysfunction have been described. related to substance: Hydro-cyanic acid

12. ECOLOGICAL INFORMATION

Elimination information (persistence and degradability)

Biodegradability	potentially biodegradable Abiotic degradation hydrolysis

Behaviour in environmental compartments

Bioaccumulation	low Adsorption am in the ground: possible
Mobility	KOC: ((air)) high related to substance: Hydro-cyanic acid

Ecotoxicity effects

Toxicity to fish	LC50 Oncorhynchus mykiss: 0.042 mg/l / 96 h Method: literature related to substance: C N - EC 10 Salvelinus fontinalis: 0.011 mg/l / 144 d Method: literature reproduction related to substance: C N - NOEC Salvelinus fontinalis: 0.006 mg/l / 144 d

Method: literature
reproduction
related to substance: C N -

Toxicity to daphnia	EC50 Daphnia magna: 0.041 mg/l / 48 h Test substance: 2-Hydroxy-2-methylpropionitrile Method: US-EPA related to substance: C N -
	EC 10 Moinodaphnia spec.: 0.022 mg/l / 5 d Method: literature reproduction related to substance: C N -
Toxicity to algae	IC 10 Scenedesmus acuminatus: 0.03 mg/l / 8 d Method: literature chronic related to substance: C N -
Toxicity to bacteria	EC 10 Pseudomonas putida: 0.001 mg/l / 16 h Method: literature related to substance: C N -
	EC50 Activated sludge: 0.6 mg/l / 0.5 h Method: 87/302/EEC related to substance: C N -
	EC 10 Uronema parduczi: 0.27 mg/l / 20 h Method: literature related to substance: C N -
Toxicity in organisms which live in the soil	EC50 Lumbriculus variegatus: 11 mg/l / 96 h Method: literature related to substance: C N -
Toxicity in terrestrial plants	EC50 terrestrial plants: 22.4 mg/l Method: literature related to substance: C N -
Toxicity in other terrestrial non-mammals	birds: moderate Test substance: Sodium cyanide related to substance: C N -
	EC50 Lymnaea luteola: 2.5 mg/l / 96 d Method: literature related to substance: C N -
	EC50 Plecoptera: 0.43 mg/l / 96 d Method: literature related to substance: C N -

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL

Advice on disposal	Waste must be disposed of in accordance with local, state, provincial and federal laws and regulations. Empty containers must be handled with care due to product residue.

14. TRANSPORT INFORMATION

T.D.G. Road/Rail

Class	6.1
UN-No	1689
Packing group	I
Proper shipping name	SODIUM CYANIDE, SOLID
Marine pollutant	Marine pollutant

Sea transport IMDG-Code

Class	6.1
UN-No	1689
Packaging group	I
Marine pollutant	Marine pollutant
EmS	F-A, S-A

Proper technical name (Proper shipping name)

SODIUM CYANIDE, SOLID

Air transport ICAO-TI/IATA-DGR

Class	6.1
UN-No	1689
Packaging group	I

Proper technical name (Proper shipping name)

Sodium cyanide, solid

Transport/further information

Do not store together with acids (danger of toxic gases) or with foodstuffs, consumables and feedstuffs.

15. REGULATORY INFORMATION

Canadian Regulations

This MSDS has been prepared in compliance with the Controlled Product Regulations except for use of the 16 headings.

WHMIS Classification

- D1A
-

International Chemical Inventory Status

Unless otherwise noted, this product is in compliance with the inventory listing of the countries shown below. For information on listing for countries not shown, please contact Degussa Canada Inc. Regulatory Affairs Department.

• Europe (EINECS/ELINCS)	Listed/registered
• USA (TSCA)	Listed/registered
• Canada (DSL)	Listed/registered
• Australia (AICS)	Listed/registered
• Japan (MITI)	Listed/registered
• Korea (TCCL)	Listed/registered
• Philippines (PICCS)	Listed/registered
• China	Listed/registered

16. OTHER INFORMATION

HMIS Ratings

Health :	3
Flammability :	1
Physical Hazard :	0

Further information

Changes since the last version are highlighted in the margin. This version replaces all previous versions.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

GARY-WILLIAMS
ENERGY CORPORATION

MATERIAL SAFETY DATA SHEET	October 20, 2004	MSDS NUMBER W-3035

EMERGENCY TELEPHONE NUMBERS	COMPANY 405-665-6565	CHEMTREC 800/424-9300

I. PRODUCT IDENTIFICATION

PRODUCT	CHEMICAL NAME AND SYNONYMS
DIESEL FUEL (CLEAR)	Petroleum Hydrocarbon Mixture, Distillate, 2- Oil # 2 Diesel Fuel, Fuel Oil #2,
CHEMICAL FAMILY	FORMULA
Petroleum Hydrocarbon Distillate	C11 - C20

National Fire Protection Association Hazard Rating Codes	HEALTH COD	FIRE CODE	REACTIVITY CODE
Least - 0 Slight - 1 Moderate - 2 High - 3 Extreme - 4	0	2	0

II. SUMMARY OF HAZARDS

CAUTION! COMBUSTIBLE LIQUID AND VAPOR. HARMFUL IF INHALED AND MAY CAUSE DELAYED LUNG INJURY. CAN CAUSE NERVOUS SYSTEM DEPRESSION. ASPIRATION HAZARD IF SWALLOWED - CAN ENTER LUNGS AND CAUSE DAMAGE. Keep away from heat and flame. Avoid breathing vapor. Use ventilation adequate to keep vapor below recommended exposure limits. Avoid contact with eyes, skin and clothing. Wash thoroughly after handling.

NIOSH, EPA, & current literature have indicated that breathing whole diesel exhaust over a working lifetime may cause cancer in humans. Animals exposed to whole diesel exhaust over a lifetime have developed lung tumors (cancer). Diesel exhaust may cause eye irritation, headache, light-headedness, nausea, vomiting, heartburn, weakness, numbness, tingling in the extremities, chest tightness and wheezing. Cough and labored breathing have been reported in garage workers without adequate ventilation (air circulation) in the garage.

DOT Hazardous Material	DOT SHIPPING NAME AND NUMBER	DOT HAZARD CLASS
YES	Diesel Fuel, 3, NA1993, III	3 (Flammable Liquid)

III. HAZARDOUS COMPONENTS

INGREDIENT	% RANGE	PEL/TLV	HAZARD
Straight Run Middle Distillate (CAS # 64741-44-2)	60 to 100 %	Petroleum Distillate TWA - 400 ppm	Combustible Acute Health Chronic Health
Light Catalytic Cracked Distillate (CAS # 64741-59-9)	0 to 40 %	Petroleum Distillate TWA - 400 ppm	

Diesel exhaust contains: Nitrogen Dioxide, Sulfuric Acid, Sulfur Dioxide, Aliphatic Aldehydes, Soot containing Polynuclear Aromatic Hydrocarbons, Carbon Monoxide, Hydrogen Sulfide.

1207 Sovereign Row / Oklahoma City, Oklahoma 73108 / (405) 945-0024 / Fax (405) 945-0067

IV. HEALTH INFORMATION

EXPOSURE BY ROUTE OF ENTRY		EXPOSURE CHARACTERISTICS AND FIRST AID
INHALATION	EFFECTS	Acute: Headache, nasal and respiratory irritation, nausea, drowsiness, breathlessness, fatigue, central nervous system depression, convulsions, and loss of consciousness.
	FIRST AID	Move exposed person to fresh air. If breathing has stopped, perform artificial respiration. Get medical attention as soon as possible.
SKIN	EFFECTS	Acute: irritation Chronic: dermatitis
	FIRST AID	If clothing soaked, immediately remove clothing and wash skin with soap and water. Launder clothing before wearing. Get medical attention promptly.
EYES	EFFECTS	Acute: irritation
	FIRST AID	Immediately flush eyes with water for a minimum of 15 minutes, occasionally lifting the lower and upper lids. Get medical attention promptly.
SWALLOWING INGESTION	EFFECTS	Acute: aspiration hazard, headache, nausea, drowsiness, fatigue, pneumonitis, pulmonary edema, central nervous system depression, convulsions and loss of consciousness.
	FIRST AID	Call a physician immediately, ONLY induce vomiting at the instruction of a physician. Never give anything by mouth to an unconscious person
Medical conditions Generally Agravated by Exposure		N/AV

LISTED AS POTENTIAL CARCINOGEN OR CARCINOGEN	NOT LISTED X INTERNATIONAL Agency for Research on Cancer _____	NATIONAL TOXICOLOGY PROGRAM____ OSHA ______

V. EMPLOYEE PROTECTION

RESPIRATORY PROTECTION (NIOSH APPROVED RESPIRATORS SEE OSHA STD. 1910.134)

Up to 4000 ppm, half-mask organic vapor respirator. Up to 20,000 ppm, full-face organic vapor respirator or full-face supplied air respirator. Greater than 20,000 ppm, fire fighting, or unknown concentration, self-contained breathing apparatus with positive pressure.

EYE	Safety glasses, chemical goggles or face shield as appropriate.
SKIN	Gloves: Nitrile, neoprene or other material resistant to distillate.

VENTILATION

Maintain local or dilution ventilation to keep air concentration below 400 ppm. Loading, unloading, tank gauging, etc., remain upwind. Request assistance of safety and industrial hygiene personnel to determine air concentrations.

VI. FIRE PROTECTION INFORMATION

FLASH POINT AND METHOD	AUTOIGNITION TEMPERATURE ESTIMATED	FLAMMABLE LIMITS % VOLUME IN AIR ESTIMATED	LOWER	UPPER
Tag Closed Cup 130 ' F	490 'F		0.7	6

EXTINGUISHING MEDIA

Carbon dioxide, dry chemical, or foam. Water stream may spread fire, use water spray only to cool containers exposed to fire. If leak or spill has not ignited, use water spray to disperse the vapors.

HAZARDOUS DECOMPOSITION PRODUCTS

Incomplete combustion can yield carbon monoxide and various hydrocarbons.

FIRE AND EXPLOSION HAZARDS

Can form combustible mixtures with air when heated.

STORAGE

Do not store with strong oxidizers. Store as OSHA Class II combustible liquid.

HAZARDOUS POLYMERIZATION	STABILITY
WILL NOT OCCUR X MAY OCCUR _______	STABLE X UNSTABLE _____

VII. PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT 330 - 675 'F	Reid VAPOR PRESSURE (RVP) at 100 'F ESTIMATED less than 0.1 pound	EVAPORATION (ETHYL ETHER = 1) ESTIMATED slower
PERCENT VOLATILE BY VOLUME (%) 100	AVG. MOLECULAR WEIGHT N/A	APPEARANCE May be clear to yellow-brown
ODOR Diesel Fuel	DROP POINT Pour Point -25 to +10 'F	ESTIMATED VAPOR DENSITY (AIR = 1) 6
SPECIFIC GRAVITY 0.8 to 0.9	VISCOSITY 2 to 4 cs at 100'F	SOLUBILITY (G/100g WATER AT 20° C) Negligible

VIII. ENVIRONMENTAL PROTECTION

SPILLS	Notify emergency response personnel. Evacuate area and remove ignition sources. Build dike to contain flow. Remove free liquid, do not flush to sewer or open water. Pick up with inert absorbent and place in closed container for disposal.
WASTE DISPOSAL	Utilize licensed waste disposal company. Consider recycling or incineration. Utilize permitted hazardous waste disposal site or industrial waste disposal site as appropriate.

ADDITIONAL INFORMATION

The following chemicals are subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and reauthorization Act of 1986 and 40 CFR Part 372:

PREPARED BY	DATE PREPARED
Johnnie L. Ray	October 20, 2004

DISCLAIMER

The information and recommendations contained in this publication have been compiled from sources beleived to be reliable and to represent the best current opinion on the subject at the time of publication. Since we cannot anticipate or control the many different conditions under which this information or our products may be used, we make no gurantee that the recommendations will be adequate for all individuals or situations. Each user of the product described herein should determine the suitability of the described product for his particular purpose and should comply with all federal and state rules and regulations concerning the described product.

ABBREVIATIONS

CAS #	Chemical Abstracts Service Number
N/A	Not Applicable
N/AV	Not Available
ppm	Parts per million
PEL	Permissible Exposure Limit
TLV	Threshold Limit Value Both the OSHA PEL and the American Conference of Governmental Industrial Hygienists TLV were reviewed. Where a difference existed, the more restrictive of the two was selected.
STEL	Short Term Exposure Limit
TWA	Time-Weighted Average

HYDROCHLORIC ACID   HCl (aqueous)

IDENTIFICATION   UN No. 1789

Common Synonyms	Observable Characteristics	Manufacturers
MURIATIC ACID HYDROGEN CHLORIDE (aqueous) CHLOROHYDRIC ACID	Water-white to pale yellow liquid. Sharp, irritating odour. Fumes in humid air.	Canadian Industries Limited, Cornwall, Ont., Becancour, Que. Dow Chemical Canada Inc., Sarnia, Ont., Fort Saskatchewan, Alta. Du Pont Canada Limited, Maitland, Ont. FMC Chemicals, Squamish, B.C. Canadian Occidental, Vancouver, B.C. St. Anne Chemicals, Macawick, N.B.

Transportation and Storage Information

Shipping State: Liquid (aqueous solution). **Classification:** Corrosive liquid. **Inert Atmosphere:** No requirement. **Venting:** Open. **Pump Type:** Gear, centrifugal, diaphragm. Rubber or plastic-lined.	**Label(s):** White and black label - CORROSIVE LIQUID; Class 8, Group II. **Storage Temperature:** Ambient. **Hose Type:** Natural rubber, polyethylene, polypropylene, PVC, etc.	**Grades or Purity:** Commercial strengths; 18°Bé (27.9% HCl); 20°Bé (31.5% HCl); 22°Bé (35.2% HCl); 23°Bé (37.1% HCl). **Containers and Materials:** Drums, tank cars, tank trucks; steel, rubber-lined.

Physical and Chemical Characteristics

Physical State (20°C, 1 atm): Liquid. **Solubility** (Water): Soluble in all proportions. **Molecular Weight:** 36.5 (HCl gas). **Vapour Pressure:** 25 mm Hg (25°C) (20°Bé); **Boiling Point:** 83°C (20°Bé); 62°C (22°Bé); 51°C (23°Bé); 98°C (18°Bé).	**Floatability** (Water): Sinks and mixes. **Odour:** Sharp, irritating (1 to 10 ppm, odour threshold). **Flash Point:** Not flammable. **Vapour Density:** 1.3 **Specific Gravity:** 1.14 (18°Bé); 1.16 (20°Bé); 1.18 (22°Bé); 1.19 (23°Bé) (15.5°C).	**Colour:** Colourless to pale yellow. **Explosive Limits:** Not flammable. **Melting Point:** -42°C (18°Bé); -53°C (20°Bé); -66°C (22°Bé); -74°C (23°Bé).

HAZARD DATA

Human Health

Symptoms: Inhalation: Vapours can produce severe irritation of the upper respiratory tract, coughing, burning of throat and choking. Contact: eyes - severe irritation of eyes and lids; burning, visual impairment may result; skin - can cause serious burns. Ingestion: very corrosive, can cause serious internal injury. May be fatal.

Toxicology: Moderately toxic by all routes.

TLV® - (inhalation) 5 ppm; 7 mg/m^3. LC_{50} - Inhalation: rat = 3 124 ppm/30 min LD_{50} - Oral: rabbit = 0.9 g/kg

Short-term Inhalation Limits - No information.   Delayed Toxicity - None known.

Fire

Fire Extinguishing Agents: Not combustible. Most fire extinguishing agents may be used on fires involving hydrochloric acid. Water spray may be used sparingly to knock down vapours.

Behaviour in Fire: When heated, toxic and corrosive hydrogen chloride gas is released.

Ignition Temperature: Not combustible.   **Burning Rate:** Not combustible.

Reactivity

With Water: Soluble, with evolution of heat.

With Common Materials: Reacts violently with acetic anhydride, ammonium hydroxide, calcium phosphide, chlorosulfonic acid, ethylenediamine, oleum, perchloric acid, propylene oxide, sodium hydroxide, sulfuric acid and vinyl acetate. Reacts with metals forming flammable H_2 gas.

Stability: Stable.

Environment

Water: Prevent entry into water intakes and waterways. Harmful to aquatic life. Fish toxicity: 282 ppm/96 h/mosquito fish/TLm/freshwater; 100 to 300 mg/L/48 h/shrimp/LC_{50}/saltwater; BOD: None.

Land-Air: No information.

Food Chain Concentration Potential: None.

EMERGENCY MEASURES

Special Hazards

CORROSIVE.

Immediate Responses

Keep non-involved people away from spill site. Issue warning: "CORROSIVE". Contact manuf .urer for guidance and assistance. Avoid contact and inhalation. Stop or reduce discharge if this can be done without risk. Contain spill by diking to prevent runoff. Notify environmental authorities.

Protective Clothing and Equipment

Respiratory protection - self-contained breathing apparatus and acid suit (rubber). Gloves - rubber. Boots - high, rubber (pants worn outside boots).

Fire and Explosion

Not combustible. Most fire extinguishing agents may be used on fires involving hydrochloric acid. Water may be used sparingly to knock down vapours.

First Aid

Move victim out of spill area to fresh air. Call for medical assistance, but start first aid at once. Contact: immediately irrigate eyes and flush skin with plenty of water for at least 30 minutes while removing contaminated clothing. Inhalation: if breathing has stopped, give artificial respiration; if laboured, give oxygen. Ingestion: if victim is conscious, give as much water or milk as possible to dilute acid. Do not induce vomiting. If medical assistance is not immediately available, transport victim to hospital, doctor or clinic.

ENVIRONMENTAL PROTECTION MEASURES

Response

Water
1. Stop or reduce discharge if safe to do so.
2. Contact manufacturer or supplier for advice.
3. If possible, contain discharge by damming or water diversion.
4. Notify environmental authorities to discuss disposal and cleanup of contaminated materials.

Land-Air
1. Stop or reduce discharge if safe to do so.
2. Contact manufacturer or supplier for advice.
3. Contain spill by diking with earth or other barrier.
4. Remove material with pumps or vacuum equipment and place in appropriate containers.
5. Adsorb residual liquid on natural or synthetic sorbents.
6. Contaminated soil can be treated with lime or soda ash (calcium hydroxide) to render it neutral.
7. Notify environmental authorities to discuss disposal and cleanup of contaminated materials.

Disposal

1. Contact manufacturer or supplier for advice on disposal.
2. Contact environmental authorities for advice on disposal.

Emergency Tel: 1800 033 111
International: +61 3 9633 2130

Material Safety Data Sheet

IDENTIFICATION

PRODUCT NAME: **Ciba® MAGNAFLOC® 1011**

Use: Flocculant

Chemical characterisation: Anionic polyacrylamide

COMPANY DETAILS:

Ciba Specialty Chemicals Pty Limited ABN 9700 506 1469
P.O. Box 482 WYONG NSW 2259 Tel (02) 43503200

HAZARD CLASSIFICATION:

U.N. NUMBER:	Not assigned	**DANGEROUS GOODS CLASS:**	Not assigned
HAZCHEM CODE:	Not assigned	**POISONS SCHEDULE:**	Not assigned
PACKAGING GROUP:	Not assigned	**EPG NUMBER:**	Not assigned

NON-HAZARDOUS ACCORDING TO THE WORKSAFE AUSTRALIA CRITERIA [NOHSC:1008(1999)]

HAZARD CLASS: Not assigned

RISK PHRASES: Not assigned
SAFETY PHRASES: Not assigned

HAZARDOUS INGREDIENTS: Not applicable

PHYSICAL & CHEMICAL PROPERTIES:

COLOUR:	White	**FORM:**	Granular powder
ODOUR:	None	**pH (1% Solution):**	Approx. 6
BOILING POINT:	Not applicable	**MELTING POINT:**	Not applicable
SOLUBILITY:	Soluble		
FLASH POINT:	Not exhibited	**FLAMMABILITY LIMITS:**	Not known
BULK DENSITY:	0.80 gm / cm^3	**SPECIFIC GRAVITY:**	Not applicable

HEALTH HAZARD INFORMATION

HEALTH EFFECTS ACUTE

SWALLOWED Low toxicity product
EYE: May cause some irritation which should cease on removal of the product.
SKIN: Not a skin irritant or sensitiser.
INHALED: The product is non-volatile, but inhalation of dust may cause irritation to the respiratory tract, and this should be avoided.

CHRONIC: There may be slight irritation with prolonged skin contact or repeated exposure, however this should clear up when contact with the product is stopped.

FIRST AID

Swallowed:
Do not make casualty vomit.
If unconscious do not give anything by mouth. Check for breathing and pulse, if present, place in the recovery position and obtain medical attention.
If conscious rinse out the mouth with water. Give 400 mls of water to drink immediately and repeated drinks of water at a rate of a cupful every 10 minutes. Obtain medical attention immediately.

Eye:
Irrigate with water for 15 minutes. If there is any irritation persisting obtain medical attention immediately.

Skin:
Wash contaminated area with soap and water. Contaminated clothing should be washed before reuse.

Inhaled:
If dust is inhaled, remove the casualty to fresh air and clear any blocked airways. Keep the casualty at rest and seek medical advice.

ADVICE TO DOCTOR

No specific advice exists for this product, treat the patient symptomatically.

PRECAUTIONS FOR USE

EXPOSURE STANDARDS
None allocated to this product. However the recommended exposure limit for dust of a general nature is 10 mg/m^3 of respirable dust. (NOHSC:3008 (1991) 14.28)

ENGINEERING CONTROLS
Ensure adequate ventilation, especially in confined areas. Provide appropriate exhaust ventilation in areas where dust is generated.

PERSONAL PROTECTION

Respiratory protection If dust is generated an effective dust mask should be worn.

Hand protection Rubber or plastic gloves are recommended

Eye protection Goggles

Skin and body protection Lightweight protective clothing.

FLAMMABILITY
Product does not pose a flammability hazard under normal conditions of use. However, this type of product has a tendency to create dust if roughly handled. It does not burn readily but as with many organic powders flammable dust clouds may be formed in air. Avoid creating dust and keep away from sources of ignition.

SAFE HANDLING INFORMATION

HANDLING
Avoid creating dust. Observe good industrial hygiene practices ie do not eat, drink or smoke whilst handling the product. Wash hands after use. Remove contaminated clothing and launder before reuse.
Very slippery when wet.

STORAGE
No special technical measures are required. Avoid damp and humid conditions.

TRANSPORT

AUSTRALIAN DG CODE (6th Edition)
Not classified as dangerous

IMDG
Not classified as dangerous

ICAO Not classified as dangerous

SPILLS

Personal precautions: Use personal protective equipment. Breathing apparatus is required in a fire situation only.

Environmental precautions: Do not flush into surface water drains or sanitary sewer system.

Methods for clean up: Sweep up and shovel into suitable containers for disposal. Residues or small spillages should be hosed away completely with plenty of water. Spilled product which becomes wet, or aqueous solutions, create a hazard due to their slippery nature. The spillage should be contained with earth or sand and removed for disposal.

DISPOSAL

Refer to state waste management authority

FIRE /EXPLOSION HAZARD

Hazchem code: None allocated

Fire / Explosive properties: None so long as dust is not created. See Precautions for use - Flammability

Extinguishing media: Foam, dry powder or carbon dioxide in preference to water spray.

Personal Protective Equipment: As for all fires involving chemicals, chemical protection suit, suitable gloves and boots and self-contained breathing apparatus.

OTHER INFORMATION

STABILITY / REACTIVITY

Stability Stable at ambient temperatures

Conditions to avoid Avoid damp and humid conditions.

Materials to avoid Avoid contact with reactive chemicals

Hazardous decomposition products No decomposition if stored and applied as directed.

TOXICOLOGY INFORMATION

By analogy with similar products the acute oral LD_{50} (rat) is expected to be >2000 mg /kg

ECOLOGICAL INFORMATION

By analogy to similar products:-

96 hr LC_{50} Freshwater fish ***Brachydanio reri*** is expected to be 357 mg/L
48 hr EC_{50} ***Daphnia magna*** is expected to be 212 mg/L
72 hr EC_{50} Freshwater unicellular algae, ***Chlorella vulgaris*** is expected to be >1000 mg/L (No observable effect concentration 708 mg/L)
24 hr EC_{50} Bacteria, ***Psuedomonas putida*** is expected to be 892 mg/L

NICNAS INFORMATION

All components of this product are listed on the Australian Inventory of Chemical Substances

CONTACT POINT:

Quality & Safety Manager: Telephone: (02) 43503216
Out of normal office hours for emergency response telephone: 1800 033 111

® are registered trademarks.

The information contained in this safety data sheet is given in good faith. It is accurate to the best of our knowledge and belief and represents the most up to date information. The information given in this data sheet does not constitute or replace the users own assessment of workplace risk as required by other health and safety legislation.

ENERGAS

MSDS FOR PROPANE

Rev 5 (11/2005)

1. Identification of the Substance/ Preparation and of the Company

Product Name: **Propane**
Chemical Formula: C_3H_8
Company Identification: Energas Limited
Westmorland Street
Hull HU2 0HX

Emergency Telephone No: 01482 329333

2. Composition/ Information on Ingredients

Substance/ Preparation: Preparation

Components/ Impurities: Liquefied Propane Gas consisting of predominantly C_3 Hydrocarbons (propane and propene) with typically <50ppm of ethyl mercaptan or other similar odorising agent added to assist leak detection. Contains <0.1% 1,3 butadeine

Hazardous Components: Hydrocarbon C3-4 rich, petroleum distillate. EINICS No 601-003-00-5
CAS No 74-98-6, F+, R12 Extremely Flammable >90%

3. Hazard Identification

- Extremely flammable (F+).
- Readily forms an explosive air-vapour mixture at ambient temperatures.
- Vapour is heavier than air and may travel to remote sources of ignition (e.g. along drainage systems, into basements etc)
- Liquid leaks generate large volumes of flammable vapour (approx 250:1)
- Cold burns (frostbite) will result from skin / eye contact with liquid.
- Liquid release or vapour pressure jets present a risk of serious damage to the eyes.
- Abuse involving wilful inhalation of high concentrations of vapour, even for short periods, can produce unconsciousness, or might prove fatal. Inhalation may cause irritation to the nose and throat, headache, nausea, vomiting, dizziness and drowsiness. In poorly ventilated areas unconsciousness or asphyxiation may result.

4. First Aid Measures

Inhalation:
Remove the affected person to fresh air. If breathing has stopped, administer artificial respiration.
Give external cardiac massage if necessary. If the person is breathing but unconscious, place them in the recovery position. Obtain medical assistance immediately.
Skin:
In case of cold burns: flush with water to normalise temperature. Cover the burns with sterile dressings Do not use ointments or powders. Obtain medical assistance immediately.
Eyes: Cold burns should be flushed with water to normalise temperature, cover the eye with a sterile dressing and obtain medical assistance immediately.
Ingestion: Not applicable.

5. Fire Fighting Measures

These materials are delivered, stored, and used at temperatures above their flash point. Avoid all naked flames, sparks, cigarettes etc.

- **IN CASE OF FIRE IMMEDIATELY ALERT THE FIRE BRIGADE.**
- Ensure an escape path is always available from any fire.
- If gas has ignited do not attempt to extinguish but stop gas flow and allow to burn out.

Use water spray to cool heat-exposed containers, and to protect surrounding areas and personnel effecting the shut off.
Every precaution must be taken to keep containers cool to avoid the possibility of a boiling liquid expanding vapour explosion (BLEVE)
Extinguishing Media:

- **Large fire:** none. Product flow must be stopped and container cooled by water spray. Water fog should be used to assist approach to the source of the fire. Large fires should only be fought by the Fire Brigade.

DO NOT USE WATER JET.
Small fire:

- Dry Powder
- DO NOT USE WATER OR FOAM

Special Protective Equipment for Fire Fighters:
In confined spaces use self-contained breathing apparatus
Hazardous Combustion Products:
Incomplete combustion may form carbon monoxide.

.

6. Accidental Release Measures

IMMEDIATE EMERGENCY ACTION:

- Clear people away from the area to a safe place.
- Do not operate electrical equipment unless flameproof;
- Summon the emergency services;
- Treat or refer casualties if necessary.

FURTHER ACTION-FIRE.

- Stop Product flow;
- Use dry powder or carbon dioxide extinguishers;
- Cool containers exposed to fire by using water / fog spray.

FURTHER ACTION – SPILLAGE

If Safe:

- Extinguish all naked lights –AVOID MAKING SPARKS
- Position fire fighting equipment;
- Try to stop flow of liquid product;
- Cover drains and disperse vapour with water spray. Note: vapour may collect in confined spaces.

7. Handling and Storage

Handling:

Refer to Energas Storage and Handling instructions.
Cylinders containing Energas Liquefied Propane gas may be designed to give liquid or vapour offtake.

- Vapour offtake cylinders must be stored and used in the vertical position.
- Liquid offtake cylinders must be stored and used in the position indicated on the cylinder.

Storage:

Store out of doors in a well ventilated storeroom.
Segregate from oxidant gases or other flammable materials in store.
Keep away from ignition sources.
Keep container below 50°C in a well-ventilated place.
Store cylinder upright.

8. Exposure Controls/ Personal Protection

EXPOSURE LIMIT VALUES.

Occupational Exposure Limits:
Energas liquefied Propane gas is not subject to a specific OEL. However as a Liquefied petroleum gas the following OEL should be applied:
Liquefied Petroleum Gas*: 1750mg.cm (1000ppm) 8-hour reference period.
2180 mg/cm (1250 ppm) 15 min reference period.

- Pure Propane is identified as a simple asphyxiant and EH40 Para 60 applies.

Recommended Protective Clothing

- Wear suitable gloves and overalls to prevent cold burns and frostbite.
- In filling operations wear protective clothing including impervious gloves safety goggles or face shield to BS EN 166, 167.and 168.
- When handling cylinders wear protective footwear to BS EN 345.

If operations are such that significant exposure to vapour may be anticipated, then suitable approved respiratory equipment should be worn.

9. Physical and Chemical Properties

Appearance/ Colour:	Colourless liquid/ gas.
Odour:	Odourless /odorant added to provide a distinctive smell.
Boiling Point:	-42.1ºC
Flash Point	-104ºC (PMCC)
Flammability Limited:	2% – 11 % in air
Auto Flammability:	460 - 580°C
Vapour Pressure:	7.5 bar at 15°C
Specific gravity (Liquid):	0.512 at 15°C
Specific gravity (Gas):	1.5 at15°C (air = 1)

10. Stability and Reactivity

Energas Liquid Propane gas is stable at ambient temperatures. Hazardous polymerisation will not occur.

Conditions to Avoid:

- Sources of ignition
- Storage above 50 deg c

Materials to avoid:

- Strong oxidizing agents (e.g. chlorates, which may be used in agriculture, peroxides).

11. Toxicological Information

Eye Contact:

Contact with liquid Propane gas will present a risk of serious damage to the eyes.

Skin Contact;

Contact with liquid propane gas will cause cold burns and frostbite to the skin.

Inhalation:

Low vapour concentrations may cause nausea, dizziness headaches and drowsiness.
May have a narcotic effect if high concentrations of vapour are inhaled, they may produce symptoms of Oxygen deficiency, which, coupled with central nervous system depression, may lead to rapid loss of consciousness.

Abuse:

Under normal conditions of use the product is not hazardous; however, abuse involving deliberate inhalation of very high concentrations of vapour, even for short periods can produce unconsciousness and/or result in a sudden fatality.

MSDS FOR PROPANE

12. Ecological Information

No known ecological effects from this product.

13. Disposal Considerations

Energas cylinders are the sole property of Energas Ltd. and should be returned to the local dealer/ stockist.
Users are recommended to contact their local Energas representative when they wish to dispose of surplus quantities of Energas liquefied Propane Gas.
Do not discharge product into areas where there is a risk of forming an explosive mixture with air.
Empty packages may contain some remaining product. Hazard warning labels are a guide to the safe handling of empty packaging and should not be removed.
Empty containers represent a fire hazard as they may contain flammable residues and vapour. Never incinerate, crush, weld solder or braze empty containers.

14. Transport Information

Proper shipping name	:	Propane
UN No.	:	1978
Class/ Division	:	2.1
ADR/RID item	:	2F
Emergency Action Code	:	2YE
Hazard Identification No.	:	23
CEFIC Tremcard No.	:	27A/20g42
Labelling ADR	:	Model No 2.1 Flammable gas.

Avoid transport on vehicles where the load space is not separated from the driver's compartment.

Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or emergency.

Ensure all cylinder valves are closed and not leaking and the load is firmly secured and complies with the applicable regulations.

15. Regulatory Information

EC Classification: F+; R12

- Symbols - road transport symbols are used and selected to the most stringent product classification.

  EC or ADR - Model No 2.1: Flammable gas.

- **Risk Phrases**
  R12 Extremely flammable

- **Safety Phrases**
  S2 Keep out of the reach of children
  S9 Keep in a well ventilated place
  S16 Keep away from sources of ignition **NO SMOKING**
  S33 Take precautionary measures against static discharge

16. Other Information

Valve Connection: BS 341 No. 4

Ensure all national/ local regulations are observed.
Ensure all users of this product understand the flammability hazard and hazards of asphyxiation.
Before using this product in any new process or experiment, a thorough material compatibility and safety study should be carried out.

Details given in this document are believed correct at the time of going to press.

Whilst proper care has been taken in the preparation of this document, no liability for injury or damage resulting from its use can be accepted.
Refer to Energas Limited General Safety and Handling Data Sheet for further details.

MSDS FOR PROPANE

Rev 5 (11/2005)

CYLINDER IDENTIFICATION TO BS EN 1089-3
GROUND COLOUR: RED (RAL 3000)(Green or White Cylinder Shroud)

ENERGAS GENERAL SAFETY AND HANDLING DATA

1. GENERAL

Only trained persons should handle compressed gases.
Observe all regulations and local requirements regarding the storage of containers.
Do not remove or deface labels provided by the supplier for the identification of the container contents.
Ascertain the identity of the gas before using it.
Know and understand the properties and hazards associated with each gas before using it.
When doubt exists as to the correct handling procedure for a particular gas contact the supplier.

2 HANDLING AND USE

Wear stout gloves.
Never lift a container by the cap or guard unless the supplier states it is designed for that purpose.
Use a trolley or other suitable device or technique for transporting heavy containers, even for a short distance.
Where necessary wear suitable eye and face protection. The choice between safety glasses, chemical goggles, or full-face shield will depend on the pressure and nature of the gas being used.

Where necessary for toxic gases see that self-contained positive pressure breathing apparatus or full face air line respirator is available in the vicinity of the working area.
Employ suitable pressure regulating devices on all containers when the gas is being emitted to systems with a lower pressure rating than that of the container.
Assertion that all electrical systems in the area are suitable for service with each gas.

Never use direct flame or electrical heating devices to raise the pressure of a container. Containers should not be subjected to temperatures above 45°C.
Never re-compress a gas mixture without consulting the supplier. Never attempt to transfer gases from one container to another.
Do not use containers as rollers or supports, or for any other purpose than to contain the gas as supplied.
Never permit oil, grease or other readily combustible substances to come into contact with valves of containers containing oxygen or other oxidants.
Keep container valve outlets clean and free from contaminants, particularly oil and water.
Do not subject containers to abnormal mechanical shocks, which may cause damage to their valves or safety devices.

Never attempt to repair or modify container valves or safety relief devices. Damaged valves should be reported immediately to the supplier.
Close the container valve whenever gas is not required even if the container is still connected to the equipment.

3 STORAGE

Containers should be stored in a well-ventilated area. Some gases will require a purpose built area.
Store containers in a location free from fire risk and away from sources of heat and ignition. Designation as a no smoking area may be desirable.

Gas containers should be segregated in the storage area according to the various categories.

The storage area should be kept clear and access should be restricted to authorised persons only, the area should be clearly marked as a storage area and appropriate hazard warning signs displayed (Flammable Toxic etc,).
The amount of flammable or toxic gases should be kept to a minimum.
Flammable gases should be stored away from other combustible materials.

Containers held in storage should be periodically checked for general condition and leakage.
Containers in storage should be properly secured to prevent toppling or rolling.
Vertical storage is recommended where the container is designed for this.
Container valves should be tightly closed and where appropriate, valve outlets should be capped or plugged. Protect containers stored in the open against rusting and extremes of weather.
Containers should not be stored in conditions likely to encourage corrosion.
Store full and empty containers separately and arrange full containers so that the oldest stock is used first.

PRODUCTION SITE ADDRESSES

Engineering and Welding Limited
Westmorland Street
Hull
HU2 0HX

Tel: 01482 329333
Fax: 01482 212335

Energas Limited
Haslams Lane
Alfreton Road
Derby, DE22 1EB

Tel: 01332 364121
Fax: 01332 291590

Energas Limited
Brownroyd Street
Off Thornton Road, Bradford
West Yorkshire, BD8 9AF

Tel: 01274 549090
Fax: 01274 548181

FOR FURTHER INFORMATION CONTACT YOUR NEAREST DISTRIBUTION CENTRE

Material Safety Data Sheet

Science Stuff, Inc.
1104 Newport Ave
Austin, TX 78753

Phone (512) 837-6020
Chemtrec 800-424-9300
24 Hour Emergency Assistance

Section 1 Identification

Product Number:	C2453
Product Name:	Silica 325 Mesh Technical Grade, Powder
Trade/Chemical Synonyms	
Formula:	SiO'
RTECS:	VV7310000
C.A.S	CAS# 7631-86-9

Health:	0
Flammability	0
Reactivity	0

Hazard Rating:

Least	Slight	Moderate	High	Extreme
0	1	2	3	4

NA = Not Applicable NE = Not Established

Section 2 Component Mixture

Sara 313	Component	CAS Number	%	Dim	Exposure Limits:
☐	Silica 325 Mesh	CAS# 7631-86-9	100%	W/W	OSHA TWA 0.1 mg/mƒ

Section 3 Hazard Identification (Also see section 11)

Generally not hazardous in normal handling, however good laboratory practices should always be used. Avoid long term exposure to skin or by inhalation.

Section 4 First Aid Measures

Generally not hazardous in normal handling, however good laboratory practices should always be used. Avoid long term exposure to skin or by inhalation.

FIRST AID: SKIN: Wash exposed area with soap and water. If irritation persists, seek medical attention.

EYES: Wash eyes with plenty of water for at least 15 minutes, lifting lids occasionally. Seek Medical Aid. INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen

INGESTION: Give several glasses of milk or water. Vomiting may occur spontaneously, but it is not necessary to induce. Never give anything by mouth to an unconscious person.

Section 5 Fire Fighting Measures

Fire Extinguisher Type:	Any means suitable for extinguishing surrounding fire
Fire/Explosion Hazards:	None Known.
Fire Fighting Procedure:	Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and clothing.

Section 6 Accidental Release Measures

Sweep up and place in suitable (fiberboard) containers for reclamation or later disposal.

Section 7 Handling and Storage

Store in a cool dry place. Do not get in eyes, on skin, on clothing. Wash thoroughly after handling. Keep tightly closed. Hygroscopic

Section 8 Exposure Controls & Personal Protection

Respiratory Protection:NIOSH/MSHA-approved respirator

Ventilation: Mechanical: ☑ Local Exhaust: ☐

Hand Protection: Chemical resistant gloves

Eye Protection: Chemical safety goggles

Other Protective Equipment: Wear appropriate clothing to prevent skin exposure

Section 9 Physical and Chemical Properties

Melting Point:	Information not available	Specific Gravity	Information not available
Boiling Point:	Information not available	Percent Volatile by Volume:	0
Vapor Pressure:	Information not available	Evaporation Rate:	0
Vapor Density:	Information not available	Evaporation Standard:	
Solubility in Water:	Insoluble in H2O	Auto ignition Temperature:	
Appearance and Odor:	A fine powder	Lower Flamm. Limit in Air:	Not applicable
Flash Point:	Noncombustible	Upper Flamm. Limit in Air:	Not applicable

Section 10 Stability and Reactivity Information

Stability: Stable Conditions to Avoid: Incompatibilities

Materials to Avoid:
Strong acids, protect from moisture

Hazardous Decomposition Products:
Not known to occur

Hazardous Polymerization:Will Not Occur

Condition to Avoid:Moisture

Section 11 Additional Information

Effects of overexposure. Acute and chronic: Material is irritating to mucous membranes and upper respiratory tract. Target organs: Lungs. Persons with pre-existing disordrers may be more susceptible.

DOT Classification: Not Regulated

DOT regulations may change from time to time. Please consult the most recent version of the relevant regulations.

Revision No:0 Date Entered: 9/1/2005 Approved by: WPF

MSDS Number: **S3122** * * * * * *Effective Date:* ***05/06/05*** * * * * * *Supercedes:* ***09/25/02***

MSDS *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS
J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SODIUM BORATE

1. Product Identification

Synonyms: Sodium borate decahydrate; borax; sodium pyroborate
CAS No.: 1330-43-4 (Anhydrous) 1303-96-4 (Decahydrate)
Molecular Weight: 381.37
Chemical Formula: Na2B4O7 . 10H2O
Product Codes:
J.T. Baker: 3568, 3570, 3574, 3575
Mallinckrodt: 7418, 7457, 7460, 7792

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Borates, Tetra, Sodium Salts (Anhydrous)	1330-43-4	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate (Life)
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate (Life)
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: Green (General Storage)

Potential Health Effects

Inhalation:
Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath.
Ingestion:
May cause nausea, vomiting, diarrhea, muscular spasms, dullness, lethargy, circulatory depression, central nervous system depression, shock, kidney damage, coma, and death. Estimated lethal dose 15 to 20 grams.
Skin Contact:
Causes irritation to skin. Symptoms include redness, itching, and pain. May be absorbed through the skin with possible systemic effects.
Eye Contact:
Causes irritation, redness, and pain.
Chronic Exposure:
Prolonged or repeated ingestion or skin absorption may cause anorexia, weight loss, vomiting, mild diarrhea, skin rash, convulsions, and anemia.
Aggravation of Pre-existing Conditions:
No information found.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
- NIOSH Recommended Exposure Limit (REL): 1 mg/m3 (TWA)

- ACGIH Threshold Limit Value (TLV): 5 mg/m3 (TWA)

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred

because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a full facepiece particulate respirator (NIOSH type N100 filters) may be worn for up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. If oil particles (e.g. lubricants, cutting fluids. glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance:
White, Gray, Bluish or Greenish White Streaked Crystals.
Odor:
Odorless.
Solubility:
6g/100g water.
Density:
1.73
pH:
Alkaline
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
320C (608F) Loses water
Melting Point:
75C (167F)
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Toxic gases and vapors may be released if involved in a fire.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Acids, alkaloids, and metallic salts.
Conditions to Avoid:
Incompatibles.

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11. Toxicological Information

Hydrate: Oral rat LD50: 2660 mg/kg. Investigated as a mutagen, reproductive effector.
Anhydrous: Investigated as a reproductive effector.

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--------\Cancer Lists\------------------------------------------------------
                                              ---NTP Carcinogen---
Ingredient                                    Known    Anticipated    IARC Category
------------------------------------          -----    -----------    -------------
Borates, Tetra, Sodium Salts                   No          No             None
(Anhydrous) (1330-43-4)
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12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater.
Environmental Toxicity:
No information found.

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13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

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14. Transport Information

Not regulated.

15. Regulatory Information

Chemical Inventory Status - Part 1

Ingredient	TSCA	EC	Japan	Australia
Borates, Tetra, Sodium Salts (Anhydrous) (1330-43-4)	Yes	Yes	Yes	Yes

Chemical Inventory Status - Part 2

Ingredient	Korea	--Canada-- DSL	--Canada-- NDSL	Phil.
Borates, Tetra, Sodium Salts (Anhydrous) (1330-43-4)	Yes	Yes	No	Yes

Federal, State & International Regulations - Part 1

Ingredient	-SARA 302- RQ	-SARA 302- TPQ	SARA 313 List	SARA 313 Chemical Catg.
Borates, Tetra, Sodium Salts (Anhydrous) (1330-43-4)	No	No	No	No

Federal, State & International Regulations - Part 2

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Borates, Tetra, Sodium Salts (Anhydrous) (1330-43-4)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Mixture / Solid)

Australian Hazchem Code: None allocated.
Poison Schedule: S5
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.

Label Precautions:
Avoid contact with eyes, skin and clothing.
Avoid breathing dust.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
No Changes.
Disclaimer:

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

Material Safety Data Sheet
Sodium Carbonate

ACC# 21080

Section 1 - Chemical Product and Company Identification

MSDS Name: Sodium Carbonate
Catalog Numbers: S71987, S71987-1, S71987-2, S78416, S78416-1, S78419, BP357-1, NC9644731, NC9657562, S261-10, S263-1, S263-10, S263-3, S263-500, S26350LC, S31150LB, S495-500, S71987-3, S719871, S719872, S719873, WESS263500, XXS261200LB, XXS263100KG, XXS263200LB
Synonyms: Crystal Carbonate, Disodium Carbonate, Sal Soda, Soda Ash, Washing Soda
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
497-19-8	Sodium carbonate	100.0	207-838-8

Hazard Symbols: XI
Risk Phrases: 36

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: white. **Warning!** Harmful if inhaled. May cause eye and skin irritation with possible burns. May cause respiratory and digestive tract irritation.
Target Organs: No data found.

Potential Health Effects
Eye: May result in corneal injury. Contact with eyes may cause severe irritation, and possible eye burns.
Skin: Contact with skin causes irritation and possible burns, especially if the skin is wet or moist.
Ingestion: May cause irritation of the digestive tract.
Inhalation: Harmful if inhaled. May cause irritation of the respiratory tract with burning pain in the nose and throat, coughing, wheezing, shortness of breath and pulmonary edema.
Chronic: Prolonged or repeated inhalation may cause nosebleeds, nasal congestion, erosion of the teeth, perforation of the nasal septum, chest pain and bronchitis.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately.
Skin: Get medical aid. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.
Ingestion: Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
Inhalation: Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid if cough or other symptoms appear.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Material will not burn. Wear appropriate protective clothing to prevent contact with skin and eyes. Wear a self-contained breathing apparatus (SCBA) to prevent contact with thermal decomposition products. Runoff from fire control or dilution water may cause pollution.
Extinguishing Media: Substance is noncombustible; use agent most appropriate to extinguish surrounding fire. Use water fog, dry chemical, carbon dioxide or alcohol type foam.

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Vacuum or sweep up material and place into a suitable disposal container. Clean up spills immediately, observing precautions in the Protective Equipment section. Avoid generating dusty conditions. Provide ventilation. Cover with material such as dry soda ash or calcium carbonate and place into a closed container for disposal.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Minimize dust generation and accumulation. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Avoid ingestion and inhalation.
Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Good general ventilation should be sufficient to control airborne levels. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Sodium carbonate	none listed	none listed	none listed

OSHA Vacated PELs: Sodium carbonate: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves and clothing to prevent skin exposure.
Clothing: Wear appropriate protective clothing to minimize contact with skin.
Respirators: Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: white
Odor: odorless
pH: 11.6 (solution)
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 400 deg C
Freezing/Melting Point:851 deg C
Autoignition Temperature: Not available.
Flash Point: Not available.
Decomposition Temperature:400 deg C
NFPA Rating: (estimated) Health: 3; Flammability: 0; Reactivity: 0
Explosion Limits, Lower: Not available.
Upper: Not available.
Solubility: Soluble in water
Specific Gravity/Density:1.55
Molecular Formula:Na_2CO_3
Molecular Weight:105.9778

Section 10 - Stability and Reactivity

Chemical Stability: Stable at room temperature in closed containers under normal storage and handling conditions.
Conditions to Avoid: Incompatible materials, dust generation, excess heat.
Incompatibilities with Other Materials: Reacts explosively with red-hot alumium metal. Incompatible with ammonia + silver nitrate, 2,4-dinitrotoluene, 2,4,6-trinitrotoluene, sulfuric acid, sodium sulfide + water, lithium, phosphorus pentoxide, fluorine, and hydrogen peroxide. Hot concentrated solutions of sodium carbonate are mildly corrosive to steel.
Hazardous Decomposition Products: Carbon dioxide, toxic fumes of sodium oxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 497-19-8: VZ4050000
LD50/LC50:
CAS# 497-19-8:
Draize test, rabbit, eye: 100 mg/24H Moderate;
Draize test, rabbit, eye: 50 mg Severe;
Draize test, rabbit, skin: 500 mg/24H Mild;
Inhalation, mouse: LC50 = 1200 mg/m3/2H;
Inhalation, rat: LC50 = 2300 mg/m3/2H;
Oral, mouse: LD50 = 6600 mg/kg;
Oral, rat: LD50 = 4090 mg/kg;
Carcinogenicity:
CAS# 497-19-8: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology: No information available.
Teratogenicity: No information available.
Reproductive Effects: No information available.
Neurotoxicity: No information available.
Mutagenicity: No information available.
Other Studies: No data available.

Section 12 - Ecological Information

Ecotoxicity: Fish: Bluegill/Sunfish: LC50 = 320 mg/L; 96 Hr.; Static Conditions Cas# 497-19-8
Environmental: No information reported.
Physical: No information found
Other: No information found

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	No information available.				No information available.
Hazard Class:					
UN Number:					

Packing Group:	

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 497-19-8 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA

Section 302 (RQ)
None of the chemicals in this material have an RQ.
Section 302 (TPQ)
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 497-19-8: acute.
Section 313
No chemicals are reportable under Section 313.
Clean Air Act:
This material does not contain any hazardous air pollutants. This material does not contain any Class 1 Ozone depletors. This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA. None of the chemicals in this product are listed as Priority Pollutants under the CWA. None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
CAS# 497-19-8 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives
Hazard Symbols:
XI
Risk Phrases:
R 36 Irritating to eyes.

Safety Phrases:
S 22 Do not breathe dust.
S 26 In case of contact with eyes, rinse immediately
with plenty of water and seek medical advice.

WGK (Water Danger/Protection)
CAS# 497-19-8: 1
Canada

CAS# 497-19-8 is listed on Canada's DSL List. CAS# 497-19-8 is listed on Canada's DSL List.
This product has a WHMIS classification of D2B.
CAS# 497-19-8 is listed on Canada's Ingredient Disclosure List.
Exposure Limits

Section 16 - Additional Information

MSDS Creation Date: 7/12/1999
Revision #1 Date: 8/02/2000

SODIUM HYDROXIDE NaOH

IDENTIFICATION

UN No. 1823 solid
1824 solution

Common Synonyms	Observable Characteristics	Manufacturers	
CAUSTIC SODA CAUSTIC LYE SODA LYE SODIUM HYDRATE WHITE CAUSTIC	Clear to slightly turbid liquid, with a clear to slightly coloured (white to yellow) appearance. Odourless. Anhydrous solid: White to slightly coloured pellets or flakes.	Canadian Industries Limited, Becancour, Que. Dow Chemical Canada Inc., Sarnia, Ont., Fort Saskatchewan, Alta.	Canadian Occidental Petroleum Ltd., Vancouver, B.C. FMC, Squamish, B.C.

Transportation and Storage Information

Shipping State: Solid and liquid (aqueous solution).
Classification: Corrosive.
Inert Atmosphere: No requirement.
Venting: Open.
Pump Type: Gear, centrifugal; steel, stainless steel (for solutions).

Label(s): White and black label - CORROSIVE; Class 8, Group II.
Storage Temperature: Ambient.
Hose Type: Natural rubber, Hypalon, polyethylene, polypropylene, flexible stainless steel (solutions).

Grades or Purity: Solution, 50%, 73% NaOH. Dry - (anhydrous, 99+% NaOH), flake, powder solid.
Containers and Materials: Liquid - tank cars, tank trucks. Dry - cans, drums, hopper cars.

Physical and Chemical Characteristics

Physical State (20°C, 1 atm): Solid.
Solubility (Water): Soluble, 42 g/100 mL (0°C); 111 g/100 mL (25°C); 347 g/100 mL (100°C).
Molecular Weight: 40.0 (solute).
Vapour Pressure: 1 mm Hg (739°C); 42 mm Hg (1000°C).
Boiling Point: 50% solution: 142 to 148°C; 73% solution: 188 to 195°C; 1 390°C (anhydrous).

Floatability (Water): Sinks and mixes.
Odour: Odourless.
Flash Point: Not flammable.
Vapour Density: No information.
Specific Gravity: 213 (anhydrous); 50% sol'n, 1.53; 73% sol'n, 2.00 (15.5°C).

Colour: Liquid - clear to slightly coloured. Solid (dry) - white.
Explosive Limits: Not flammable.
Melting Point: Anhydrous 318°C; 50% solution, 12 to 15°C; 73% solution, 63°C.

HAZARD DATA

Human Health

Symptoms: Contact: skin - severe burns, often resulting in deep ulceration and ultimate scarring, can result from contact with solid or liquid forms. Eyes - solid or liquid; very rapidly causes severe damage. Inhalation: of dust or mist may cause damage to upper respiratory tract and even to lung tissue proper. Ingestion: (liquid or solid) severe damage to mucous membranes or deeper tissues. If perforation occurs, subsequent severe scar formation may occur. Penetration into vital areas may be fatal.
Toxicology: Highly toxic upon contact and ingestion.
TLV®- (inhalation) 2 mg/m^3 (particulate).
Short-term Inhalation Limits - No information.
LC_{50} - No information.
Delayed Toxicity - None known.
LD_{Lo} - Oral: rabbit = 0.5 g/kg (10% solution).

Fire

Fire Extinguishing Agents: Not combustible. Most fire extinguishing agents may be used in fires involving sodium hydroxide. Use water in flooding amounts. Anhydrous form in contact with water may generate sufficient heat to ignite combustible materials. May cause ignition on contact with organic chemicals.
Behaviour in Fire: Not combustible.
Ignition Temperature: Not combustible.
Burning Rate: Not combustible.

Reactivity

With Water: Anhydrous form dissolves with great heat evolution. Boils and splatters.
With Common Materials: Reacts violently with acetaldehyde, acetic acid, acetic anhydride, acrolein, acrylonitrile, allyl alcohol, allyl chloride, aluminum, chlorohydrin, chloronitrotoluenes, chlorosulfonic acid, 1,2-dichloroethylene, ethylene cyanohydrin, glyoxyl, hydrochloric acid, hydrofluoric acid, hydroquinone, maleic anhydride, nitric acid, nitroparaffins, oleum, phosphorus, phosphorus pentoxide, sulfuric acid, tetrahydrofuran and trichloroethylene.
Stability: Stable.

Environment

Water: Prevent entry into water intakes and waterways. Harmful to aquatic life in high concentrations. Fish toxicity: 25 ppm/24 h/brook trout/LC_{100}/freshwater; 99 ppm/48 h/bluegill/TLm/freshwater; 10 to 33 ppm/48 h/shrimp/LC_{50}/saltwater; BOD: None.
Land-Air: No information.
Food Chain Concentration Potential: None.

EMERGENCY MEASURES

Special Hazards

CORROSIVE.

Immediate Responses

Keep non-involved people away from spill site. Issue warning: "CORROSIVE". Call Fire Department. Contain spill by diking with earth or other available material. Contact manufacturer for advice. Avoid contact and inhalation. Stop or reduce discharge, if this can be done without risk. Notify environmental authorities.

Protective Clothing and Equipment

Respiratory protection - suitable respirator. Goggles - (mono), tight fitting. If face shield used, it must not replace goggles. Gloves - rubber. Boots - high, rubber (pants should be worn outside boots). Outerwear - as required; coveralls, aprons, suits - rubber, vinyl.

Fire and Explosion

Not combustible. Most fire extinguishing agents may be used in fires involving sodium hydroxide. Use water in flooding amounts. Anhydrous form in contact with water may generate sufficient heat to ignite combustible materials. May cause ignition on contact with organic materials.

First Aid

Move victim out of spill site to fresh air. Call for medical assistance, but start first aid at once. Contact: eyes - irrigate with plenty of water; skin -flush with plenty of water, while removing contaminated clothing. Continue washing (eyes and skin) for an additional 30 minutes if considered necessary. Ingestion: give large quantities of milk or water to conscious victim only, to dilute chemical. Vomiting may occur spontaneously but should not be induced. If medical assistance is not immediately available, transport victim to hospital, doctor or clinic.

ENVIRONMENTAL PROTECTION MEASURES

Response

Water
1. Stop or reduce discharge if safe to do so.
2. Contact manufacturer or supplier for advice.
3. If possible, contain discharge by damming or water diversion.
4. Dredge or vacuum pump to remove contaminants, liquids and contaminated bottom sediments.
5. Notify environmental authorities to discuss disposal and cleanup of contaminated materials.

Land-Air
1. Stop or reduce discharge if safe to do so.
2. Contact manufacturer or supplier for advice.
3. Dike to prevent runoff from rainwater or water application.
4. Remove material by manual or mechanical means.
5. Recover undamaged containers.
6. Notify environmental authorities to discuss disposal and cleanup of contaminated materials.

Disposal

1. Contact manufacturer or supplier for advice on disposal.
2. Contact environmental authorities for advice on disposal.

Material Safety Data Sheet

Sodium Metabisulfite

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Sodium Metabisulfite

OTHER/GENERIC NAMES: Anhydrous Sodium Bisulfite
Sodium Pyrosulfite
ABS

PRODUCT USE: Drug manufacture, food additive, water treatment, textile manufacture, photographic chemicals, and other chemical processes.

MANUFACTURER: Esseco General Chemical
90 East Halsey Road
Parsippany, NJ 07054
USA

FOR MORE INFORMATION CALL: 973-515-1840
(Monday-Friday, 9:00am-4:30pm)

IN CASE OF EMERGENCY CALL: 800-631-8050 or 973-515-0900 (Outside of USA)
(24 Hours/Day, 7 Days/Week)

2. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME	CAS NUMBER	WEIGHT %
Sodium metabisulfite	7681-57-4	>98
Sodium sulfite	7757-83-7	<1.5

Trace impurities and additional material names not listed above may appear in Section 15 of this MSDS. These materials may be listed for local "Right-To-Know" compliance and for other reasons.

OSHA Hazard Communication Standard: *This product is considered hazardous under the OSHA Hazard Communication Standard.*

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Fine, white granular product with a pungent sulfur dioxide gas odor. May irritate the skin. May cause irritation and/or burns to the eyes. Harmful if swallowed or inhaled. May cause severe and possibly fatal allergic reactions if inhaled or swallowed by some asthmatics and other 'sulfite-sensitive' individuals. Reacts with acids to form toxic and irritating sulfur dioxide gas. Releases sulfur dioxide if heated above 300ºF.

POTENTIAL HEALTH HAZARDS

SKIN: Repeated or prolonged contact with dust may cause irritation. Contact with solutions will cause skin irritation.

EYES: Dust or mist may irritate or burn the eyes. Solutions will irritate or burn.

INHALATION: Contact with acids, water and/or ice, releases sulfur dioxide gas which may be harmful or deadly if inhaled. May cause severe or deadly allergic reactions in some asthmatics and sulfite sensitive individuals. Inhalation of dust or mist can irritate the respiratory tract. Possible signs and symptoms of allergic reactions include bronchoconstriction, sweating, flushing, hives, rapid heart rate, decreased blood pressure and anaphylaxis.

INGESTION: May irritate the gastrointestinal tract. May cause severe or deadly allergic reactions in some asthmatics and sulfite sensitive individuals. Very large doses may cause violent colic, diarrhea, depression, and even death.

DELAYED EFFECTS: None known.

Ingredients found on one of the three OSHA designated carcinogen lists are listed below.

INGREDIENT NAME	NTP STATUS	IARC STATUS	OSHA LIST
No ingredients listed in this section.			

4. FIRST AID MEASURES

SKIN: Immediately wash skin with plenty of soap and water. Remove contaminated clothing and wash before reuse. Get medical attention if irritation persists.

EYES: Flush eyes immediately with water for at least 15 minutes. Get medical attention.

INHALATION: Promptly remove to fresh air. Get immediate medical attention if signs of suffocation, irritation or other symptoms develop.

INGESTION: If conscious, immediately give a large quantity of water or milk and induce vomiting by touching finger to back of throat. Get immediate medical attention. Never give anything by mouth to an unconscious person.

ADVICE TO PHYSICIAN: Treat symptomatically. Note potential for anaphylactic shock with allergic individuals.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT:	Not flammable
FLASH POINT METHOD:	Not applicable
AUTOIGNITION TEMPERATURE:	Not applicable
UPPER FLAME LIMIT (volume % in air):	Not applicable
LOWER FLAME LIMIT (volume % in air):	Not applicable
FLAME PROPAGATION RATE (solids):	Not applicable
OSHA FLAMMABILITY CLASS:	Not applicable

EXTINGUISHING MEDIA:
Material is not flammable. Use extinguishing media appropriate for material in surrounding fire.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
Releases toxic and irritating sulfur dioxide at fire temperatures.

SPECIAL FIRE FIGHTING PRECAUTIONS/INSTRUCTIONS:
Wear NIOSH-approved self-contained breathing apparatus.

6. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR OTHER RELEASE: (See section 8 for recommended personal protective equipment.)
Promptly sweep up material with minimum dusting and shovel into an empty container with a cover. Cautiously spray residue with plenty of water. Provide ventilation to clear sulfur dioxide fumes which may be generated by contact with water.

Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding reporting requirements.

7. HANDLING AND STORAGE

NORMAL HANDLING: (See section 8 for recommended personal protective equipment.)
Avoid contact with skin, eyes and clothing. Do not breathe dust. Do not eat or drink in the work area. Use normal personal hygiene and housekeeping. Keep away from water, ice, acids, heat and oxidizing agents. For Food Grade product, see precautions in section 16 regarding on-board use in preserving shrimp and fish.

STORAGE RECOMMENDATIONS:
Store in a cool, dry, well-ventilated area away from water, ice, acids and oxidizing agents. Releases sulfur dioxide gas slowly at ambient temperatures.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS:
Local exhaust if dusty conditions exist or if there is a release of sulfur dioxide gas. Do not use in unventilated spaces, e.g., the holds of fishing boats, walk-in coolers or confined spaces.

PERSONAL PROTECTIVE EQUIPMENT

SKIN PROTECTION:	For handling dry material, wear cotton gloves and full work clothing, including long-sleeved shirt and trousers. When handling solutions and there is prolonged or repeated contact, wear impervious gloves, clothing and boots.
EYE PROTECTION:	Wear a hard hat (or other head covering) and chemical safety goggles. Do not wear contact lenses.
RESPIRATORY PROTECTION:	Where required, use a NIOSH-approved respirator for dust, mist and/or sulfur dioxide gas, as conditions indicate. Some exposures may require a NIOSH-approved self-contained breathing apparatus or supplied-air respirator.
ADDITIONAL RECOMMENDATIONS:	Eyewash and safety shower is recommended.

EXPOSURE GUIDELINES

INGREDIENT NAME	ACGIH TLV	OSHA PEL	OTHER LIMIT
Sodium metabisulfite	5 mg/m^3 TWA	-----	-----

[1] = Limit established by General Chemical Corporation.
[2] = Workplace Environmental Exposure Level (AIHA).
[3] = Biological Exposure Index (ACGIH).

OTHER EXPOSURE LIMITS FOR POTENTIAL DECOMPOSITION PRODUCTS:
Sulfur dioxide: OSHA TWA = 5 ppm
ACGIH TLV = 2 ppm
ACGIH STEL = 5 ppm

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:	Fine, white granular material.
PHYSICAL STATE:	Solid.
MOLECULAR WEIGHT:	190.11
CHEMICAL FORMULA:	$Na_2S_2O_5$
ODOR:	Pungent sulfur dioxide odor.
SPECIFIC GRAVITY (water = 1.0):	1.48
SOLUBILITY IN WATER (weight %):	39% at 16C
pH:	1% solution – 4.3
BOILING POINT:	Not applicable.
MELTING POINT:	Begins to rapidly decompose above 150C
VAPOR PRESSURE:	Not applicable.
VAPOR DENSITY (air = 1.0):	Not applicable.
EVAPORATION RATE:	Not applicable. **COMPARED TO:** Not applicable
% VOLATILES:	Not applicable.
FLASH POINT:	Not flammable.

(Flash point method and additional flammability data are found in Section 5.)

10. STABILITY AND REACTIVITY

NORMALLY STABLE? (CONDITIONS TO AVOID):
Normally stable. Avoid elevated temperatures. Temperatures above 150C cause the rapid evolution of toxic and corrosive sulfur dioxide gas.

INCOMPATIBILITIES:
Oxidizers: may cause strong exothermic reactions.
Acids, water and ice: releases sulfur dioxide gas which is toxic, corrosive, and potentially deadly. Water and/or ice speeds the production of sulfur dioxide gas.

HAZARDOUS DECOMPOSITION PRODUCTS:
Sulfur dioxide and sodium sulfide residue. Sodium sulfide is flammable, a dangerous fire risk, a strong irritant to skin and tissue, and is incompatible with acids.

HAZARDOUS POLYMERIZATION:
Will not occur.

11. TOXICOLOGICAL INFORMATION

IMMEDIATE (ACUTE) EFFECTS:
Sodium metabisulfite – LD_{50} (oral, rat) = 424 mg/kg
Sodium bisulfite – LD_{50} (oral, mouse) = 820 mg/kg

DELAYED (SUBCHRONIC AND CHRONIC) EFFECTS:
Sodium sulfite has been demonstrated to be mutagenic in microbial systems; however, it is not mutagenic in studies involving insects and is not considered to present a mutagenic threat to multi-cell organisms.

OTHER DATA:
None

12. ECOLOGICAL INFORMATION

For Sodium sulfite:
2600 ppm/24, 48 & 96 hr/mosquito fish/TL_m/fresh water
Biological Oxygen Demand (BOD): 0.12 lb/lb, instantaneous

13. DISPOSAL CONSIDERATIONS

RCRA

Is the unused product a RCRA hazardous waste if discarded? No.

If yes, the RCRA ID number is: Not applicable.

OTHER DISPOSAL CONSIDERATIONS:
Dispose of in accordance with applicable Federal, State and Local regulations.

The information offered in section 13 is for the product as shipped. Use and/or alterations to the product such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

14. TRANSPORT INFORMATION

US DOT HAZARD CLASS: Not regulated.
US DOT ID NUMBER: Not applicable.
PROPER SHIPPING NAME: Not applicable.
For additional information on shipping regulations affecting this material, contact the information number found in Section 1.

15. REGULATORY INFORMATION

TOXIC SUBSTANCES CONTROL ACT (TSCA)

TSCA INVENTORY STATUS: All components are listed on TSCA Inventory of Chemical Substances.

OTHER TSCA ISSUES: None.

SARA TITLE III/CERCLA

"Reportable Quantities" (RQs) and/or "Threshold Planning Quantities" (TPQs) exist for the following ingredients.

INGREDIENT NAME	SARA/CERCLA RQ (lb)	SARA EHS TPQ (lb)
No ingredients listed in this section.		

Spills or releases resulting in the loss of any ingredient at or above its RQ requires immediate notification to the National Response Center [(800) 424-8802] and to your Local Emergency Planning Committee.

SECTION 311 HAZARD CLASS: Immediate.

SARA 313 TOXIC CHEMICALS:
The following ingredients are SARA 313 "Toxic Chemicals" and may be subject to annual reporting requirements. CAS numbers and weight percents are found in Section 2.

INGREDIENT NAME	COMMENT
No ingredients listed in this section.	

STATE RIGHT-TO-KNOW

In addition to the ingredients found in Section 2, the following are listed for state right-to-know purposes.

INGREDIENT NAME	WEIGHT %	COMMENT
No ingredients listed in this section.		

ADDITIONAL REGULATORY INFORMATION:
None

WHMIS CLASSIFICATION (CANADA):
D2B

FOREIGN CHEMICAL CONTROL INVENTORY STATUS:
Listed on Canadian DSL and EU EINECS.

16. OTHER INFORMATION

CURRENT ISSUE DATE: April, 2003
PREVIOUS ISSUE DATE: January, 2002

CHANGES TO MSDS FROM PREVIOUS ISSUE DATE ARE DUE TO THE FOLLOWING:
Change in company name.

MATERIAL SAFETY DATA SHEET
Sodium Metabisulfite

OTHER INFORMATION: Only NF grade is for use in drug formulation. Only Food Grade material is for use as a food additive.

On-board ship use of Food Grade material to preserve shrimp and fish:
NEVER apply dry material to shrimp or fish. ALWAYS prepare and use a solution in a well-ventilated area.
NEVER use below deck or in any confined space such as a hold or cooler. Injury or death may occur.
ALWAYS use on deck with plenty of ventilation.
Follow mixing and use directions printed on bag.

MSDS Number: **S4466** * * * * * *Effective Date:* ***12/04/05*** * * * * * *Supercedes:* ***08/10/04***

MSDS *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SODIUM NITRITE

1. Product Identification

Synonyms: Nitrous acid, sodium salt
CAS No.: 7632-00-0
Molecular Weight: 69.00
Chemical Formula: NaNO2
Product Codes:
J.T. Baker: 3780, 3782
Mallinckrodt: 7824

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Nitrite	7632-00-0	97 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. HEAT, SHOCK, OR CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE OR EXPLOSIVE DECOMPOSITION. HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 3 - Severe (Oxidizer)
Contact Rating: 2 - Moderate (Life)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Yellow (Reactive)

Potential Health Effects

Inhalation:
Toxic. Causes irritation to the respiratory tract and systemic poisoning with symptoms paralleling ingestion.
Ingestion:
Toxic. Can irritate the mouth, esophagus, stomach, etc. Excessive amounts effect the blood and blood vessels. Signs and symptoms of nitrite poisoning include intense cyanosis, nausea, dizziness, vomiting, collapse, spasms of abdominal pain, rapid heart beat, irregular breathing, coma, convulsions, and death due to circulatory collapse. Estimated lethal dose 1 to 2 grams.
Skin Contact:
Causes irritation, redness and pain. May be absorbed through the skin causing systemic poisoning; symptoms may parallel ingestion.
Eye Contact:
Causes irritation, redness, and pain.
Chronic Exposure:
Repeated exposure through any route may cause symptoms similar to acute toxicity.
Aggravation of Pre-existing Conditions:
No information found.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.
Skin Contact:

Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention if irritation develops.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Increases the flammability of any combustible material.
Explosion:
Contact with oxidizable substances may cause extremely violent combustion. May explode when heated to 537C (1000F) or on severe impact or on contact with cyanides, ammonium salts, cellulose, lithium, potassium plus ammonia, and sodium thiosulfate.
Fire Extinguishing Media:
Water or water spray in early stages of fire. Foam may also be used, but avoid the use of multi-purpose dry chemical fire extinguishers where contact with sodium nitrite may occur. Water streams may scatter molten material.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Decomposition of sodium nitrite may leave a caustic residue.

---

6. Accidental Release Measures

Remove all sources of ignition. Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Clean up spills in a manner that does not disperse dust into the air. Use non-sparking tools and equipment. Reduce airborne dust and prevent scattering by moistening with water. Pick up spill for recovery or disposal and place in a closed container. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

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7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage and moisture. Isolate from any source of heat or ignition. Avoid storage on wood floors. Separate from incompatibles, combustibles, organic or other readily oxidizable materials. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
None established.
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures as low as possible. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
For conditions of use where exposure to dust or mist is apparent and engineering controls are not feasible, a particulate respirator (NIOSH type N95 or better filters) may be worn. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-face positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
White or yellowish-white crystalline granules.
Odor:
Odorless.
Solubility:
85.2 g/100 g water @ 20C (68F)
Density:
2.17
pH:
9.0 Aqueous solution
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
> 320C (> 608F)
Melting Point:
271C (520F)
Vapor Density (Air=1):
No information found.

Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
This material is stable in closed containers at room temperature. Material slowly oxidizes to sodium nitrate when exposed to air. Very hygroscopic.
Hazardous Decomposition Products:
Oxides of nitrogen.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Reacts vigorously with reducing materials and is incompatible with many substances including ammonium salts, cellulose, cyanides, lithium, potassium plus ammonia, sodium thiosulfate, aminoguanide salts, butadiene, phthalic acid, phthalic anhydride, reducants, sodium amide, sodium disulphite, sodium thiocyanate, urea, wood and organic matter.
Conditions to Avoid:
Heat, flame, ignition sources, shock, friction, incompatibles.

11. Toxicological Information

Oral rat LD50: 180 mg/kg; inhalation rat LC50: 5500 ug/m3; irritation: eye rabbit: 500 mg/24H mild. Investigated as a tumorigen, mutagen, reproductive effector.

--------\Cancer Lists\--

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Sodium Nitrite (7632-00-0)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
96 Hr LC50 rainbow trout (juvenile):0.19 mg/L (flow-through) Dangerous to the environment. Very toxic to aquatic organisms.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: SODIUM NITRITE
Hazard Class: 5.1, 6.1
UN/NA: UN1500
Packing Group: III
Information reported for product/size: 12KG

International (Water, I.M.O.)

Proper Shipping Name: SODIUM NITRITE
Hazard Class: 5.1, 6.1
UN/NA: UN1500
Packing Group: III
Information reported for product/size: 12KG

15. Regulatory Information

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--------\Chemical Inventory Status - Part 1\---------------------------------
Ingredient                                       TSCA  EC   Japan  Australia
-----------------------------------------------  ----  ---  -----  ---------
Sodium Nitrite (7632-00-0)                        Yes  Yes   Yes      Yes

--------\Chemical Inventory Status - Part 2\---------------------------------
                                                        --Canada--
Ingredient                                       Korea  DSL   NDSL  Phil.
-----------------------------------------------  -----  ---   ----  -----
Sodium Nitrite (7632-00-0)                        Yes   Yes   No     Yes

--------\Federal, State & International Regulations - Part 1\----------------
                                           -SARA 302-    ------SARA 313------
Ingredient                                 RQ    TPQ     List  Chemical Catg.
-----------------------------------------  ---   -----   ----  --------------
Sodium Nitrite (7632-00-0)                 No    No      Yes        No

--------\Federal, State & International Regulations - Part 2\----------------
                                                      -RCRA-    -TSCA-
Ingredient                                 CERCLA     261.33     8(d)
```

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  -----------------------------------------  ------     ------    ------
  Sodium Nitrite (7632-00-0)                 100        No         No


Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: No   Fire: Yes Pressure: No
Reactivity: Yes         (Pure / Solid)
```

Australian Hazchem Code: 1[T]
Poison Schedule: S5
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **2** Flammability: **0** Reactivity: **1** Other: **Oxidizer**
Label Hazard Warning:
DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. HEAT, SHOCK, OR CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE OR EXPLOSIVE DECOMPOSITION. HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.
Label Precautions:
Keep from contact with clothing and other combustible materials.
Store in a tightly closed container.
Remove and wash contaminated clothing promptly.
Avoid contact with eyes, skin and clothing.
Avoid breathing dust.
Use with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 3, 12.
Disclaimer:
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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

APPENDIX E

AIR QUALITY & METEOROLOGIC DATA

Tisch Environmental, Inc.
TSP Sampler Calibration
(Dickson recorder)

SITE

Location:	Moose River	Date:	January 3 ,2007
Sampler:	GRASW00-003	Tech:	Joyce Mac Donald

CONDITIONS

Sampler Elevation (feet):	477		
Sea Level Pressure (in Hg):	30.40	Corrected Pressure (mm Hg):	760
Temperature (deg F):	68	Temperature (deg K):	293
Seasonal SL Press. (in Hg):	30.40	Corrected Seasonal (mm Hg):	760
Seasonal Temp. (deg F):	38	Seasonal Temp. (deg K):	276

**** Note-calibrated to standard temperature and pressure**

CALIBRATION ORIFICE

Make:	Tisch	Qstd Slope:	2.04500
Model:	TE-5028A	Qstd Intercept:	-0.21530
Serial#:	3	Date Certified:	Original

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m^3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION	
1	4.00	1.092	48.0	48.41	Slope =	39.5287
2	3.40	1.015	44.0	44.38	Intercept =	4.6792
3	2.70	0.916	40.0	40.34	Corr. coeff.=	0.9979
4	1.80	0.767	35.0	35.30		
5	1.20	0.646	30.0	30.26	# of Observations:	5

Calculations

Qstd = 1/m[Sqrt(H_2O(Pa/Pstd)(Tstd/Ta))-b]
IC = I[Sqrt(Pa/Pstd)(Tstd/Ta)]

Qstd = standard flow rate
IC = corrected chart response
I = actual chart response
m = calibrator Qstd slope
b = calibrator Qstd intercept
Ta = actual temperature during calibration (deg K)

Pa = actual pressure during calibration (mm Hg)
Tstd = 298 deg K
Pstd = 760 mm Hg
For subsequent calculation of sampler flow:
1/m((I)[Sqrt(298/Tav)(Pav/760)]-b)

m = sampler slope
b = sampler intercept
I = chart response
Tav = daily average temperature
Pav = daily average pressure

Tisch Environmental, Inc.
TSP Sampler Calibration
(Dickson recorder)

SITE

Location:	Moose River	Date:	January 4 ,2007
Sampler:	GRASW00-02	Tech:	Joyce Mac Donald

CONDITIONS

Sampler Elevation (feet):	477		
Sea Level Pressure (in Hg):	30.40	Corrected Pressure (mm Hg):	760
Temperature (deg F):	68	Temperature (deg K):	293
Seasonal SL Press. (in Hg):	30.40	Corrected Seasonal (mm Hg):	760
Seasonal Temp. (deg F):	68	Seasonal Temp. (deg K):	293

**** Note- calibrated to standard temperature and pressure.**

CALIBRATION ORIFICE

Make:	Tisch	Qstd Slope:	2.04500
Model:	TE-5028A	Qstd Intercept:	-0.21530
Serial#:	3	Date Certified:	Original

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m^3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION	
1	4.40	1.140	55.0	55.47	Slope =	47.0075
2	3.60	1.041	51.0	51.43	Intercept =	2.2395
3	3.00	0.959	47.0	47.40	Corr. coeff.=	0.9993
4	2.00	0.803	40.0	40.34		
5	1.30	0.668	33.0	33.28	# of Observations:	5

Calculations

Qstd = 1/m[Sqrt(H_2O(Pa/Pstd)(Tstd/Ta))-b]
IC = I[Sqrt(Pa/Pstd)(Tstd/Ta)]

Qstd = standard flow rate
IC = corrected chart response
I = actual chart response
m = calibrator Qstd slope
b = calibrator Qstd intercept
Ta = actual temperature during calibration (deg K)

Pa = actual pressure during calibration (mm Hg)
Tstd = 298 deg K
Pstd = 760 mm Hg
For subsequent calculation of sampler flow:
1/m((I)[Sqrt(298/Tav)(Pav/760)]-b)

m = sampler slope
b = sampler intercept
I = chart response
Tav = daily average temperature
Pav = daily average pressure

Tisch Environmental, Inc.
TSP Sampler Calibration
(Dickson recorder)

SITE

Location:	Moose River	Date:	January 3 ,2007
Sampler:	GRASW00-003	Tech:	Joyce Mac Donald

CONDITIONS

Sampler Elevation (feet):	477		
Sea Level Pressure (in Hg):	30.40	Corrected Pressure (mm Hg):	760
Temperature (deg F):	68	Temperature (deg K):	293
Seasonal SL Press. (in Hg):	30.40	Corrected Seasonal (mm Hg):	760
Seasonal Temp. (deg F):	38	Seasonal Temp. (deg K):	276

**** Note-calibrated to standard temperature and pressure**

CALIBRATION ORIFICE

Make:	Tisch	Qstd Slope:	2.04500
Model:	TE-5028A	Qstd Intercept:	-0.21530
Serial#:	3	Date Certified:	Original

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m^3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION	
1	4.00	1.092	48.0	48.41	Slope =	39.5287
2	3.40	1.015	44.0	44.38	Intercept =	4.6792
3	2.70	0.916	40.0	40.34	Corr. coeff.=	0.9979
4	1.80	0.767	35.0	35.30		
5	1.20	0.646	30.0	30.26	# of Observations:	5

Calculations

Qstd = 1/m[Sqrt(H_2O(Pa/Pstd)(Tstd/Ta))-b]
IC = I[Sqrt(Pa/Pstd)(Tstd/Ta)]

Qstd = standard flow rate
IC = corrected chart response
I = actual chart response
m = calibrator Qstd slope
b = calibrator Qstd intercept
Ta = actual temperature during calibration (deg K)

Pa = actual pressure during calibration (mm Hg)
Tstd = 298 deg K
Pstd = 760 mm Hg
For subsequent calculation of sampler flow:
1/m((I)[Sqrt(298/Tav)(Pav/760)]-b)

m = sampler slope
b = sampler intercept
I = chart response
Tav = daily average
temperature
Pav = daily average pressure

Table 1. Environment Canada Meteorological Data - Halifax International Airport

Year	Month	Day	Time	Temperature (°C)	Pressure (kPa)	Average Wind Speed (km/h)	Wind Direction (degrees)
2007	1	3	0:00	-2.4	99.38	19	290
2007	1	3	1:00	-2.6	99.45	41	310
2007	1	3	2:00	-2.7	99.61	30	290
2007	1	3	3:00	-3.9	99.78	30	290
2007	1	3	4:00	-4.3	99.87	19	280
2007	1	3	5:00	-4.6	99.93	20	300
2007	1	3	6:00	-4.8	100.04	20	280
2007	1	3	7:00	-5	100.17	20	290
2007	1	3	8:00	-4.8	100.21	19	290
2007	1	3	9:00	-3.7	100.29	20	270
2007	1	3	10:00	-2.2	100.31	22	270
2007	1	3	11:00	-0.6	100.3	15	260
2007	1	3	12:00	0.9	100.21	17	280
2007	1	3	13:00	2.5	100.15	22	260
2007	1	3	14:00	3.1	100.11	24	250
2007	1	3	15:00	3.8	100.1	15	260
2007	1	3	16:00	3.6	100.07	15	240
2007	1	3	17:00	0.2	100.04	15	200
2007	1	3	18:00	-0.2	100.02	15	200
2007	1	3	19:00	-0.9	99.95	13	200
2007	1	3	20:00	0.8	99.92	24	210
2007	1	3	21:00	1.5	99.88	22	230
2007	1	3	22:00	2	99.83	24	230
2007	1	3	23:00	2.2	99.79	19	230
2007	1	4	0:00	2.3	99.72	19	230
2007	1	4	1:00	2.3	99.7	15	240
2007	1	4	2:00	2.5	99.69	17	240
2007	1	4	3:00	2.5	99.76	15	260
2007	1	4	4:00	1.3	99.72	11	250
2007	1	4	5:00	1	99.81	11	240
2007	1	4	6:00	0.9	99.85	13	260
2007	1	4	7:00	1	99.91	9	260
2007	1	4	8:00	0.1	99.98	13	260
2007	1	4	9:00	1.6	100	13	250
2007	1	4	10:00	2.2	100	9	230
2007	1	4	11:00	4.1	100.06	15	250
2007	1	4	12:00	4.5	100.01	15	230
2007	1	4	13:00	6.3	99.92	17	240
2007	1	4	14:00	7	99.86	19	230
2007	1	4	15:00	7.2	99.86	22	220
2007	1	4	16:00	6.2	99.84	19	220
2007	1	4	17:00	3	99.8	13	180
2007	1	4	18:00	3.2	99.78	17	200
2007	1	4	19:00	1.8	99.81	15	190
2007	1	4	20:00	0.9	99.83	15	200
2007	1	4	21:00	1.5	99.82	9	210
2007	1	4	22:00	0.9	99.77	11	220
2007	1	4	23:00	-0.8	99.7	11	190
2007	1	5	0:00	1.4	99.66	19	240

Table 1. Environment Canada Meteorological Data - Halifax International Airport

Year	Month	Day	Time	Temperature (°C)	Pressure (kPa)	Average Wind Speed (km/h)	Wind Direction (degrees)
2007	1	5	1:00	2.9	99.6	17	240
2007	1	5	2:00	3.7	99.65	13	240
2007	1	5	3:00	3.9	99.63	9	230
2007	1	5	4:00	3.9	99.62	15	230
2007	1	5	5:00	4.2	99.59	13	230
2007	1	5	6:00	4.5	99.64	13	220
2007	1	5	7:00	4.1	99.69	13	220
2007	1	5	8:00	3.8	99.73	7	230
2007	1	5	9:00	4.1	99.74	17	200
2007	1	5	10:00	5.2	99.77	13	230
2007	1	5	11:00	5.9	99.71	20	230
2007	1	5	12:00	6.9	99.64	22	220
2007	1	5	13:00	7.9	99.52	15	220
2007	1	5	14:00	7.5	99.46	20	200
2007	1	5	15:00	7.4	99.45	24	200
2007	1	5	16:00	7.6	99.37	26	190
2007	1	5	17:00	8.2	99.37	30	200
2007	1	5	18:00	8.5	99.33	33	200
2007	1	5	19:00	8.4	99.29	32	200
2007	1	5	20:00	8.6	99.29	26	210
2007	1	5	21:00	9.4	99.34	19	230
2007	1	5	22:00	9.7	99.36	19	210
2007	1	5	23:00	9.4	99.4	13	210
2007	1	6	0:00	9.2	99.4	19	220
2007	1	6	1:00	9	99.39	17	220
2007	1	6	2:00	8.9	99.39	15	210
2007	1	6	3:00	9.1	99.39	15	210
2007	1	6	4:00	9.2	99.36	13	190
2007	1	6	5:00	9.3	99.33	11	210
2007	1	6	6:00	8.6	99.28	11	170
2007	1	6	7:00	8.2	99.2	19	160
2007	1	6	8:00	7.5	99.15	19	180
2007	1	6	9:00	7.2	99.07	26	180
2007	1	6	10:00	8	98.97	32	190
2007	1	6	11:00	9.5	98.83	37	200
2007	1	6	12:00	10.4	98.6	37	200
2007	1	6	13:00	10	98.45	41	200
2007	1	6	14:00	10.5	98.4	35	210
2007	1	6	15:00	10.8	98.3	32	200
2007	1	6	16:00	11.9	98.25	43	210
2007	1	6	17:00	12.1	98.2	35	210
2007	1	6	18:00	11.5	98.11	41	210
2007	1	6	19:00	11	98.04	35	210
2007	1	6	20:00	11.4	98.02	37	220
2007	1	6	21:00	10.9	97.98	35	220
2007	1	6	22:00	10.9	97.95	30	220
2007	1	6	23:00	10.7	97.94	33	220
2007	1	9	0:00	9.5	97.68	35	220
2007	1	9	1:00	8.7	97.67	28	220

Table 1. Environment Canada Meteorological Data - Halifax International Airport

Year	Month	Day	Time	Temperature (°C)	Pressure (kPa)	Average Wind Speed (km/h)	Wind Direction (degrees)
2007	1	9	2:00	8.1	97.78	32	240
2007	1	9	3:00	7.5	97.81	19	220
2007	1	9	4:00	6.4	97.82	15	260
2007	1	9	5:00	3.9	97.86	19	270
2007	1	9	6:00	2.6	97.89	19	240
2007	1	9	7:00	2.7	97.9	19	230
2007	1	9	8:00	2.3	97.94	20	240
2007	1	9	9:00	3.1	98.03	20	250
2007	1	9	10:00	4.2	98.09	30	260
2007	1	9	11:00	4.7	98.11	33	250
2007	1	9	12:00	5	98.07	28	260
2007	1	9	13:00	3.4	98.06	24	280
2007	1	9	14:00	5.1	98.15	24	270
2007	1	9	15:00	4.8	98.25	17	270
2007	1	9	16:00	4.6	98.32	30	240
2007	1	9	17:00	3.3	98.42	13	250
2007	1	9	18:00	2.3	98.49	17	240
2007	1	9	19:00	1.9	98.59	24	230
2007	1	9	20:00	1.9	98.63	24	250
2007	1	9	21:00	0.6	98.71	20	240
2007	1	9	22:00	0.8	98.76	24	250
2007	1	9	23:00	0.3	98.82	19	250
2007	1	10	0:00	-0.7	98.86	19	240
2007	1	10	1:00	-1	98.9	19	230
2007	1	10	2:00	-1.4	98.97	17	230
2007	1	10	3:00	-1.9	98.99	15	230
2007	1	10	4:00	-2.5	98.99	13	220
2007	1	10	5:00	-2.8	98.96	13	210
2007	1	10	6:00	-3.6	98.99	11	190
2007	1	10	7:00	-2.7	99.1	11	180
2007	1	10	8:00	-3.2	99.04	9	180
2007	1	10	9:00	-0.7	99.01	6	160
2007	1	10	10:00	-1	98.87	9	350
2007	1	10	11:00	-0.2	98.81	0	0
2007	1	10	12:00	0.2	98.79	6	350
2007	1	10	13:00	0.9	98.81	4	160
2007	1	10	14:00	1.3	98.83	0	0
2007	1	10	15:00	1.4	98.91	7	260
2007	1	10	16:00	1.3	98.98	7	330
2007	1	10	17:00	-0.2	99.02	6	360
2007	1	10	18:00	-0.2	99.06	11	320
2007	1	10	19:00	-0.8	99.11	13	320
2007	1	10	20:00	-0.9	99.14	9	310
2007	1	10	21:00	-1.3	99.16	9	290
2007	1	10	22:00	-1.2	99.2	13	290
2007	1	10	23:00	-1.8	99.29	19	340
2007	1	11	0:00	-2.3	99.35	19	320
2007	1	11	1:00	-3	99.41	20	310
2007	1	11	2:00	-3.6	99.51	20	310

Table 1. Environment Canada Meteorological Data - Halifax International Airport

Year	Month	Day	Time	Temperature (°C)	Pressure (kPa)	Average Wind Speed (km/h)	Wind Direction (degrees)
2007	1	11	3:00	-3.8	99.67	17	300
2007	1	11	4:00	-4.5	99.8	13	290
2007	1	11	5:00	-5.4	99.96	24	320
2007	1	11	6:00	-5.9	100.12	26	310
2007	1	11	7:00	-6.6	100.3	17	310
2007	1	11	8:00	-6.7	100.41	22	310
2007	1	11	9:00	-7.5	100.57	30	300
2007	1	11	10:00	-7	100.75	24	310
2007	1	11	11:00	-7.3	100.83	24	310
2007	1	11	12:00	-6.8	100.8	24	300
2007	1	11	13:00	-6.6	100.86	30	300
2007	1	11	14:00	-6.2	100.89	26	320
2007	1	11	15:00	-6.3	100.97	22	300
2007	1	11	16:00	-6.2	101.09	19	310
2007	1	11	17:00	-6.7	101.17	15	310
2007	1	11	18:00	-7.4	101.22	11	290
2007	1	11	19:00	-7.2	101.34	17	280
2007	1	11	20:00	-7.6	101.4	13	260
2007	1	11	21:00	-7.9	101.41	13	240
2007	1	11	22:00	-8.4	101.39	13	220
2007	1	11	23:00	-7.5	101.39	24	220
2007	1	12	0:00	-7.2	101.32	9	200
2007	1	12	1:00	-6.1	101.28	11	200
2007	1	12	2:00	-5	101.25	15	220
2007	1	12	3:00	-4	101.19	24	210
2007	1	12	4:00	-2.1	101.15	20	220
2007	1	12	5:00	-0.9	101.05	17	210
2007	1	12	6:00	0.6	100.96	37	230
2007	1	12	7:00	1.4	100.87	35	220
2007	1	12	8:00	2.2	100.79	39	220
2007	1	12	9:00	2.7	100.8	24	230
2007	1	12	10:00	3.1	100.74	33	210
2007	1	12	11:00	3.8	100.67	33	220
2007	1	12	12:00	4.1	100.49	32	230
2007	1	12	13:00	4.1	100.33	33	220
2007	1	12	14:00	4.1	100.23	30	220
2007	1	12	15:00	4.4	100.17	28	220
2007	1	12	16:00	4.4	100.12	20	220
2007	1	12	17:00	4.4	100.17	19	240
2007	1	12	18:00	4.4	100.15	13	240
2007	1	12	19:00	4.4	100.13	9	240
2007	1	12	20:00	4.2	100.09	15	240
2007	1	12	21:00	4.2	100.1	19	270
2007	1	12	22:00	3.1	100.1	11	270
2007	1	12	23:00	2.1	100.09	11	250

Your Project #: 820933C MOOSE RIVER AMBIENT SA
Site: MOOSE RIVER

Attention: Joyce MacDonald
Conestoga-Rovers and Associates Ltd
Dartmouth
31 Gloster Crt
Dartmouth , NS
B3B 1X9

Report Date: 2007/01/17

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: A701973
Received: 2007/01/08, 15:44

Sample Matrix: Air
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Particulate Matter in Air (1)	5	N/A	2007/01/12	ATL SOP 00172	Based on EPAIO-2.1

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

(1) This test was performed by Sydney, NS (ESL)

Encryption Key

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

MICHELLE HILL, Project Manager
Email: Michelle.Hill.Reports@maxxamanalytics.com
Phone# (902) 420-0203

==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CAEAL have approved this reporting process and electronic report format.

Total cover pages: 1

Maxxam Job #: A701973
Report Date: 2007/01/17

Conestoga-Rovers and Associates Ltd
Client Project #: 820933C MOOSE RIVER AMBIENT SA
Project name: MOOSE RIVER
Sampler Initials:

RESULTS OF ANALYSES OF AIR

Maxxam ID		Q43173	Q43175	Q43176	Q43177		
Sampling Date		2007/01/03	2007/01/03	2007/01/04	2007/01/04		
	Units	**LOCATION #1**	**LOCATION #2**	**LOCATION #3**	**LOCATION #4**	**RDL**	**QC Batch**
INORGANICS							
Total Suspended Particulate	mg	20	22	24	32	0.5	1143253

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		Q43178		
Sampling Date		2007/01/04		
	Units	**LOCATION #5**	**RDL**	**QC Batch**
INORGANICS				
Total Suspended Particulate	mg	31	0.5	1143253

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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

Maxxam Job #: A701973
Report Date: 2007/01/17

Conestoga-Rovers and Associates Ltd
Client Project #: 820933C MOOSE RIVER AMBIENT SA
Project name: MOOSE RIVER
Sampler Initials:

GENERAL COMMENTS

Sample Q43173-01: The wrong side of the filter was used for sampling.

Sample Q43175-01: The wrong side of the filter was used for sampling.

Sample Q43176-01: The wrong side of the filter was used for sampling.

Sample Q43177-01: The wrong side of the filter was used for sampling.

Sample Q43178-01: The wrong side of the filter was used for sampling.

Results relate only to the items tested.

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

APPENDIX F

SURFACE WATER SAMPLING DATA

Table 1. Results of Laboratory Analyses for Surface Water Samples Collected From Sampling Location SW1 from September 2004 to February 2007

	Units	RDL	FWAL 2006	1-Sep-04	15-Oct-04	8-Nov-04	6-Dec-04	11-Jan-05	17-Feb-05	20-Apr-05	13-May-05	13-Jun-05	12-Jul-05	4-Aug-05	4-Aug-05 Duplicate	8-Sep-05	8-Sep-05 Duplicate	7-Oct-05	23-Nov-05	20-Jan-06	20-Jan-06 Duplicate	24-Feb-06	23-Mar-06
INORGANICS																							
Total Alkalinity (Total as $CaCO_3$)	mg/L	5	-	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	NA	<5	NA	<5	<5	<5	NA	<5	<5
Color	TCU	5	-	110	49	57	540	42	49	31	45	53	54	48	NA	29	NA	31	50	39	NA	31	30
Dissolved Hardness ($CaCO_3$)	mg/L	1	-	5.7	5.8	6	4.80	5.60	4.5	3.80	3.8	4.6	5.7	4.9	NA	4.7	NA	6.7	6	5	NA	6	4
Nitrate + Nitrite (as N)	mg/L	0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	0.08	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<0.05	NA	<0.05	<0.05	0.06	NA	0.06	<0.05
Nitrate (as N)	mg/L	0.05	2.9	<0.05	<0.05	<0.05	<0.05	<0.05	0.08	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<0.05	<0.05	<0.05	<0.05	0.06	NA	0.06	<0.05
Nitrite (N)	mg/L	0.01	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	NA	<0.01	NA	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	x	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<0.05	NA	<0.05	<0.05	<0.05	NA	<0.05	<0.05
Total Kjeldahl Nitrogen (TKN)	mg/L	0.1	-	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA	NS	NS
Total Nitrogen	mg/L		-	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA	NS	NS
Total Org. Carbon (by UV)	mg/L	0.5	-	10.1	8.5	11.2	8.4	6.8	7.2	4.1	6.5	8.1	7.5	6.4	NA	4.7	NA	6.4	12	6.2	NA	6.3	3.8
Ortho Phosphate (as P)	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	NA	<0.01	NA	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Phosphorus	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	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1
pH	units	0.1	>6.5;<9.0	5.4	5.8	5.9	5.6	6.8	5.25	5.8	6.27	6.5	7.41	7.19	NA	5.98	NA	6.31	6.13	5.15	5.11	7.65	5.47
Reactive Silica (as SiO_2)	mg/L	0.5	-	0.9	0.9	2.1	1.9	2.4	2.2	0.6	0.8	<0.5	<0.5	<0.5	NA	<0.5	NA	0.9	1.9	1.8	NA	1.8	1.5
Dissolved Chloride (Cl)	mg/L	1	-	4	4	4	4	5	4.8	4	3.5	3.5	3.7	3.7	NA	4.3	NA	4	5	5	NA	6	4
Calcium	mg/L	0.1	-	1.3	1.5	1.4	1.1	1.4	1	0.9	0.9	1.1	1.5	1.1	1.1	1.1	1.1	1.6	1.5	1.2	NA	1.5	1
Magnesium	mg/L	0.1	-	0.6	0.5	0.6	0.5	0.5	0.5	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.7	0.5	NA	0.6	0.5
Potassium	mg/L	0.1	-	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.2	0.3	0.3	0.2	0.2	0.2	0.3	0.3	0.3	NA	0.3	0.3
Sodium	mg/L	0.1	-	2.7	3.9	3.2	2.5	3.2	2.8	2.2	2.1	2.5	2.7	2.7	2.7	2.8	2.8	3.2	3.2	2.8	NA	3.4	2.5
Dissolved Sulphate (SO_4)	mg/L	2	-	<2	<2	2	2	4	<2	<2	<5	<2	<2	<2	NA	<5	NA	4	<2	<2	NA	<2	<2
Conductivity	uS/cm	1	-	26	26	31	31	30	29	22	23	23	24	24	NA	26	NA	30	36	29	29	32	27
Turbidity	NTU	0.1	-	1.0	0.6	1.1	1.0	0.6	0.5	0.7	1	0.6	0.8	1.2	NA	1	NA	0.5	2.6	1.7	NA	9.1	0.7
Total Suspended Solids	mg/L	2	-	3.6	1.8	<2	<2	<2	<2	<2	<2	2.5	2.4	<2	NA	3.1	NA	<2	4	<2	NA	50	11
RCAP CALCULATIONS																							
Anion Sum	meq/L	-	-	0.36	0.26	0.26	0.26	0.33	0.141	0.11	0.0983	0.0995	0.105	0.105	NA	0.122	NA	0.208	0.155	0.145	NA	0.164	0.115
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<5	<5	<5	<5	<5	<1	<1	<1	<1	<1	<1	NA	<1	NA	<1	<1	<1	NA	<1	<1
Calculated TDS	mg/L	0.1	-	18	16	17	16	20	12.4	9	9	9	10	10	NA	10	NA	16	14	12	NA	14	10
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<5	<5	<5	<5	<5	<1	<1	<1	<1	<1	<1	NA	<1	NA	<1	<1	<1	NA	<1	<1
Cation Sum	meq/L	0.10	-	0.24	0.3	0.27	0.22	0.26	0.238	0.191	0.195	0.232	0.282	0.262	NA	0.243	NA	0.295	0.292	0.248	NA	0.289	0.212
Elements (ICP-MS)																							
Total Aluminum (Al)	μg/L	10	5-100	250	200	230	180	160	150	109	150	180	160	120	130	99	100	100	284	200	NA	219	151
Total Antimony (Sb)	μg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2
Total Arsenic (As)	μg/L	2	5	17	8	9	8	7	4.8	7	7.4	16	26	27	26	14	15	10	7.9	5.1	NA	39.9	4.4
Total Barium (Ba)	μg/L	5	-	<5	<5	5	5	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	6.9	5.5	NA	6.1	<5
Total Beryllium (Be)	μg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2
Total Bismuth (Bi)	μg/L	2	-	<2	<2	<2	<2	<2	<2	<2	2.2	<2	<2	<2	<2	<2	<2	<2	ND	<2	NA	<2	<2
Total Boron (B)	μg/L	5	-	5	<5	<5	<5	<5	<5	<5	<5	<5	5	<5	<5	9	9.7	7	5.7	<5	NA	<5	<5
Total Cadmium (Cd)	μg/L	0.3	0.017	<0.3	<0.3	<0.3	0.030	0.020	<0.3	0.031	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.024	0.02	NA	0.027	0.049
Total Chromium (Cr)	μg/L	2	y	<2	<2	<2	<2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2
Total Cobalt (Co)	μg/L	0.4	-	<0.4	<0.4	<0.4	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<1	<1	<0.4	0.51	<0.4	NA	<0.4	<0.4
Total Copper (Cu)	μg/L	2	2-4	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2
Total Iron (Fe)	μg/L	50	300	1200	660	640	360	330	320	186	250	570	1100	1100	1100	680	700	380	446	300	NA	443	217
Total Lead (Pb)	μg/L	0.5	1-7	0.5	<0.5	0.5	<0.5	0.5	<0.5	<0.5	<0.5	0.5	0.8	0.8	0.8	<0.5	<0.5	<0.5	<0.5	<0.5	NA	0.95	<0.5
Total Manganese (Mn)	μg/L	2	-	65	34	64	80	69	88	66.9	68	100	53	30	32	31	31	33	106	87.4	NA	82.1	90.7
Total Mercury (Hg)	μg/L	0.01	z	NS	NS	NS	NS	<0.01	NS	NS	<0.01	NS	<0.01	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total Molybdenum (Mo)	μg/L	2	73	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2
Total Nickel (Ni)	μg/L	2	25-150	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2
Total Selenium (Se)	μg/L	2	1	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<1.0	<1.0	<2	<2	<2	NA	<2	<2
Total Silver (Ag)	μg/L	0.5	0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA	<0.5	<0.5
Total Strontium (Sr)	μg/L	5	-	8	8	10	8	9	6.5	5.5	5	5.9	6.7	6.8	6.9	7.2	7.4	10	9.3	8.3	NA	8.1	6.7
Total Thallium (Tl)	μg/L	0.1	0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<.1
Total Tin (Sn)	μg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2
Total Titanium (Ti)	μg/L	2	-	3	2	2	2	<2	<2	<2	<2	<2	2.4	2.7	2.9	<2	<2	<2	2.3	<2	NA	<2	<2
Total Uranium (U)	μg/L	0.1	-	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1
Total Vanadium (V)	μg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2	<2	<2	NA	<2	<2
Total Zinc (Zn)	μg/L	5	30	8	8	6	9	52	6.3	<5	5.4	<5	11	6.5	6.6	<5	<5	9	8.6	12.1	NA	11	<2
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.002		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
E. Coli (Colilert)	MPN/100ml			NS	12	NS	0	NS	NS	ND	NS	NS	3.1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total Coliform (Colilert)	MPN/100ml			NS	>2420	NS	>200	NS	NS	>200	NS	NS	>200	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

FWAL 2006 = Canadian Environmental Quality Guidelines - Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (2006)

NS = Not sampled

NA= Not analyzed

RDL = Reportable Detection Limit

x = Ammonia Guideline is based on pH and Temperature

y = Chromium Guideline is based on speciation (Cr III = 8.9 ug/L, CR VI = 1ug/L)

z = Mercury Guideline is based on speciation (Inorganic Hg = 0.026ug/L, Methyl Hg= 0.004ug/L

Table 1. Results of Laboratory Analyses for Surface Water Samples Collected From Sampling Location SW1 from September 2004 to February 2007

	Units	RDL	FWAL 2006	28-Apr-06	25-May-06	28-Jun-06	26-Jul-06	26-Jul-06 Lab-Dup	28-Aug-06	28-Sep-06	28-Sep-06 Lab-Dup	27-Oct-06	27-Nov-06	27-Nov-06	14-Dec-06	18-Jan-07	7-Feb-07	MIN	MAX
INORGANICS																			
Total Alkalinity (Total as $CaCO_3$)	mg/L	5	-	<5	<5	<5	<5	NA	<5	<5	NA	<5	<5	<5	<5	<5	<5	<5	<10
Color	TCU	5	-	36	54	90	110	NA	67	49	NA	52	45	43	43	43	36	29	540
Dissolved Hardness ($CaCO_3$)	mg/L	1	-	4	4	4	5	NA	6	6	NA	7	6	6	6	6	7	3.8	7
Nitrate + Nitrite (as N)	mg/L	0.05	-	0.05	<0.05	<0.05	<0.05	NA	0.07	<0.05	NA	<0.05	<0.05	<0.05	<0.05	0.14	0.08	<0.05	0.14
Nitrate (as N)	mg/L	0.05	2.9	0.05	<0.05	<0.05	<0.05	NA	0.07	<0.05	NA	<0.05	<0.05	<0.05	<0.05	0.14	0.08	<0.05	0.14
Nitrite (N)	mg/L	0.01	0.06	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	x	<0.05	<0.05	<0.05	<0.05	NA	0.08	<0.05	NA	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.08
Total Kjeldahl Nitrogen (TKN)	mg/L	0.1	-	NS	NS	NS	0.4	NA	0.5	0.3	NA	0.4	0.5	0.5	0.4	0.5	0.5	0.3	0.5
Total Nitrogen	mg/L		-	NS	NS	NS	0.31	NA	0.41	0.28	NA	0.26	0.2	0.21	0.22	0.27	NA	0.2	0.41
Total Org. Carbon (by UV)	mg/L	0.5	-	6.2	8.8	14	15	NA	11	7.3	NA	10	8	8.1	7.7	6.6	6.2	3.8	15
Ortho Phosphate (as P)	mg/L	0.01	-	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phosphorus	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	<0.1	<0.1	<0.1
pH	units	0.1	>6.5;<9.0	5.92	5.39	4.96	5.35	NA	5.93	7.33	NA	5.33	5	5.67	5.51	5.52	5.52	4.96	7.65
Reactive Silica (as SiO_2)	mg/L	0.5	-	0.5	<0.5	1.3	1.7	NA	<0.5	<0.5	NA	1.6	1.7	1.6	1.7	2	1.8	<0.5	2.4
Dissolved Chloride (Cl)	mg/L	1	-	3	3	3	3	NA	3	4	NA	4	4	5	5	6	5	3	6
Calcium	mg/L	0.1	-	1	1	1	1.3	1.3	1.5	1.4	1.3	1.8	1.3	1.5	1.3	1.5	1.7	0.9	1.8
Magnesium	mg/L	0.1	-	0.5	0.4	0.4	0.5	0.5	0.5	0.6	0.5	0.6	0.6	0.6	0.5	0.6	0.7	0.4	0.7
Potassium	mg/L	0.1	-	0.3	0.3	0.3	0.2	0.2	0.3	0.3	0.2	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.4
Sodium	mg/L	0.1	-	2.5	2.4	2.2	2.4	2.5	3.3	2.2	2.1	2.7	2.6	2.9	2.6	3.3	3.7	2.1	3.9
Dissolved Sulphate (SO_4)	mg/L	2	-	<2	<2	<2	<2	NA	<2	<2	NA	<2	<2	<2	<2	<2	<2	<2	4
Conductivity	uS/cm	1	-	26	25	23	24	NA	22	23	NA	29	29	31	29	36	34	22	36
Turbidity	NTU	0.1	-	2.6	0.9	0.7	1.1	NA	0.8	0.5	NA	0.9	0.5	0.8	0.8	1.1	1	0.5	9.1
Total Suspended Solids	mg/L	2	-	2	2		<2	NA	1	1	NA	<2	<2	6	8	<1	<1	<1	50
RCAP CALCULATIONS																			
Anion Sum	meq/L	-	-	0.0971	0.0959	0.0722	0.0816	NA	0.0972	0.108	NA	0.125	0.12	0.138	0.131	0.168	0.16	0.0722	0.36
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<1	<1	<1	<1	NA	<1	<1	NA	<1	<1	<1	<1	<1	<1	<1	<1
Calculated TDS	mg/L	0.1	-	9	8	8	10	NA	10	9	NA	12	11	12	11	14	14	8	20
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<1	<1	<1	<1	NA	<1	<1	NA	<1	<1	<1	<1	<1	<1	<1	<1
Cation Sum	meq/L	0.10	-	0.217	0.212	0.217	0.265	NA	0.313	0.246	NA	0.292	0.256	0.272	0.245	0.287	0.32	0.191	0.32
Elements (ICP-MS)																			
Total Aluminum (Al)	µg/L	10	5-100	167	208	277	308	325	221	154	156	236	184	191	193	192	185	99	325
Total Antimony (Sb)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Arsenic (As)	µg/L	2	5	6.7	8.8	12.1	26.5	28.1	20.9	16.6	16.6	8.5	10.2	9.4	6.6	7.2	8.1	4.4	39.9
Total Barium (Ba)	µg/L	5	-	<5	<5	5.6	5.5	5.7	<5	<5	<5	5.6	<5.0	5.5	5.6	5.9	6.2	<5	6.9
Total Beryllium (Be)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Bismuth (Bi)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.2	2.2
Total Boron (B)	µg/L	5	-	<5	<5	5	5.7	5.2	13.6	8.2	7.1	5.3	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	13.6
Total Cadmium (Cd)	µg/L	0.3	0.017	<0.3	<0.3	0.02	<0.3	0.024	0.031	0.031	0.018	0.025	0.027	0.042	0.049	0.03	0.025	0.018	0.049
Total Chromium (Cr)	µg/L	2	y	<2	<2	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	>2.0	<2.0	>2.0	>2.0
Total Cobalt (Co)	µg/L	0.4	-	<0.4	<0.4	0.43	0.44	0.47	<0.4	<0.4	<0.4	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.51
Total Copper (Cu)	µg/L	2	2-4	<2	<2	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0
Total Iron (Fe)	µg/L	50	300	240	427	587	1140	1200	907	767	767	550	375	387	353	332	344	186	1200
Total Lead (Pb)	µg/L	0.5	1-7	<0.5	<0.5	0.61	0.75	0.77	0.78	0.59	0.58	<0.50	<0.50	<0.50	<0.50	<0.50	0.54	0.5	0.95
Total Manganese (Mn)	µg/L	2	-	56.5	85.5	101	98.8	104	33	18.4	18.8	67.9	64.5	62.1	61.5	61.4	69.5	18.4	106
Total Mercury (Hg)	µg/L	0.01	z	NS	NS	NS	<0.01	NS	<0.01	<0.01	NS	<0.01	NS	<0.01	0.01	NS	<0.01	<0.01	0.01
Total Molybdenum (Mo)	µg/L	2	73	<2	<2	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Nickel (Ni)	µg/L	2	25-150	<2	<2	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Selenium (Se)	µg/L	2	1	<2	<2	<1.0	<2	<2	<2	<2	<2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Silver (Ag)	µg/L	0.5	0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Strontium (Sr)	µg/L	5	-	6.5	6.4	6.6	8.2	8.7	7.8	7	6.9	8	8.6	9.9	7.2	10	8.2	5	10
Total Thallium (Tl)	µg/L	0.1	0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Tin (Sn)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	<0.10	<2.0	<0.10	<0.10
Total Titanium (Ti)	µg/L	2	-	<2	2.3	<2	2.2	2.8	2.1	2.1	2.3	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	3
Total Uranium (U)	µg/L	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10	0.1
Total Vanadium (V)	µg/L	2	-	<2	<2	<2.0	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Zinc (Zn)	µg/L	5	30	5.5	<2	13.3	7.6	7.7	11.1	<5	5.4	6.9	5.9	9.2	8.8	9.6	8.5	<5	52
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.002		NS	NS	NS	NS	NS	NS	NS	NS	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
E. Coli (Colilert)	MPN/100ml			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0	12
Total Coliform (Colilert)	MPN/100ml			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	>200	>2420

FWAL 2006 = Canadian Environmental Quality Guidelines - Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (2006)

NS = Not sampled

NA= Not analyzed

RDL = Reportable Detection Limit

x = Ammonia Guideline is based on pH and Temperature

y = Chromium Guideline is based on speciation (Cr III = 8.9 ug/L, CR VI = 1ug/L)

z = Mercury Guideline is based on speciation (Inorganic Hg = 0.026ug/L, Methyl Hg= 0.004ug/L

Table 2. Results of Laboratory Analyses for Surface Water Samples Collected From Sampling Location SW2 from September 2004 to February 2007

	Units	RDL	FWAL 2006	1-Sep-04	15-Oct-04	8-Nov-04	6-Dec-04	11-Jan-04	17-Feb-05	20-Apr-05	13-May-05	13-Jun-05	12-Jul-05	4-Aug-05	8-Sep-05	8-Sep-05 Duplicate	7-Oct-05	23-Nov-05	20-Jan-06	24-Feb-06	23-Mar-06	28-Apr-06	25-May-06
INORGANICS																							
Total Alkalinity (Total as $CaCO_3$)	mg/L	5	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	NA	<5	<5	<5	<5	<5	<5	<5
Color	TCU	5	-	53	40	50	8	37	46	27	39	43	35	32	19	NA	22	50	42	30	30	31	46
Dissolved Hardness ($CaCO_3$)	mg/L	1	-	6.5	8.5	6	5.1	6.5	5.5	5	4.3	5.2	5.9	5.8	5.6	NA	7.1	6	6	6	5	5	5
Nitrate + Nitrite (as N)	mg/L	0.05	-	<0.05	<0.05	<0.05	0.42	<0.05	0.09	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05
Nitrate (as N)	mg/L	0.05	2.9	<0.05	<0.05	<0.05	0.41	<0.05	0.09	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05
Nitrite (N)	mg/L	0.01	0.06	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	x	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Kjeldahl Nitrogen (TKN)	mg/L	0.1		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total Nitrogen	mg/L			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total Org. Carbon (by UV)	mg/L	0.5	-	8.3	7.5	10.6	8.4	7.1	6.3	4.4	6	6.9	5.5	5.1	3.2	NA	5.5	10	6.1	6.2	4.7	4.8	7.8
Ortho Phosphate (as P)	mg/L	0.01	-	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phosphorus	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	NA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
pH	units	0.1	>6.5;<9.0	5.8	6	5.4	5.1	6	7.37	5.64	7.45	6.24	6.5	6.8	6.24	NA	6.06	4.97	5.1	6.83	5.41	5.65	7.31
Reactive Silica (as SiO_2)	mg/L	0.5	-	1	0.9	1.7	1.6	2.3	2	0.8	0.8	<0.5	<0.5	<0.5	ND	NA	0.8	1.9	2.2	1.7	1.6	0.8	0.5
Dissolved Chloride (Cl)	mg/L	1	-	6	6	4	5	5	5.8	5.3	4.3	4.4	5.1	5.1	5.6	NA	5	6	8	4	5	4	4
Calcium	mg/L	0.1	-	1.6	2.4	1.4	1.2	1.6	1.4	1.3	1.1	1.3	1.5	1.5	1.4	NA	1.8	1.5	1.4	1.4	1.3	1.2	1.2
Magnesium	mg/L	0.1	-	0.6	0.6	0.6	0.5	0.6	0.5	0.4	0.4	0.5	0.5	0.5	0.5	NA	0.7	0.6	0.5	0.5	0.5	0.5	0.5
Potassium	mg/L	0.1	-	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.2	0.3	NA	0.3	0.4	0.2	0.3	0.2	0.3	0.3
Sodium	mg/L	0.1	-	3.7	6.1	3.5	3	3.4	3.1	3.1	2.7	3.1	3.5	3.7	3.6	NA	3.8	3.4	4.1	2.6	3.2	3.1	3.1
Dissolved Sulphate (SO_4)	mg/L	2	-	3	2	2	2	4	<2	<2	<5	<5	<5	<5	<2	NA	4	<5	<2	<2	<2	<2	<2
Conductivity	uS/cm	1	-	35	36	32	33	33	32	27	25	26	29	31	32	NA	33	36	37	27	32	29	27
Turbidity	NTU	0.1	-	0.9	0.8	1.2	1.4	0.9	0.8	0.7	1	0.9	0.8	0.6	1.3	NA	0.7	2.4	1.7	0.7	3.7	1.4	1.1
Total Suspended Solids	mg/L	2	-	2.1	<2	<2	<2	<2	<2	<2	<2	<2	11	<2	<2	NA	3	5	<2	<2	9	2	2
RCAP CALCULATIONS																							
Anion Sum	meq/L	-	-	0.34	0.31	0.26	0.31	0.33	0.169	0.15	0.123	0.125	0.144	0.144	0.157	NA	0.23	0.164	0.215	0.125	0.145	0.125	0.123
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<5	<5	<5	<5	<5	<1	<1	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1	<1
Calculated TDS	mg/L	0.1	-	19	22	17	19	20	13.9	11.6	10	10.2	11.8	11.9	11.9	NA	17	14	16	11	12	11	10
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<5	<5	<5	<5	<5	<1	<1	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1	<1
Cation Sum	meq/L	0.1	-	0.3	0.45	0.29	0.25	0.29	0.265	0.253	0.223	0.265	0.305	0.312	0.294	NA	0.329	0.31	0.309	0.244	0.272	0.249	0.257
Elements (ICP-MS)																							
Total Aluminum (Al)	µg/L	10	5-100	190	170	220	190	160	150	121	160	160	120	100	72	NA	80	254	190	162	219	156	192
Total Antimony (Sb)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2	<2	<2	<2	<2	<2
Total Arsenic (As)	µg/L	2	5	21	23	8	7	6	5.1	14.7	7	17	31	35	26	NA	18	9.1	<2	6.9	28.4	5.2	12.4
Total Barium (Ba)	µg/L	5	-	5	<5	6	6	6	5.1	<5	<5	<5	<5	<5	<5	NA	<5	6.6	<5	<5	6.1	5.1	5.5
Total Beryllium (Be)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2	<2	<2	<2	<2	<2
Total Bismuth (Bi)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Total Boron (B)	µg/L	5	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5.2	NA	6	6	<5	<5	<5	5.5	<5
Total Cadmium (Cd)	µg/L	0.3	0.017	<0.3	<0.3	<0.3	0.02	0.02	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	NA	<0.3	0.031	<0.3	0.023	0.033	<0.3	0.03
Total Chromium (Cr)	µg/L	2	y	<2	<2	<2	<2	6	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2	<2	<2	<2	<2	<2
Total Cobalt (Co)	µg/L	1	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.4	NA	<1	0.5	<1	<1	0.44	<1	<1
Total Copper (Cu)	µg/L	2	2-4	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2	<2	<2	<2	<2	<2
Total Iron (Fe)	µg/L	50	300	780	620	550	320	340	330	216	350	470	670	760	490	NA	320	413	170	220	419	212	389
Total Lead (Pb)	µg/L	0.5	1-7	0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.4	0.5	<0.5	NA	<0.5	<0.5	<0.5	<0.5	0.62	<0.5	0.51
Total Manganese (Mn)	µg/L	2	-	56	53	62	88	73	82	65.9	65	81	53	40	40	NA	38	102	50.3	65	105	53.4	87.8
Total Mercury (Hg)	µg/L	0.01	z	NS	NS	NS	NS	<0.01	NS	NS	0.01	NS	<0.01	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total Molybdenum (Mo)	µg/L	2	73	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2	<2	<2	<2	<2	<2
Total Nickel (Ni)	µg/L	2	25-150	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2	<2	<2	<2	<2	<2
Total Selenium (Se)	µg/L	2	1	<2	<2	<2	<2	<2	<2	<2	<2	<2	<1.0	<1.0	<2	NA	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Silver (Ag)	µg/L	0.5	0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Strontium (Sr)	µg/L	5	-	8	9	8	8	8	7.1	6.3	5.4	6.4	7.5	6.7	7	NA	9	8.8	7.5	9	7	6.7	7.6
Total Thallium (Tl)	µg/L	0.1	0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Tin (Sn)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2	<2	<2	<2	<2	<2
Total Titanium (Ti)	µg/L	2	-	3	2	2	<2	<2	<2	<2	3.8	<2	<2	<2	<2	NA	<2	2.2	<2	<2	<2	<2	<2
Total Uranium (U)	µg/L	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Vanadium (V)	µg/L	2	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Zinc (Zn)	µg/L	5	30	8	8	ND	5	36	11	6.4	5.7	18	5.7	5.8	<5	NA	6	10.2	17.4	5.7	<5	<5	9.8
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.002		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

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RDL = Reportable Detection Limit

x = Ammonia Guideline is based on pH and Temperature

y = Chromium Guideline is based on speciation (Cr III = 8.9 ug/L, CR VI = 1ug/L)

z = Mercury Guideline is based on speciation (Inorganic Hg = 0.026ug/L, Methyl Hg= 0.004ug/L

Table 2. Results of Laboratory Analyses for Surface Water Samples Collected From Sampling Location SW2 from September 2004 to February 2007

	Units	RDL	FWAL 2006	28-Jun-06	26-Jul-06	28-Aug-06	28-Sep-06	28-Sep-06 Lab-Dup	27-Oct-06	27-Nov-06 Lab-Dup	14-Dec-06	18-Jan-07	7-Feb-07	MIN	MAX
INORGANICS															
Total Alkalinity (Total as $CaCO_3$)	mg/L	5	-	<5	<5	<5	<5	NA	<5	NA	<5	<5	<5	<5	<5
Color	TCU	5	-	80	84	48	37	NA	62	NA	44	40	34	8	84
Dissolved Hardness ($CaCO_3$)	mg/L	1	-	4	5	7	7	NA	6	NA	5	5	5	4	8.5
Nitrate + Nitrite (as N)	mg/L	0.05	-	<0.05	<0.05	<0.05	<0.05	NA	<0.05	NA	<0.05	0.08	0.07	<0.05	0.42
Nitrate (as N)	mg/L	0.05	2.9	<0.05	<0.05	<0.05	<0.05	NA	<0.05	NA	<0.05	0.08	0.07	<0.05	0.41
Nitrite (N)	mg/L	0.01	0.06	<0.01	<0.01	<0.01	<0.01	NA	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	x	<0.05	<0.05	0.07	<0.05	<0.05	<0.05	NA	0.06	<0.05	<0.05	<0.05	0.07
Total Kjeldahl Nitrogen (TKN)	mg/L	0.1		NS	2	0.5	0.3	NA	0.3	NA	0.3	NA	0.5	0.3	2
Total Nitrogen	mg/L			NS	0.28	0.23	0.28	NA	0.31	NA	0.22	0.2	NA	0.2	0.31
Total Org. Carbon (by UV)	mg/L	0.5	-	11	14	8.5	6.4	NA	11	NA	8	6.4	6.6	3.2	14
Ortho Phosphate (as P)	mg/L	0.01	-	<0.01	<0.01	<0.01	<0.01	NA	<0.01	NA	<0.01	<0.01	<0.01	<0.01	0.02
Phosphorus	mg/L	0.1	-	<0.1	<0.1	<0.1	<0.1	NA	<0.1	NA	<0.1	<0.1	<0.1	<0.1	<0.1
pH	units	0.1	>6.5;<9.0	5.26	5.21	6.2	6.62	NA	5.14	NA	4.88	5.11	5.23	4.88	7.45
Reactive Silica (as SiO_2)	mg/L	0.5	-	1	1.4	<0.5	<0.5	NA	1.8	NA	1.8	1.7	1.6	<0.5	2.3
Dissolved Chloride (Cl)	mg/L	1	-	3	3	5	5	NA	4	NA	4	3	4	3	8
Calcium	mg/L	0.1	-	1	1.3	1.9	1.9	NA	1.3	NA	1.2	1.1	1.1	1	2.4
Magnesium	mg/L	0.1	-	0.4	0.5	0.6	0.6	NA	0.6	NA	0.5	0.5	0.6	0.4	0.7
Potassium	mg/L	0.1	-	0.3	0.2	0.2	0.4	NA	0.4	NA	0.3	0.2	0.2	0.2	0.4
Sodium	mg/L	0.1	-	2.5	2.6	4	3.4	NA	2.2	NA	2.2	2.3	2.5	2.2	6.1
Dissolved Sulphate (SO_4)	mg/L	2	-	<2	<2	<2	<2	NA	<2	NA	<2	<2	<2	2	4
Conductivity	uS/cm	1	-	25	25	30	32	NA	29	NA	28	27	29	25	37
Turbidity	NTU	0.1	-	1.1	1.2	1.2	0.7	0.7	0.8	0.5	0.5	0.6	0.6	0.5	3.7
Total Suspended Solids	mg/L	2	-	<2	3	<2	1	NA	<1	NA	1	NA	<1	<1	11
RCAP CALCULATIONS															
Anion Sum	meq/L	-	-	0.0986	0.086	0.134	0.131	NA	0.109	NA	0.115	0.101	0.12	0.086	0.34
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<1	<1	<1	<1	NA	<1	NA	<1	<1	<1	NA	NA
Calculated TDS	mg/L	0.1	-	9	10	13	12	NA	11	NA	10	10	11	9	22
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<1	<1	<1	<1	NA	<1	NA	<1	<1	<1	<1	<1
Cation Sum	meq/L	0.1	-	0.23	0.267	0.366	0.336	NA	0.244	NA	0.233	0.216	0.23	0.216	0.45
Elements (ICP-MS)															
Total Aluminum (Al)	µg/L	10	5-100	264	284	216	156	NA	221	NA	179	192	159	72	284
Total Antimony (Sb)	µg/L	2	-	<2	<2	<2	<2	NA	<2.0	NA	<2.0	<2.0	<2.0	<2.0	<2.0
Total Arsenic (As)	µg/L	2	5	10.5	25.3	54.2	31.5	NA	9.8	NA	7.6	7.2	8.5	5.1	54.2
Total Barium (Ba)	µg/L	5	-	6.2	5.5	<5	<5	NA	5	NA	<5.0	5.9	<5.0	<5.0	6.6
Total Beryllium (Be)	µg/L	2	-	<2	<2	<2	<2	NA	<2.0	NA	<2.0	<2.0	<2.0	<2.0	<2.0
Total Bismuth (Bi)	µg/L	2	-	<2	<2	<2	<2	NA	<2.0	NA	<2.0	<2.0	<2.0	<2.0	<2.0
Total Boron (B)	µg/L	5	-	5.1	<5	5.8	5.6	NA	<5.0	NA	<5.0	<5.0	<5.0	<5.0	6
Total Cadmium (Cd)	µg/L	0.3	0.017	0.04	0.022	0.035	<0.3	NA	0.019	NA	0.023	0.03	0.021	0.019	0.04
Total Chromium (Cr)	µg/L	2	y	<2	<2	<2	<2	NA	<2.0	NA	<2.0	<2.0	10.8	<2.0	6
Total Cobalt (Co)	µg/L	1	-	0.42	0.43	0.5	<1	NA	<0.40	NA	<0.40	<0.40	<0.40	<0.40	0.5
Total Copper (Cu)	µg/L	2	2-4	<2	<2	<2	<2	NA	2.3	NA	<2.0	<2.0	<2.0	<2.0	<2.0
Total Iron (Fe)	µg/L	50	300	544	988	1080	806	NA	513	NA	321	332	297	170	1080
Total Lead (Pb)	µg/L	0.5	1-7	0.56	0.76	1.04	0.63	NA	0.54	NA	<0.50	<0.50	<0.50	<0.50	3.4
Total Manganese (Mn)	µg/L	2	-	112	102	96.3	67.7	NA	76.6	NA	60.9	61.4	65.7	38	112
Total Mercury (Hg)	µg/L	0.01	z	NS	<0.01	<0.01	<0.01	NA	<0.01	NA	0.01	NS	<0.01	<0.01	0.01
Total Molybdenum (Mo)	µg/L	2	73	<2	<2	<2	<2	NA	<2.0	NA	<2.0	<2.0	<2.0	<2.0	<2.0
Total Nickel (Ni)	µg/L	2	25-150	<2	<2	<2	<2	NA	<2.0	NA	<2.0	<2.0	<2.0	<2.0	<2.0
Total Selenium (Se)	µg/L	2	1	<2	<1.0	<1.0	<1.0	NA	<1.0	NA	<1.0	<1.0	<1.0	<1.0	<1.0
Total Silver (Ag)	µg/L	0.5	0.1	<0.5	<0.5	<0.5	<0.5	NA	<0.10	NA	<0.10	<0.10	<0.10	<0.10	<0.10
Total Strontium (Sr)	µg/L	5	-	6.4	7.4	8.1	7.3	NA	8.3	NA	7.1	7	8	5.4	9
Total Thallium (Tl)	µg/L	0.1	0.8	<0.1	<0.1	<0.1	<0.1	NA	<0.10	NA	<0.10	<0.10	<0.10	<0.10	<0.10
Total Tin (Sn)	µg/L	2	-	<2	<2	<2	<2	NA	<2.0	NA	<2.0	<2.0	<2.0	<2.0	<2.0
Total Titanium (Ti)	µg/L	2	-	<2	2.3	2.7	<2	NA	<2.0	NA	<2.0	<2.0	<2.0	<2.0	3.8
Total Uranium (U)	µg/L	0.1	-	<0.1	<0.1	<0.1	<0.1	NA	<0.10	NA	<0.1	<0.1	<0.10	<0.10	<0.10
Total Vanadium (V)	µg/L	2	-	<2	<2.0	<2.0	<2.0	NA	<2.0	NA	<2.0	<2.0	<2.0	<2.0	<2.0
Total Zinc (Zn)	µg/L	5	30	10.4	<5	9.1	6.3	NA	6.9	NA	8	5.2	8.4	<5	36
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.002		NS	NS	NS	NS	NS	<0.002	NS	<0.002	NS	<0.002	<0.002	<0.002

FWAL 2006 = Canadian Environmental Quality Guidelines - Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (2006)

NS = Not sampled

NA= Not analyzed

RDL = Reportable Detection Limit

x = Ammonia Guideline is based on pH and Temperature

y = Chromium Guideline is based on speciation (Cr III = 8.9 ug/L, CR VI = 1ug/L)

z = Mercury Guideline is based on speciation (Inorganic Hg = 0.026ug/L, Methyl Hg= 0.004ug/L

Table 3. Results of Laboratory Analyses for Surface Water Samples Collected From Sampling Location SW3 from September 2004 to February 2007

	Units	RDL	FWAL 2006	1-Sep-04	15-Oct-04	8-Nov-04	6-Dec-04	11-Jan-05	11-Jan-05 DUP	20-Apr-05	13-May-05	13-Jun-05	12-Jul-05	4-Aug-05	8-Sep-05	7-Oct-05	23-Nov-05	20-Jan-06	24-Feb-06	23-Mar-06	28-Apr-06
INORGANICS																					
Total Alkalinity (Total as $CaCO_3$)	mg/L	5	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5	<5	<5	<5	<5	<5
Color	TCU	5	-	130	47	77	36	27	26	29	51	65	38	33	30	39	68	42	25	23	45
Dissolved Hardness ($CaCO_3$)	mg/L	1	-	8.4	6	7.1	5.3	3.9	3.9	6.2	4.3	5.7	7.6	8.6	9.4	15	8	6	8	8	6
Nitrate + Nitrite (as N)	mg/L	0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.07	0.14	0.09	<0.05	<0.05	<0.05	0.09	0.06	<0.05
Nitrate (as N)	mg/L	0.05	2.9	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.07	0.14	0.09	<0.05	<0.05	<0.05	0.09	0.06	<0.05
Nitrite (N)	mg/L	0.01	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	x	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Kjeldahl Nitrogen (TKN)	mg/L	0.1		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total Nitrogen	mg/L			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total Org. Carbon (by UV)	mg/L	0.5	-	15.8	10	17.2	7.7	6.7	6.7	4.1	NS	10	7.3	5.7	6.3	9.7	15	6.1	4	3	7.1
Ortho Phosphate (as P)	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	<0.01	<0.01	<0.01	<0.01	<0.01
Phosphorus	mg/L	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	5.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
pH	units	0.1	>6.5;<9.0	5.6	5.5	4.9	5.2	5.1	5	5.73	6.28	6.07	6.45	6.19	6.35	6.32	4.65	5.1	6.47	5.69	5.52
Reactive Silica (as SiO_2)	mg/L	0.5	-	3.2	2.7	3.2	3	2.2	2.3	1.8	1.7	<0.5	1.1	0.8	1.5	2.7	2.2	2.2	3.2	2.3	1.6
Dissolved Chloride (Cl)	mg/L	1	-	8	4	6	6	4	4	8.6	5.5	6.4	8.8	9.8	12	8	9	8	9	10	6
Calcium	mg/L	0.1	-	2.2	1.4	1.7	1.3	0.9	0.9	1.6	1.1	1.4	1.9	2.1	2.4	3.7	1.9	1.4	1.9	2	1.4
Magnesium	mg/L	0.1	-	0.7	0.6	0.7	0.5	0.4	0.4	0.5	0.4	0.5	0.7	0.8	0.8	1.3	0.8	0.5	0.7	0.7	0.5
Potassium	mg/L	0.1	-	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.2	0.3	0.3	0.4	0.3	0.5	0.2	0.2	0.2	0.3
Sodium	mg/L	0.1	-	5.6	2.9	4.8	4	2.3	2.3	5.3	3.5	4.6	5.8	6.4	6.8	6.4	4.4	4.1	5.5	6.1	4.5
Dissolved Sulphate (SO_4)	mg/L	2	-	<5.0	<5.0	2	2	2	2	<5	<5	<5	<5	<5	<5	10	<5	<2	<2	<2	<2
Conductivity	us/cm	1	-	42	26	43	39	26	26	40	29	34	45	52	56	59	50	37	45	51	36
Turbidity	NTU	0.1	-	0.7	0.4	0.5	0.2	0.5	0.3	0.2	0.4	0.7	<0.1	0.5	1.3	0.3	3.1	1.7	0.2	0.5	0.7
Total Suspended Solids	mg/L	2	-	1.6	1.8	<2	<2	<2	<2	<2	<2	3	3	2.9	9.5	12	<2	<2	<2	<2	<2
RCAP CALCULATIONS																					
Anion Sum	meq/L	-	-	0.43	0.26	0.1	0.31	0.26	0.26	0.243	0.154	0.181	0.252	0.287	0.341	0.537	0.253	0.215	0.256	0.299	0.18
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5	<5	<5	<5	<5	<5
Calculated TDS	mg/L	0.1	-	28	<0.1	22	20	15	15	18.3	12.8	13.6	19.2	21.1	24.4	36	19	16	21	22	15
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cation Sum	meq/L	0.1	-	0.42	0.26	0.38	0.3	0.2	0.2	0.368	0.256	0.333	0.421	0.466	0.499	0.587	0.4	0.309	0.399	0.438	0.325
Elements (ICP-MS)																					
Total Aluminum (Al)	ug/L	10	5-100	390	240	310	160	120	120	93.7	150	180	91	65	67	97	305	190	119	129	186
Total Antimony (Sb)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Total Arsenic (As)	µg/L	2	5	3	<2	<2	<2	<2	<2	<2	<2	2.5	2.7	2.3	<2	<2	<2	<2	<2	<2	<2
Total Barium (Ba)	µg/L	5	-	7	<5	7	<5	<5	<5	<5	<5	<5	<5	<5	<5	6	7.6	<5	<5	<5	<5
Total Beryllium (Be)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Total Bismuth (Bi)	µg/L	2	-	<2	<2	<2	<2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Total Boron (B)	µg/L	5	-	6	<5	<5	<5	5	<5	<5	<5	<5	6	5.5	6.8	9	7.4	<5	<5	<5	5.4
Total Cadmium (Cd)	µg/L	0.3	0.017	<0.3	<0.3	<0.3	0.03	<0.3	0.02	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.03	<0.3	<0.3	0.023	0.018
Total Chromium (Cr)	µg/L	2	y	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Total Cobalt (Co)	µg/L	1	-	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.49	<0.4	<1	<1	<1
Total Copper (Cu)	µg/L	2	2-4	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Total Iron (Fe)	µg/L	50	300	610	430	460	200	240	260	91	150	300	260	190	130	140	255	170	96	149	142
Total Lead (Pb)	µg/L	0.5	7-Jan	0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Manganese (Mn)	µg/L	2	-	76	66	99	70	61	64	25.8	39	41	23	22	14	16	117	50.3	31	68.9	36.6
Total Mercury (Hg)	µg/L	0.01	z	NS	NS	NS	NS	<0.01	<0.01	NS	0.01	NS	<0.01	NS	NS	NS	NS	NS	NS	NS	NS
Total Molybdenum (Mo)	µg/L	2	73	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Total Nickel (Ni)	µg/L	2	25-150	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Total Selenium (Se)	µg/L	2	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total Silver (Ag)	µg/L	0.5	0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Strontium (Sr)	µg/L	5	-	10	6	9	7	5	5	6.3	<5	6.2	8	9.8	11	16	9.5	7.5	8.4	8.5	6.1
Total Thallium (Tl)	µg/L	0.1	0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Tin (Sn)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Total Titanium (Ti)	µg/L	2	-	3	2	3	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	4	<2	<2	<2	<2
Total Uranium (U)	µg/L	0.1	-	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Vanadium (V)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Total Zinc (Zn)	µg/L	5	30	7	6	6	5	47	48	<5	<5	<5	<5	5.8	<5	7	10	17.4	<5	<5	<5
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.002	-	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

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NS = Not sampled

NA= Not analyzed

RDL = Reportable Detection Limit

x = Ammonia Guideline is based on pH and Temperature

y = Chromium Guideline is based on speciation (Cr III = 8.9 ug/L, CR VI = 1ug/L)

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Table 3. Results of Laboratory Analyses for Surface Water Samples Collected From Sampling Location SW3 from September 2004 to February 2007

	Units	RDL	FWAL 2006	25-May-06	28-Jun-06	26-Jul-06	26-Jul-06	28-Aug-06	28-Sep-06	27-Oct-06	27-Oct-06	27-Nov-06	14-Dec-06	18-Jan-07	7-Feb-07	MIN	MAX
INORGANICS																	
Total Alkalinity (Total as $CaCO_3$)	mg/L	5	-	<5	<5	<5	NA	<5	<5	<5	NA	<5	<5	NA	NS	<5.0	<5
Color	TCU	5	-	59	110	130	NA	46	31	55	NA	46	40	NA	NS	23	130
Dissolved Hardness ($CaCO_3$)	mg/L	1	-	6	5	7	NA	11	8	7	NA	7	6	NA	NS	3.9	15
Nitrate + Nitrite (as N)	mg/L	0.05	-	<0.05	<0.05	0.09	NA	0.08	0.08	<0.05	NA	<0.05	<0.05	NA	NS	<0.05	0.14
Nitrate (as N)	mg/L	0.05	2.9	<0.05	<0.05	0.09	NA	0.08	0.08	<0.05	NA	<0.05	<0.05	NA	NS	<0.05	0.14
Nitrite (N)	mg/L	0.01	0.06	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	NA	<0.01	<0.01	NA	NS	<0.01	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	x	<0.05	<0.05	<0.05	NA	<0.05	<0.05	<0.05	NA	<0.05	<0.05	NA	NS	<0.05	<0.05
Total Kjeldahl Nitrogen (TKN)	mg/L	0.1		NS	NS	1.2	NA	0.5	0.3	0.3	NA	NA	0.3	NA	NS	0.3	1.2
Total Nitrogen	mg/L			NS	NS	0.36	NA	0.37	0.3	0.28	NA	0.21	NA	0.21	NS	0.21	0.37
Total Org. Carbon (by UV)	mg/L	0.5	-	9.7	17	23	NA	8.5	5.3	11	NA	9	6.6	NA	NS	3	23
Ortho Phosphate (as P)	mg/L	0.01	-	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	NA	<0.01	<0.01	NA	NS	<0.01	<0.01
Phosphorus	mg/L	0.1	-	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	NA	<0.1	<0.1	NA	NS	<0.1	5.3
pH	units	0.1	>6.5;<9.0	6.04	5.02	4.86	4.74	6.57	6.04	5.22	5.28	5.04	5.33	NA	NS	4.65	6.57
Reactive Silica (as SiO_2)	mg/L	0.5	-	1.4	2.3	2.8	NA	2.6	1.9	3.5	NA	3.4	2.9	NA	NS	0.8	3.5
Dissolved Chloride (Cl)	mg/L	1	-	6	4	4	NA	7	9	6	NA	7	6	NA	NS	4	12
Calcium	mg/L	0.1	-	1.5	1.2	1.7	NA	3.1	2.2	1.7	NA	1.6	1.4	NA	NS	0.9	3.7
Magnesium	mg/L	0.1	-	0.5	0.4	0.6	NA	0.7	0.7	0.6	NA	0.7	0.5	NA	NS	0.4	1.3
Potassium	mg/L	0.1	-	0.2	0.2	0.2	NA	0.2	0.3	0.2	NA	0.2	0.1	NA	NS	0.1	0.5
Sodium	mg/L	0.1	-	4.7	3.3	3.5	NA	5.3	4.3	3.5	NA	3.9	3.2	NA	NS	2.3	6.8
Dissolved Sulphate (SO_4)	mg/L	2	-	<2	<2	<2	NA	<2	<2	<2	NA	<2	<2	NA	NS	<2.0	10
Conductivity	us/cm	1	-	35	28	33	NA	40	42	36	35	37	32	NA	NS	26	59
Turbidity	NTU	0.1	-	0.3	0.3	0.5	NA	1.2	0.3	0.5	NA	0.5	0.3	NA	NS	0.2	3.1
Total Suspended Solids	mg/L	2	-	<2	<2	3	NA	7	2	<1	NA	NA	2	NA	NS	1.6	12
RCAP CALCULATIONS																	
Anion Sum	meq/L	-	-	0.175	0.105	0.123	NA	0.209	0.247	0.176	NA	0.192	0.165	NA	NS	0.1	0.537
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<5	<5	<5	NA	<1	<1	<1	NA	<1	<1	NA	NS	<1.0	5
Calculated TDS	mg/L	0.1	-	15	12	14	NA	20	19	16	NA	17	14	NA	NS	12	36
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<5	<5	<5	NA	<1	<1	<1	NA	<1	<1	NA	NS	<1.0	<1
Cation Sum	meq/L	0.1	-	0.338	0.269	0.322	NA	0.465	0.37	0.308	NA	0.327	0.262	NA	NS	0.2	0.587
Elements (ICP-MS)																	
Total Aluminum (Al)	ug/L	10	5-100	216	330	446	NA	171	74.3	235	NA	219	165	NA	NS	65	446
Total Antimony (Sb)	μg/L	2	-	<2	<2	<2	NA	<2	<2	<2	NA	<2	<2	NA	NS	<2.0	<2.0
Total Arsenic (As)	μg/L	2	5	<2	<2	2.1	NA	3.7	<2	<2.0	NA	<2.0	<2	NA	NS	<2.0	3.7
Total Barium (Ba)	μg/L	5	-	<5	5.4	7.1	NA	<5	<5	<5.0	NA	7.1	<5	NA	NS	<5.0	7.6
Total Beryllium (Be)	μg/L	2	-	<2	<2	<2	NA	<2	<2	<2.0	NA	<2.0	<2	NA	NS	<2.0	<2
Total Bismuth (Bi)	μg/L	2	-	<2	<2	<2	NA	<2	<2	<2.1	NA	<2.0	<2.0	NA	NS	<2.0	2
Total Boron (B)	μg/L	5	-	5.3	5.7	<5	NA	7.7	6.5	<5.0	NA	<5.0	<5.0	NA	NS	<5.0	9
Total Cadmium (Cd)	μg/L	0.3	0.017	0.036	0.02	0.036	NA	<0.3	<0.3	0.02	NA	0.018	0.017	NA	NS	<0.017	0.036
Total Chromium (Cr)	μg/L	2	y	<2	<2	<2	NA	<2	<2	<2.0	NA	<2.0	<2.0	NA	NS	<2.0	<2.0
Total Cobalt (Co)	μg/L	1	-	<1	<1	0.47	NA	0.91	<1	<0.40	NA	<0.40	<0.40	NA	NS	<0.40	0.91
Total Copper (Cu)	μg/L	2	2-4	<2	<2	<2	NA	<2	<2	<2.0	NA	<2.0	<2.0	NA	NS	<2.0	<2.0
Total Iron (Fe)	μg/L	50	300	196	298	446	NA	462	129	250	NA	215	170	NA	NS	91	610
Total Lead (Pb)	μg/L	0.5	7-Jan	<0.5	0.62	0.76	NA	0.97	<0.5	<0.50	NA	<0.50	<0.50	NA	NS	<0.50	0.97
Total Manganese (Mn)	μg/L	2	-	39	58.9	108	NA	141	12.9	56.2	NA	52.8	42.4	NA	NS	12.9	141
Total Mercury (Hg)	μg/L	0.01	z	NS	NS	<0.01	NA	<0.01	<0.01	<0.01	NA	<0.01	<0.01	NA	NS	<0.01	<0.01
Total Molybdenum (Mo)	μg/L	2	73	<2	<2	<2	NA	<2	<2	<2.0	NA	<2.0	<2.0	NA	NS	<2.0	<2.0
Total Nickel (Ni)	μg/L	2	25-150	<2	<2	<2	NA	<2	<2	<2.0	NA	<2.0	<2.0	NA	NS	<2.0	<2.0
Total Selenium (Se)	μg/L	2	1	<1	<1	<1	NA	<1	<1	<1.0	NA	<1.0	<1.0	NA	NS	<1.0	<1.0
Total Silver (Ag)	μg/L	0.5	0.1	<0.5	<0.5	<0.5	NA	<0.1	<0.1	<0.10	NA	<0.10	<0.10	NA	NS	<0.10	<0.10
Total Strontium (Sr)	μg/L	5	-	6.8	6.3	8.4	NA	8.7	8.3	7.5	NA	7.9	6.1	NA	NS	<5	16
Total Thallium (Tl)	μg/L	0.1	0.8	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10	NA	<0.10	<0.10	NA	NS	<0.10	<0.10
Total Tin (Sn)	μg/L	2	-	<2	<2	<2	NA	<2	<2	<2.0	NA	<2.0	<2.0	NA	NS	<2.0	<2.0
Total Titanium (Ti)	μg/L	2	-	<2	2.4	3.2	NA	2.5	<2	<2.0	NA	<2.0	<2.0	NA	NS	<2.0	4
Total Uranium (U)	μg/L	0.1	-	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10	NA	<0.10	<0.10	NA	NS	<0.10	0.1
Total Vanadium (V)	μg/L	2	-	<2	<2	<2	NA	<2	<2	<2.0	NA	<2.0	<2.0	NA	NS	<2.0	<2.0
Total Zinc (Zn)	μg/L	5	30	5.9	12.9	9.4	NA	6.9	6	6.1	NS	7.8	6.1	NA	NS	<5.0	48
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.002	-	NS	NS	<0.002	NA	<0.002	<0.002	<0.002	<0.002	NS	<0.002	NA	NS	<0.002	<0.002

FWAL 2006 = Canadian Environmental Quality Guidelines - Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (2006)
NS = Not sampled
NA= Not analyzed
RDL = Reportable Detection Limit
x = Ammonia Guideline is based on pH and Temperature
y = Chromium Guideline is based on speciation (Cr III = 8.9 ug/L, CR VI = 1ug/L)
z = Mercury Guideline is based on speciation (Inorganic Hg = 0.026ug/L, Methyl Hg= 0.004ug/L

Table 4. Results of Laboratory Analyses for Surface Water Samples Collected From Sampling Location SW4 from September 2004 to January 2007

	Units	RDL	FWAL 2006	1-Sep-04	15-Oct-04	8-Nov-04	6-Dec-04	11-Jan-05	17-Feb-05	20-Apr-05	13-May-05	13-Jun-05	12-Jul-05	4-Aug-05	8-Sep-05	8-Sep-05 Duplicate	7-Oct-05	23-Nov-05	20-Jan-06	24-Feb-06	23-Mar-06
INORGANICS																					
Total Alkalinity (Total as $CaCO_3$)	mg/L	5	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	NS	<5
Color	TCU	5	-	110	70	54	30	27	45	34	39	58	47	33	20	19	35	53	40	NS	30
Dissolved Hardness ($CaCO_3$)	mg/L	1	-	6	8.9	5.5	4.6	7	3.9	4	3.5	4.1	5.1	5	5.9	NA	10	7	5	NS	5
Nitrate + Nitrite (as N)	mg/L	0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<0.05	<0.05	<0.05	NS	0.06
Nitrate (as N)	mg/L	0.05	2.9	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<0.05	<0.05	<0.05	NS	0.06
Nitrite (N)	mg/L	0.01	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	NS	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	x	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<0.05	<0.05	<0.05	NS	<0.05
Total Kjeldahl Nitrogen (TKN)	mg/L	0.1		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA	NS	NS	NS	NS	NS
Total Nitrogen	mg/L			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NA	NS	NS	NS	NS	NS
Total Org. Carbon (by UV)	mg/L	0.5	-	14.8	13	13.6	6.8	5.3	7.2	5.1	6.3	10	8.8	5.8	5.3	NA	10	13	6.8	NS	5.2
Ortho Phosphate (as P)	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	NA	<0.01	<0.01	<0.01	NS	<0.01
Phosphorus	mg/L	0.1	-	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	NS	<0.1
pH	units	0.1	>6.5;<9.0	5.2	5.6	4.8	5.3	5.5	5.92	5.48	5.56	5.73	6.22	6.18	5.96	NA	5.66	4.65	4.94	NS	5.28
Reactive Silica (as SiO_2)	mg/L	0.5	-	2.6	3.8	2.4	1.5	3.6	1.9	1	0.7	<0.5	0.5	<0.5	1.1	NA	2.3	1.8	1.8	NS	2
Dissolved Chloride (Cl)	mg/L	1	-	4	8	4	4	8	3.6	4.1	3.6	3.5	4	3.6	4.3	NA	5	7	4	NS	4
Calcium	mg/L	0.1	-	1.4	2.4	1.2	1	1.8	0.9	1	0.8	0.9	1.3	1.3	1.4	NA	2.4	1.5	1.1	NS	1.1
Magnesium	mg/L	0.1	-	0.6	0.7	0.6	0.5	0.6	0.4	0.4	0.3	0.4	0.4	0.4	0.6	NA	1	0.7	0.4	NS	0.5
Potassium	mg/L	0.1	-	0.3	0.6	0.3	0.3	0.3	0.4	0.3	0.3	0.2	0.3	0.2	0.4	NA	0.6	0.4	0.2	NS	0.3
Sodium	mg/L	0.1	-	2.6	7.2	3	2.7	5	2.3	2.3	2.1	2.3	2.6	2.5	2.9	NA	3.6	3.4	2.3	NS	2.7
Dissolved Sulphate (SO_4)	mg/L	2	-	<5	<5	<5	<5	3	<5	6.6	<5	<5	<5	<5	<5	<5	6	<5	<5	NS	<5
Conductivity	uS/cm	1	-	26	40	32	27	41	24		20	21	22	22	28	NA	40	40	26	NS	27
Turbidity	NTU	0.1	-	0.6	0.4	0.3	0.4	0.3	0.6	0.3	0.6	0.7	0.3	0.3	1.9	NA	0.3	1.2	0.8	NS	0.4
Total Suspended Solids	mg/L	2	-	1.4	1.6	1	<2	<2	<2	<2	<2	3	3.8	<2	3.6	NA	10	<2	NS	NS	6
RCAP CALCULATIONS																					
Anion Sum	meq/L	-	-	0.32	0.37	0.26	0.26	0.39	0.103	0.254	0.102	0.0974	0.113	0.102	0.122	NA	0.276	0.191	0.125	NS	0.121
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	NA	<5	<5	<5	NS	<1
Calculated TDS	mg/L	0.1	-	20	28	17	15	26	10	15.9	8	8	10	9	12.2	NA	22	15	11	NS	11
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<1	NS	<1
Cation Sum	meq/L	0.1	-	0.25	0.51	0.27	0.22	0.37	0.198	0.198	0.181	0.208	0.246	0.243	0.293	NA	0.385	0.322	0.218	NS	0.237
Elements (ICP-MS)																					
Total Aluminum (Al)	µg/L	10	5-100	320	300	220	140	140	140	106	120	170	150	120	310	NA	130	220	162	NS	172
Total Antimony (Sb)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2	<2	NS	<2
Total Arsenic (As)	µg/L	2	5	2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2.8	NA	<2	<2	<2	NS	<2
Total Barium (Ba)	µg/L	5	-	5	5	5	<5	<5	<5	<5	<5	<5	<5	<5	6.8	NA	5	6.2	<5	NS	<5
Total Beryllium (Be)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2	<2	NS	<2
Total Bismuth (Bi)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2.0	<2.0	<2.0	NS	<2.0
Total Boron (B)	µg/L	5	-	5	<5	<5	<5	<5	<5	<5	<5	<5	5.6	<5	6.4	NA	9	5.2	<5	NS	<5
Total Cadmium (Cd)	µg/L	0.3	0.017	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	NA	<0.3	0.09	0.031	NS	0.03
Total Chromium (Cr)	µg/L	2	y	<2	<2	<2	<2	4	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2	<2	NS	<2
Total Cobalt (Co)	µg/L	<0.4	-	1	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	2.8	NA	<0.40	0.46	<0.40	NS	<0.40
Total Copper (Cu)	µg/L	2	2-4	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2	4.1	NS	<2
Total Iron (Fe)	µg/L	50	300	930	410	450	240	250	240	151	190	420	550	700	1100	NA	220	242	223	NS	254
Total Lead (Pb)	µg/L	0.5	1-7	0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	0.6	2	NA	<0.5	<0.5	0.54	NS	<0.5
Total Manganese (Mn)	µg/L	2	-	130	36	110	80	58	68	56.2	51	64	54	64	480	NA	110	157	75.5	NS	86.6
Total Mercury (Hg)	µg/L	0.01	z	NS	NS	NS	NS	<0.01	NS	NS	<0.01	NS	<0.01	NS	NS	NS	NS	NS	NS	NS	NS
Total Molybdenum (Mo)	µg/L	2	73	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NA	<2.0	<2.0	<2.0	NS	<2.0
Total Nickel (Ni)	µg/L	2	25-150	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	17	<2.0	<2.0	<2.0	<2.0	NA	<2.0	<2.0	<2.0	NS	<2.0
Total Selenium (Se)	µg/L	1	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	NA	<1.0	1.6	<1.0	NS	<1.0
Total Silver (Ag)	µg/L	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	NS	<0.1
Total Strontium (Sr)	µg/L	5	-	7	10	6	5	8	<5	<5	<5	<5	5.2	6.1	7.4	NA	12	7.9	7	NS	5.9
Total Thallium (Tl)	µg/L	0.1	0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	NS	<0.1
Total Tin (Sn)	µg/L	2	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NA	<2.0	<2.0	<2.0	NS	<2.0
Total Titanium (Ti)	µg/L	2	-	3	2	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.2	2.5	6.5	NA	<2.0	<2.0	<2.0	NS	2.1
Total Uranium (U)	µg/L	0.1	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	NA	<0.10	<0.10	<0.10	NS	<0.10
Total Vanadium (V)	µg/L	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2	<2	NS	<2
Total Zinc (Zn)	µg/L	5	30	6	20	5	5	55	7.9	<5	6.3	<5	6.4	8.8	5.6	NA	11	10.7	20	NS	<5
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.002		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

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NS = Not sampled

NA= Not analyzed

RDL = Reportable Detection Limit

x = Ammonia Guideline is based on pH and Temperature

y = Chromium Guideline is based on speciation (Cr III = 8.9 ug/L, CR VI = 1ug/L)

z = Mercury Guideline is based on speciation (Inorganic Hg = 0.026ug/L, Methyl Hg= 0.004ug/L

Table 4. Results of Laboratory Analyses for Surface Water Samples Collected From Sampling Location SW4 from September 2004 to January 2007

	Units	RDL	FWAL 2006	28-Apr-06	25-May-06	28-Jun-06	26-Jul-06	26-Jul-06	28-Aug-06	28-Sep-06	28-Sep-06	27-Oct-06	27-Nov-06	27-Nov-06 Duplicate	14-Dec-06	18-Jan-07	MIN	MAX
INORGANICS																		
Total Alkalinity (Total as $CaCO_3$)	mg/L	5	-	<5	<5	<5	<5	<5	<5	<5	NA	<5	<5	NA	<5	<5	<5	<5
Color	TCU	5	-	41	52	86	100	110	82	46	NA	45	40	NA	38	38	19	110
Dissolved Hardness ($CaCO_3$)	mg/L	1	-	4	4	5	5	NA	8	5	NA	5	5	NA	6	5	3.5	10
Nitrate + Nitrite (as N)	mg/L	0.05	-	<0.05	0.1	<0.05	<0.05	NA	0.05	<0.05	NA	<0.05	0.07	NA	0.06	0.14	<0.05	0.14
Nitrate (as N)	mg/L	0.05	2.9	<0.05	0.1	<0.05	<0.05	NA	0.05	<0.05	NA	<0.05	0.07	NA	0.06	0.14	0.05	0.14
Nitrite (N)	mg/L	0.01	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	x	<0.05	<0.05	<0.05	0.07	NA	<0.05	<0.05	NA	<0.05	<0.05	NA	<0.05	<0.05	<0.05	0.07
Total Kjeldahl Nitrogen (TKN)	mg/L	0.1		NS	NS	NS	2	NA	0.6	0.4	NA	0.4	NA	NA	0.3	NA	0.3	2
Total Nitrogen	mg/L			NS	NS	NS	0.38	NA	0.57	0.3	NA	0.26	0.21	NA	NA	0.3	0.21	0.57
Total Org. Carbon (by UV)	mg/L	0.5	-	7.5	9.5	13	18	NA	14	7.7	NA	9.2	7.9	NA	7.3	6.8	5.1	18
Ortho Phosphate (as P)	mg/L	0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01
Phosphorus	mg/L	0.1	-	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	NA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
pH	units	0.1	>6.5;<9.0	5.47	5.7	5.11	5.06	NA	6.12	5.55	5.57	4.98	4.99	NA	5.69	5.32	4.65	6.22
Reactive Silica (as SiO_2)	mg/L	0.5	-	0.9	0.7	1.1	2	2	1.5	<0.5	NA	1.3	1.8	NA	1.5	1.5	<0.5	3.8
Dissolved Chloride (Cl)	mg/L	1	-	3	4	3	3	3	4	4	NA	4	5	NA	4	4	3	8
Calcium	mg/L	0.1	-	1.1	1	1.1	1.2	NA	2.4	1.1	NA	1.1	1.1	1.1	1.5	1.4	0.8	2.4
Magnesium	mg/L	0.1	-	0.4	0.4	0.4	0.5	NA	0.5	0.5	NA	0.5	0.5	0.5	0.6	0.5	0.3	1
Potassium	mg/L	0.1	-	0.4	0.2	0.3	0.2	NA	0.5	0.4	NA	0.3	0.3	0.3	0.3	0.3	0.2	0.6
Sodium	mg/L	0.1	-	2.4	2.3	2.4	2.4	NA	2.8	2	NA	2.2	15	15	2.1	2.6	2	15
Dissolved Sulphate (SO_4)	mg/L	2	-	<5	<5	<5	<5	<5	<5	<5	NA	<2	<2	NA	<2	<2	3	6.6
Conductivity	uS/cm	1	-	24	25	22	25	NA	26	23	23	27	29	NA	25	28	20	41
Turbidity	NTU	0.1	-	2	0.4	0.4	0.5	NA	1	0.7	NA	0.9	0.4	NA	2.1	0.6	0.3	2.1
Total Suspended Solids	mg/L	2	-	<2	2	NS	<2	NA	3	<2	<2	2	<2	NA	2	<2	1	10
RCAP CALCULATIONS																		
Anion Sum	meq/L	-	-	0.0942	0.107	0.0836	0.0869	NA	0.111	0.112	NA	0.104	0.135	NA	0.115	0.117	0.0836	0.39
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<1	<1	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	<1	<1
Calculated TDS	mg/L	0.1	-	9	9	9	11	NA	13	9	NA	10	24	NA	11	11	8	28
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<1	<1	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	<1	<1
Cation Sum	meq/L	0.1	-	0.21	0.207	0.233	0.26	NA	0.345	0.221	NA	0.222	0.79	NA	0.236	0.249	0.181	0.79
Elements (ICP-MS)																		
Total Aluminum (Al)	µg/L	10	5-100	160	175	257	306	NA	212	132	NA	171	166	163	217	<2.0	<2.0	320
Total Antimony (Sb)	µg/L	2	-	<2	<2	<2	<2	NA	<2	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Arsenic (As)	µg/L	2	5	<2	<2	<2	2.6	NA	2.7	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.8
Total Barium (Ba)	µg/L	5	-	<5	<5	<5	5.1	NA	<5	<5	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	6.8
Total Beryllium (Be)	µg/L	2	-	<2	<2	<2	<2	NA	<2	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Bismuth (Bi)	µg/L	2	-	<2.0	<2.0	<2.0	<2.0	NA	<2.0	<2.0	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Boron (B)	µg/L	5	-	<5	<5	6.1	5.1	NA	5.6	5.4	NA	5.1	<5.0	<5.0	<5.0	<5.0	<5.0	9
Total Cadmium (Cd)	µg/L	0.3	0.017	0.03	<0.3	<0.3	0.03	NA	<0.3	<0.3	NA	<0.017	0.017	<0.017	0.033	0.02	<0.017	0.09
Total Chromium (Cr)	µg/L	2	y	<2	<2	<2	<2	NA	<2	3.4	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	4
Total Cobalt (Co)	µg/L	<0.4	-	<0.40	<0.40	0.49	0.92	NA	0.5	0.47	NA	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	2.8
Total Copper (Cu)	µg/L	2	2-4	<2	<2	<2	<2	NA	<2	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	4.1
Total Iron (Fe)	µg/L	50	300	196	334	581	896	NA	1180	725	NA	354	308	301	357	314	151	1180
Total Lead (Pb)	µg/L	0.5	1-7	<0.5	<0.5	0.5	0.53	NA	0.66	<0.5	NA	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	2
Total Manganese (Mn)	µg/L	2	-	60.6	84.3	111	220	NA	85.9	92.1	NA	86.2	74.9	73.3	67.5	57.6	36	480
Total Mercury (Hg)	µg/L	0.01	z	NS	NS	NS	<0.01	NA	<0.01	<0.01	NA	<0.01	<0.01	NA	<0.1	<0.01	<0.01	<0.1
Total Molybdenum (Mo)	µg/L	2	73	<2.0	<2.0	<2.0	<2.0	NA	<2.0	<2.0	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Nickel (Ni)	µg/L	2	25-150	<2.0	<2.0	<2.0	<2.0	NA	<2.0	<2.0	NA	<2.0	<2.0	<2.0	<2.0	<2.0	17	17
Total Selenium (Se)	µg/L	1	1	<1.0	<1.0	<1.0	<1.0	NA	<1.0	<1.0	NA	<1.0	<1.0	<1.0	<1.0	<1.0	1.6	1.6
Total Silver (Ag)	µg/L	0.1	0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	NA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Strontium (Sr)	µg/L	5	-	<5	5.5	7	6.5	NA	6.6	5.2	NA	5.1	5.9	5.9	5.1	11.3	5	12
Total Thallium (Tl)	µg/L	0.1	0.8	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	NA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Tin (Sn)	µg/L	2	-	<2.0	<2.0	<2.0	<2.0	NA	<2.0	<2.0	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Titanium (Ti)	µg/L	2	-	<2.0	<2.0	<2.0	2.5	NA	2.3	<2.0	NA	<2.0	<2.0	<2.0	3.8	<2.0	<2.0	6.5
Total Uranium (U)	µg/L	0.1	-	<0.10	<0.10	<0.10	<0.10	NA	<0.10	<0.10	NA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Vanadium (V)	µg/L	2	-	<2	<2	<2	<2	NA	<2	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Zinc (Zn)	µg/L	5	30	9	6.9	22.8	7.2	NA	13.4	5.9	NA	7.5	6.3	6.2	10.8	13.3	5	55
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.002		NS	NS	NS	<0.002	NA	<0.002	<0.002	NA	0.002	0.002	NA	<0.002	<0.002	<0.002	0.002

FWAL 2006 = Canadian Environmental Quality Guidelines - Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (2006)

NS = Not sampled

NA= Not analyzed

RDL = Reportable Detection Limit

x = Ammonia Guideline is based on pH and Temperature

y = Chromium Guideline is based on speciation (Cr III = 8.9 ug/L, CR VI = 1ug/L)

z = Mercury Guideline is based on speciation (Inorganic Hg = 0.026ug/L, Methyl Hg= 0.004ug/L

Table 5. Results of Laboratory Analysis for Surface Water Samples Collected From Sampling Location SW5 from July 2005 to June 2006

	Units	RDL	FWAL 2006	12-Jul-05	4-Aug-05	8-Sep-05	7-Oct-05	23-Nov-05	23-Nov-05 Duplicate	20-Jan-06	24-Feb-06	23-Mar-06	28-Apr-06	25-May-06	28-Jun-06	MIN	MAX
INORGANICS																	
Total Alkalinity (Total as $CaCO_3$)	mg/L	5	-	5.6	12	11	10	<5	NA	<5	NS	<5	<5	<5	<5	<5	12
Color	TCU	5	-	97	83	160	170	69	NA	49	NS	34	55	79	120	34	170
Dissolved Hardness ($CaCO_3$)	mg/L	1	-	10	14	37	13	6	NA	4	NS	5	5	5	5	4	37
Nitrate + Nitrite (as N)	mg/L	0.05	-	0.09	<0.05	<0.05	<0.05	<0.05	NA	0.08	NS	0.06	<0.05	<0.05	<0.05	<0.05	0.09
Nitrate (as N)	mg/L	0.05	2.4	0.09	<0.05	<0.05	<0.05	<0.05	NA	0.08	NS	0.06	<0.05	<0.05	<0.05	<0.05	0.09
Nitrite (N)	mg/L	0.01	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	NS	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	x	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<0.05	NS	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Kjeldahl Nitrogen (TKN)	mg/L	0.1		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
Total Nitrogen	mg/L			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
Total Org. Carbon (by UV)	mg/L	0.5	-	16	7.5	22	28	14	NA	7.2	NS	4.4	10	14	17	4.4	28
Ortho Phosphate (as P)	mg/L	0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	NS	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phosphorus	mg/L	0.1	-	<0.1	<0.1	0.3	<0.1	<0.1	NA	<0.1	NS	<0.1	<0.1	<0.1	<0.1	<0.1	0.3
pH	units	0.1	>6.5;<9.0	6.17	6.32	5.91	5.92	4.47	NA	5.03	NS	5.39	5.29	5.4	5.03	4.47	6.32
Reactive Silica (as SiO_2)	mg/L	0.5	-	4.8	4.3	5.1	5	2.3	NA	2.1	NS	3	1.2	0.7	1.2	0.7	5.1
Dissolved Chloride (Cl)	mg/L	1	-	6.3	6.4	9.4	9	9	NA	6	NS	5	4	4	4	4	9.4
Calcium	mg/L	0.1	-	2.6	3.6	11	3.3	1.1	NA	1	NS	1.3	1	1	1.2	1	11
Magnesium	mg/L	0.1	-	0.9	1.2	2.2	1.1	0.7	NA	0.5	NS	0.6	0.5	0.5	0.5	0.5	2.2
Potassium	mg/L	0.1	-	1.2	1.5	4.1	2.4	2.1	NA	1.3	NS	1.1	1.3	1.4	1.5	1.1	4.1
Sodium	mg/L	0.1	-	3.8	4.1	4.4	4.3	3.5	NA	2.6	NS	3.1	2.7	2.7	2.4	2.4	4.4
Dissolved Sulphate (SO_4)	mg/L	2	-	<2	<2	<2	<2	<2	NA	<2	NS	<2	<2	<2	<2	<2	<2
Conductivity	uS/cm	1	-	39	51	59	53	53	NA	31	NS	32	29	28	27	27	59
Turbidity	NTU	0.1	-	0.5	3.4	5.3	2	2.1	NA	2.7	NS	0.3	2.8	1.1	0.4	0.3	5.3
Total Suspended Solids	mg/L	2	-	13	8.2	220	9	4	2	<2	NS	<2	<2	6	<2	<2	220
RCAP CALCULATIONS																	
Anion Sum	meq/L	-	-	0.296	0.426	0.49	0.456	0.252	NA	0.168	NS	0.145	0.123	0.114	0.0989	0.0989	0.49
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	6	12.3	11.3	10	<1	NA	<1	NS	<1	<1	<1	<1	<1	12.3
Calculated TDS	mg/L	0.1	-	24.7	32	59.2	36	20	NA	14	NS	15	12	11	11	11	59.2
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<1	<1	<1	<1	<1	NA	<1	NS	<1	<1	<1	<1	<1	<1
Cation Sum	meq/L	0.1	-	0.423	0.522	1.34	0.603	0.369	NA	0.253	NS	0.282	0.257	0.259	0.266	0.253	1.34
Elements (ICP-MS)																	
Total Aluminum (Al)	µg/L	10	5-100	330	250	3000	460	366	NA	216	NS	167	239	307	407	167	3000
Total Antimony (Sb)	µg/L	2	-	<2	<2	<2	<2	<2	NA	<2	NS	<2	<2	<2	<2	<2	<2
Total Arsenic (As)	µg/L	2	5	<2	<2	6.6	2	<2	NA	<2	NS	<2	<2	<2	<2	2	6.6
Total Barium (Ba)	µg/L	5	-	5.5	15	130	15	9.3	NA	6.3	NS	5.6	5.7	8.4	8.2	5.5	130
Total Beryllium (Be)	µg/L	2	-	<2	<2	<2	<2	<2	NA	<2	NS	<2	<2	<2	<2	<2	<2
Total Bismuth (Bi)	µg/L	2	-	<2	<2	<2	<2	<2	NA	<2	NS	<2	<2	<2	<2	<2	<2
Total Boron (B)	µg/L	5	-	6.3	6	9.5	9	7.3	NA	6	NS	<5	6.7	6.4	10.4	5	10.4
Total Cadmium (Cd)	µg/L	0.3	0.017	<0.3	<0.3	<0.3	<0.3	0.062	NA	0.032	NS	0.042	0.033	0.033	0.03	0.03	0.062
Total Chromium (Cr)	µg/L	2	y	<2	<2	<2	<2	<2	NA	<2	NS	<2	<2	<2	<2	<2	<2
Total Cobalt (Co)	µg/L	<0.4	-	2	3.9	25	4	2.83	NA	0.45	NS	0.7	0.48	0.62	0.64	0.45	25
Total Copper (Cu)	µg/L	2	2-4	<2	<2	4.9	<2	<2	NA	<2	NS	<2	<2	<2	<2	<2	4.9
Total Iron (Fe)	µg/L	50	300	620	690	8900	2600	300	NA	213	NS	212	227	357	416	212	8900
Total Lead (Pb)	µg/L	0.5	1-7	0.7	0.6	23	1.2	0.55	NA	<0.5	NS	0.52	<0.5	0.57	0.75	<.5	23
Total Manganese (Mn)	µg/L	2	-	650	2500	7600	1800	489	NA	255	NS	234	191	223	237	191	7600
Total Mercury (Hg)	µg/L	0.01	z	<0.01	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		<0.01	<0.01
Total Molybdenum (Mo)	µg/L	2	73	<2	<2	<2	<2	<2	NA	<2	NS	<2	<2	<2	<2	<2	<2
Total Nickel (Ni)	µg/L	2	25-150	<2	<2	4.6	<2	<2	NA	<2	NS	<2	<2	<2	<2	<2	4.6
Total Selenium (Se)	µg/L	1	1	<1	<1	<1	<1	2.7	NA	<1	NS	<1	<1	<1	<1	<1	2.7
Total Silver (Ag)	µg/L	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	NS	<0.1	<0.1	<0.1	<0.1	<.1	<.1
Total Strontium (Sr)	µg/L	5	-	9	15	55	13	6.8	NA	5.3	NS	6.7	<5	<5	5.5	<5	55
Total Thallium (Tl)	µg/L	0.1	0.8	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	NS	<0.1	<0.1	<0.1	<0.1	<.1	<.1
Total Tin (Sn)	µg/L	2	-	<2	<2	<2	<2	<2	NA	<2	NS	<2	<2	<2	<2	<2	<2
Total Titanium (Ti)	µg/L	2	-	4.1	4	34	7	4.6	NA	2.3	NS	2.2	<2	2.7	3.3	<2	34
Total Uranium (U)	µg/L	0.1	-	<0.1	<0.1	0.4	<0.1	<0.1	NA	<0.1	NS	<0.1	<0.1	<0.1	<0.1	0.4	0.4
Total Vanadium (V)	µg/L	2	-	<2	<2	3.8	<2	<2	NA	<2	NS	<2	<2	<2	<2	<2	3.8
Total Zinc (Zn)	µg/L	5	30	6.7	12	35	11	13.1	NA	12.7	NS	15	6.5	6.7	18.9	6.5	35
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.002		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		

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RDL = Reportable Detection Limit

x = Ammonia Guideline is based on pH and Temperature

y = Chromium Guideline is based on speciation (Cr III = 8.9 ug/L, CR VI = 1ug/L)

z = Mercury Guideline is based on speciation (Inorganic Hg = 0.026ug/L, Methyl Hg= 0.004ug/L

Table 6. Results of Laboratory Analyses for Surface Water Samples Collected From Sampling Location SW6 from July 2005 to January 2007

	Units	RDL	FWAL 2006	12-Jul-05	4-Aug-05	4-Aug-05 Duplicate	8-Sep-05	7-Oct-05	23-Nov-05	23-Nov-05 Duplicate	20-Jan-06	24-Feb-06	23-Mar-06	28-Apr-06	25-May-06	28-Jun-06	26-Jul-06	28-Aug-06	28-Sep-06	27-Oct-06	27-Nov-06	14-Dec-06	18-Jan-07	MIN	MAX
INORGANICS																									
Total Alkalinity (Total as $CaCO_3$)	mg/L	5	-	ND	ND	ND	ND	<5	<5	NA	<5	NS	NS	<5	<5	<5	<5	6	<5	<5	<5	<5	<5	<5	6
Color	TCU	5	-	91	120	120	35	48	69	NA	38	NS	NS	35	53	97	110	76	48	52	39	35	23	23	120
Dissolved Hardness ($CaCO_3$)	mg/L	1	-	5.2	6	5.9	14	11	9	NA	5	NS	NS	5	5	5	6	10	7	6	6	5	4	4	14
Nitrate + Nitrite (as N)	mg/L	0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<0.05	NS	NS	0.12	0.08	<0.05	<0.05	<0.05	<0.05	0.06	0.06	0.06	0.11	<0.05	0.12
Nitrate (as N)	mg/L	0.05	2.9	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<0.05	NS	NS	0.12	0.08	<0.05	<0.05	<0.01	<0.05	0.06	0.06	0.06	0.11	0.06	0.12
Nitrite (N)	mg/L	0.01	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	NS	NS	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	x	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	NA	<0.05	NS	NS	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Total Kjeldahl Nitrogen (TKN)	mg/L	0.1		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.9	0.5	0.5	0.3	0.3	0.5	0.3	0.3	0.9
Total Nitrogen	mg/L			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.32	0.24	0.19	0.27	0.17	0.16	0.19	0.16	0.32
Total Org. Carbon (by UV)	mg/L	0.5	-	12	14	14	8.2	10	15	NA	5.9	NS	NS	5.3	9.8	18	20	12	8.3	8.9	7.1	9	4	4	20
Ortho Phosphate (as P)	mg/L	0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	NS	NS	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phosphorus	mg/L	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	NS	NS	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
pH	units	0.1	>6.5;<9.0	6.35	6.31	6.2	6.26	5.46	4.71	4.69	5.05	NS	NS	5.44	5.42	5.03	5.01	6.6	5.35	5.29	5.08	5.26	5.31	4.69	6.6
Reactive Silica (as SiO_2)	mg/L	0.5	-	6.8	10	10	4.2	4.3	2.5	NA	2.9	NS	NS	3.4	3.7	1.9	3.9	6.8	9	5.5	4.6	3.9	4.2	1.9	10
Dissolved Chloride (Cl)	mg/L	1	-	4.2	4.4	4.3	4.1	5	8	NA	5	NS	NS	4	3	3	3	4	5	4	5	4	3	3	8
Calcium	mg/L	0.1	-	1.3	1.5	1.4	3.6	2.6	2.1	NA	1.2	NS	NS	1	1.1	1.1	1.5	3	1.6	1.4	1.3	1.1	1	1	3.6
Magnesium	mg/L	0.1	-	0.5	0.6	0.5	1.2	1	0.9	NA	0.5	NS	NS	0.5	0.5	0.5	0.6	0.5	0.6	0.6	0.6	0.5	0.5	0.5	1.2
Potassium	mg/L	0.1	-	0.3	0.5	0.4	0.3	0.3	0.6	NA	0.4	NS	NS	0.4	0.4	0.5	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.6
Sodium	mg/L	0.1	-	3	3.2	3.1	4.3	4.2	3.4	NA	3	NS	NS	2.5	2.8	2.4	2.6	3.1	2.8	2.5	3	2.3	2.3	2.3	4.3
Dissolved Sulphate (SO_4)	mg/L	2	-	<2	<2	<2	9.2	9	<2	NA	<2	NS	NS	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	9.2
Conductivity	uS/cm	1	-	25	25	26	49	46	45	46	29	NS	NS	27	26	26	26	31	30	29	31	27	26	25	49
Turbidity	NTU	0.1	-	0.3	1.4	1.5	2.7	0.6	0.6	0.7	0.5	NS	NS	0.8	0.3	1.1	0.7	0.5	0.8	1.2	0.2	36	0.2	0.2	36
Total Suspended Solids	mg/L	2	-	10	31	NA	19	3	<2	<2	<2	NS	NS	<2	4	4	4	2	2	2	2	<1	1	<1	31
RCAP CALCULATIONS																									
Anion Sum	meq/L	-	-	0.118	0.125	0.12	0.307	0.316	0.222	NA	0.15	NS	NS	0.114	0.101	0.0938	0.0841	0.22	0.132	0.122	0.144	0.124	0.101	0.0841	0.316
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<1	<1	<1	<1	<1	<1	NA	<1	NS	NS	<1	<1	<1	<1	6	<1	<1	<1	<1	<1	<1	6
Calculated TDS	mg/L	0.1	-	16.9	21.6	19.9	27.7	26	18	NA	14	NS	NS	12	13	11	12	22	20	16	15	13	12	11	27.7
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<1	<1	<1	<1	<1	<1	NA	<1	NS	NS	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cation Sum	meq/L	0.1	-	0.269	0.32	0.265	0.502	0.423	0.377	NA	0.255	NS	NS	0.217	0.24	0.253	0.271	0.36	0.293	0.271	0.275	0.213	0.204	0.204	0.502
Elements (ICP-MS)												NS	NS												
Total Aluminum (Al)	µg/L	10	5-100	370	650	NA	360	190	338	NA	221	NS	NS	195	258	323	471	388	289	374	217	190	159	159	650
Total Antimony (Sb)	µg/L	2	-	<2	<2	NA	<2	<2	<2	NA	<2	NS	NS	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Arsenic (As)	µg/L	2	5	<2	3.5	NA	17	5	<2	NA	<2	NS	NS	<2	<2	25.5	4.8	2.9	<2	2.1	<2.0	<2.0	<2.0	2.1	25.5
Total Barium (Ba)	µg/L	5	-	5.2	7.3	NA	25	10	10.4	NA	5.9	NS	NS	<5	5.4	8	8.1	6.1	6.1	6.5	5.6	<5.0	<5.0	5.2	25
Total Beryllium (Be)	µg/L	2	-	<2.0	<2.0	NA	<2.0	<2.0	<2.0	NA	<2.0	NS	NS	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Bismuth (Bi)	µg/L	2	-	<2.0	<2.0	NA	<2.0	<2.0	<2.0	NA	<2.0	NS	NS	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Boron (B)	µg/L	5	-	5.1	5.3	NA	12	10	7.2	NA	5	NS	NS	<5.0	<5.0	6.2	8.4	6	5.2	<5.0	<5.0	<5.0	<5.0	<5.0	12
Total Cadmium (Cd)	µg/L	0.3	0.017	<0.3	<0.3	NA	<0.3	<0.3	0.047	NA	0.036	NS	NS	0.021	0.018	0.033	0.025	0.074	0.023	0.022	<0.017	0.023	0.02	0.018	0.074
Total Chromium (Cr)	µg/L	2	y	<2.0	<2.0	NA	<2.0	<2.0	<2.0	NA	<2.0	NS	NS	<2.0	<2.0	<2.0	<2.0	<2.0	3.4	<2.0	<2.0	<2.0	<2.0	<2.0	3.4
Total Cobalt (Co)	µg/L	<0.4	-	<0.4	<0.4	NA	<0.4	<0.4	<0.4	NA	<0.4	NS	NS	<0.4	<0.4	0.5	<0.4	0.4	<0.4	<0.40	<0.40	<0.40	<0.40	<0.40	0.5
Total Copper (Cu)	µg/L	2	2-4	<2.0	<2.0	NA	<2.0	<2.0	<2.0	NA	3.5	NS	NS	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	3.5	3.5
Total Iron (Fe)	µg/L	50	300	610	1200	NA	750	340	231	NA	171	NS	NS	130	230	666	490	618	620	825	202	182	119	119	1200
Total Lead (Pb)	µg/L	0.5	1-7	0.5	1.7	NA	1	<0.5	<0.5	NA	<0.5	NS	NS	<0.5	<0.5	0.66	0.56	0.59	<0.5	0.69	<0.50	<0.50	<0.50	<0.50	1.7
Total Manganese (Mn)	µg/L	2	-	50	58	NA	78	90	89	NA	39.6	NS	NS	28.2	28.5	83.4	43.9	38.6	43.6	34.4	39.1	34.7	27.3	27.3	90
Total Mercury (Hg)	µg/L	0.01	z	<0.01	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1
Total Molybdenum (Mo)	µg/L	2	73	<2	<2	NA	<2	<2	<2	NA	<2	NS	NS	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Nickel (Ni)	µg/L	2	25-150	<2	<2	NA	<2	<2	<2	NA	<2	NS	NS	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Selenium (Se)	µg/L	1	1	<1	<1	NA	<1	<1	1.2	NA	<1	NS	NS	<1	<1	<1	<1	<1	<1	<1.0	<1.0	<1.0	<1.0	1.2	1.2
Total Silver (Ag)	µg/L	0.1	0.1	<0.10	<0.10	NA	<0.10	<0.10	<0.10	NA	<0.10	NS	NS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Strontium (Sr)	µg/L	5	-	7.7	9	NA	26	17	14.2	NA	8.7	NS	NS	6.8	9	7.4	9.7	9.3	9.4	8.9	8.7	6.8	6.5	6.5	26
Total Thallium (Tl)	µg/L	0.1	0.8	<0.10	<0.10	NA	<0.10	<0.10	<0.10	NA	<0.10	NS	NS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Tin (Sn)	µg/L	2	-	<2.0	<2.0	NA	<2.0	<2.0	<2.0	NA	<2.0	NS	NS	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Titanium (Ti)	µg/L	2	-	4.9	13	NA	5.9	<2.0	3.4	NA	2.2	NS	NS	<2.0	2.8	2.2	5.8	5.9	3.7	4.1	2.4	2	<2.0	2	13
Total Uranium (U)	µg/L	0.1	-	<0.10	<0.10	NA	<0.10	<0.10	<0.10	NA	<0.10	NS	NS	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Vanadium (V)	µg/L	2	-	<2	<2	NA	<2	<2	<2	NA	<2	NS	NS	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Zinc (Zn)	µg/L	5	30	6.1	20	NA	15	10	13.2	NA	15.5	NS	NS	<5	15.6	14	10.8	11.1	11.5	7.9	8.2	7	5.1	5.1	20
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.002		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	ND	ND	<0.002	NS	<0.002	NS	<0.002	<0.002

FWAL 2006 = Canadian Environmental Quality Guidelines - Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (2006)
NS = Not sampled
NA= Not analyzed
RDL = Reportable Detection Limit
x = Ammonia Guideline is based on pH and Temperature
y = Chromium Guideline is based on speciation (Cr III = 8.9 ug/L, CR VI = 1ug/L)
z = Mercury Guideline is based on speciation (Inorganic Hg = 0.026ug/L, Methyl Hg= 0.004ug/L

Table 7. Results of Laboratory Analysis for Surface Water Samples Collected From Sampling Location SW5 from January 2006 to January 2007

	Units	RDL	FWAL 2006	20-Jan-06	24-Feb-06	23-Mar-06	28-Apr-06	25-May-06	28-Jun-06	26-Jul-06	26-Jul-06 Lab-Dup	28-Sep-06	27-Oct-06	27-Nov-06	14-Dec-06	18-Jan-07	MIN	MAX
INORGANICS																		
Total Alkalinity (Total as $CaCO_3$)	mg/L	5	-	<5	<5	<5	<5	<5	<5	<5	NA	<5	<5	<5	<5	<5	<5	<5
Color	TCU	5	-	40	27	25	39	51	93	95	NA	29	45	39	29	29	25	95
Dissolved Hardness ($CaCO_3$)	mg/L	1	-	5	5	5	4	4	4	5	NA	8	6	6	5	5	4	8
Nitrate + Nitrite (as N)	mg/L	0.05	-	<0.05	0.12	0.07	<0.05	<0.05	0.09	<0.05	NA	<0.05	<0.05	<0.05	0.06	0.08	<0.05	0.12
Nitrate (as N)	mg/L	0.05	2.9	<0.05	0.12	0.07	<0.05	<0.05	0.09	<0.05	NA	<0.05	<0.05	<0.05	0.06	0.08	<0.05	0.12
Nitrite (N)	mg/L	0.01	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	x	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Kjeldahl Nitrogen (TKN)	mg/L	0.1		NS	NS	NS	NS	NS	NS	0.5	NA	0.3	0.3	0.3	0.3	<2	0.3	0.5
Total Nitrogen	mg/L			NS	NS	NS	NS	NS	NS	0.29	NA	0.16	0.21	0.16	0.16	0.16	0.16	0.29
Total Org. Carbon (by UV)	mg/L	0.5	-	6.3	8.9	3.2	6.6	9	15	18	NA	5.3	10	6.7	5.1	6.1	3.2	18
Ortho Phosphate (as P)	mg/L	0.01	-	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
Phosphorus	mg/L	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
pH	units	0.1	>6.5;<9.0	4.95	6.12	5.53	5.26	5.46	5.09	4.93	NA	5.86	5.12	5.05	5.16	5.46	4.93	6.12
Reactive Silica (as SiO_2)	mg/L	0.5	-	2	2.5	1.4	0.8	0.5	2.2	2.9	NA	3.4	3.2	3	2.7	3.3	0.5	3.4
Dissolved Chloride (Cl)	mg/L	1	-	5	4	4	4	3	3	3	NA	4	4	5	4	4	3	5
Calcium	mg/L	0.1	-	1.2	1.2	1.2	1	1	1	1.3	NA	1.8	1.4	1.3	1.2	1.2	1	1.8
Magnesium	mg/L	0.1	-	0.5	0.6	0.6	0.5	0.5	0.5	0.5	NA	0.8	0.6	0.6	0.5	0.5	0.5	0.8
Potassium	mg/L	0.1	-	0.2	0.3	0.3	0.4	0.2	0.2	0.1	NA	0.4	0.3	0.3	0.1	0.2	0.1	0.4
Sodium	mg/L	0.1	-	2.5	2.8	2.8	2.6	2.5	2.2	2.4	NA	2.5	2.2	2.8	2.5	2.4	2.2	2.8
Dissolved Sulphate (SO_4)	mg/L	2	-	<2	<2	<2	<2	<2	<2	<2	NA	<2	<2	<2	<2	<2	<2	<2
Conductivity	uS/cm	1	-	28	28	28	26	24	23	25	NA	33	29	30	28	27	23	33
Turbidity	NTU	0.1	-	0.8	2	<0.1	2.2	0.3	0.2	0.4	NA	0.5	0.3	0.5	0.3	0.3	0.2	2.2
Total Suspended Solids	mg/L	2	-	<2	<2	<2	<2	<2	<2	<2	NA	<2	2	<2	13	<2	<2	13
RCAP CALCULATIONS																		
Anion Sum	meq/L	-	-	0.132	0.129	0.12	0.103	0.0912	0.0829	0.0789	NA	0.124	0.115	0.143	0.117	0.108	0.0789	0.143
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<1	<1	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1	<1
Calculated TDS	mg/L	0.1	-	11	12	11	9	8	10	11	NA	14	12	13	12	12	8	14
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<1	<1	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1	<1
Cation Sum	meq/L	0.1	-	0.231	0.24	0.243	0.219	0.211	0.21	0.244	NA	0.288	0.24	0.259	0.234	0.221	0.21	0.288
Elements (ICP-MS)																		
Total Aluminum (Al)	μg/L	10	5-100	188	131	136	182	226	318	385	NA	113	216	190	192	158	113	385
Total Antimony (Sb)	μg/L	2	-	<2	<2	<2	<2	<2	<2	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Arsenic (As)	μg/L	2	5	<2	<2	<2	<2	<2	2.1	2.8	NA	4.7	2.2	2.6	<2.0	<2.0	<2.0	4.7
Total Barium (Ba)	μg/L	5	-	<5	<5	<5	<5	<5	6	7.3	NA	<5.0	5	5.5	<5.0	<5.0	<5.0	7.3
Total Beryllium (Be)	μg/L	2	-	<2	<2	<2	<2	<2	<2	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Bismuth (Bi)	μg/L	2	-	<2	<2	<2	<2	<2	<2	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Boron (B)	μg/L	5	-	<5	<5	<5	5.1	<5	6.7	6.9	NA	7	<5.0	<5.0	<5.0	<5.0	<5.0	7
Total Cadmium (Cd)	μg/L	0.3	0.017	0.018	<0.3	<0.3	0.019	0.022	0.022	0.04	NA	<0.017	0.022	0.018	0.02	<0.017	<0.017	0.04
Total Chromium (Cr)	μg/L	2	y	<2	<2	<2	<2	<2	<2	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Cobalt (Co)	μg/L	<0.4	-	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.63	NA	0.5	<0.40	<0.40	<0.40	<0.40	<0.40	0.63
Total Copper (Cu)	μg/L	2	2-4	<2	<2	<2	<2	<2	<2	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Iron (Fe)	μg/L	50	300	156	121	115	130	206	301	418	NA	230	290	210	224	156	115	418
Total Lead (Pb)	μg/L	0.5	1-7	<0.5	<0.5	<0.5	<0.5	<0.5	0.62	0.53	NA	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.62
Total Manganese (Mn)	μg/L	2	-	62.9	33.9	33.8	43.8	65.2	95	147	NA	47	72.8	70.6	62.5	46.5	33.8	147
Total Mercury (Hg)	μg/L	0.01	z	NS	NS	NS	NS	NS	NS	<0.1	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Molybdenum (Mo)	μg/L	2	73	<2	<2	<2	<2	<2	<2	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Nickel (Ni)	μg/L	2	25-150	<2	<2	<2	<2	<2	<2	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Selenium (Se)	μg/L	1	1	<1	<1	<1	<1	<1	<1	<1	NA	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Silver (Ag)	μg/L	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Strontium (Sr)	μg/L	5	-	7.6	6.3	6	5.2	5.3	6	7.3	NA	6.1	6.5	7	5.6	5.9	5.2	7.6
Total Thallium (Tl)	μg/L	0.1	0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Tin (Sn)	μg/L	2	-	<2	<2	<2	<2	<2	<2	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Titanium (Ti)	μg/L	2	-	<2	<2	<2	<2	<2	<2	2.3	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.3
Total Uranium (U)	μg/L	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Vanadium (V)	μg/L	2	-	<2	<2	<2	<2	<2	<2	<2	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Zinc (Zn)	μg/L	5	30	10.6	9.3	<5	5.1	<5	12.2	7.1	NA	5	6.2	6.8	7.9	<5.0	<5.0	12.2
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.002		NS	NS	NS	NS	NS	NS	<0.002	NA	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

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RDL = Reportable Detection Limit

x = Ammonia Guideline is based on pH and Temperature

y = Chromium Guideline is based on speciation (Cr III = 8.9 ug/L, CR VI = 1ug/L)

z = Mercury Guideline is based on speciation (Inorganic Hg = 0.026ug/L, Methyl Hg= 0.004ug/L

Table 8. Results of Laboratory Analysis for Surface Water Samples Collected From Sampling Location SW8 from July 2006 to January 2007

	Units	RDL	FWAL 2006	26-Jul-06	28-Aug-06	27-Oct-06	27-Nov-06	14-Dec-06	18-Jan-06	MIN	MAX
INORGANICS											
Total Alkalinity (Total as $CaCO_3$)	mg/L	5	-	<5	<5	<5	<5	<5	<5	<5	<5
Color	TCU	5	-	200	140	100	82	64	61	61	200
Dissolved Hardness ($CaCO_3$)	mg/L	1	-	9	10	8	8	7	6	6	10
Nitrate + Nitrite (as N)	mg/L	0.05	-	<0.05	0.06	<0.05	0.14	0.11	0.19	<0.05	0.19
Nitrate (as N)	mg/L	0.05	2.9	<0.05	0.06	<0.05	0.14	0.11	0.19	<0.05	0.19
Nitrite (N)	mg/L	0.01	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	x	0.06	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	0.06
Total Kjeldahl Nitrogen (TKN)	mg/L	0.2		1.1	0.6	0.6	NA	0.4	NA	0.4	1.1
Total Nitrogen	mg/L			0.55	0.52	0.37	0.31	NA	0.51	0.31	0.55
Total Org. Carbon (by UV)	mg/L	0.5	-	32	20	17	15	11	14	11	32
Ortho Phosphate (as P)	mg/L	0.01	-	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Phosphorus	mg/L	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
pH	units	0.1	>6.5;<9.0	4.85	5.81	5	4.91	5.02	5.18	4.85	5.81
Reactive Silica (as SiO_2)	mg/L	0.5	-	3.1	2.6	2.9	3	2.9	3.9	2.6	3.9
Dissolved Chloride (Cl)	mg/L	1	-	4	5	5	6	4	4	4	6
Calcium	mg/L	0.1	-	2.5	2.8	2.3	2.1	1.8	1.6	1.6	2.8
Magnesium	mg/L	0.1	-	0.6	0.6	0.7	0.6	0.5	0.5	0.5	0.7
Potassium	mg/L	0.1	-	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.9
Sodium	mg/L	0.1	-	2.4	3.5	2.3	2.7	2.1	2.2	2.1	3.5
Dissolved Sulphate (SO_4)	mg/L	2	-	<2.0	<2.0	<2	<2	<2	<2	<2	<2
Conductivity	uS/cm	1	-	33	34	34	37	31	31	31	37
Turbidity	NTU	0.1	-	0.8	0.8	0.5	0.3	1.6	0.8	0.3	1.6
Total Suspended Solids	mg/L	2		<2.0	19	120	120	2	3	2	120
RCAP CALCULATIONS											
Anion Sum	meq/L	-	-	0.0994	0.138	0.131	0.173	0.13	0.125	0.0994	0.173
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	<1	<1	<1	<1	<1	<1	<1	<1
Calculated TDS	mg/L	0.1	-	14	16	15	16	13	14	13	16
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	-	ND	ND	<1	<1	<1	<1	<1	<1
Cation Sum	meq/L	0.1	-	0.361	0.402	0.328	0.322	0.267	0.254	0.254	0.402
Elements (ICP-MS)											
Total Aluminum (Al)	µg/L	10	5-100	559	417	360	275	247	211	211	559
Total Antimony (Sb)	µg/L	2	-	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Arsenic (As)	µg/L	2	5	8.1	6.7	4.6	3.3	2.8	2.5	2.5	8.1
Total Barium (Ba)	µg/L	5	-	7.3	5.4	5.4	5	<5.0	<5.0	5	7.3
Total Beryllium (Be)	µg/L	2	-	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Bismuth (Bi)	µg/L	2	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Boron (B)	µg/L	5	-	7.1	9.3	5.7	<5.0	<5.0	<5.0	<5.0	9.3
Total Cadmium (Cd)	µg/L	0.017	0.017	0.045	0.037	0.028	0.026	0.024	0.03	0.024	0.045
Total Chromium (Cr)	µg/L	2	y	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Cobalt (Co)	µg/L	<0.4	-	0.66	0.5	<0.40	<0.40	<0.40	<0.40	<0.40	0.66
Total Copper (Cu)	µg/L	2	2-4	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Iron (Fe)	µg/L	50	300	979	954	653	418	408	309	309	979
Total Lead (Pb)	µg/L	0.5	1-7	1.28	1.14	0.69	0.63	0.61	0.52	0.52	1.28
Total Manganese (Mn)	µg/L	2	-	133	71.1	87.8	78.3	62.2	56.6	56.6	133
Total Mercury (Hg)	ug/L	0.01	z	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total Molybdenum (Mo)	µg/L	2	73	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Nickel (Ni)	µg/L	2	25-150	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Selenium (Se)	µg/L	1	1	<1	<1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Silver (Ag)	µg/L	0.1	0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Strontium (Sr)	µg/L	5	-	12.2	11.2	10.6	10.4	8.3	8	8	12.2
Total Thallium (Tl)	µg/L	0.1	0.8	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Tin (Sn)	µg/L	2	-	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Titanium (Ti)	µg/L	2	-	7	6.5	4.3	3.6	3.5	2.9	2.9	7
Total Uranium (U)	µg/L	0.1	-	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Vanadium (V)	µg/L	2	-	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Zinc (Zn)	µg/L	5	30	10.5	10.2	13.3	9	8.8	9.9	8.8	13.3
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.002		<0.002	<0.002	<0.002	NS	<0.002	NS	<0.002	<0.002

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NA= Not analyzed

RDL = Reportable Detection Limit

x = Ammonia Guideline is based on pH and Temperature

y = Chromium Guideline is based on speciation (Cr III = 8.9 ug/L, CR VI = 1ug/L)

z = Mercury Guideline is based on speciation (Inorganic Hg = 0.026ug/L, Methyl Hg= 0.004ug/L

Historical Moose River Surface Water Samples

Parameter	Units	FWAL 2006	SW1	SW2
			7-Apr-88	7-Apr-88
Sodium	mg/L	---	1.4	1.2
Potassium	mg/L	---	0.1	0.1
Calcium	mg/L	---	0.8	1
Magnesium	mg/L	---	0.33	0.37
Hardness	mg/L	---	3.4	3.9
Alkalinity	mg/L	---	<1	<1
Sulphate	mg/L	---	3.5	2.7
Chloride	mg/L	---	2.2	2.2
Flouride	mg/L	---	<0.1	<0.1
Reactive Silica	mg/L	---	1.3	1.5
Phosphate	mg/L	---	<0.01	0.01
Nitrate+Nitrate	mg/L	---	<0.05	<0.05
Ammonium	mg/L	x	<0.05	<0.05
Arsenic	mg/L	0.005	<0.005	<0.005
Iron	mg/L	0.3	0.19	0.22
Manganese	mg/L	---	0.05.	0.06
Lead	mg/L	0.001 – 0.007	<0.002	<0.002
Copper	mg/L	0.002 – 0.004	<0.01	0.01
Zinc	mg/L	0.03	<0.01	<0.01
Color	TCU	---	36	32
Turbidity	JTU	---	1.2	1.3
Conductivity	uaho/ca	---	20.2	20.9
pH	mg/L	>6.5;<9.0	5.1	5.2
Total Organic Carbon	mg/L	---	6.5	5.3
Hardness	mg/L	---	16.2	14.6
Aluminum	mg/L	0.005 – 0.1	0.15	0.16
Boron	mg/L	---	<0.02	<0.02
Barium	mg/L	---	0.01	0.01
Beryllium	mg/L	---	<0.005	<0.005
Chromium	mg/L	y	<0.01	0.01
Cobalt	mg/L	---	<0.01	<0.01
Nickel	mg/L	0.025 – 0.15	<0.02	<0.02
Selenium	mg/L	0.001	<0.1	<0.1
Tin	mg/L	---	<0.03	<0.03
Vanadium	mg/L	---	<0.01	<0.01
Mercury	mg/L	z	<0.05	<0.05
Cadmium	mg/L	0.000017	<0.01	<0.01

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y = Chromium Guideline is based on speciation (Cr III = 8.9 ug/L, CR VI = 1ug/L)

z = Mercury Guideline is based on speciation (Inorganic Hg = 0.026ug/L, Methyl Hg= 0.004ug/L

Results of Laboratory Analysis of Surface Water Samples Collected from Square Lake on 11/28/2006

Parameter	Units	RDL	FWAL (2006)	Square Lake
INORGANICS				
Total Alkalinity (Total as $CaCO_3$)	mg/L	5	---	<5
Color	TCU	5	---	22
Dissolved Hardness ($CaCO_3$)	mg/L	1	---	4
Nitrate + Nitrite (as N)	mg/L	0.05	---	<0.05
Nitrate (as N)	mg/L	0.05	2.9	<0.01
Nitrite (N)	mg/L	0.01	0.06	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	x	<0.05
Total Org. Carbon (by UV)	mg/L	0.5	---	6.4
Ortho Phosphate (as P)	mg/L	0.01	---	<0.01
Phosphorus	mg/L	0.1	---	<0.1
Total Phosphorus	mg/L	0.02	---	0.02
pH	units	0.1	6.5 - 9	5.73
Reactive Silica (as SiO_2)	mg/L	0.5	---	0.9
Dissolved Chloride (Cl)	mg/L	1	---	4
Calcium	mg/L	0.1	---	1
Magnesium	mg/L	0.1	---	0.5
Potassium	mg/L	0.1	---	0.5
Sodium	mg/L	0.1	---	2.7
Dissolved Sulphate (SO_4)	mg/L	2	---	<2
Conductivity	µS/cm	1	---	23
Turbidity	NTU	0.1	---	0.5
RCAP CALCULATIONS				
Anion Sum	meq/L	-	---	0.107
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	---	<1
Calculated TDS	mg/L	0.1	---	10
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	---	<1
Cation Sum	meq/L	0.1	---	0.224
Elements (ICP-MS)				
Total Aluminum (Al)	µg/L	10	5-100	150
Total Antimony (Sb)	µg/L	2	---	<2
Total Arsenic (As)	µg/L	2	5	<2
Total Barium (Ba)	µg/L	5		<5
Total Beryllium (Be)	µg/L	2	---	<2
Total Bismuth (Bi)	µg/L	2	---	<2
Total Boron (B)	µg/L	5	---	<5
Total Cadmium (Cd)	µg/L	0.017	0.017	0.5
Total Chromium (Cr)	µg/L	2	y	<2
Total Cobalt (Co)	µg/L	<0.4	---	<1
Total Copper (Cu)	µg/L	2	4-Feb	<2
Total Iron (Fe)	µg/L	50	300	160
Total Lead (Pb)	µg/L	0.5	7-Jan	<0.5
Total Manganese (Mn)	µg/L	2	---	31
Total Mercury (Hg)	ug/L	0.01	z	<0.01
Total Molybdenum (Mo)	µg/L	2	73	<2
Total Nickel (Ni)	µg/L	2	25-150	<2
Total Selenium (Se)	µg/L	1	1	<2
Total Silver (Ag)	µg/L	<0.5	0.1	<0.5
Total Strontium (Sr)	µg/L	5	---	5
Total Thallium (Tl)	µg/L	0.1	0.8	<0.1
Total Tin (Sn)	µg/L	2	---	<2
Total Titanium (Ti)	µg/L	2	---	<2
Total Uranium (U)	µg/L	0.1	---	<0.1
Total Vanadium (V)	µg/L	2	---	<2
Total Zinc (Zn)	µg/L	5	30	8

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Water Quality Parameters of Water Samples Collected From the Mine Pit and from Scraggy Lake on January 25, 2007

	Units	RDL	FWAL 2006	MINE PIT	SCRAGGY LAKE
INORGANICS					
Total Alkalinity (Total as CaCO3)	mg/L	5	---	13	<5
Dissolved Chloride (Cl)	mg/L	1	---	6	4
Colour	TCU	5	---	<5	47
Hardness (CaCO3)	mg/L	1	---	35	5
Nitrate + Nitrite	mg/L	0.05	---	1.3	0.09
Nitrite (N)	mg/L	0.01	0.06	<0.01	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	x	<0.05	<0.05
Total Organic Carbon (C)	mg/L	0.5	---	1.6	6.6
Orthophosphate (P)	mg/L	0.01	---	<0.01	<0.01
pH	pH	---	>6.5;<9.0	6.46	5.11
Reactive Silica (SiO2)	mg/L	0.5	---	3.6	3.5
Dissolved Sulphate (SO4)	mg/L	2	---	17	<2
Turbidity	NTU	0.1	---	13	0.5
Conductivity	uS/cm	1	---	100	28
RCAP CALCULATIONS					
Anion Sum	me/L	---	---	0.88	0.12
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	1	---	13	<1
Calculated TDS	mg/L	1	---	60	13
Carb. Alkalinity (calc. as CaCO3)	mg/L	1	---	<1	<1
Cation Sum	me/L	---	---	1.01	0.24
Ion Balance (% Difference)	%	---	---	6.88	33.3
Langelier Index (@ 20C)	N/A	---	---	-2.71	NC
Langelier Index (@ 4C)	N/A	---	---	-2.96	NC
Saturation pH (@ 20C)	N/A	---	---	9.17	NC
Saturation pH (@ 4C)	N/A	---	---	9.42	NC
Elements (ICP-MS)					
Total Aluminum (Al)	ug/L	5	5 - 100	453	130
Total Antimony (Sb)	ug/L	2		<2.0	<2.0
Total Arsenic (As)	ug/L	2	5	21.4	<2.0
Total Barium (Ba)	ug/L	5	---	14.8	<5.0
Total Beryllium (Be)	ug/L	2	---	<2.0	<2.0
Total Bismuth (Bi)	ug/L	2	---	<2.0	<2.0
Total Boron (B)	ug/L	5	---	6.4	<5.0
Total Cadmium (Cd)	ug/L	0.017	0.017	0.1	0.02
Total Chromium (Cr)	ug/L	2	y	128	<2.0
Total Cobalt (Co)	ug/L	0.4	---	0.92	<0.40
Total Copper (Cu)	ug/L	2	2 - 4	4.1	<2.0
Total Iron (Fe)	ug/L	50	300	1100	152
Total Lead (Pb)	ug/L	0.5	1 - 7	2.24	<0.50
Total Manganese (Mn)	ug/L	2	---	103	43
Total Mercury (Hg)	ug/L	0.01	z	0.01	0.02
Total Molybdenum (Mo)	ug/L	2	73	<2.0	<2.0
Total Nickel (Ni)	ug/L	2	25-150	5.5	<2.0
Total Selenium (Se)	ug/L	1	1	<1.0	<1.0
Total Silver (Ag)	ug/L	0.1	0.1	<0.10	<0.10
Total Strontium (Sr)	ug/L	5	---	30	<5.0
Total Thallium (Tl)	ug/L	0.1	0.8	<0.10	<0.10
Total Tin (Sn)	ug/L	2	---	<2.0	<2.0
Total Titanium (Ti)	ug/L	2	---	3.5	<2.0
Total Uranium (U)	ug/L	0.1	---	<0.10	<0.10
Total Vanadium (V)	ug/L	2	---	<2.0	<2.0
Total Zinc (Zn)	ug/L	5	30	21.9	6.6
Elements (ICP-OES)					
Total Calcium (Ca)	mg/L	0.1	---	11	1
Total Magnesium (Mg)	mg/L	0.1	---	2.2	0.5
Total Phosphorus	mg/L	0.002	---	0.072	0.005
Total Potassium (K)	mg/L	0.1	---	1.1	0.5
Total Sodium (Na)	mg/L	0.1	---	5.4	2.7
RCAP CALCULATIONS			---		
Nitrate (N)	mg/L	0.05	2.9	1.3	0.09
INORGANICS					
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.002	---	<0.002	<0.002

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APPENDIX G

WATER AVAILABILITY CALCULATIONS FOR SQUARE LAKE

Touquoy Mine - Moose River
Square Lake Hydrologic Budget Data

Precipitation Summary:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average (1968 - 2003)	127.6	99.2	124.2	103.9	103.0	96.6	101.0	100.3	101.1	119.3	134.3	137.5	1348.1
Rain:													
Average (1968 - 2003)	50.6	45.9	86.1	99.6	102.7	96.6	101.0	100.3	101.1	119.3	125.1	85.9	1114.3
Melt:													
Average (1968 - 2003)	41.0	50.9	92.3	18.8	0.3	0.0	0.0	0.0	0.0	0.0	5.7	24.8	233.8
Water Surplus:													
Average (1968 - 2003)	87.4	94.4	170.4	93.2	41.4	18.0	11.2	9.8	10.9	50.9	95.6	104.2	787.4
Runoff:													
Average (1968 - 2003)	85.8	90.1	130.3	111.7	76.6	47.3	29.2	19.5	15.2	33.1	64.3	84.3	787.4
Evaporation:													
Average	0	0	0	0	89.9	102	111.6	99.2	69	40.3	0	0	512.0

Square Lake:	Catchment Area (less lake):	91 ha
	Lake Area:	33 ha
Existing Pit:	Contributing Catchment Area:	5 ha
	Pit Surface Area:	0.5 ha

Average Conditions:

Existing Pit: Volumes (m^3)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lake Rain/Melt	476	504	928	615	536	503	525	522	526	620	680	575
Evap	0	0	0	0	467	530	580	516	359	210	0	0
Runoff In	4292	4506	6514	5586	3828	2365	1462	975	761	1653	3217	4213
Total In	4769	5010	7442	6201	3896	2337	1406	981	928	2064	3898	4789
Start Vol	4769	5010	7442	6201	3896	2337	1406	981	125000	127064	3898	4789
Remain Vol	0	0	0	0	0	0	0	0		0	0	0

Square Lake: Volumes (m^3)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lake Rain/Melt	30234	31966	58886	39055	33995	31894	33324	33098	33372	39375	43157	36522
Evap	0	0	0	0	29667	33660	36828	32736	22770	13299	0	0
Runoff In	78118	82014	118549	101663	69666	43038	26601	17745	13843	30085	58558	76677
Total In	108353	113980	177435	140717	73993	41272	23097	18107	24446	56160	101715	113199
Withdraw	135000	135000	135000	0	0	0	0	0	0	135000	135000	135000
Input From Pit	4769	5010	7442	6201	3896	2337	1406	981		127064	3898	4789
Net In	-21879	-16010	49876	146919	77889	43609	24503	19088	24446	48224	-29388	-17012
Start Vol	629050	607171	591161	641037	787956	865845	909454	933957	627225	627225	675449	646062
Remain Vol	607171	591161	641037	787956	865845	909454	933957	953045		675449	646062	629050
WSE	128.95	128.90	129.06	129.48					129	129.16	129.07	129.02
Calc	607171	591160.7	641037	787955.6						675449.4	646061.8	629049.6
Check	0	0	0	0						0	0	0

820933 - Touquoy Mine Project
Square Lake Bathymetry

Depth (m)	Area (m^2)	Volume (m^3)	Cumulative (m^3)
4	10,634	0	0
3.5	44,898	13,883	13,883
3	69,810	28,677	42,560
2.5	101,585	42,849	85,409
2	133,453	58,759	144,168
1.5	195,918	82,343	226,511
1	249,264	111,295	337,807
0	329,573	289,419	**627,225**

El. (m)	Area (m^2)	Volume (m^3)	Cumulative (m^3)
129	329,573	289,419	**627,225**
128	249,264	111,295	337,807
127.5	195,918	82,343	226,511
127	133,453	58,759	144,168
126.5	101,585	42,849	85,409
126	69,810	28,677	42,560
125.5	44,898	13,883	13,883
125	10,634	0	0

APPENDIX H

PETER CLIFTON & ASSOCIATES REPORT
"HYDROGEOLOGICAL INVESTIGATIONS TOUQUOY GOLD PROJECT"

APPENDIX I

SITE GROUNDWATER DATA

Results of Analyses of Groundwater Samples Collected from Boreholes on the Moose River Gold Mines Site - November 7, 2006

INORGANICS	Units	RDL	HC Drinking Water 20006	FWAL 2006	WB-1	WB-2	WB-3	WB-4	WB-7	WB-8
Total Alkalinity (Total as $CaCO_3$)	mg/L	5	---	---	120	110	85	99	33	130
Color	TCU	5	15	---	<5	<5	<5	<5	140	<5
Dissolved Hardness ($CaCO_3$)	mg/L	1	---	---	120	160	80	110	45	81
Nitrate + Nitrite (as N)	mg/L	0.05	---	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrate (as N)	mg/L	0.05	10	2.9	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrite (N)	mg/L	0.01	3.2	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	---	x	<0.05	0.07	<0.05	<0.05	0.15	3.2
Total Org. Carbon (by UV)	mg/L	0.5	---	---	0.6	<3	<3	<3	8	5
Ortho Phosphate (as P)	mg/L	0.01	---	---	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Phosphorus	mg/L	0.1	---	---	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
Total Phosphorus	mg/L	0.02	---	---	0.08	0.05	0.07	0.04	0.2	0.28
pH	units	0.1	6.5 - 8.5	6.5 - 9	7.81	8.08	8.05	7.98	7.02	7.84
Reactive Silica (as SiO_2)	mg/L	0.5	---	---	11	7.3	2.7	2.1	3	7.7
Dissolved Chloride (Cl)	mg/L	1	250	---	4	19	3	14	5	66
Calcium	mg/L	0.1	---	---	36	43	21	33	14	21
Magnesium	mg/L	0.1	---	---	7.2	12	6.9	7.5	2.4	6.9
Potassium	mg/L	0.1	---	---	0.9	0.8	1.4	1.5	1.2	2.3
Sodium	mg/L	0.1	200	---	9.1	7.1	7.2	16	2.9	64
Dissolved Sulphate (SO_4)	mg/L	2	500	---	17	19	4	<2	3	5
Conductivity	uS/cm	1	---	---	270	300	180	240	90	470
Turbidity	NTU	0.1	1	---	130	120	130	170	130	23
RCAP CALCULATIONS										
Anion Sum	meq/L	-	---	---	2.88	3.09	1.87	2.39	0.866	4.57
Bicarb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	---	---	119	106	84	98	33	130
Calculated TDS	mg/L	0.1	---	---	173	194	138	175	89	263
Carb. Alkalinity (calc. as $CaCO_3$)	mg/L	1	---	---	<1	1	<1	<1	<1	<1
Cation Sum	meq/L	0.1	---	---	3.35	4.16	<1	4.42	2.28	4.97
Elements (ICP-MS)										
Total Aluminum (Al)	µg/L	10	---	5-100	700	190	270	360	1600	890
Total Antimony (Sb)	µg/L	2	6	---	<2	<2	<2	<2	<2	<2
Total Arsenic (As)	µg/L	2	25	5	140	180	<2	<2	230	110
Total Barium (Ba)	µg/L	5	1000		21	17	5	22	14	10
Total Beryllium (Be)	µg/L	2	---	---	<2	<2	<2	<2	<2	<2
Total Bismuth (Bi)	µg/L	2	---	---	<2	<2	<2	<2	<2	<2
Total Boron (B)	µg/L	5	5000	---	23	14	16	23	9	130
Total Cadmium (Cd)	µg/L	0.017	5	0.017	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Total Chromium (Cr)	µg/L	2	50	y	<2	<2	<2	<2	4	80
Total Cobalt (Co)	µg/L	0.4	---	---	1	<1	2	<1	4	<1
Total Copper (Cu)	µg/L	2	1000	2-4	4	<2	<2	<2	4	6
Total Iron (Fe)	µg/L	50	300	300	14000	18000	37000	38000	31000	6600
Total Lead (Pb)	µg/L	0.5	10	1-7	2.1	<0.5	1.4	1.3	3.9	2
Total Manganese (Mn)	µg/L	2	50	---	630	550	480	1300	3400	170
Total Mercury (Hg)	ug/L	0.01	0.001	z	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Molybdenum (Mo)	µg/L	2	---	73	5	<2	<2	<2	<2	<2
Total Nickel (Ni)	µg/L	2	---	25-150	4	<2	8	3	7	4
Total Selenium (Se)	µg/L	1	10	1	<2	<2	<2	<2	<2	4
Total Silver (Ag)	µg/L	<0.5	---	0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<2
Total Strontium (Sr)	µg/L	5	---	---	140	170	99	170	51	480
Total Thallium (Tl)	µg/L	0.1	---	0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Tin (Sn)	µg/L	2	---	---	<2	<2	<2	<2	<2	<2
Total Titanium (Ti)	µg/L	2	---	---	12	3	3	3	7	11
Total Uranium (U)	µg/L	0.1	20	---	1	0.6	<0.1	0.3	0.2	1.3
Total Vanadium (V)	µg/L	2	---	---	<2	<2	<2	<2	<2	<2
Total Zinc (Zn)	µg/L	5	5000	30	13	10	14	19	17	12

HC Drinking Water 2006 = Health Canada Guidelines for Canadian Drinking Water Quality (March 2006)

FWAL 2006 = Canadian Environmental Quality Guidelines - Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (2006)

x = Ammonia Guideline is based on pH and Temperature

y = Chromium Guideline is based on Speciation (Cr III = 8.9 ug/L, Cr VI = 1 ug/L)

z = Mercury Guideline is based on Speciation (Inorganic Hg = 0.026 ug/L, Methyl Hg = 0.004 ug/L)

Results of Laboratory Analyses of Well Water Samples from Wells in Moose River Gold Mines on November 4, 1988

Parameter	Domestic Well Number																						
	GW 1	GW 2	GW 3	GW 4	GW 5	GW 6	GW 7	GW 8	GW 9	GW 10	GW 11	GW 12	GW 13	GW 14	GW 15	GW 16	GW 17	GW 18	GW 19	GW 20	GW 21	GW 22	GW 23
Calcium	3.2	5	4.7	5.5	75	48	30	12	39	7.6	4.6	85	11	11	2.8	1.1	30	4.9	4.7	3.5	4.6	2.1	15
Magnesium	0.37	0.76	0.43	0.77	4.1	6.8	3.4	4.1	4.9	0.76	0.86	4.6	2.5	1.6	0.78	0.37	2	0.8	0.68	0.42	0.91	0.4	2.3
Hardness	9.5	15.6	13.5	16.9	204.2	147.9	88.9	46.8	117.6	22.1	15	231.2	37.8	34.1	10.2	4.3	83.1	15.5	14.5	10.5	15.2	6.9	46.9
Alkalinity	6.4	12	10	13	160	110	51	5.8	78	14	15	230	15	20	6.4	1.3	110	12	8.7	7.4	6.3	2.7	37
SO_4	2.9	2.9	2	3.9	24	34	34	5.9	69	8.9	<2	3.8	18	9.2	3	3.7	5.3	3.7	4.7	<2.0	5	3.5	7.4
Chloride	1.8	5.7	1.7	2.8	42	15	18	47	12	2.9	3	2.6	8.9	1.7	4.3	2.1	3.1	4.2	2.5	1.7	5.4	3	8.1
NOx	0.1	<0.05	0.13	<0.05	0.3	0.82	4.3	<0.05	1.5	<0.05	<0.05	1.7	0.64	1.1	0.18	<0.05	0.09	0.19	0.16	0.44	0.42	0.06	0.09
NH_4	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.005	<0.005	<0.005	0.08	0.006	0.5	0.03	<0.005	<0.005	<0.005	<0.005	<0.005	0.03	0.02	<0.005	<0.005	<0.005	0.007	<0.005	<0.005	<0.005	<0.005	<0.005
Iron	<0.02	0.07	0.03	0.08	0.21	0.09	0.98	0.23	0.19	0.1	0.11	0.05	0.03	0.04	0.03	0.03	0.16	0.04	0.11	0.03	0.04	0.05	0.03
Manganese	0.03	<0.01	<0.01	<0.01	0.65	0.61	0.12	0.02	0.05	0.02	0.01	<0.01	<0.01	0.02	<0.01	0.06	0.01	<0.01	0.02	0.02	<0.01	0.02	0.02
Color	<3.0	<3.0	<0.3	12	<3.0	<3.0	9	<3.0	6	<3.0	<3.0	<3.0	4	6	<3.0	4	<3.0	<3.0	3	<3.0	5	<3.0	<3.0
pH	6.2	6.3	6.4	6.3	6	7.6	6.3	6	6.3	6.2	6.2	7.8	6.6	6.3	6.2	5.8	7.9	6.1	5.9	6.2	6.2	5.9	6.7
Total Coliform	0	0	0	5	0	0	3	0	15	0	0	0	6	4	0	0	0	0	2	0	0	3	0
Well type	Dug	Dug	Dug	Dug	Drilled	Drilled	Dug	Dug	Dug	Dug	Dug	Dug	Dug	Dug	Dug	Dug	Dug	Dug	Dug	Dug	Spring	Dug	Dug

APPENDIX J

ACCDC LISTS OF RARE SPECIES RECORDED WITHIN 100 KM OF MOOSE RIVER GOLD MINES

NOVA SCOTIA MUSEUM SCREENING

Table 1 Atlantic Canada Conservation Data Council (ACCDC) list of rare vascular plants reported within 100 km of the Touquoy Gold Project Site

Binomial	Common Name	NS DNR Rank	Sub-National Rank	Global Rank	Closest Observation (km)
Adiantum pedatum	Northern Maidenhair-Fern	Red	S1	G5	52.1Km +/-1
Agrimonia gryposepala	Tall Hairy Groovebur	Green	S3?	G5	56.2Km +/-0
Alisma gramineum	Narrow-Leaf Water-Plantain	Green	S1SE	Undetermined	69.4Km +/-5
Allium schoenoprasum var. sibiricum	Wild Chives	Undetermined	S2	G5T5	52.9Km +/-10
Allium tricoccum	Small White Leek	Red	S1	G5	55.4Km +/-0.1
Alopecurus aequalis	Short-Awn Foxtail	Yellow	S2S3	G5	45.4Km +/-5
Anemone canadensis	Canada Anemone	Yellow	S2	G5	79.9Km +/-10
Anemone quinquefolia	Wood Anemone	Yellow	S2	G5	30.5Km +/-0.1
Anemone virginiana	Virginia Anemone	Yellow	S1S2	G5	52.1Km +/-10
Anemone virginiana var. alba	River Anemone	Yellow	S1S2	G5T4T5	48.4Km +/-1
Antennaria parlinii	a Pussytoes	Red	S1	G4G5	61.3Km +/-10
Arabis drummondii	Drummond Rockcress	Yellow	S2	G5	80Km +/-1
Asclepias incarnata	Swamp Milkweed	Green	S3	G5	13.8Km +/-10
Asplenium trichomanes-ramosum	Green Spleenwort	Yellow	S2	G4	87.4Km +/-10
Atriplex acadiensis	Maritime Saltbush	Undetermined	S1?	G?	84.1Km +/-10
Atriplex franktonii	Frankton's Saltbush	Green	S3S4	G?	90.9Km +/-1
Bartonia virginica	Yellow Screwstem	Green	S3	G5	50.1Km +/-10
Bidens connata	Purple-Stem Swamp Beggar-Ticks	Yellow	S3?	G5	67.2Km +/-0.5
Botrychium dissectum	Cutleaf Grape-Fern	Green	S3	G5	52.7Km +/-1
Botrychium lanceolatum var. angustisegmentum	Lance-Leaf Grape-Fern	Yellow	S2	G5T4	69.4Km +/-1
Botrychium lunaria	Moonwort Grape-Fern	Red	S1	G5	39.1Km +/-0.1
Botrychium simplex	Least Grape-Fern	Yellow	S2S3	G5	35.5Km +/-0.1
Caltha palustris	Marsh Marigold	Yellow	S2	G5	83.4Km +/-0.1
Campanula aparinoides	Marsh Bellflower	Yellow	S3?	G5	54.6Km +/-0.1
Cardamine parviflora	Small-Flower Bitter-Cress	Yellow	S2	G5	94.2Km +/-50.1
Carex adusta	Crowded Sedge	Yellow	S2S3	G5	30.9Km +/-10
Carex bebbii	Bebb's Sedge	Red	S1S2	G5	85.9Km +/-5
Carex bromoides	Brome-Like Sedge	Green	S3	G5	25.3Km +/-0.1

Table 1 Atlantic Canada Conservation Data Council (ACCDC) list of rare vascular plants reported within 100 km of the Touquoy Gold Project Site

Binomial	Common Name	NS DNR Rank	Sub-National Rank	Global Rank	Closest Observation (km)
Carex castanea	Chestnut-Colored Sedge	Red	S2	G5	80.5Km +/-0
Carex comosa	Bristly Sedge	Yellow	S2	G5	59.3Km +/-0.1
Carex eburnea	Ebony Sedge	Yellow	S3	G5	51.3Km +/-0.1
Carex foenea	Dry-Spike Sedge	Green	S3?	G5	54Km +/-0
Carex garberi	Elk Sedge	Red	S1	G4	49.3Km +/-0
Carex haydenii	Cloud Sedge	Red	S1	G5	52Km +/-1
Carex hirtifolia	Pubescent Sedge	Red	S2S3	G5	38.7Km +/-10
Carex houghtoniana	A Sedge	Yellow	S2?	G5	36.6Km +/-5
Carex hystericina	Porcupine Sedge	Red	S1S2	G5	92Km +/-1
Carex livida var. radicaulis	Livid Sedge	Red	S1	G5T5	94.4Km +/-10
Carex lupulina	Hop Sedge	Green	S3	G5	25.3Km +/-0
Carex peckii	White-Tinged Sedge	Red	S2?	G4G5	54.6Km +/-0.1
Carex pellita	Woolly Sedge	Red	S1	G5	13.8Km +/-10
Carex pensylvanica	Pennsylvania Sedge	Undetermined	S1S2	G5	48.1Km +/-0.1
Carex plantaginea	Plantain-Leaved Sedge	Blue	S1	G5	50.9Km +/-0.1
Carex rosea	Rosy Sedge	Green	S3	G5	50.4Km +/-0.5
Carex tenera	Slender Sedge	Yellow	S1S2	G5	61.7Km +/-5
Carex tuckermanii	Tuckerman Sedge	Red	S1	G4	69.2Km +/-0.1
Caulophyllum thalictroides	Blue Cohosh	Red	S2	G4G5	42Km +/-10
Chenopodium rubrum	Coast-Blite Goosefoot	Red	S1?	G5	76.6Km +/-10
Clethra alnifolia	Coast Pepper-Bush	Red	S1S2	G5	62.2Km +/-0.1
Cochlearia tridactylites	Limestone Scurvy-grass	Red	S1	G?	65.3Km +/-1
Coeloglossum viride var. virescens	Long-Bract Green Orchis	Yellow	S2	G5T5	81.4Km +/-0.1
Conioselinum chinense	Hemlock Parsley	Yellow	S2S3	G5	61.1Km +/-5
Corallorhiza trifida	Early Coralroot	Green	S3	G5	48.4Km +/-0.5
Crassula aquatica	Water Pigmy-Weed	Yellow	S2	G5	94.7Km +/-0.1
Crataegus robinsonii	A Hawthorn	Undetermined	S1?	G2G4Q	50.6Km +/-5
Crataegus submollis	A Hawthorn	Undetermined	S1?	G5	49.8Km +/-10

Table 1 Atlantic Canada Conservation Data Council (ACCDC) list of rare vascular plants reported within 100 km of the Touquoy Gold Project Site

Binomial	Common Name	NS DNR Rank	Sub-National Rank	Global Rank	Closest Observation (km)
Cryptogramma stelleri	Fragile Rockbrake	Yellow	S1S2	G5	90.1Km +/-0
Cuscuta cephalanthi	Button-Bush Dodder	Red	S1	G5	75.7Km +/-1
Cynoglossum virginianum	Wild Comfrey	Red	S1	G5	88.7Km +/-1
Cynoglossum virginianum var. boreale	Northern Wild Comfrey	Red	S1	G5T4	88.3Km +/-1
Cypripedium arietinum	Ram's-Head Lady's-Slipper	Red	S1	G3	82.2Km +/-5
Cypripedium parviflorum	Small Yellow Lady's-Slipper	Yellow	S2S3	G5	77.4Km +/-5
Cypripedium parviflorum var. makasin	Small Yellow Lady's-Slipper	Yellow	S2	G5T4?	87.2Km +/-5
Cypripedium parviflorum var. pubescens	Large Yellow Lady's-Slipper	Yellow	S2	G5T4T5	61.8Km +/-10
Cypripedium reginae	Showy Lady's-Slipper	Red	S2	G4	16.4Km +/-5
Cystopteris bulbifera	Bulblet Fern	Green	S3S4	G5	39.3Km +/-0.1
Cystopteris tenuis	A Bladderfern	Green	S3?	G4G5	48.4Km +/-0
Desmodium canadense	Showy Tick-Trefoil	Red	S1	G5	48.9Km +/-0.1
Desmodium glutinosum	Large Tick-Trefoil	Red	S2	G5	80Km +/-0
Dichanthelium acuminatum var. lindheimeri	Panic Grass	Green	S1?	G5T5	70.5Km +/-0.1
Dichanthelium clandestinum	Deer-Tongue Witchgrass	Green	S3	G5?	32.8Km +/-0
Dichanthelium linearifolium	Slim-Leaf Witchgrass	Yellow	S2?	G5	67Km +/-10
Dirca palustris	Eastern Leatherwood	Red	S1	G4	41.2Km +/-1
Dryopteris fragrans var. remotiuscula	Fragrant Fern	Yellow	S2	G5T?	57.3Km +/-10
Eleocharis nitida	Slender Spike-Rush	Green	S3	G3G4	68.2Km +/-5
Eleocharis ovata	Ovate Spikerush	Yellow	S2?	G5	65.5Km +/-0.5
Elymus hystrix	Bottle-Brush Grass	Red	S1	G5	58.5Km +/-1
Elymus hystrix	Bottle-Brush Grass	Red	S1	G5	81.6Km +/-1
Elymus hystrix var. bigeloviana	Bottlebrush Grass	Red	S1	G5T?	53.9Km +/-1
Elymus wiegandii	Wiegand's Wild Rye	Red	S1	G5T?	56.5Km +/-0
Empetrum eamesii	Rock Crowberry	Yellow	S2S3	G5	61.5Km +/-10
Epilobium coloratum	Purple-Leaf Willow-Herb	Yellow	S2?	G5	68Km +/-0.1
Equisetum pratense	Meadow Horsetail	Yellow	S2	G5	39.3Km +/-0
Equisetum scirpoides	Dwarf Scouring Rush	Green	S3S4	G5	46.2Km +/-0

Table 1 Atlantic Canada Conservation Data Council (ACCDC) list of rare vascular plants reported within 100 km of the Touquoy Gold Project Site

Binomial	Common Name	NS DNR Rank	Sub-National Rank	Global Rank	Closest Observation (km)
Equisetum variegatum	Variegated Horsetail	Green	S3	G5	44.6Km +/-0.1
Erigeron hyssopifolius	Daisy Fleabane	Yellow	S2S3	G5	51.4Km +/-0.1
Erigeron philadelphicus	Philadelphia Fleabane	Yellow	S2	G5	13.8Km +/-10
Eriophorum gracile	Slender Cotton-Grass	Yellow	S2	G5	46.8Km +/-10
Euthamia caroliniana	Grass-Leaved Goldenrod	Yellow	S3	G5	24.4Km +/-5
Euthamia galetorum	Narrow-Leaf Fragrant Golden-Rod	Green	S3S4	G3	16.2Km +/-10
Festuca subverticillata	Nodding Fescue	Red	S1S2	G5	58.8Km +/-5
Floerkea proserpinacoides	False Mermaid-Weed	Yellow	S2S3	G5	48Km +/-10
Fraxinus nigra	Black Ash	Yellow	S3	G5	53.4Km +/-1
Fraxinus pennsylvanica	Green Ash	Red	S1	G5	71.9Km +/-0.5
Galium boreale	Northern Bedstraw	Red	S2	G5	88.2Km +/-5
Goodyera pubescens	Downy Rattlesnake-Plantain	Red	S1	G5	34Km +/-1
Goodyera tesselata	Checkered Rattlesnake-Plantain	Green	S3	G5	45.7Km +/-1
Gratiola neglecta	Clammy Hedge-Hyssop	Yellow	S1	G5	30.6Km +/-0.1
Halenia deflexa	Spurred Gentian	Yellow	S2S3	G5	76.3Km +/-1
Hedeoma pulegioides	American Pennyroyal	Yellow	S2S3	G5	4.9Km +/-5
Helianthemum canadense	Canada Frostweed	Red	S1	G5	77.1Km +/-1
Hepatica nobilis	Round-Lobe Hepatica	Red	S1	G5	23.3Km +/-0.1
Hepatica nobilis var. obtusa	Round-Leaved Liverleaf	Red	S1	G5T5	23.1Km +/-1
Hieracium kalmii	Kalm's Hawkweed	Undetermined	S2?	G5	70.8Km +/-1
Hieracium kalmii var. fasciculatum	Kalm's Hawkweed	Undetermined	S1?	G5T3T5	60.3Km +/-5
Hieracium kalmii var. kalmii	Kalm's Hawkweed	Undetermined	S2?	G5T?	63.7Km +/-5
Hieracium robinsonii	Robinson's Hawkweed	Yellow	S2	G2	48.4Km +/-1
Hieracium umbellatum	Umbellate Hawkweed	Undetermined	S2?	G5?	50.6Km +/-5
Hudsonia ericoides	Golden-Heather	Yellow	S2	G4	61.5Km +/-10
Hudsonia tomentosa	Sand-Heather	Red	S1	G5	79.8Km +/-10
Huperzia selago	Fir Clubmoss	Undetermined	S1S3	G5	59.2Km +/-5
Hypericum dissimulatum	Disguised St. John's-Wort	Yellow	S2S3	G5Q	59Km +/-0.5

Table 1 Atlantic Canada Conservation Data Council (ACCDC) list of rare vascular plants reported within 100 km of the Touquoy Gold Project Site

Binomial	Common Name	NS DNR Rank	Sub-National Rank	Global Rank	Closest Observation (km)
Hypericum majus	Larger Canadian St. John's Wort	Blue	S1	G5	61.5Km +/-10
Impatiens pallida	Pale Jewel-Weed	Yellow	S2	G5	91.5Km +/-10
Iris prismatica	Slender Blue Flag	Red	S1	G4G5	78Km +/-10
Isoetes acadiensis	Acadian Quillwort	Yellow	S3	G3?	78.6Km +/-10
Isoetes lacustris	Lake Quillwort	Yellow	S3?	G5	70.1Km +/-0.5
Isoetes prototypus	Prototype Quillwort	Red	S2	G2?	83.4Km +/-0
Juncus dudleyi	Dudley's Rush	Yellow	S2?	G5	49.6Km +/-1
Juncus greenei	Greene's Rush	Yellow	S1S2	G5	63.7Km +/-10
Juncus nodosus	Knotted Rush	Green	S3S4	G5	61.7Km +/-0
Juncus subcaudatus	Woods-Rush	Undetermined	S3	G5	13.8Km +/-10
Juncus subcaudatus var. planisepalus	Woods-Rush	Undetermined	S3	G5T?	12.2Km +/-0.5
Lactuca hirsuta var. sanguinea	Hairy Wild Lettuce	Yellow	S2	G5?T5?	39.6Km +/-10
Laportea canadensis	Wood Nettle	Yellow	S3	G5	31.6Km +/-0.1
Lilium canadense	Canada Lily	Yellow	S2S3	G5	42Km +/-10
Limosella australis	Mudwort	Yellow	S2S3	G4G5	23.5Km +/-5
Lindernia dubia	Yellow-Seed False-Pimpernel	Yellow	S3S4	G5	61.6Km +/-0
Liparis loeselii	Loesel's Twayblade	Green	S3S4	G5	51.1Km +/-5
Listera australis	Southern Twayblade	Red	S1	G4	48.6Km +/-0.1
Listera convallarioides	Broad-Leaved Twayblade	Green	S3	G5	81.9Km +/-0.1
Lobelia spicata	Pale-Spiked Lobelia	Red	S1S2SE	G5	66.2Km +/-10
Luzula parviflora	Small-Flowered Wood-Rush	Green	S3	G5	88.3Km +/-0
Lycopodiella appressa	Southern Bog Clubmoss	Green	S3	G5	19.9Km +/-1
Lycopodium complanatum	Trailing Clubmoss	Green	S3?	G5	77.3Km +/-0
Lycopodium hickeyi	Hickey's Clubmoss	Undetermined	S2?	G5	52.1Km +/-1
Lycopodium sabinifolium	Ground-Fir	Green	S3?	G4	60.2Km +/-0.1
Lycopodium sitchense	Alaskan Clubmoss	Green	S3?	G5	55.1Km +/-5
Lysimachia thyrsiflora	Water Loosestrife	Green	S3S4	G5	49.1Km +/-1
Malaxis brachypoda	White Adder's-Mouth	Red	S1	G4Q	98.9Km +/-1

Table 1 Atlantic Canada Conservation Data Council (ACCDC) list of rare vascular plants reported within 100 km of the Touquoy Gold Project Site

Binomial	Common Name	NS DNR Rank	Sub-National Rank	Global Rank	Closest Observation (km)
Megalodonta beckii	Beck Water-Marigold	Yellow	S3	G4G5	27.1Km +/-0.5
Milium effusum	Tall Millet-Grass	Green	S3	G5	90.8Km +/-0
Minuartia groenlandica	Mountain Sandwort	Yellow	S2	G5	25.5Km +/-10
Montia fontana	Fountain Miner's-Lettuce	Yellow	S1	G5	65.3Km +/-1
Myriophyllum farwellii	Farwell's Water-Milfoil	Undetermined	S2	G5	26.8Km +/-0.1
Myriophyllum verticillatum	Whorled Water-Milfoil	Yellow	S2	G5	71Km +/-10
Najas gracillima	Thread-Like Naiad	Undetermined	S1S2	G5?	77.8Km +/-0.1
Oenothera fruticosa ssp. glauca	Shrubby Sundrops	Green	S2S3SE?	G5T5	52.9Km +/-10
Ophioglossum pusillum	Adder's Tongue	Yellow	S2S3	G5	46.8Km +/-10
Osmorhiza longistylis	Smoother Sweet-Cicely	Undetermined	S2	G5	55.9Km +/-0
Packera paupercula	Balsam Groundsel	Green	S3	G5	53.4Km +/-1
Panax trifolius	Dwarf Ginseng	Green	S3	G5	70.9Km +/-0.1
Panax trifolius	Dwarf Ginseng	Green	S3	G5	91.7Km +/-0
Panicum philadelphicum	Philadelphia Panic Grass	Yellow	S2S3SE	G5	79.1Km +/-0
Pilea pumila	Canada Clearweed	Yellow	S1	G5	39Km +/-0
Piptatherum canadense	Canada Mountain-Ricegrass	Yellow	S2	G5	43Km +/-1
Plantago rugelii	Black-Seed Plantain	Undetermined	S1SE	G5	52.9Km +/-10
Platanthera flava	Southern Rein-Orchid	Yellow	S2	G4	54.7Km +/-10
Platanthera flava var. herbiola	Pale Green Orchid	Green	S1S2	G4T4Q	80.6Km +/-0
Platanthera grandiflora	Large Purple-Fringe Orchis	Green	S3	G5	37.1Km +/-1
Platanthera hookeri	Hooker Orchis	Green	S3	G5	87.5Km +/-1
Platanthera macrophylla	Large Round-Leaved Orchid	Green	S2	G5?T4	60.3Km +/-1
Platanthera orbiculata	Large Roundleaf Orchid	Yellow	S3	G5?	52.9Km +/-10
Poa glauca	White Bluegrass	Yellow	S2S3	G5	79.6Km +/-1
Polygala polygama	Racemed Milkwort	Undetermined	S1SE	G5	63.7Km +/-1
Polygala sanguinea	Field Milkwort	Yellow	S2S3	G5	25.1Km +/-100
Polygonum arifolium	Halberd-Leaf Tearthumb	Yellow	S2	G5	95.9Km +/-0.1
Polygonum buxiforme	Small's Knotweed	Undetermined	S2S3SE	G5	52.9Km +/-10

Table 1 Atlantic Canada Conservation Data Council (ACCDC) list of rare vascular plants reported within 100 km of the Touquoy Gold Project Site

Binomial	Common Name	NS DNR Rank	Sub-National Rank	Global Rank	Closest Observation (km)
Polygonum pensylvanicum	Pennsylvania Smartweed	Green	S3	G5	39.2Km +/-1
Polygonum scandens	Climbing False-Buckwheat	Yellow	S2	G5	52.9Km +/-10
Polypodium appalachianum	Appalachian Polypody	Undetermined	S3?	G4G5	45.9Km +/-0
Polystichum braunii	Braun's Holly-Fern	Green	S3S4	G5	70.2Km +/-1
Potamogeton confervoides	Algae-Like Pondweed	Green	S3S4	G4	31.7Km +/-1
Potamogeton friesii	Fries' Pondweed	Undetermined	S2	G4	48.9Km +/-1
Potamogeton nodosus	Longleaf Pondweed	Undetermined	S1	G5	74.2Km +/-5
Potamogeton obtusifolius	Blunt-Leaf Pondweed	Yellow	S2	G5	90.8Km +/-1
Potamogeton praelongus	White-Stem Pondweed	Undetermined	S3?	G5	55.9Km +/-1
Potamogeton pulcher	Spotted Pondweed	Undetermined	S1	G5	13.8Km +/-10
Potamogeton richardsonii	Redhead Grass	Undetermined	S3?	G5	77.2Km +/-1
Potamogeton zosteriformis	Flatstem Pondweed	Yellow	S2S3	G5	12Km +/-10
Primula mistassinica	Bird's-Eye Primrose	Undetermined	S2	G5	26.6Km +/-1
Proserpinaca palustris	Marsh Mermaid-Weed	Green	S3S4	G5	95.4Km +/-0.1
Proserpinaca pectinata	Comb-Leaved Mermaid-Weed	Yellow	S3	G5	31.7Km +/-1
Pyrola asarifolia	Pink Wintergreen	Green	S3	G5	25Km +/-50.1
Ranunculus flammula var. flammula	Greater Creeping Spearwort	Yellow	S2	G5T4T5	48Km +/-10
Ranunculus gmelinii	Small Yellow Water-Crowfoot	Green	S3?	G5	54.7Km +/-0.5
Ranunculus pensylvanicus	Bristly Crowfoot	Red	S1	G5	90.8Km +/-0
Ranunculus sceleratus	Cursed Crowfoot	Undetermined	S1S2	G5	59.9Km +/-0.5
Rhamnus alnifolia	Alderleaf Buckthorn	Yellow	S3	G5	34.7Km +/-1
Ribes americanum	Wild Black Currant	Undetermined	S1SE	G5	50.6Km +/-5
Rudbeckia laciniata	Cut-Leaved Coneflower	Yellow	S2S3	G5	50.4Km +/-0
Rumex salicifolius	Willow Dock	Yellow	S2	G5	87.5Km +/-1
Salix pedicellaris	Bog Willow	Yellow	S2	G5	15.2Km +/-0.1
Salix petiolaris	Meadow Willow	Green	S3	G5	24.7Km +/-0
Salix sericea	Silky Willow	Yellow	S2	G5	50.1Km +/-1
Sanguinaria canadensis	Bloodroot	Green	S3S4	G5	54.9Km +/-0.1

Table 1 Atlantic Canada Conservation Data Council (ACCDC) list of rare vascular plants reported within 100 km of the Touquoy Gold Project Site

Binomial	Common Name	NS DNR Rank	Sub-National Rank	Global Rank	Closest Observation (km)
Sanicula odorata	Black Snake-Root	Red	S1	G5	53.8Km +/-10
Schizaea pusilla	Curly-Grass Fern	Green	S3	G3	36.6Km +/-1
Scirpus pedicellatus	Stalked Bulrush	Undetermined	S1	G4	38.7Km +/-1
Senecio pseudoarnica	Seabeach Groundsel	Yellow	S2	G5	40.8Km +/-10
Shepherdia canadensis	Canada Buffalo-Berry	Yellow	S2	G5	79.8Km +/-10
Sisyrinchium angustifolium	Pointed Blue-Eyed-Grass	Green	S3S4	G5	65.3Km +/-0
Solidago hispida	Hairy Goldenrod	Undetermined	S1?	G5	38.5Km +/-10
Solidago simplex var. randii	Mountain Goldenrod	Blue	SH	G5T4	74.5Km +/-1
Sparganium fluctuans	Floating Bur-Reed	Undetermined	S3?	G5	61.9Km +/-0.5
Sparganium natans	Small Bur-Reed	Green	S3	G5	17.5Km +/-1
Sphenopholis intermedia	Slender Wedge Grass	Yellow	S3S4	G5	39.5Km +/-0
Spiranthes lucida	Shining Ladies'-Tresses	Undetermined	S2	G5	39.5Km +/-0.1
Spiranthes ochroleuca	Yellow Nodding Ladies'-Tresses	Yellow	S2	G4	67.1Km +/-1
Spiranthes romanzoffiana	Hooded Ladies'-Tresses	Green	S3S4	G5	49.6Km +/-5
Stellaria humifusa	Creeping Sandwort	Undetermined	S2	G5?	19.2Km +/-0.1
Stellaria longifolia	Longleaf Stitchwort	Yellow	S3	G5	17.1Km +/-0.1
Stuckenia filiformis ssp. alpina	Northern Slender Pondweed	Undetermined	S2S3	G5T5	36.8Km +/-0.5
Suaeda calceoliformis	American Sea-Blite	Green	S2S3	G5	61.5Km +/-10
Symphyotrichum boreale	Boreal American-Aster	Undetermined	S2?	G5	52.9Km +/-10
Symphyotrichum ciliolatum	Lindley's Aster	Undetermined	S2S3	G5	17.6Km +/-5
Symphyotrichum undulatum	Wavy-leaf American-Aster	Yellow	S2	G5	65.2Km +/-10
Teucrium canadense	American Germander	Yellow	S2S3	G5	40.2Km +/-5
Thuja occidentalis	Northern White Cedar	Red	S1S2	G5	56.2Km +/-1
Tiarella cordifolia	Heart-Leaved Foam-Flower	Yellow	S2	G5	21.8Km +/-5
Trillium erectum	Ill-Scent Trillium	Green	S3	G5	52Km +/-0.1
Triosteum aurantiacum	Coffee Tinker's-Weed	Red	S2	G5	48Km +/-10
Trisetum spicatum	Narrow False Oats	Green	S3	G5	62Km +/-0
Utricularia gibba	Humped Bladderwort	Yellow	S2	G5	20Km +/-10

Table 1 Atlantic Canada Conservation Data Council (ACCDC) list of rare vascular plants reported within 100 km of the Touquoy Gold Project Site

Binomial	Common Name	NS DNR Rank	Sub-National Rank	Global Rank	Closest Observation (km)
Utricularia radiata	Small Swollen Bladderwort	Green	S3	G4	97.1Km +/-1
Vaccinium boreale	Northern Blueberry	Red	S2	G4	66.4Km +/-1
Vaccinium caespitosum	Dwarf Blueberry	Yellow	S2	G5	75.2Km +/-0
Vaccinium uliginosum	Alpine Blueberry	Yellow	S2	G5	67.8Km +/-10
Vallisneria americana	Eel-Grass	Undetermined	S2	G5	25.5Km +/-10
Verbena hastata	Blue Vervain	Green	S3	G5	38.8Km +/-0
Viola canadensis	Canada Violet	Blue	S1	G5	48Km +/-10
Viola nephrophylla	Northern Bog Violet	Yellow	S2	G5	17Km +/-1
Viola sagittata	Arrow-Leaved Violet	Yellow	S3S4	G5	83.2Km +/-0
Zizia aurea	Common Alexanders	Yellow	S1S2	G5	17Km +/-1

Table 2 Atlantic Canada Conservation Data Council (ACCDC) list of rare animals reported within 100 km of the Touquoy Gold Project Site

Binomial	Common Name	NSDNR Rank	Sub-national Rank	Global Rank	Closest Observation (km)
Podiceps grisegena	Red-necked Grebe	Green	S3S4M	G5	60.5Km +/-10
Anas acuta	Northern Pintail	Green	S2B	G5	38.5Km +/-5
Aythya marila	Greater Scaup	Green	S3N	G5	53.7Km +/-5
Bucephala clangula	Common Goldeneye	Green	S2B	G5	33.4Km +/-5
Bucephala islandica	Barrow's Goldeneye (Eastern population)	Yellow	S1N	G5	83.9Km +/-0.1
Mergus serrator	Red-breasted Merganser	Green	S2S3B	G5	25.2Km +/-5
Accipiter gentilis	Northern Goshawk	Yellow	S3B	G5	24.1Km +/-1
Falco columbarius	Merlin	Green	S3S4B	G5	28.5Km +/-1
Falco peregrinus anatum	American Peregrine Falcon	Red	S1B	G4T3	90.9Km +/-50.1
Rallus limicola	Virginia Rail	Green	S2B	G5	38.5Km +/-5
Gallinula chloropus	Common Moorhen	Green	S1B	G5	85.3Km +/-5
Fulica americana	American Coot	Green	S2B	G5	81.4Km +/-1
Charadrius semipalmatus	Semipalmated Plover	Green	S2B,S5M	G5	83Km +/-1
Charadrius melodus	Piping Plover	Red	S1B	G3	21.2Km +/-50.1
Tringa melanoleuca	Greater Yellowlegs	Green	S2B,S5M	G5	10Km +/-5
Bartramia longicauda	Upland Sandpiper	Accidental	S1B	G5	94.4Km +/-5
Calidris minutilla	Least Sandpiper	Green	S1B,S5M	G5	59.7Km +/-1
Calidris maritima	Purple Sandpiper	Yellow	S3N	G5	60.5Km +/-10
Larus ridibundus	Black-headed Gull	Green	S3N	G5	27.1Km +/-5
Sterna dougallii	Roseate Tern	Red	S1B	G4	31.4Km +/-0.1
Sterna hirundo	Common Tern	Yellow	S3B	G5	20.5Km +/-0.1
Sterna paradisaea	Arctic Tern	Yellow	S3B	G5	20.5Km +/-0.1
Alca torda	Razorbill	Yellow	S1B,SZN	G5	53.7Km +/-1
Cepphus grylle	Black Guillemot	Green	S3	G5	47.9Km +/-1
Coccyzus erythropthalmus	Black-billed Cuckoo	Green	S3B	G5	52.4Km +/-1
Caprimulgus vociferus	Whip-Poor-Will	Green	S2B	G5	21.7Km +/-1
Sayornis phoebe	Eastern Phoebe	Green	S2S3B	G5	43.3Km +/-5
Myiarchus crinitus	Great Crested Flycatcher	Green	S2S3B	G5	45.5Km +/-5
Eremophila alpestris	Horned Lark	Green	S2B	G5	44.8Km +/-1

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Binomial	Common Name	NSDNR Rank	Sub-national Rank	Global Rank	Closest Observation (km)
Poecile hudsonica	Boreal Chickadee	Yellow	S3S4	G5	10Km +/-5
Sialia sialis	Eastern Bluebird	Yellow	S2S3B	G5	28.5Km +/-1
Hylocichla mustelina	Wood Thrush	Green	S2B	G5	65.4Km +/-5
Mimus polyglottos	Northern Mockingbird	Green	S3B	G5	50Km +/-1
Toxostoma rufum	Brown Thrasher	Green	S1?B	G5	64.4Km +/-5
Vireo philadelphicus	Philadelphia Vireo	Green	S2B	G5	28.9Km +/-5
Piranga olivacea	Scarlet Tanager	Green	S3B	G5	28.5Km +/-1
Passerina cyanea	Indigo Bunting	Green	S2S3B	G5	65.5Km +/-1
Pooecetes gramineus	Vesper Sparrow	Yellow	S2S3B	G5	65.4Km +/-5
Passerculus sandwichensis princeps	Ipswich Sparrow	Yellow	S1S2B	G5T2	92.8Km +/-1
Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow	Green	S2S3B	G5	25.2Km +/-5
Dolichonyx oryzivorus	Bobolink	Yellow	S3B	G5	14.1Km +/-1
Sturnella magna	Eastern Meadowlark	Green	S1S2B	G5	98.4Km +/-5
Euphagus carolinus	Rusty Blackbird	Yellow	S3S4B	G5	10Km +/-5
Icterus galbula	Baltimore Oriole	Green	S3B	G5	38.5Km +/-5
Loxia curvirostra	Red Crossbill	Undetermined	S3S4	G5	25.2Km +/-5
Sorex dispar	Long-Tailed or Rock Shrew	Yellow	S1	G4	80.4Km +/-10
Pipistrellus subflavus	Eastern Pipistrelle	Yellow	S1?	G5	56.2Km +/-1
Lasiurus cinereus	Hoary Bat	Undetermined	S2?	G5	33.8Km +/-10
Alces alces	Moose	Red	S1	G5	19.2Km +/-10
Salmo salar	Atlantic Salmon	Red	S2	G5	24.6Km +/-50.1
Hemidactylium scutatum	Four-toed Salamander	Green	S3	G5	39.9Km +/-10
Dermochelys coriacea	Leatherback Turtle; Tinglar	NA	S1S2N	G3	94.6Km +/-5
Glyptemys insculpta	Wood Turtle	Yellow	S3	G4	10.4Km +/-10
Alasmidonta undulata	Triangle Floater; Heavy-toothed Wedgemussel	Yellow	S2S3	G4	19.4Km +/-0.1
Alasmidonta varicosa	Brook Floater	Yellow	S1S2	G3	35.7Km +/-0.1
Lampsilis radiata	Eastern Lampmussel	Green	S2	G5	25.8Km +/-0.1
Cordulegaster diastatops	Delta-Spotted Spiketail	Green	S3	G5	53.6Km +/-1
Cordulegaster maculata	Twin-Spotted Spiketail	Green	S3	G5	40.2Km +/-1

Table 2 Atlantic Canada Conservation Data Council (ACCDC) list of rare animals reported within 100 km of the Touquoy Gold Project Site

Binomial	Common Name	NSDNR Rank	Sub-national Rank	Global Rank	Closest Observation (km)
Dromogomphus spinosus	Black-Shouldered Spinyleg	Green	S2	G5	25.8Km +/-0.1
Gomphus ventricosus	Skillet Clubtail	Red	S1	G3	47.1Km +/-0.1
Gomphus borealis	Beaverpond Clubtail	Green	S2	G4	39.2Km +/-1
Gomphus descriptus	Harpoon Clubtail	Yellow	S2	G4	95.5Km +/-0.1
Gomphus exilis	Lancet Clubtail	Green	S3	G5	28.1Km +/-1
Gomphus spicatus	Dusky Clubtail	Green	S2	G5	28.4Km +/-10
Gomphus adelphus	Mustached Clubtail	Green	S2	G4	44.1Km +/-1
Hagenius brevistylus	Dragonhunter	Green	S3	G5	21.8Km +/-0.1
Lanthus parvulus	Northern Pygmy Clubtail/Zorro Clubtail	Yellow	S2	G4	88.8Km +/-1
Stylogomphus albistylus	Least Clubtail	Green	S3	G5	36Km +/-1
Ophiogomphus aspersus	Brook Snaketail	Red	S1	G3G4	86.1Km +/-0.1
Ophiogomphus carolus	Riffle Snaketail	Green	S3	G5	36Km +/-1
Ophiogomphus mainensis	Maine Snaketail/ Twinhorned Snaketail	Red	S1	G4	90.2Km +/-0.1
Ophiogomphus rupinsulensis	Rusty Snaketail	Red	S1	G5	47.1Km +/-0.1
Aeshna canadensis	Canada Darner	Green	S3	G5	38.3Km +/-0.1
Aeshna clepsydra	Mottled Darner	Green	S2	G4	42.5Km +/-1
Aeshna constricta	Lance-Tipped Darner	Undetermined	S2	G5	43.6Km +/-0.1
Aeshna eremita	Lake Darner	Green	S3	G5	15.1Km +/-1
Aeshna sitchensis	Zigzag Darner	Green	S2	G5	72.8Km +/-1
Aeshna subarctica	Subarctic Darner/Muskeg Darner	Green	S3	G5	45.5Km +/-1
Aeshna tuberculifera	Black-Tipped Darner	Green	S3	G4	18.6Km +/-1
Aeshna verticalis	Green-Striped Darner	Green	S2	G5	40.2Km +/-0.1
Anax junius	Common Green Darner	Green	S3	G5	38.3Km +/-0.1
Basiaeschna janata	Springtime Darner	Green	S3	G5	39.6Km +/-0.1
Boyeria grafiana	Ocellated Darner	Undetermined	S2	G5	53.6Km +/-1
Boyeria vinosa	Fawn Darner	Green	S3	G5	26.1Km +/-1
Gomphaeschna furcillata	Harlequin Darner	Yellow	S1	G5	60.8Km +/-1
Didymops transversa	Stream Cruiser	Green	S3	G5	39.6Km +/-0.1
Macromia illinoiensis	Illinois River Cruiser	Green	S3	G5	21.8Km +/-0.1

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Binomial	Common Name	NSDNR Rank	Sub-national Rank	Global Rank	Closest Observation (km)
Cordulia shurtleffii	American Emerald	Green	S3	G5	40.2Km +/-0.1
Dorocordulia lepida	Petite Emerald	Green	S3	G5	39.4Km +/-0.1
Dorocordulia libera	Racket-Tailed Emerald	Green	S2	G5	43.6Km +/-0.1
Epitheca princeps	Prince Baskettail	Yellow	S2	G5	55.7Km +/-0.5
Epitheca canis	Beaverpond Baskettail	Green	S3	G5	14.2Km +/-1
Epitheca cynosura	Common Baskettail	Undetermined	S3	G5	28.4Km +/-10
Epitheca spinigera	Spiny Baskettail	Green	S3	G5	52.3Km +/-1
Helocordulia uhleri	Uhler's Sundragon	Green	S3	G5	39.4Km +/-0.1
Somatochlora cingulata	Lake Emerald	Green	S2	G5	39.6Km +/-0.1
Somatochlora elongata	Ski-Tailed Emerald	Green	S3	G5	38Km +/-0.1
Somatochlora forcipata	Forcipate Emerald	Undetermined	S2	G5	64Km +/-1
Somatochlora franklini	Delicate Emerald	Undetermined	S1	G5	73.7Km +/-0.1
Somatochlora incurvata	Incurvate Emerald/Warpaint Emerald	Green	S3	G4	23.3Km +/-1
Somatochlora minor	Ocellated Emerald	Green	S2	G5	39.3Km +/-0.1
Somatochlora tenebrosa	Clamp-Tipped Emerald	Yellow	S2	G5	72.8Km +/-0.1
Somatochlora walshii	Brush-Tipped Emerald/Walsh's Emerald	Green	S3	G5	41.7Km +/-1
Williamsonia fletcheri	Ebony Boghaunter	Red	S1	G3G4	95Km +/-0.1
Celithemis elisa	Calico Pennant	Green	S2	G5	31.3Km +/-1
Celithemis martha	Martha's Pennant	Green	S2	G4	42.4Km +/-1
Leucorrhinia frigida	Frosted Whiteface	Green	S3	G5	39.6Km +/-0.1
Leucorrhinia glacialis	Crimson-Ringed Whiteface	Green	S3	G5	50.4Km +/-1
Leucorrhinia hudsonica	Hudsonian Whiteface	Green	S3	G5	39.3Km +/-0.1
Leucorrhinia intacta	Dot-Tailed Whiteface	Green	S3	G5	15.1Km +/-1
Leucorrhinia proxima	Red-Waisted Whiteface	Green	S3	G5	15.1Km +/-1
Libellula incesta	Slaty Skimmer	Green	S3	G5	42.5Km +/-1
Libellula luctuosa	Widow Skimmer/Pied Slimmer	Blue	SH	G5	73.7Km +/-0.1
Libellula pulchella	Twelve-Spotted Skimmer	Green	S2	G5	38Km +/-0.1
Ladona exusta	White Corporal	Green	S3	G4	28.1Km +/-1
Plathemis lydia	Common Whitetail	Green	S3	G5	39.3Km +/-0.1

Table 2 Atlantic Canada Conservation Data Council (ACCDC) list of rare animals reported within 100 km of the Touquoy Gold Project Site

Binomial	Common Name	NSDNR Rank	Sub-national Rank	Global Rank	Closest Observation (km)
Ladona julia	Chalk-Fronted Corporal	Green	S3	G5	43.6Km +/-0.1
Nannothemis bella	Elfin Skimmer	Green	S2	G4	71.2Km +/-1
Sympetrum costiferum	Saffron-Winged Meadowhawk/Saffron-bordered Meadowfly	Green	S3	G5	25.8Km +/-0.1
Sympetrum danae	Black Meadowhawk	Green	S2	G5	97.1Km +/-1
Sympetrum obtrusum	White-Faced Meadowhawk	Green	S3	G5	36.3Km +/-5
Sympetrum rubicundulum	Ruby Meadowhawk	Undetermined	S2	G5	42.2Km +/-1
Sympetrum semicinctum	Band-Winged Meadowhawk	Green	S3	G5	25.8Km +/-0.1
Sympetrum vicinum	Yellow-Legged Meadowhawk	Green	S3	G5	28.4Km +/-10
Calopteryx aequabilis	River Jewelwing/Black-Tipped Jewelwing	Green	S3	G5	21.8Km +/-0.1
Calopteryx amata	Superb Jewelwing	Green	S3	G4	26.1Km +/-1
Lestes dryas	Emerald Spreadwing	Green	S3	G5	38.3Km +/-0.1
Lestes forcipatus	Sweetflag Spreadwing	Undetermined	S2	G5	39.2Km +/-1
Lestes congener	Spotted Spreadwing	Green	S3	G5	22.2Km +/-0.1
Lestes eurinus	Amber-Winged Spreadwing	Undetermined	S2	G4	39.3Km +/-0.1
Lestes rectangularis	Slender Spreadwing	Green	S3	G5	28.4Km +/-10
Lestes unguiculatus	Lyre-Tipped Spreadwing	Green	S2	G5	51.3Km +/-1
Lestes vigilax	Swamp Spreadwing	Undetermined	S2	G5	28.4Km +/-10
Argia fumipennis violacea	Variable Dancer	Green	S3	G5T5	28.4Km +/-10
Argia moesta	Powdered Dancer	Green	S3	G5	36Km +/-1
Coenagrion resolutum	Taiga Bluet	Red	S1	G5	55.7Km +/-0.5
Enallagma boreale	Boreal Bluet	Green	S3	G5	39Km +/-1
Enallagma carunculatum	Tule Bluet	Undetermined	S1	G5	73.7Km +/-0.1
Enallagma vernale	a Bluet Damselfly/Springtime Bluet	Undetermined	S2	G4Q	38Km +/-0.1
Enallagma minusculum	Little Bluet	Yellow	S2	G3G4	28.4Km +/-10
Enallagma aspersum	Azure Bluet/Bog Bluet	Green	S2	G5	34.8Km +/-0.1
Enallagma civile	Familiar Bluet	Green	S3	G5	38.3Km +/-0.1
Enallagma ebrium	Marsh Bluet	Green	S3	G5	38.3Km +/-0.1
Enallagma exsulans	Stream Bluet	Green	S2	G5	32.2Km +/-1
Enallagma hageni	Hagen's Bluet	Green	S3	G5	28.4Km +/-10

Table 2 Atlantic Canada Conservation Data Council (ACCDC) list of rare animals reported within 100 km of the Touquoy Gold Project Site

Binomial	Common Name	NSDNR Rank	Sub-national Rank	Global Rank	Closest Observation (km)
Enallagma signatum	Orange Bluet	Undetermined	S1	G5	66.2Km +/-0.1
Ischnura posita	Fragile Forktail	Green	S3	G5	38.3Km +/-0.1
Nehalennia irene	Sedge Sprite	Green	S3	G5	30.8Km +/-1
Nehalennia gracilis	Sphagnum Sprite	Undetermined	S2	G5	72.8Km +/-0.1
Amphiagrion saucium	Eastern Red Damsel	Green	S2	G5	51.3Km +/-1
Chromagrion conditum	Aurora Damsel	Green	S3	G5	39.6Km +/-0.1
Stylurus scudderi	Zebra Clubtail	Undetermined	S1	G4	44.1Km +/-1

NOVA SCOTIA
Tourism, Culture & Heritage
Heritage Division
1747 Summer Street
Halifax, Nova Scotia
B3H 3A6
Tel: (902) 424-6475
Fax: (902) 424-0560

Memorandum

TO: Allan Lines
MGI Limited

FROM: Bob Ogilvie

RE: **Environmental Screening 04-04-20**
Moose River Gold Mines

DATE: May 21, 2004

Further to your request of April 20, 2004, staff of the Heritage Division have reviewed their files for reference to the presence of known heritage resources in the study area. Please be aware that our information is not comprehensive, in that it is incomplete and of varying degrees of accuracy with respect to the precise location and condition of heritage resources.

Archaeology
This area has not been subject to previous archaeological assessment. The nearest recorded archaeological site is at the north end of Lake Charlotte and was found by local residents and subsequently recorded by an archaeologist. This location is marked as an Indian Reserve on the 1898 Dawson Geological Survey of Canada Map (Sheet 50). Of particular interest is a path, in part called Portage Road, that runs from the top of Lake Charlotte through part of the study area. Another map notation notes Indian Guzzle on the Moose River, also within the study area. Various lake/river confluences and rapids increase the potential for historic Mi'kmaq and Pre-Contact archaeological sites in the area.

In addition to the likely Mi'kmaq use of the area for resource harvesting and settlement, a major reason for Historic Period settlement was mining. There are likely to be surviving archaeological sites associated with this activity. An Icelandic Settlement appears to be west of the study area.

We would strongly recommend that an archaeological assessment be undertaken prior to development in the area. There is a high probability of historic Mi'kmaq land use and settlement, and Pre-Contact sites are probably present as well. These sites generally tend to be small and localized. More detailed documentary research will provide details of past mining use and identify locations of interest.

An archaeological reconnaissance survey, with sub-surface testing is sensitive areas that will be subject to development, is recommended.

Natural Heritage
The staff of the Nova Scotia Museum of Natural History have reviewed their records and make the following observations:

Botany
We have no records of botanical species-at-risk known from the area within the potential footprint of the project. This does not mean there are no species-at-risk present, only that none have been found to date.

The following species-at-risk are known from adjacent areas and in similar habitats:

Betula michauxii - Yellow listed
Cypripedium reginae - Red listed
Megalodonta beckii - Yellow listed
Rhamnus alnifolius - Yellow listed
Viola nephrophylla - Yellow listed
Potamogeton zosteriformis - Yellow listed
Proserpinaca pectinata - Yellow listed
Zizia aurea - Yellow listed

A botanical inventory of all vegetation conducted during the growing season would provide a comprehensive list of plants present and ascertain whether or not any species at risk will be impacted by the project.

Zoology
We have no zoological collection records for the immediate site. Depending on the habitat present, there may be wood turtles *Glyptemys (Clemmys) insculpta* within the study area.

I have attached an invoice for the staff time spent reviewing our records and compiling this response.

If you have any questions, please contact me at 424-6475.

APPENDIX K

WETLAND EVALUATIONS

WETLAND 1 REPORT

Wetland Delineation

Wetland 1 encompasses 3.57 ha and consists of low shrub bog and treed bog centered on 4980678 N, 506067 E. Its geographical boundaries are listed in Table 1. See Figure 1 for the location of this project within Nova Scotia and Figure 2 for the location of this wetland on the project site.

Table 1. Geographical Boundaries of Wetland 1 (NAD 83)

Boundary	Northing	Easting
North	4980819 N	506051 E
South	4980611 N	506044 E
East	4980829 N	505956 E
West	4980585 N	506044 E

During the field survey on September 13 2006, all species of plant, bird, mammal, reptile and amphibian detected within the wetland were recorded. Evidence of wildlife species such as sightings, vocalizations, tracks, faeces, skeletal remains, and characteristic bite marks or dens was recorded.

Ecological Characterization

Plants

Wetland 1 is predominately a low shrub bog. It is characterized by a low layer of ericaceous shrubs (< 1m) consisting of leatherleaf (*Chamaedaphne calyculata),* lambkill (*Kalmia angustifolia),* pale laurel *(K. polifolia),* Labrador tea *(Ledum groenlandicum)*, and rhodora (*Rhododendron canadense* are also present. Ground vegetation consists of low-growing ericaceous plants such as small cranberry (*Vaccinium oxycoccos)* and black crowberry (*Empterum nigrum),* as well as of sphagnum (*Sphagnum spp.*), goldthread *(Coptis trifolia),* and bog goldenrod (*Solidago uliginosa)*, with a considerable patch of northern pitcher plant (*Sarracenia purpurea)* located in the northeast corner of the wetland.

At the eastern edge of the wetland, the low shrub bog grades into treed bog. This area is dominated by black spruce (*Picea mariana*), with scattered larch (*Larix laracina*) and immature red maple (*Acer rubrum*). The shrub layer consists of lambkill, possum-haw viburnum (*Viburnum nudum*), and rhodora. Ground vegetation consists of sphagnum, small cranberry and goldthread.

The Atlantic Canada Conservation Data Centre (ACCDC) database consists of records of uncommon to rare plant and animal species from the 1850s to the present. A review in 2005 for information or rare plants within 100 km of the project site yielded a list of five plants with habitat requirements similar to habitat present in the wetland. These are listed in Table 2. In addition, an environmental screening of all natural heritage resources in the area (within an approximate 10 km radius of the site) was compiled by the Nova Scotia Museum (NSM) in 2004, encompassing all their data from 1847 to 2004. As the Museum is a government department, not all of it its species records are available to the non-governmental ACCDC database. Thus the NSM screening generated a list of seven additional species known from the general area or from similar habitats (the complete screening may be found in Appendix H). Of these, two species had potential to occur in habitats present in Wetland 1 (Table 2). None of the species listed by the ACCDC or the NSM are listed as rare or endangered under the *Nova Scotia Endangered Species Act* (NSESA) or Committee On the Status of Endangered Wildlife/Species at Risk Act (COSEWIC/SARA).

Table 2. Phenology and Habitat Preferences of Rare Vascular Plants Reported within 100 km (ACCDC search) or 10 km (NSM screening) of Wetland 1

Species	Common Name	NSDNR Status	Bloom Period	Preferred Habitat	Record Source
Coeloglossum viride	Long-bract green orchis	Yellow	May-August	Boggy spots, damp mature (sugar maple) woods, fir or floodplain forest	ACCDC
Listera australis	Southern twayblade	Red	June	Sphagnum bog	ACCDC
Planthaera flava	Southern rein orchid	Yellow	May-August	Sandy gravelly beach, wet peat, lake edge, bog	ACCDC
Salix pedicellaris	Bog willow	Yellow	Late May-Early June	Sphagnous lakeshores, acid bogs	ACCDC
Utricularia gibba	Humped bladderwort	Yellow	Late June-Sept	Shallow lake edge, small pool, pond in peaty area	ACCDC
Betula michauxii	Michaux's dwarf birch	Yellow	June and July	Peat and sphagnous bogs	NSM
Viola nephrophylla	Northern bog violet	Yellow	May to July	Cool mossy bogs, borders of streams, and damp woods	NSM

None of these plants were observed in the wetland on the survey on September 13, 2006. An additional botany survey is planned for spring 2007.

Birds

During the field survey for Wetland 1 on September 13 2006, no bird species were observed within the wetland. Due to the field survey being conducted in late summer, a breeding bird survey was not possible for this wetland. A desktop review of bird species known to breed in the area where the wetland is located was conducted using the Atlas of Breeding Birds of the Maritime Provinces (Erskine 1990). A list of the status of each breeding bird species recorded from the 10 x 10 km atlas square containing Wetland 1 is provided in Table 3.

Table 3. Breeding Status of Birds Listed in the Atlas Square in Which Wetland 1 is Located

Common Name	Species Name	Breeding Status in Atlas Square
Common Loon	*Gavia immer*	Possible
Canada Goose	*Branta canadensis*	Probable
American Black Duck	*Anas rubripes*	Probable
Ring-Necked Duck	*Aythya collaris*	Confirmed
Common Merganser	*Mergus merganser*	Confirmed
Sharp-Shinned Hawk	*Accipiter striatus*	Possible
Broad-Winged Hawk	*Buteo platypterus*	Probable
American Kestrel	*Falco sparverius*	Possible
Common Nighthawk	*Chordeiles minor*	Confirmed
Chimney Swift	*Chaetura pelagica*	Possible
Belted Kingfisher	*Ceryle alcyon*	Possible
Hairy Woodpecker	*Picoides villosus*	Confirmed
Northern Flicker	*Colaptes auratus*	Confirmed
Pileated Woodpecker	*Dryocopus pileatus*	Possible
Olive-sided Flycatcher	*Contopus borealis*	Possible
Eastern Wood-pewee	*Contopus virens*	Possible
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Confirmed
Alder Flycatcher	*Empidonax alnorum*	Possible
Least Flycatcher	*Empidonax minimus*	Probable
Tree Swallow	*Tachycineta bicolor*	Confirmed
Barn Swallow	*Hirundo rustica*	Confirmed
Gray Jay	*Perisoreus canadensis*	Confirmed
Blue Jay	*Cyanocitta cristata*	Possible
American Crow	*Corvus brachyrhynchos*	Confirmed
Common Raven	*Corvus corax*	Possible
Black-capped Chickadee	*Poecile atricapillus*	Confirmed
Boreal Chickadee	*Poecile hudsonicus*	Confirmed
Red-breasted Nuthatch	*Sitta Canadensis*	Confirmed
Winter Wren	*Troglodytes troglodytes*	Confirmed
Golden-crowned Kinglet	*Regulus satrapa*	Confirmed
Ruby-crowned Kinglet	*Regulus calendula*	Confirmed
Swainson's Thrush	*Catharus ustulatus*	Confirmed
Hermit Thrush	*Catharus guttatus*	Confirmed

Table 3. Breeding Status of Birds Listed in the Atlas Square in Which Wetland 1 is Located

Common Name	Species Name	Breeding Status in Atlas Square
American Robin	*Turdus migratorius*	Confirmed
Cedar Waxwing	*Bombycilla cedrorum*	Probable
Blue-headed Vireo	*Vireo solitarius*	Confirmed
Red-eyed Vireo	*Vireo olivaceus*	Probable
Tennessee Warbler	*Vermivora peregrine*	Possible
Nashville Warbler	*Vermivora ruficappilla*	Confirmed
Northern Parula Warbler	*Parula americana*	Confirmed
Chestnut-sided Warbler	*Dendroica pensylvanica*	Confirmed
Magnolia Warbler	*Dendroica magnolia*	Confirmed
Black-throated Blue Warbler	*Dendroica caerulescens*	Possible
Yellow-Rumped Warbler	*Dendroica coronata*	Confirmed
Black-throated Green Warbler	*Dendroica virens*	Confirmed
Blackburnian Warbler	*Dendroica fusca*	Confirmed
Palm Warbler	*Dendroica palmarum*	Confirmed
Bay-breasted Warbler	*Dendroica castanea*	Confirmed
Black-and-white Warbler	*Mniotilta varia*	Confirmed
American Redstart	*Setophaga ruticilla*	Confirmed
Ovenbird	*Seiurus aurocapillus*	Confirmed
Mourning Warbler	*Oporinis philadelphia*	Confirmed
Common Yellowthroat	*Geothlypis trichas*	Confirmed
Canada Warbler	*Wilsonia canadensis*	Confirmed
Song Sparrow	*Melospiza melodia*	Confirmed
Lincoln's Sparrow	*Melospiza lincolnii*	Confirmed
Swamp Sparrow	*Melospiza georgiana*	Confirmed
White-throated Sparrow	*Zonotrichia albicollis*	Confirmed
Dark-eyed Junco	*Junco hyemalis*	Confirmed
Red-winged Blackbird	*Agelaius phoeniceus*	Possible
Rusty Blackbird	*Euphagus carolinus*	Confirmed
Common Grackle	*Quiscalus quiscula*	Confirmed
Pine Grosbeak	*Pinicola enucleator*	Probable
Purple Finch	*Carpodacus purpureus*	Possible
White Winged Crossbill	*Loxia leucoptera*	Probable
Pine Siskin	*Carduelis pinus*	Possible
American Goldfinch	*Carduelis tristis*	Possible
Evening Grosbeak	*Coccothraustes vespertinus*	Probable

None of these bird species were observed in Wetland 1 during the field survey on September 13 2006. Wetland 1 is not considered to be critical breeding habits for any of these species. A breeding bird survey is planned in this wetland for spring 2007.

A review of the ACCDC database of rare species records revealed fourteen at–risk species reported in the region. Three red-listed and eleven yellow-listed bird species were listed within 100 km by the ACCDC search. Each species' habitat preference was determined based on Erksine's 1990 data, and the likelihood of their presence on site was determined based on comparison of known habitat preferences with habitats present in the wetland. A summary of the rare bird species, their provincial status and their habitat preferences is provided in Table 4.

Table 4. Habitat Preferences of Listed Bird Species Reported within 100 km of Wetland 1

NSDNR Status	Common Name	Binomial	Habitat Preference
Red	Roseate Tern	*Sterna dougallii*	Coast
Red	Peregrine Falcon	*Falco peregrinus*	Rocky cliffs
Red	Piping Plover	*Charadrius melodus*	Sandy Beaches
Yellow	Common Tern	*Sterna hirundo*	Coast
Yellow	Arctic Tern	*Sterna paradisea*	Coast
Yellow	Barrow's Goldeneye	*Bucephala islandica*	Small clear lakes and ponds
Yellow	Northern Goshawk	*Accipiter gentiles*	Mature woods
Yellow	Semipalmated Sandpiper	*Calidris pusilla*	Beaches, mudflats, shallow estuaries, and inlets.
Yellow	Eastern Meadowlark	*Sturnella magna*	Grassy fields, pastures, cultivated areas
Yellow	Razorbill	*Alca torda*	Coastal islands
Yellow	Eastern Bluebird	*Sialia sialis*	Areas with scattered trees and short ground cover.
Yellow	Vesper Sparrow	*Poecetes gramineus*	Areas with short grass or low shrubs
Yellow	Sharp-tailed Sparrow	*Ammodramus caudacutus*	Breed in meadows adjacent to salt marshes
Yellow	Bobolink	*Dolichonyx oryzivorus*	Grasslands

Arctic Terns, Common Terns, and Razorbills are coastal species, and so should not be present in Wetland 1. Sharp-tailed Sparrows breed in meadows adjacent to salt marshes. Vesper Sparrows are characteristic of areas with short grass or low shrubs, such as sandy pastures, blueberry fields, and clearings. Goshawks prefer heavily wooded areas, and prefer to breed in mature mixed wood. Eastern Bluebirds, (*Sialis sialis*) nest in clear-cut areas, which are adjacent to the wetland, and in woodpecker cavities. Eastern Meadowlarks and Bobolinks are grassland/meadow species. Semipalmated Sandpipers and Barrow's Goldeneyes inhabit areas near large bodies of water. None of these three red-listed species or the eleven yellow-listed bird species is expected to be present in the Wetland 1 or to use Wetland 1 due to the lack of suitable habitat (Table 4). None of the birds listed in the ACCDC search were observed during the wetland survey and the area is not critical habitat for any of these species. A breeding bird survey will be conducted in spring of 2007. The environmental screening conducted by the NSM found no records of rare or endangered birds on the Project site (Appendix H).

Mammals

Evidence of varying (snowshoe) hare (*Lepas americana*) and white-tailed deer (*Odocoileus virginianus*) was noted in Wetland 1 during the Sept 13 2006 wetland survey.

Four uncommon to rare mammals were listed in the ACCDC 100 km database search. Two species of rare bat, the hoary bat, (*Lasiurus cinereus*), and the eastern pipistrelle (*Pipstrellus subflavus*), were reported within 100 km; however, bats are not expected to make use of any habitat in this wetland. The eastern moose (A*lces alces americana*) is listed as endangered in Nova Scotia and was listed on the ACCDC database search for this area. The low density of moose in the area, and the tiny size of Wetland 1 results in the removal of this wetland having very low potential to affect moose. A Moose Mitigation Plan has been developed for the Touquoy Gold Project (see section 9 of the main document).

The fourth rare mammal listed by the ACCDC request is the long-tailed shrew (*Sorex dispar*), which lives only on talus slopes, thus they would be not be expected to occur within this wetland. Additional mammal observations will be taken concurrently with the spring botany surveys in 2007. The environmental screening conducted by the NSM found no records of rare or endangered mammals on the Project site (Appendix H).

Reptiles and Amphibians

No reptiles or amphibians were observed during the wetland survey. The ACCDC request and the environmental screening conducted by the NSM both noted the presence of wood turtles and four-toed salamanders within 100 km of the site. Wood turtles (*Glyptemys insculpta*) are listed as yellow by NSDNR. There is no hibernating or breeding habitat for turtles in this wetland, as they require deep sections of rivers in which to hibernate, and sandy or gravelly banks for nesting. Four-toed salamanders (*Hemidactylium scutatum*) were previously yellow-listed by NSDNR; however, their status has been recently changed to green, indicating they are not considered to be sensitive or at-risk in Nova Scotia. The dry nature of Wetland 1 in summer makes the possibility of four-toed salamanders breeding in this wetland unlikely. There is no suitable habitat for any rare or endangered reptiles or amphibians in Wetland 1. Additional herpetile observations will be taken concurrently with the spring botany surveys in 2007.

Odonates

The ACCDC search reported several rare odonates within a 100 km radius of Wetland 1. Most odonates (dragonflies and damselflies) lay their eggs in bodies of water, where they hatch and develop through several larval stages before emerging from the water and metamorphosing into the adult form. In most species, this larval stage lasts for about one year. The fact that Wetland 1 is a low shrub bog which contains no standing water in late summer indicates that most odonate species would be unable to complete larval development in this bog. As see in Table 5, most rare odonates listed in the ACCDC 100 km search inhabit areas near streams or rivers. Two species present in Nova Scotia, the ebony boghaunter (*Williamsonia fletcheri*) and the harlequin darner (*Gomphhaeschna furcillata*) are known to breed in sphagnum bogs (Table 4).

The ebony boghaunter is red-listed by NSDNR, and was reported once in the ACCDC 100 km search, from a location 95 km away. No ebony boghaunters were observed in Wetland 1 during the survey on September 13, 2004, however, they are an early-flying species (June) and adults would not be expected to be present at this time. The harlequin darner is a yellow-listed species for which there were two records in the ACCDC 100 km list. The closest record was 60 km from Wetland 1. No harlequin darners were observed in Wetland 1 during the survey on September 13, 2004, however, they are also an early-flying species (early June) and adults would not be expected to be present at this time. In addition, the dry nature of Wetland 1 in summer indicates this wetland is not suitable breeding habitat for these species, which require bogs containing standing water.

Table 5. Rare Odonates Reported Within 100 km of Wetland 1

Scientific Name	Common Name	Status	Preferred Habitat
Ophiogomphus rupinsulensis	Rusty Snaketail	RED	Large clear flowing streams and rivers
Gomphus ventricosus	Skillet Clubtail	RED	Slow-moving rivers
Coenagrion resolutum	Taiga Bluet	RED	Small ponds with grassy or marshy borders, often shaded
Ophiogomphus mainensis	Twinhorned Snaketail	RED	Streams and small rivers
Williamsonia fletcheri	Ebony Boghaunter	RED	Small pools in sphagnum bogs
Gomphaeschna furcillata	Harlequin Darner	YELLOW	Sphagnum bogs and wooded swamps
Lanthus parvulus	Zorro Clubtail	YELLOW	Mountain streams with muddy substrate

Hydrological Characterization

There is no surface connection between this wetland and any surface watercourses or lakes in the immediate area, based on 1:10,000 topographical mapping, air photography, and field surveys. As a bog, this wetland is not expected to receive surface runoff and thus, its role in surface flow regulation is expected to be minimal. It has no role as a supply for local surface watercourse flow.

Hydrogeological Characterization

This wetland lies in an area with a thin layer of coarse till overlying the bedrock. The bedrock consists of quartzite and slate, and thus is relatively impermeable. The till tends to be coarse-grained and thus the layer is hydrologically conductive. The groundwater level is very shallow (likely < 2m) in this area. General movement of groundwater is from north to south over the project site, mirroring surface water patterns. Bogs are not fed by groundwater discharge. There are no seeps or springs visible.

Reason for the Alteration

The wetland in question will be removed due to the construction of a tailings pond for an adjacent open-pit gold mine being constructed on the site.

Nature of the Proposed Alteration

The wetland will be entirely removed.

Alternatives That Have Been Considered

Alternative positions for the tailings management facilty have been considered, however, positions either to the east or west of the proposed location would have significant impacts on Moose River or Fish River with their sensitive fish habitat, and would impact additional wetlands. Moving the tailings management facility north could result in impacts to Square Lake, while moving it south might impact Scraggy Lake, which is considered significant habitat for brook trout, Atlantic salmon, and gaspereau by NSDNR. The project boundary has already been adjusted to avoid the wetland complex located southeast of the Project site, and to avoid impacting Moose River.

Gold mining can be undertaken by either underground or open pit methods. In this particular instance the gold is relatively uniformly distributed, and at relatively low grades, throughout the local rock mass to the extent that large scale, high volume throughput from an open pit is commercially viable. Concentrations of gold of sufficient grade, continuity or predictability in quartz veins or other specific sites at Touquoy to support a commercial underground operation are not present. Commercial underground gold mining at Touquoy is not an option. There are no options for re-positioning of the open pit – the site of concentration of gold is fixed in nature.

Identifiable Impacts to Wetland

Wetland 1 will be entirely removed by the mine project. There are no species at risk or species of conservation concern known to be present in this wetland. Additional plant and wetland surveys will be conducted in spring of 2007, as well as a breeding bird survey. Additional mammal and herpetile surveys will be conducted concurrently.

No aquatic habitats or fish species are present, as the wetland is a low shrub bog which is dry during late summer months.

Past Impacts To The Wetland

Possible past impacts to the wetland may have arisen from forestry clear-cutting activities that have occurred in the area, which may have impacted drainage patterns to some extent. Aerial photography of the site dating from 1964, 1974, 1982, 1993, and 2003 was reviewed to provide information on historical forestry activities in the area.

Clearing occurred less than 1 km to the north of Wetland 1 prior to 1992. Extensive clearing, as well as the creation of logging roads, occurred less than 1 km south of the wetland during the period between 1992 and 2003.

Mitigation

The project footprint has been adjusted so as to minimize impacts to wetlands and watercourses in the area. DDV Gold Limited (DDVG) will work with NSDNR to develop the required mitigation measures including wetland compensation at a ratio agreed upon with NSDNR. DDVG is considering various approaches to the wetland compensation issue. The first approach, preferred by NSDNR, is to create wetland habitat within the same watershed as the wetland which is to be altered. DDVG is considering creating wetland habitat onsite once mine operations are completed by ensuring that the flooded quarry pit has sufficiently shallow edges to support a marsh-type wetland. If this is not possible, the proponent will consider a wetland enhancement or creation project outside of the local watershed. Contribution to wetland education and/or protection programs may also be considered.

Summary

In summary, assuming that the proposed mitigation measures are applied, and that existing site drainage conditions are maintained, the Touquoy Gold Project is not likely to have significant effects on wetland functional attributes in the area. At this point in time, removal of this wetland is not expected to have negative impacts on any rare or endangered species in the area, although additional plant and animal surveys will be conducted in spring 2007.

Evaluation Expertise
Conestoga-Rovers & Associates is a multi-disciplinary engineering, environmental consulting, construction, and information technology (IT) services firm. Since its inception in 1976, CRA has provided practical, innovative, and effective services in the areas of environmental site assessment, impact assessment, environmental remediation, regulatory compliance and permitting, risk assessment, hydrology, solid and hazardous waste management, air quality management, and municipal infrastructure planning and design. We are an established, reputable company with a strong history of solving engineering and environmental challenges in a responsive and cost-efficient manner.

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WETLAND 2 REPORT

Wetland Delineation

Wetland 2 is a small 0.44 ha wetland complex consisting of treed bog and two areas of low shrub bog. The two areas of low shrub bog are connected by a band of treed bog, as seen in Figure 1. Wetland 2 is centered on 4980867 N, 506474 E and its geographical boundaries are listed in Table 1. See Figure 1 for the location of this project within Nova Scotia and Figure 2 for the location of this wetland on the project site.

Table 1 Geographical Boundaries of Wetland 2 (NAD 83)

Boundary	Northing	Easting
North	4980885 N	506498 E
South	4980842 N	506492 E
East	4980878 N	506412 E
West	4980835 N	506546 E

During the field survey on September 14 2006, all species of plant, bird, mammal, reptile and amphibian detected within the wetland were recorded. Evidence of wildlife species such as sightings, vocalizations, tracks, faeces, skeletal remains, and characteristic bite marks or dens was recorded.

Ecological Characterization

Plants

The treed bog supports a plant community dominated by black spruce, *Picea mariana* and larch, *Larix laracina*, with a few scattered Red maple, *Acer rubrum*. Shrubs consist of possum-haw viburnum (*Viburnum nudum)* and black holly (*Ilex verticillata)*, while ground vegetation consists of dwarf dogwood (*Cornus sanadensis)*, bristly dewberry (*Rubus hispidus),* and violets *(Viola* spp).

The low shrub bog areas are characterized by a low layer of ericaceous shrubs (< 1m) consisting of leatherleaf (*Chamaedaphne calyculata)*, lambkill (*Kalmia angustifolia)*, and Labrador tea (*Ledum groenlandicum)*, while the ground vegetation consists of sphagnum mosses (*Sphagnum spp.*), reindeer lichens (*Cladonia* spp.), small cranberry (*Vaccinium oxycoccos)*, tawny cottongrass (*Eriophorum virginicum*), three-leaved false Solomon's seal (*Smilacina trifolia)*, bog goldenrod (*Solidago uliginosa)*, and round-leaved sundew (*Drosera rotundifolia)*.

The Atlantic Canada Conservation Data Centre (ACCDC) database consist of records of uncommon to rare plant and animal species from the 1850s to the present. A review in 2005 for information or rare plants within 100 km of the project site yielded a list of five plants with habitat requirements similar to habitat present in the wetland. These are listed in Table 2. In addition, an environmental screening of all natural heritage resources in the area (within an approximate 10 km radius of the site) was compiled by the Nova Scotia Museum (NSM) in 2004, encompassing all their data from 1847 to 2004. As the Museum is a government department, not all of it its species records are available to the non-governmental ACCDC database. Thus the NSM screening generated a list of seven additional species known from the general area or from similar habitats (the complete screening may be found in Appendix H). Of these, two species had potential to occur in habitats present in Wetland 2 (Table 2). None of the species listed by the ACCDC or the NSM are listed as rare or endangered under the *Nova Scotia Endangered Species Act* (NSESA) or Committee On the Status of Endangered Wildlife/ Species at Risk Act (COSEWIC/SARA).

Table 2. Phenology and Habitat Preferences of Rare Vascular Plants Reported Within 100 km (ACCDC search) or 10 km (NSM screening) of Wetland 2

Species	Common Name	NSDNR Status	Bloom Period	Preferred Habitat	Record Source
Coeloglossum viride	Long-bract green orchis	Yellow	May-August	Boggy spots, damp mature (sugar maple) woods, fir or floodplain forest	ACCDC
Listera australis	Southern twayblade	Red	June	Sphagnum bog	ACCDC
Planthaera flava	Southern rein orchid	Yellow	May-August	Sandy gravelly beach, wet peat, lake edge, bog	ACCDC
Salix pedicellaris	Bog willow	Yellow	Late May-Early June	Sphagnous lakeshore, acid bog	ACCDC
Utricularia gibba	Humped bladderwort	Yellow	Late June-Sept	Shallow lake edge, small pool, pond in peaty area	ACCDC
Betula michauxii	Michaux's dwarf birch	Yellow	June and July	Peat and sphagnous bogs	NSM
Viola nephrophylla	Northern bog violet	Yellow	May to July	Cool mossy bogs, borders of streams, and damp woods	NSM

None of these plants were observed in the wetland on the survey on September 14, 2006. An additional botany survey is planned for spring 2007.

Birds

During the field survey for Wetland 2 on September 14 2006, no bird species were observed within the wetland. Due to the field survey being conducted in late summer, a breeding bird survey was not possible for this wetland. A desktop review of bird species known to breed in the area where the wetland is located was conducted using the Atlas of Breeding Birds of the Maritime Provinces (Erskine 1990). A list of the status of each breeding bird species recorded from the 10 x 10 km atlas square containing Wetland 2 is provided in Table 3.

Table 3. Breeding Status of Birds Listed in the Atlas Square in Which Wetland 2 is Located

Common Name	Species Name	Breeding Status in Atlas Square
Common Loon	*Gavia immer*	Possible
Canada Goose	*Branta canadensis*	Probable
American Black Duck	*Anas rubripes*	Probable
Ring-Necked Duck	*Aythya collaris*	Confirmed
Common Merganser	*Mergus merganser*	Confirmed
Sharp-Shinned Hawk	*Accipiter striatus*	Possible
Broad-Winged Hawk	*Buteo platypterus*	Probable
American Kestrel	*Falco sparverius*	Possible
Common Nighthawk	*Chordeiles minor*	Confirmed
Chimney Swift	*Chaetura pelagica*	Possible
Belted Kingfisher	*Ceryle alcyon*	Possible
Hairy Woodpecker	*Picoides villosus*	Confirmed
Northern Flicker	*Colaptes auratus*	Confirmed
Pileated Woodpecker	*Dryocopus pileatus*	Possible
Olive-sided Flycatcher	*Contopus borealis*	Possible
Eastern Wood-pewee	*Contopus virens*	Possible
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Confirmed
Alder Flycatcher	*Empidonax alnorum*	Possible
Least Flycatcher	*Empidonax minimus*	Probable
Tree Swallow	*Tachycineta bicolor*	Confirmed
Barn Swallow	*Hirundo rustica*	Confirmed
Gray Jay	*Perisoreus canadensis*	Confirmed

Table 3. Breeding Status of Birds Listed in the Atlas Square in Which Wetland 2 is Located

Common Name	Species Name	Breeding Status in Atlas Square
Blue Jay	*Cyanocitta cristata*	Possible
American Crow	*Corvus brachyrhynchos*	Confirmed
Common Raven	*Corvus corax*	Possible
Black-capped Chickadee	*Poecile atricapillus*	Confirmed
Boreal Chickadee	*Poecile hudsonicus*	Confirmed
Red-breasted Nuthatch	*Sitta Canadensis*	Confirmed
Winter Wren	*Troglodytes troglodytes*	Confirmed
Golden-crowned Kinglet	*Regulus satrapa*	Confirmed
Ruby-crowned Kinglet	*Regulus calendula*	Confirmed
Swainson's Thrush	*Catharus ustulatus*	Confirmed
Hermit Thrush	*Catharus guttatus*	Confirmed
American Robin	*Turdus migratorius*	Confirmed
Cedar Waxwing	*Bombycilla cedrorum*	Probable
Blue-headed Vireo	*Vireo solitarius*	Confirmed
Red-eyed Vireo	*Vireo olivaceus*	Probable
Tennessee Warbler	*Vermivora peregrine*	Possible
Nashville Warbler	*Vermivora ruficappilla*	Confirmed
Northern Parula Warbler	*Parula americana*	Confirmed
Chestnut-sided Warbler	*Dendroica pensylvanica*	Confirmed
Magnolia Warbler	*Dendroica magnolia*	Confirmed
Black-throated Blue Warbler	*Dendroica caerulescens*	Possible
Yellow-Rumped Warbler	*Dendroica coronata*	Confirmed
Black-throated Green Warbler	*Dendroica virens*	Confirmed
Blackburnian Warbler	*Dendroica fusca*	Confirmed
Palm Warbler	*Dendroica palmarum*	Confirmed
Bay-breasted Warbler	*Dendroica castanea*	Confirmed

Table 3. Breeding Status of Birds Listed in the Atlas Square in Which Wetland 2 is Located

Common Name	Species Name	Breeding Status in Atlas Square
Black-and-white Warbler	*Mniotilta varia*	Confirmed
American Redstart	*Setophaga ruticilla*	Confirmed
Ovenbird	*Seiurus aurocapillus*	Confirmed
Mourning Warbler	*Oporinis philadelphia*	Confirmed
Common Yellowthroat	*Geothlypis trichas*	Confirmed
Canada Warbler	*Wilsonia canadensis*	Confirmed
Song Sparrow	*Melospiza melodia*	Confirmed
Lincoln's Sparrow	*Melospiza lincolnii*	Confirmed
Swamp Sparrow	*Melospiza georgiana*	Confirmed
White-throated Sparrow	*Zonotrichia albicollis*	Confirmed
Dark-eyed Junco	*Junco hyemalis*	Confirmed
Red-winged Blackbird	*Agelaius phoeniceus*	Possible
Rusty Blackbird	*Euphagus carolinus*	Confirmed
Common Grackle	*Quiscalus quiscula*	Confirmed
Pine Grosbeak	*Pinicola enucleator*	Probable
Purple Finch	*Carpodacus purpureus*	Possible
White Winged Crossbill	*Loxia leucoptera*	Probable
Pine Siskin	*Carduelis pinus*	Possible
American Goldfinch	*Carduelis tristis*	Possible
Evening Grosbeak	*Coccothraustes vespertinus*	Probable

None of these bird species were observed in Wetland 2 during the field survey on September 14 2006. Wetland 2 is not considered to be critical breeding habits for any of these species. A breeding bird survey is planned in this wetland for spring 2007.

A review of the ACCDC database of rare species records revealed fourteen at–risk species reported in the region. Three red-listed and eleven yellow-listed bird species were listed within

100 km by the ACCDC search. Each species' habitat preference was determined based on Erksine's 1990 data, and the likelihood of their presence on site was determined based on comparison of known habitat preferences with habitats present in the wetland. A summary of the rare bird species, their provincial status and their habitat preferences is provided in Table 4.

Table 4. Habitat Preferences of Listed Bird Species Reported Within 100 km of Wetland 2

NSDNR Status	Common Name	Binomial	Habitat Preference
Red	Roseate Tern	*Sterna dougallii*	Coast
Red	Peregrine Falcon	*Falco peregrinus*	Rocky cliffs
Red	Piping Plover	*Charadrius melodus*	Sandy Beaches
Yellow	Common Tern	*Sterna hirundo*	Coast
Yellow	Arctic Tern	*Sterna paradisea*	Coast
Yellow	Barrow's Goldeneye	*Bucephala islandica*	Small clear lakes and ponds
Yellow	Northern Goshawk	*Accipiter gentiles*	Mature woods
Yellow	Semipalmated Sandpiper	*Calidris pusilla*	Beaches, mudflats, shallow estuaries, and inlets.
Yellow	Eastern Meadowlark	*Sturnella magna*	Grassy fields, pastures, cultivated areas
Yellow	Razorbill	*Alca torda*	Coastal islands
Yellow	Eastern Bluebird	*Sialia sialis*	Areas with scattered trees and short ground cover.
Yellow	Vesper Sparrow	*Poecetes gramineus*	Areas with short grass or low shrubs
Yellow	Sharp-tailed Sparrow	*Ammodramus caudacutus*	Breed in meadows adjacent to salt marshes
Yellow	Bobolink	*Dolichonyx oryzivorus*	Grasslands

Arctic Terns, Common Terns, and Razorbills are coastal species, and so should not be present in Wetland 2. Sharp-tailed Sparrows breed in meadows adjacent to salt marshes. Vesper Sparrows are characteristic of areas with short grass or low shrubs, such as sandy pastures, blueberry fields, and clearings. Goshawks prefer heavily wooded areas, and prefer to breed in mature mixed woods. Eastern Bluebirds, (*Sialis sialis*) nest in clear-cut areas, which are adjacent to the wetland, and in woodpecker cavities. Eastern Meadowlarks and Bobolinks are grassland/meadow species. Semipalmated Sandpipers and Barrow's Goldeneyes inhabit areas near large bodies of water. None of these three red-listed species or the eleven yellow-listed bird species is expected to be present in Wetland 2 or to use Wetland 2 due to the lack of suitable habitat (Table 4). None of the birds listed in the ACCDC search were observed during the wetland survey and the area is not critical habitat for any of these species. A breeding bird survey will be conducted in spring of 2007. The environmental screening conducted by the NSM found no records of rare or endangered birds on the Project site (Appendix H).

Mammals

Evidence of varying (snowshoe) hare (*Lepas americana*) was noted in Wetland 2 during the Sept 14 2006 wetland survey.

Four uncommon to rare mammals were listed in the ACCDC 100 km database search. Two species of rare bat, the hoary bat, (*Lasiurus cinereus*), and the eastern pipistrelle (*Pipstrellus subflavus*), were reported within 100 km; however, bats are not expected to make use of any habitat in this wetland. The eastern moose (A*lces alces americana*) is listed as endangered in Nova Scotia and was listed on the ACCDC database search for this area. The low density of moose in the area, and the tiny size of Wetland 2 results in the removal of this wetland having very low potential to affect moose. A Moose Mitigation Plan has been developed for the Touquoy Gold Project (see section 9 of the main document).

The fourth rare mammal listed by the ACCDC request is the long-tailed shrew (*Sorex dispar*), which lives only on talus slopes, thus they would be not be expected to occur within this wetland. Additional mammal observations will be taken concurrently with the spring botany surveys in 2007. The environmental screening conducted by the NSM found no records of rare or endangered mammals on the Project site (Appendix H).

Reptiles and Amphibians

No reptiles or amphibians were observed during the wetland survey. The ACCDC request and the environmental screening conducted by the NSM both noted the presence of wood turtles and four-toed salamanders within 100 km of the site. Wood turtles (*Glyptemys insculpta*) are listed as yellow by NSDNR. There is no hibernating or breeding habitat for turtles in this wetland, as they require deep sections of rivers in which to hibernate, and sandy or gravelly banks for nesting. Four-toed salamanders (*Hemidactylium scutatum*) were previously yellow-listed by NSDNR; however, their status has been recently changed to green, indicating they are not considered to be sensitive or at-risk in Nova Scotia. The dry nature of Wetland 2 in summer makes the possibility of four-toed salamanders breeding in this wetland unlikely. There is no suitable habitat for any rare or endangered reptiles or amphibians in Wetland 2. Additional herpetile observations will be taken concurrently with the spring botany surveys in 2007.

Odonates

The ACCDC search reported several rare odonates within a 100 km radius of Wetland 2. Most odonates (dragonflies and damselflies) lay their eggs in bodies of water, where they hatch and develop through several larval stages before emerging from the water and metamorphosing into the adult form. In most species, this larval stage lasts for about one year. The fact that Wetland 2 is a low shrub bog/treed bog complex which contains no standing water in late summer indicates that most odonate species would be unable to complete larval development in this bog. As see in Table 5, most rare odonates listed in the ACCDC 100 km search inhabit areas near streams or rivers. Two species present in Nova Scotia, the ebony boghaunter (*Williamsonia fletcheri*) and the harlequin darner (*Gomphhaeschna furcillata*) are known to breed in sphagnum bogs (Table 5).

The ebony boghaunter is red-listed by NSDNR, and was reported once in the ACCDC 100 km search, from a location 95 km away. No ebony boghaunters were observed in Wetland 2 during the survey on September 14, 2004, however, they are an early-flying species (June) and adults would not be expected to be present at this time. The harlequin darner is a yellow-listed species for which there were two records in the ACCDC 100 km list. The closest record was 60 km from Wetland 2. No harlequin darners were observed in Wetland 2 during the survey on September 14, 2004, however, they are also an early-flying species (early June) and adults would not be expected to be present at this time. In addition, the dry nature of Wetland 2 in summer indicates this wetland is not suitable breeding habitat for these species, which require bogs containing standing water.

Table 5. Rare Odonates Reported Within 100 km of Wetland 2

Scientific Name	Common Name	Status	Preferred Habitat
Ophiogomphus rupinsulensis	Rusty Snaketail	RED	Large clear flowing streams and rivers
Gomphus ventricosus	Skillet Clubtail	RED	Slow-moving rivers
Coenagrion resolutum	Taiga Bluet	RED	Small ponds with grassy or marshy borders, often shaded
Ophiogomphus mainensis	Twinhorned Snaketail	RED	Streams and small rivers
Williamsonia fletcheri	Ebony Boghaunter	RED	Small pools in sphagnum bogs
Gomphaeschna furcillata	Harlequin Darner	YELLOW	Sphagnum bogs and wooded swamps
Lanthus parvulus	Zorro Clubtail	YELLOW	Mountain streams with muddy substrate

Hydrological Characterization

There is no surface connection between this wetland and any surface watercourses or lakes in the immediate area, based on 1:10,000 topographical mapping, air photography, and field surveys. As a bog, this wetland is not expected to receive surface runoff and thus its role in surface flow regulation is expected to be minimal. It has no role as a supply for local surface watercourse flow.

Hydrogeological Characterization

This wetland lies in an area with a thin layer of coarse till overlying the bedrock. The bedrock consists of quartzite and slate, and thus is relatively impermeable. The till tends to be coarse-grained and thus the layer is hydrologically conductive. The groundwater level is likely very shallow (< 2m) in this area. General movement of groundwater is from north to south over the project site, mirroring surface water patterns. Bogs are not fed by groundwater discharge. There are no seeps or springs visible.

Reason for the Alteration

The wetland in question will be removed due to the construction of a tailings pond from an adjacent open-pit gold mine being constructed on the site.

Nature of the Proposed Alteration

The wetland will be entirely removed.

Alternatives That Have Been Considered

Alternative positions for the tailings management facilty have been considered, however, positions either to the east or west of the proposed location would have significant impacts on Moose River or Fish River with their sensitive fish habitat, and would impact additional wetlands. Moving the tailings management facilty north could result in impacts to Square Lake, while moving it south might impact Scraggy Lake, which is considered significant habitat for brook trout, Atlantic salmon, and gaspereau by NSDNR. The project boundary has already been adjusted to avoid the wetland complex located southeast of the Project site, and to avoid impacting Moose River.

Gold mining can be undertaken by either underground or open pit methods. In this particular instance the gold is relatively uniformly distributed, and at relatively low grades, throughout the local rock mass to the extent that large scale, high volume throughput from an open pit is commercially viable. Concentrations of gold of sufficient grade, continuity or predictability in quartz veins or other specific sites at Touquoy to support a commercial underground operation are not present. Commercial underground gold mining at Touquoy is not an option. There are no options for re-positioning of the open pit – the site of concentration of gold is fixed in nature.

Identifiable Impacts to Wetland

Wetland 2 will be entirely removed by the mine project. There are no species at risk or species of conservation concern known to be present in this wetland. Additional plant and wetland surveys will be conducted in spring of 2007, as well as a breeding bird survey. Additional mammal and herpetile surveys will be conducted concurrently.

No aquatic habitats or fish species are present, as the wetland is a low shrub bog/treed complex without any permanent standing water.

Past Impacts To The Wetland

Possible past impacts to the wetland may have arisen from forestry clear-cutting activities that have occurred in the area, which may have impacted drainage patterns to some extent. Aerial photography of the site dating from 1964, 1974, 1982, 1993, and 2003 was reviewed to provide information on historical forestry activities in the area. Clearing occurred less than 1 km to the north of Wetland 2 prior to 1992. Extensive clearing, as well as the creation of logging roads, occurred less than 1km south of the wetland during the period between 1992 and 2003.

Mitigation

The project footprint has been adjusted so as to minimize impacts to wetlands and watercourses in the area. As per NSDNR regulations, three times the wetland area to be removed must be recreated as compensation. DDV Gold Limited (DDVG) will work with NSDNR to develop the required mitigation measures including wetland compensation. DDVG is considering various approaches to the wetland compensation issue. The first approach, preferred by NSDNR, is to create wetland habitat within the same watershed as the wetland which is to be altered. DDVG is considering creating wetland habitat onsite once mine operations are completed by ensuring that the flooded quarry pit has sufficiently shallow edges to support a marsh-type wetland. If this is not possible, the proponent will consider a wetland enhancement or creation project outside of the local watershed. Contribution to wetland education and/or protection programs may also be considered.

Summary

In summary, assuming that the proposed mitigation measures are applied, and that existing site drainage conditions are maintained, the Touquoy Gold Project is not likely to have significant effects on wetland functional attributes in the area. At this point in time, removal of this wetland is not expected to have negative impacts on any rare or endangered species in the area, although additional plant and animal surveys will be conducted in spring 2007.

Evaluation Expertise

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Nova Scotia Department of Natural Resources. Wetlands Database

Zinck, M. 1998. Roland's Flora of Nova Scotia.

WETLAND 3 REPORT

Wetland Delineation

Wetland 3 is a very small wetland dominated by low shrub bog. This wetland is 0.09 ha in area and is centred on 4980582 N, 506334 E. See Figure 1 for the location of this project within Nova Scotia and Figure 2 for the location of this wetland on the project site.

During the field survey on September 21 2006, all species of plant, bird, mammal, reptile and amphibian detected within the wetland were recorded. Evidence of wildlife species such as sightings, vocalizations, tracks, faeces, skeletal remains, and characteristic bite marks or dens was recorded.

Ecological Characterization

Plants

Wetland 3 supports a plant community dominated by bog shrubs such as leatherleaf (*Chamaedaphne calyculata*), lambkill (*Kalmia angustifolia*), Labrador tea (*Ledum groendlandicum*), pale laurel (*K. polifolia)*, and stunted black spruce (*Picea mariana*). Some possum-haw viburnum (*Viburnum nudum)* is also present around the margins of the bog. A few tree-height black spruce are also present. Ground vegetation consists of reindeer lichens (*Cladonia* spp.), sphagnum mosses (*Sphagnum* spp.) and black crowberry (*Empetrum nigrum)*, with some tussock sedge (*Carex stricta)* and goldthread (*Coptis trifolia*) as well.

The Atlantic Canada Conservation Data Centre (ACCDC) database consist of records of uncommon to rare plant and animal species from the 1850s to the present. A review in 2005 for information or rare plants within 100 km of the project site yielded a list of five plants with habitat requirements similar to habitat present in the wetland. These are listed in Table 1. In addition, an environmental screening of all natural heritage resources in the area (within an approximate 10 km radius of the site) was compiled by the Nova Scotia Museum (NSM) in 2004, encompassing all their data from 1847 to 2004. As the Museum is a government department, not all of it its species records are available to the non-governmental ACCDC database. Thus the NSM screening generated a list of seven additional species known from the general area or from similar habitats (the complete screening may be found in Appendix H). Of these, two species had potential to occur in habitats present in Wetland 3 (Table 1). None of the species listed by the ACCDC or the NSM are listed as rare or endangered under the *Nova Scotia Endangered Species Act* (NSESA) or Committee on the Status of Endangered Wildlife/ Species at Risk Act (COSEWIC/SARA).

Table 1. Phenology and Habitat Preferences of Rare Vascular Plants Reported Within 100 km (ACCDC search) or 10 km (NSM screening) of Wetland 3

Species	Common Name	NSDNR Status	Bloom Period	Preferred Habitat	Record Source
Coeloglossum viride	long-bract green orchis	Yellow	May-August	Boggy spots, damp mature (sugar maple) woods, fir or floodplain forest	ACCDC
Listera australis	southern twayblade	Red	June	Sphagnum bog	ACCDC
Planthaera flava	southern rein orchid	Yellow	May-August	Sandy gravelly beach, wet peat, lake edge, bog	ACCDC
Salix pedicellaris	bog willow	Yellow	Late May-Early June	Sphagnous lakeshore, acid bog	ACCDC
Utricularia gibba	humped bladderwort	Yellow	Late June-Sept	Shallow lake edge, small pool, pond in peaty area	ACCDC
Betula michauxii	Michaux's dwarf birch	Yellow	June and July	Peat and sphagnous bogs	NSM
Viola nephrophylla	northern bog violet	Yellow	May to July	Cool mossy bogs, borders of streams, and damp woods	NSM

None of these plants were observed in the wetland on the survey on September 21, 2006. An additional botany survey is planned for spring 2007.

Birds

During the field survey for Wetland 3 on September 21 2006, no bird species were observed within the wetland. Due to the field survey being conducted in late summer, a breeding bird survey was not possible for this wetland. A desktop review of bird species known to breed in the area where the wetland is located was conducted using the Atlas of Breeding Birds of the Maritime Provinces (Erskine 1990). A list of the status of each breeding bird species recorded from the 10 x 10 km atlas square containing Wetland 3 is provided in Table 2.

Table 2. Breeding Status of Birds Listed in the Atlas Square in Which Wetland 3 is Located

Common Name	Species Name	Breeding Status in Atlas Square
Common Loon	*Gavia immer*	Possible
Canada Goose	*Branta Canadensis*	Probable
American Black Duck	*Anas rubripes*	Probable
Ring-Necked Duck	*Aythya collaris*	Confirmed
Common Merganser	*Mergus merganser*	Confirmed
Sharp-Shinned Hawk	*Accipiter striatus*	Possible
Broad-Winged Hawk	*Buteo platypterus*	Probable
American Kestrel	*Falco sparverius*	Possible
Common Nighthawk	*Chordeiles minor*	Confirmed
Chimney Swift	*Chaetura pelagica*	Possible
Belted Kingfisher	*Ceryle alcyon*	Possible
Hairy Woodpecker	*Picoides villosus*	Confirmed
Northern Flicker	*Colaptes auratus*	Confirmed
Pileated Woodpecker	*Dryocopus pileatus*	Possible

Table 2. Breeding Status of Birds Listed in the Atlas Square in Which Wetland 3 is Located

Common Name	Species Name	Breeding Status in Atlas Square
Olive-sided Flycatcher	*Contopus borealis*	Possible
Eastern Wood-pewee	*Contopus virens*	Possible
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Confirmed
Alder Flycatcher	*Empidonax alnorum*	Possible
Least Flycatcher	*Empidonax minimus*	Probable
Tree Swallow	*Tachycineta bicolor*	Confirmed
Barn Swallow	*Hirundo rustica*	Confirmed
Gray Jay	*Perisoreus canadensis*	Confirmed
Blue Jay	*Cyanocitta cristata*	Possible
American Crow	*Corvus brachyrhynchos*	Confirmed
Common Raven	*Corvus corax*	Possible
Black-capped Chickadee	*Poecile atricapillus*	Confirmed
Boreal Chickadee	*Poecile hudsonicus*	Confirmed
Red-breasted Nuthatch	*Sitta Canadensis*	Confirmed
Winter Wren	*Troglodytes troglodytes*	Confirmed
Golden-crowned Kinglet	*Regulus satrapa*	Confirmed
Ruby-crowned Kinglet	*Regulus calendula*	Confirmed
Swainson's Thrush	*Catharus ustulatus*	Confirmed
Hermit Thrush	*Catharus guttatus*	Confirmed
American Robin	*Turdus migratorius*	Confirmed
Cedar Waxwing	*Bombycilla cedrorum*	Probable
Blue-headed Vireo	*Vireo solitarius*	Confirmed
Red-eyed Vireo	*Vireo olivaceus*	Probable
Tennessee Warbler	*Vermivora peregrine*	Possible
Nashville Warbler	*Vermivora ruficappilla*	Confirmed
Northern Parula Warbler	*Parula americana*	Confirmed
Chestnut-sided Warbler	*Dendroica pensylvanica*	Confirmed
Magnolia Warbler	*Dendroica magnolia*	Confirmed
Black-throated Blue Warbler	*Dendroica caerulescens*	Possible
Yellow-Rumped Warbler	*Dendroica coronata*	Confirmed
Black-throated Green Warbler	*Dendroica virens*	Confirmed
Blackburnian Warbler	*Dendroica fusca*	Confirmed
Palm Warbler	*Dendroica palmarum*	Confirmed
Bay-breasted Warbler	*Dendroica castanea*	Confirmed
Black-and-white Warbler	*Mniotilta varia*	Confirmed
American Redstart	*Setophaga ruticilla*	Confirmed
Ovenbird	*Seiurus aurocapillus*	Confirmed
Mourning Warbler	*Oporinis philadelphia*	Confirmed
Common Yellowthroat	*Geothlypis trichas*	Confirmed
Canada Warbler	*Wilsonia canadensis*	Confirmed
Song Sparrow	*Melospiza melodia*	Confirmed
Lincoln's Sparrow	*Melospiza lincolnii*	Confirmed
Swamp Sparrow	*Melospiza georgiana*	Confirmed
White-throated Sparrow	*Zonotrichia albicollis*	Confirmed
Dark-eyed Junco	*Junco hyemalis*	Confirmed
Red-winged Blackbird	*Agelaius phoeniceus*	Possible
Rusty Blackbird	*Euphagus carolinus*	Confirmed
Common Grackle	*Quiscalus quiscula*	Confirmed

Table 2. Breeding Status of Birds Listed in the Atlas Square in Which Wetland 3 is Located

Common Name	Species Name	Breeding Status in Atlas Square
Pine Grosbeak	*Pinicola enucleator*	Probable
Purple Finch	*Carpodacus purpureus*	Possible
White Winged Crossbill	*Loxia leucoptera*	Probable
Pine Siskin	*Carduelis pinus*	Possible
American Goldfinch	*Carduelis tristis*	Possible
Evening Grosbeak	*Coccothraustes vespertinus*	Probable

None of these bird species were observed in Wetland 3 during the field survey on September 21 2006. Wetland 3 is not considered to be critical breeding habits for any of these species. A breeding bird survey is planned in this wetland for spring 2007.

A review of the ACCDC database of rare species records revealed fourteen at–risk species reported in the region. Three red-listed and eleven yellow-listed bird species were listed within 100 km by the ACCDC search. Each species' habitat preference was determined based on Erksine's 1990 data, and the likelihood of their presence on site was determined based on comparison of known habitat preferences with habitats present in the wetland. A summary of the rare bird species, their provincial status and their habitat preferences is provided in Table 3.

Table3. Habitat Preferences of Listed Bird Species Reported within 100 km of Wetland 3

NSDNR Status	Common Name	Binomial	Habitat Preference
Red	Roseate Tern	*Sterna dougallii*	Coast
Red	Peregrine Falcon	*Falco peregrinus*	Rocky cliffs
Red	Piping Plover	*Charadrius melodus*	Sandy Beaches
Yellow	Common Tern	*Sterna hirundo*	Coast
Yellow	Arctic Tern	*Sterna paradisea*	Coast
Yellow	Barrow's Goldeneye	*Bucephala islandica*	Small clear lakes and ponds
Yellow	Northern Goshawk	*Accipiter gentiles*	Mature woods
Yellow	Semipalmated Sandpiper	*Calidris pusilla*	Beaches, mudflats, shallow estuaries, and inlets.
Yellow	Eastern Meadowlark	*Sturnella magna*	Grassy fields, pastures, cultivated areas
Yellow	Razorbill	*Alca torda*	Coastal islands
Yellow	Eastern Bluebird	*Sialia sialis*	Areas with scattered trees and short ground cover.
Yellow	Vesper Sparrow	*Poecetes gramineus*	Areas with short grass or low shrubs
Yellow	Sharp-tailed Sparrow	*Ammodramus caudacutus*	Breed in meadows adjacent to salt marshes
Yellow	Bobolink	*Dolichonyx oryzivorus*	Grasslands

Arctic Terns, Common Terns, and Razorbills are coastal species, and so should not be present in Wetland 3. Sharp-tailed Sparrows breed in meadows adjacent to salt marshes. Vesper Sparrows are characteristic of areas with short grass or low shrubs, such as sandy pastures, blueberry fields, and clearings. Goshawks prefer heavily wooded areas, and prefer to breed in mature mixed woods. Eastern Bluebird, (*Sialis sialis*) nests in clear-cut areas, which are adjacent to the wetland, and in woodpecker cavities. Eastern Meadowlarks and Bobolinks are grassland/meadow species. Semipalmated Sandpipers and Barrow's Goldeneyes inhabit areas near large bodies of water. None of these three red-listed species or the eleven yellow-listed bird species is expected to be present in the Wetland 3 or to use Wetland 3 due to the lack of suitable habitat (Table 3). None of the birds listed in the ACCDC search were observed during the wetland survey and the area is not critical habitat for any of these species. A breeding bird survey will be conducted in spring of 2007. The environmental screening conducted by the NSM found no records of rare or endangered birds on the Project site (Appendix H).

Mammals

Evidence of varying (snowshoe) hare (*Lepas americana*) was noted in Wetland 3 during the Sept 21 2006 wetland survey.

Four uncommon to rare mammals were listed in the ACCDC 100 km database search. Two species of rare bat, the hoary bat, (*Lasiurus cinereus*), and the eastern pipistrelle (*Pipstrellus subflavus*), were reported within 100 km; however, bats are not expected to make use of any habitat in this wetland. The eastern moose (A*lces alces americana*) is listed as endangered in Nova Scotia and was listed on the ACCDC database search for this area. The low density of moose in the area, and the tiny size of Wetland 3 results in the removal of this wetland having very low potential to affect moose. A Moose Mitigation Plan has been developed for the Touquoy Gold Project (see section 9 of the main document).

The fourth rare mammal listed by the ACCDC request is the long-tailed shrew (*Sorex dispar*), which lives only on talus slopes, thus they would be not be expected to occur within this wetland. Additional mammal observations will be taken concurrently with the spring botany surveys in 2007. The environmental screening conducted by the NSM found no records of rare or endangered mammals on the Project site (Appendix H).

Reptiles and Amphibians

No reptiles or amphibians were observed during the wetland survey. The ACCDC request and the environmental screening conducted by the NSM both noted the presence of wood turtles and four-toed salamanders within 100 km of the site. Wood turtles (*Glyptemys insculpta*) are listed as yellow by NSDNR. There is no hibernating or breeding habitat for turtles in this wetland, as they require deep sections of rivers in which to hibernate, and sandy or gravelly banks for nesting. Four-toed salamanders (*Hemidactylium scutatum*) were previously yellow-listed by NSDNR; however, their status has been recently changed to green, indicating they are not considered to be sensitive or at-risk in Nova Scotia. The dry nature of Wetland 3 in summer makes the possibility of four-toed salamanders breeding in this wetland unlikely. There is no suitable habitat for any rare or endangered reptiles or amphibians in Wetland 3. Additional herpetile observations will be taken concurrently with the spring botany surveys in 2007.

Odonates

The ACCDC search reported several rare odonates within a 100 km radius of Wetland 3. Most odonates (dragonflies and damselflies) lay their eggs in bodies of water, where they hatch and develop through several larval stages before emerging from the water and metamorphosing into the adult form. In most species, this larval stage lasts for about one year. The fact that Wetland 3 is a low shrub bog which contains no standing water in late summer indicates that most odonate species would be unable to complete larval development in this bog. As see in Table 4, most rare odonates listed in the ACCDC 100 km search inhabit areas near streams or rivers. Two species present in Nova Scotia, the ebony boghaunter (*Williamsonia fletcheri*) and the harlequin darner (*Gomphhaeschna furcillata*) are known to breed in sphagnum bogs (Table 4).

The ebony boghaunter is red-listed by NSDNR, and was reported once in the ACCDC 100 km search, from a location 95 km away. No ebony boghaunters were observed in Wetland 3 during the survey on September 21, 2004, however, they are an early-flying species (June) and adults would not be expected to be present at this time. The harlequin darner is a yellow-listed species for which there were two records in the ACCDC 100 km list. The closest record was 60 km from Wetland 3. No harlequin darners were observed in Wetland 3 during the survey on September 21, 2004, however, they are also an early-flying species (early June) and adults would not be expected to be present at this time. In addition, the dry nature of Wetland 3 in summer indicates this wetland is not suitable breeding habitat for these species, which require bogs containing standing water.

Table 4. Rare Odonates Reported Within 100 km of Wetland 3

Scientific Name	Common Name	Status	Preferred Habitat
Ophiogomphus rupinsulensis	Rusty Snaketail	RED	Large clear flowing streams and rivers
Gomphus ventricosus	Skillet Clubtail	RED	Slow-moving rivers
Coenagrion resolutum	Taiga Bluet	RED	Small ponds with grassy or marshy borders, often shaded
Ophiogomphus mainensis	Twinhorned Snaketail	RED	Streams and small rivers
Williamsonia fletcheri	Ebony Boghaunter	RED	Small pools in sphagnum bogs
Gomphaeschna furcillata	Harlequin Darner	YELLOW	Sphagnum bogs and wooded swamps
Lanthus parvulus	Zorro Clubtail	YELLOW	Mountain streams with muddy substrate

Hydrological Characterization

There is no surface connection between this wetland and any surface watercourses or lakes in the immediate area as it is a bog, this is based on 1:10,000 topographical mapping, air photography, and field surveys. As a bog, this wetland is not expected to receive surface water flow and thus has no role in surface flow regulation. It has no role as a supply for local surface watercourse flow.

Hydrogeological Characterization

This wetland lies in an area with a thin layer of coarse till overlying the bedrock. The bedrock consists of quartzite and slate, and thus is relatively impermeable. The till tends to be coarse-grained and thus the layer is hydrologically conductive. The groundwater level is very shallow (likely < 2m) in this area. General movement of groundwater is from north to south over the project site, mirroring surface water patterns. Bogs are not fed by groundwater discharge. There are no seeps or springs visible.

Reason for the Alteration

The wetland in question will be removed due to the construction of a tailings pond from an adjacent open-pit gold mine being constructed on the site.

Nature of the Proposed Alteration

The wetland will be entirely removed.

Alternatives That Have Been Considered

Alternative positions for the tailings management facilty have been considered, however, positions either to the east or west of the proposed location would have significant impacts on Moose River or Fish River with their sensitive fish habitat, and would impact additional wetlands. Moving the tailings management facilty north could result in impacts to Square Lake, while moving it south might impact Scraggy Lake, which is considered significant habitat for brook trout, Atlantic salmon, and gaspereau by NSDNR. The project boundary has already been adjusted to avoid the wetland complex located southeast of the Project site, and to avoid impacting Moose River.

Gold mining can be undertaken by either underground or open pit methods. In this particular instance the gold is relatively uniformly distributed, and at relatively low grades, throughout the local rock mass to the extent that large scale, high volume throughput from an open pit is commercially viable. Concentrations of gold of sufficient grade, continuity or predictability in quartz veins or other specific sites at Touquoy to support a commercial underground operation are not present. Commercial underground gold mining at Touquoy is not an option. There are no options for re-positioning of the open pit – the site of concentration of gold is fixed in nature.

Identifiable Impacts to Wetland

Wetland 3 will be entirely removed by the mine project. There are no species at risk or species of conservation concern known to be present in this wetland. Additional plant and wetland surveys will be conducted in spring of 2007, as well as a breeding bird survey. Additional mammal and herpetile surveys will be conducted concurrently.

No aquatic habitats or fish species are present, as the wetland is a low shrub bog which is dry during late summer months.

Past Impacts To The Wetland

Possible past impacts to the wetland may have arisen from forestry clear-cutting activities that have occurred in the area, which may have impacted drainage patterns to some extent. Aerial photography of the site dating from 1964, 1974, 1982, 1993, and 2003 was reviewed to provide information on historical forestry activities in the area. Clearing occurred less than 1 km to the north of Wetland 3 prior to 1992. Extensive clearing, as well as the creation of logging roads, occurred less than 1km south of the wetland during the period between 1992 and 2003.

Mitigation

The project footprint has been adjusted so as to minimize impacts to wetlands and watercourses in the area. As per NSDNR regulations, three times the wetland area to be removed must be recreated as compensation. DDV Gold Limited (DDVG) will work with NSDNR to develop the required mitigation measures including wetland compensation. DDVG is considering various approaches to the wetland compensation issue. The first approach, preferred by NSDNR, is to create wetland habitat within the same watershed as the wetland which is to be altered. DDVG is considering creating wetland habitat onsite once mine operations are completed by ensuring that the flooded quarry pit has sufficiently shallow edges to support a marsh-type wetland. If this is not possible, the proponent will consider a wetland enhancement or creation project outside of the local watershed. Contribution to wetland education and/or protection programs may also be considered.

Summary

In summary, assuming that the proposed mitigation measures are applied, and that existing site drainage conditions are maintained, the Touquoy Gold Project is not likely to have significant effects on wetland functional attributes in the area. At this point in time, removal of this wetland is not expected to have negative impacts on any rare or endangered species in the area, although additional plant and animal surveys will be conducted in spring 2007.

Evaluation Expertise

Conestoga-Rovers & Associates is a multi-disciplinary engineering, environmental consulting, construction, and information technology (IT) services firm. Since its inception in 1976, CRA has provided practical, innovative, and effective services in the areas of environmental site assessment, impact assessment, environmental remediation, regulatory compliance and permitting, risk assessment, hydrology, solid and hazardous waste management, air quality management, and municipal infrastructure planning and design. We are an established, reputable company with a strong history of solving engineering and environmental challenges in a responsive and cost-efficient manner.

The CRA Family of Companies employs more than 2,600 professional and support staff in over 70 offices located throughout North America, with additional offices in Brazil and England. Our headquarter office is located in Waterloo, Ontario, Canada.

Beth Cameron, B.Sc. M.Sc., is a Terrestrial Ecologist with Conestoga-Rover & Associates' Halifax office. She has significant experience conducting surveys for flora and fauna, as well as wetland surveys, and has worked on federal and provincial environmental screenings involving wetland alterations.

Kristen Nyborg is an Environmental Technologist with Conestoga-Rover & Associates' Halifax office. She holds an Ontario Wetland Evaluation System Certificate, and has significant wetland field experience. She also has gained hydrological and hydrogeological work experience with CRA.

Susan Belford, B.Sc., M.Sc., is a Senior Project Manager with Conestoga-Rovers & Associates' Halifax office. She is very familiar with wetland legislation, having worked on many environmental assessment projects involving provincial and federal regulations and processes.

Dave Strajt, M. Eng., is a Water Resources Engineer/Hydrologist with Conestoga-Rovers & Associates' Halifax office. He is very familiar with surface water processes as they relate to mining process.

Peter Oram, CESA, P.Geo. is a Geologist with Conestoga-Rovers & Associates' Halifax office. He has assisted with ten wetland alteration permits, providing hydrogeological advice. He is very familiar with wetland legislation, having worked on many environmental assessment projects involving provincial and federal legislative processes.

References

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WETLAND 4 REPORT

Wetland Delineation

Wetland 4 is a very small wetland dominated by low shrub bog. This wetland is 0.04 ha in area and is centered on 4980452 N, 506366 E. See Figure 1 for the location of this project within Nova Scotia and Figure 2 for the location of this wetland on the project site.

During the field survey on September 21 2006, all species of plant, bird, mammal, reptile and amphibian detected within the wetland were recorded. Evidence of wildlife species such as sightings, vocalizations, tracks, faeces, skeletal remains, and characteristic bite marks or dens was recorded.

Ecological Characterization

Plants

This wetland is dominated by leatherleaf (*Chamaedaphne calyculata*) and lambkill (*Kalmia angustifolia*), with some Labrador tea (*Ledum groenlandicum*), and a few stunted larch (*Larix laricina*) and black spruce (*Picea mariana*). Ground vegetation consists of small cranberry (*Vaccinium oxycoccos)*, black crowberry (*Empetrum nigrum)*, cottongrass (*Eriophorum virginicum*), and an orchid which has been tentatively identified as Loesel's Twayblade (*Liparis loeselli*). This identification will be confirmed during the spring 2007 wetlands survey. Dwarf dogwood (*Cornus canadensis)* and goldthread (*Coptis trifolia*) are also present. This wetland also contains open mucky areas which were considerably wetter at the time of the survey than all other wetlands on the study site. Ephemeral pools are likely present during wetter periods, and likely provide habitat for *Utricularia* (bladderwort) species.

The Atlantic Canada Conservation Data Centre (ACCDC) database consist of records of uncommon to rare plant and animal species records from the 1850s to the present. A review in 2005 for information or rare plants within 100 km of the project site yielded a list of five plants with habitat requirements similar to habitats present in the wetland. These are listed in Table 1. In addition, an environmental screening of all natural heritage resources in the area (within an approximate 10 km radius of the site) was compiled by the Nova Scotia Museum (NSM) in 2004, encompassing all their data from 1847 to 2004. As the Museum is a government department, not all of it its species records are available to the non-governmental ACCDC database. Thus the NSM screening generated a list of seven additional species known from the general area or from similar habitats (the complete screening may be found in Appendix H). Of these, two species had potential to occur in habitats present in Wetland 4 (Table 1). None of the species listed by the ACCDC or the NSM are listed as rare or endangered under the *Nova Scotia Endangered Species Act* (NSESA) or committee on the status of endangered wildlife/ Species at Risk Act (COSEWIC/SARA).

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Utricularia gibba	humped bladderwort	Yellow	Late June-Sept	Shallow lake edge, small pool, pond in peaty area	ACCDC
Betula michauxii	Michaux's dwarf birch	Yellow	June and July	Peat and sphagnous bogs	NSM
Viola nephrophylla	northern bog violet	Yellow	May to July	Cool mossy bogs, borders of streams, and damp woods	NSM

None of these plants were observed in the wetland on the survey on September 21, 2006. An additional botany survey is planned for spring 2007.

Birds

During the field survey for Wetland 4 on September 21 2006, no bird species were observed within the wetland. Due to the field survey being conducted in late summer, a breeding bird survey was not possible for this wetland. A desktop review of bird species known to breed in the area where the wetland is located was conducted using the Atlas of Breeding Birds of the Maritime Provinces (Erskine 1990). A list of the status of each breeding bird species recorded from the 10 x 10 km atlas square containing Wetland 4 is provided in Table 2.

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Common Merganser	*Mergus merganser*	Confirmed
Sharp-Shinned Hawk	*Accipiter striatus*	Possible
Broad-Winged Hawk	*Buteo platypterus*	Probable

Table 2. Breeding Status of Birds Listed in the Atlas Square in Which Wetland 4 is Located

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Common Nighthawk	*Chordeiles minor*	Confirmed
Chimney Swift	*Chaetura pelagica*	Possible
Belted Kingfisher	*Ceryle alcyon*	Possible
Hairy Woodpecker	*Picoides villosus*	Confirmed
Northern Flicker	*Colaptes auratus*	Confirmed
Pileated Woodpecker	*Dryocopus pileatus*	Possible
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Blackburnian Warbler	*Dendroica fusca*	Confirmed
Palm Warbler	*Dendroica palmarum*	Confirmed
Bay-breasted Warbler	*Dendroica castanea*	Confirmed
Black-and-white Warbler	*Mniotilta varia*	Confirmed
American Redstart	*Setophaga ruticilla*	Confirmed
Ovenbird	*Seiurus aurocapillus*	Confirmed
Mourning Warbler	*Oporinis philadelphia*	Confirmed

Table 2. Breeding Status of Birds Listed in the Atlas Square in Which Wetland 4 is Located

Common Name	Species Name	Breeding Status in Atlas Square
Common Yellowthroat	*Geothlypis trichas*	Confirmed
Canada Warbler	*Wilsonia canadensis*	Confirmed
Song Sparrow	*Melospiza melodia*	Confirmed
Lincoln's Sparrow	*Melospiza lincolnii*	Confirmed
Swamp Sparrow	*Melospiza georgiana*	Confirmed
White-throated Sparrow	*Zonotrichia albicollis*	Confirmed
Dark-eyed Junco	*Junco hyemalis*	Confirmed
Red-winged Blackbird	*Agelaius phoeniceus*	Possible
Rusty Blackbird	*Euphagus carolinus*	Confirmed
Common Grackle	*Quiscalus quiscula*	Confirmed
Pine Grosbeak	*Pinicola enucleator*	Probable
Purple Finch	*Carpodacus purpureus*	Possible
White Winged Crossbill	*Loxia leucoptera*	Probable
Pine Siskin	*Carduelis pinus*	Possible
American Goldfinch	*Carduelis tristis*	Possible
Evening Grosbeak	*Coccothraustes vespertinus*	Probable

None of these bird species were observed in Wetland 4 during the field survey on September 21 2006. Wetland 4 is not considered to be critical breeding habits for any of these species. A breeding bird survey is planned in this wetland for spring 2007.

A review of the ACCDC database of rare species records revealed fourteen at–risk species reported in the region. Three red-listed and eleven yellow-listed bird species were listed within 100 km by the ACCDC search. Each species' habitat preference was determined based on Erksine's 1990 data, and the likelihood of their presence on site was determined based on comparison of known habitat preferences with habitats present in the wetland. A summary of the rare bird species, their provincial status and their habitat preferences is provided in Table 3.

Table 3. Habitat Preferences of Listed Bird Species Reported Within 100 km of Wetland 4

NSDNR Status	Common Name	Binomial	Habitat Preference
Red	Roseate Tern	*Sterna dougallii*	Coast
Red	Peregrine Falcon	*Falco peregrinus*	Rocky cliffs
Red	Piping Plover	*Charadrius melodus*	Sandy Beaches
Yellow	Common Tern	*Sterna hirundo*	Coast
Yellow	Arctic Tern	*Sterna paradisea*	Coast
Yellow	Barrow's Goldeneye	*Bucephala islandica*	Small clear lakes and ponds
Yellow	Northern Goshawk	*Accipiter gentiles*	Mature woods
Yellow	Semipalmated Sandpiper	*Calidris pusilla*	Beaches, mudflats, shallow estuaries, and inlets.

Table 3. Habitat Preferences of Listed Bird Species Reported Within 100 km of Wetland 4

NSDNR Status	Common Name	Binomial	Habitat Preference
Yellow	Eastern Meadowlark	*Sturnella magna*	Grassy fields, pastures, cultivated areas
Yellow	Razorbill	*Alca torda*	Coastal islands
Yellow	Eastern Bluebird	*Sialia sialis*	Areas with scattered trees and short ground cover.
Yellow	Vesper Sparrow	*Poecetes gramineus*	Areas with short grass or low shrubs
Yellow	Sharp-tailed Sparrow	*Ammodramus caudacutus*	Breed in meadows adjacent to salt marshes
Yellow	Bobolink	*Dolichonyx oryzivorus*	Grasslands

Arctic Terns, Common Terns, and Razorbills are coastal species, and so should not be present in Wetland 4. Sharp-tailed Sparrows breed in meadows adjacent to salt marshes. Vesper Sparrows are characteristic of areas with short grass or low shrubs, such as sandy pastures, blueberry fields, and clearings. Goshawks prefer heavily wooded areas, and prefer to breed in mature mixed woods. Eastern Bluebirds, (*Sialis sialis*) nest in clear-cut areas, which are adjacent to the wetland, and in woodpecker cavities. Eastern Meadowlarks and Bobolinks are grassland/meadow species. Semipalmated Sandpipers and Barrow's Goldeneyes inhabit areas near large bodies of water. None of these three red-listed species or the eleven yellow-listed bird species is expected to be present in the Wetland 4 or to use Wetland 4 due to the lack of suitable habitat (Table 3). None of the birds listed in the ACCDC search were observed during the wetland survey and the area is not critical habitat for any of these species. A breeding bird survey will be conducted in spring of 2007. The environmental screening conducted by the NSM found no records of rare or endangered birds on the Project site (Appendix H).

Mammals

Evidence of varying (snowshoe) hare (*Lepas americana*), white-tailed deer (*Odocoileus virginanus*), and eastern moose (*Alces alces americana*) was noted in Wetland 4 during the September 21 2006 wetland survey. One of these mammals, the mainland population of eastern moose, is listed as endangered in Nova Scotia and was listed on the ACCDC database search for this area. A small number of old moose tracks were observed around the perimeter of this bog. A winter moose track survey is planned for early winter 2007. A Moose Mitigation Plan has been developed for the Touquoy Gold Project (see section 9 of the main document).

Three other rare mammals were also listed in the ACCDC database search. Two species of rare bat, the hoary bat, (*Lasiurus cinereus*), and the eastern pipistrelle (*Pipstrellus subflavus*), were reported; however, bats are not expected to make use of any habitat in this wetland. The fourth rare mammal listed by the ACCDC request is the long-tailed shrew (*Sorex dispar*), which lives only on talus slopes, thus they would be not be expected to occur within this wetland. Additional mammal observations will be taken concurrently with the spring botany surveys in

2007. The environmental screening conducted by the NSM found no records of rare or endangered mammals on the Project site (Appendix H).

One endangered species, the eastern moose, has been shown to be present in this wetland on an infrequent basis. The results of the field survey suggest that the wetland does not provide significant habitat for moose. Important habitats for moose tend to be wintering and spring calving (late May) areas. Preferred wintering habitat typically consists of mature conifer or mixed conifer stands where snow tends to be less deep and browse is available, reducing winter energy demands. Calving areas are often associated with aquatic/wetland areas; however moose will use a wide range of habitats for calving such as islands on beaver ponds and wetland areas with standing water. The low density of moose in the area, and the tiny size of Wetland 4 results in the removal of this wetland having very low potential to affect wintering or calving of moose. The low shrub bog habitat that occupies most of the wetland is a common wetland type in this area, so this particular wetland is not considered to provide a unique habitat type for wildlife.

Reptiles and Amphibians

No reptiles or amphibians were observed during the wetland survey. The ACCDC request and the environmental screening conducted by the NSM both noted the presence of wood turtles and four-toed salamanders within 100 km of the site. Wood turtles (*Glyptemys insculpta*) are listed as yellow by NSDNR. There is no hibernating or breeding habitat for turtles in this wetland, as they require deep sections of rivers in which to hibernate, and sandy or gravelly banks for nesting. Four-toed salamanders (*Hemidactylium scutatum*) were previously yellow-listed by NSDNR; however, their status has been recently changed to green, indicating they are not considered to be sensitive or at-risk in Nova Scotia. Four-toed salamanders may nest in the sphagnum moss hummocks around the margins of small pools in Wetland 4. Thus, with the recent change in status rank for four-toed salamanders, there is no suitable habitat for any rare or endangered reptiles or amphibians in Wetland 4. Additional herpetile observations will be taken concurrently with the spring botany surveys in 2007.

Odonates

The ACCDC search reported several rare odonates within a 100 km radius of Wetland 4. Most odonates (dragonflies and damselflies) lay their eggs in bodies of water, where they hatch and develop through several larval stages before emerging from the water and metamorphosing into the adult form. In most species, this larval stage lasts for about one year. The fact that Wetland 4 is a low shrub bog which frequently contains only very shallow (< 15 cm) ephemeral pools indicates that most odonate species would be unable to complete larval development in this bog. As see in Table 4, most rare odonates listed in the ACCDC 100 km search inhabit areas near streams or rivers. However, at least two species present in Nova Scotia, the ebony boghaunter (*Williamsonia fletcheri*) and the harlequin darner (*Gomphhaeschna furcillata*) are known to breed in sphagnum bogs (Table 4).

The ebony boghaunter is red-listed by NSDNR, and was reported once in the ACCDC 100 km search, from a location 95 km away. No ebony boghaunters were observed in Wetland 4 during the survey on September 21, 2004, however, they are an early-flying species (June) and adults would not be expected to be present at this time. The harlequin darner is a yellow-listed species for which there were two records in the ACCDC 100 km list. The closest record was 60 km from Wetland 4. No harlequin darners were observed in Wetland 4 during the survey on September 21, 2004, however, they are also an early-flying species (early June) and adults would not be expected to be present at this time.

Table 4. Rare Odonates Reported Within 100 km of Wetland 4

Scientific Name	Common Name	Status	Preferred Habitat
Ophiogomphus rupinsulensis	Rusty Snaketail	Red	Large clear flowing streams and rivers
Gomphus ventricosus	Skillet Clubtail	Red	Slow-moving rivers
Coenagrion resolutum	Taiga Bluet	Red	Small ponds with grassy or marshy borders, often shaded
Ophiogomphus mainensis	Twinhorned Snaketail	Red	Streams and small rivers
Williamsonia fletcheri	Ebony Boghaunter	Red	Small pools in sphagnum bogs
Gomphaeschna furcillata	Harlequin Darner	Yellow	Sphagnum bogs and wooded swamps
Lanthus parvulus	Zorro Clubtail	Yellow	Mountain streams with muddy substrate

Hydrological Characterization

There is no surface connection between this wetland and any surface watercourses or lakes in the immediate area, based on 1:10,000 topographical mapping, air photography, and field surveys. As a bog, this wetland is not expected to receive surface water flow and thus its role in surface flow regulation is expected to be minimal. It has no role as a supply for local surface watercourse flow.

Hydrogeological Characterization

This wetland lies in an area with a thin layer of coarse till overlying the bedrock. The bedrock consists of quartzite and slate, and thus is relatively impermeable. The till tends to be coarse-grained and thus the layer is hydrologically conductive. The groundwater level is very shallow (likely < 2m) in this area. General movement of groundwater is from north to south over the project site, mirroring surface water patterns. Bogs are not fed by groundwater discharge. There are no seeps or springs visible.

Reason for the Alteration

The wetland in question will be removed due to the construction of a polishing pond from an adjacent open-pit gold mine being constructed on the site.

Nature of the Proposed Alteration
The wetland will be entirely removed.

Alternatives That Have Been Considered
Alternative positions for the tailings management facilty have been considered, however, positions either to the east or west of the proposed location would have significant impacts on Moose River or Fish River with their sensitive fish habitat, and would impact additional wetlands. Moving the tailings management facility north could result in impacts to Square Lake, while moving it south might impact Scraggy Lake, which is considered significant habitat for brook trout, Atlantic salmon, and gaspereau by NSDNR. The project boundary has already been adjusted to avoid the wetland complex located southeast of the Project site, and to avoid impacting Moose River.

Gold mining can be undertaken by either underground or open pit methods. In this particular instance the gold is relatively uniformly distributed, and at relatively low grades, throughout the local rock mass to the extent that large scale, high volume throughput from an open pit is commercially viable. Concentrations of gold of sufficient grade, continuity or predictability in quartz veins or other specific sites at Touquoy to support a commercial underground operation are not present. Commercial underground gold mining at Touquoy is not an option. There are no options for re-positioning of the open pit – the site of concentration of gold is fixed in nature.

Identifiable Impacts to Wetland
Wetland 4 will be entirely removed by the mine project. There are no species at risk or species of conservation concern known to be present in this wetland, although it may be visited infrequently by mainland moose. Additional plant and wetland surveys will be conducted in spring of 2007, as well as a breeding bird survey. Additional mammal and herpetile surveys will be conducted concurrently.

No aquatic habitats or fish species are present, as the wetland is a low shrub bog which is dry during late summer months.

Past Impacts To The Wetland
Possible past impacts to the wetland may have arisen from forestry clear-cutting activities that have occurred in the area, which may have impacted drainage patterns to some extent. Aerial photography of the site dating from 1964, 1974, 1982, 1993, and 2003 was reviewed to provide information on historical forestry activities in the area. Clearing occurred less than 1 km to the north of Wetland 4 prior to 1992. Extensive clearing, as well as the creation of logging roads, occurred less than 1km south of the wetland during the period between 1992 and 2003.

Mitigation
The project footprint has been adjusted so as to minimize impacts to wetlands and watercourses in the area. As per NSDNR regulations, three times the wetland area to be removed must be

recreated as compensation. DDV Gold Limited (DDVG) will work with NSDNR to develop the required mitigation measures including wetland compensation. The client is considering various approaches to the wetland compensation issue. The first approach, preferred by NSDNR, is to create wetland habitat within the same watershed as the wetland which is to be altered. DDVG is considering creating wetland habitat onsite once mine operations are completed by ensuring that the flooded quarry pit has sufficiently shallow edges to support a marsh-type wetland. If this is not possible, the proponent will consider a wetland enhancement or creation project outside of the local watershed. Contribution to wetland education and/or protection programs may also be considered.

Summary

In summary, assuming that the proposed mitigation measures are applied, and that existing site drainage conditions are maintained, the Touquoy Gold Project is not likely to have significant effects on wetland functional attributes in the area. At this point in time, removal of this wetland is not expected to have negative impacts on any rare or endangered species in the area, although additional plant and animal surveys will be conducted in spring 2007.

Evaluation Expertise

Conestoga-Rovers & Associates is a multi-disciplinary engineering, environmental consulting, construction, and information technology (IT) services firm. Since its inception in 1976, CRA has provided practical, innovative, and effective services in the areas of environmental site assessment, impact assessment, environmental remediation, regulatory compliance and permitting, risk assessment, hydrology, solid and hazardous waste management, air quality management, and municipal infrastructure planning and design. We are an established, reputable company with a strong history of solving engineering and environmental challenges in a responsive and cost-efficient manner.

The CRA Family of Companies employs more than 2,600 professional and support staff in over 70 offices located throughout North America, with additional offices in Brazil and England. Our headquarter office is located in Waterloo, Ontario, Canada.

Beth Cameron, B.Sc. M.Sc., is a Terrestrial Ecologist with Conestoga-Rover & Associates' Halifax office. She has significant experience conducting surveys for flora and fauna, as well as wetland surveys, and has worked on federal and provincial environmental screenings involving wetland alterations.

Kristen Nyborg is an Environmental Technologist with Conestoga-Rover & Associates' Halifax office. She holds an Ontario Wetland Evaluation System Certificate, and has significant wetland field experience. She also has gained hydrological and hydrogeological work experience with CRA.

Susan Belford, B.Sc., M.Sc., is a Senior Project Manager with Conestoga-Rovers & Associates' Halifax office. She is very familiar with wetland legislation, having worked on many environmental assessment projects involving provincial and federal regulations and processes.

Dave Strajt, M. Eng., is a Water Resources Engineer/Hydrologist with Conestoga-Rovers & Associates' Halifax office. He is very familiar with surface water processes as they relate to mining process.

Peter Oram, CESA, P.Geo. is a Geologist with Conestoga-Rovers & Associates' Halifax office. He has assisted with ten wetland alteration permits, providing hydrogeological advice. He is very familiar with wetland legislation, having worked on many environmental assessment projects involving provincial and federal legislative processes.

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WETLAND 5 REPORT

Wetland Delineation

The wetland referred to as Wetland 5 was assessed by Dillon Consulting Limited on behalf of CRA on June 13, July 14 and September 14, 2005. The entire wetland is a 6.0 ha wetland consisting of open water wetland surrounded by shrub bog with tall shrub swamp around the perimeter.

This wetland is centered on 4980758 N, 0505629 E. Its geographical boundaries are listed in Table 1. See Figure 1 for the location of this project within Nova Scotia and Figure 2 for the location of this wetland on the project site.

Table 1. Geographical Boundaries of Wetland 5 (NAD 83)

Boundary	Northing	Easting
North	4890667	505786
South	4980590	505595
East	4890744	505496
West	4981019	505615

A small portion (0.19 ha) of the easternmost section of the wetland, lies within the Project footprint. Conestoga-Rovers & Associates surveyed this area on September 13 2006.

During the field surveys in 2005 and 2006, all species of plant, bird, mammal, reptile and amphibian detected within the wetland were recorded. Evidence of wildlife species such as sightings, vocalizations, tracks, faeces, skeletal remains, and characteristic bite marks or dens was recorded.

Ecological Characterization

Plants

The open water portion of this wetland is home to submerged and emergent aquatic species such as pipewort (*Eriocaulon aquaticum*) and pondweeds (*Potamogeton spp*. (confirmed not to be the listed pondweed species). The bog portion surrounding the open water contains shrub species such as pale laurel (*Kalmia polifola*), Labrador tea (*Ledum groenlandicum*), speckled alder (*Alnus rugosa*), and meadowsweet (*spiraea alba*), with rhodora (*Rhododendron canadense*) and leatherleaf (*Chamaedaphne calyculata*) in wetter areas. There are also a few black spruce (*Picea mariana*) and tamarack (*Larix laracina*) scattered throughout and around the perimeter. There are scattered pockets of sphagnum development containing typical species such as northern pitcher plant (*Sarracenia purpurea*) and round-leaved sundew (*Drosera rotundifolia*). Surrounding the bog, there are areas of tall shrub swamp containing larch, speckled alder, meadowsweet, red maple, and Labrador tea.

It is a small portion (0.20 ha) of the tall shrub swamp area which will be impacted by the proposed Project. The tree layer in this region consists of scattered larch (*Larix laracina*) and black spruce. Shrubs such as speckled alder, meadowsweet, possum-haw viburnum (*Viburnum nudum)*, immature red maple, and Labrador tea. Ground vegetation consists of sphagnum mosses (*Sphagnum* spp.), dewberry (*Rubus hispidus*), dwarf dogwood (*Cornus canadensis*), and scattered sedges (*Carex trisperma* and *C. imtumescens*), all common and upiquitous species in Nova Scotia

The Atlantic Canada Conservation Data Centre (ACCDC) database consist of records of uncommon to rare plant and animal species from the 1850s to the present. A review in 2005 for information or rare plants within 100 km of the project site yielded a list of five plants with habitat requirements similar to habitat present in the wetland. These are listed in Table 1. (The complete list of rare plants is available in Appendix H for the Touquoy Gold Project).

In addition, an environmental screening of all natural heritage resources in the area (within an approximate 10 km radius of the site) was compiled by the Nova Scotia Museum (NSM) in 2004, encompassing all their data from 1847 to 2004. As the Museum is a government department, not all of it its species records are available to the non-governmental ACCDC database. Thus the NSM screening generated a list of seven additional species known from the general area or from similar habitats (the complete screening may be found in Appendix H). Of these, none had potential to occur in habitats present in Wetland 5 (Table 1). None of the species listed by the ACCDC or the NSM are listed as rare or endangered under the *Nova Scotia Endangered Species Act* (NSESA) or committee on the status of endangered wildlife/ Species at Risk Act (COSEWIC/SARA).

Table 2. Phenology and Habitat Preferences of Rare Vascular Plants Reported Within 100 km (ACCDC search) or 10 km (NSM screening) of Wetland 5

Species	Common Name	NSDNR Status	Bloom Period	Preferred Habitat	Record Source
Coeloglossum viride	long-bract green orchis	Yellow	May-August	Boggy spots, damp mature (sugar maple) woods, fir or floodplain forest	ACCDC
Listera australis	southern twayblade	Red	June	Sphagnum bog	ACCDC
Planthaera flava	southern rein orchid	Yellow	May-August	Sandy gravelly beach, wet peat, lake edge, bog	ACCDC
Salix pedicellaris	Bog willow	Yellow	Late May-Early June	Sphagnous lakeshore, acid bog	ACCDC
Utricularia gibba	Humped bladderwort	Yellow	Late June-Sept	Shallow lake edge, small pool, pond in peaty area	ACCDC
Betula michauxii	Michaux's dwarf birch	Yellow	June and July	Peat and sphagnous bogs	NSM
Viola nephrophylla	northern bog violet	Yellow	May to July	Cool mossy bogs, borders of streams, and damp woods	NSM

None of these plants were observed in the wetland on the surveys in 2005 or 2006. An additional botany survey is planned for spring 2007.

Birds

Due to the field survey being conducted in late summer, a breeding bird survey was not possible for this wetland. A desktop review of bird species known to breed in the area where the wetland is located was conducted using the Atlas of Breeding Birds of the Maritime Provinces (Erskine 1990). A list of the status of each breeding bird species recorded from the 10 x 10 km atlas square containing Wetland 5 is provided in Table 2.

Table 2. Breeding Status of Birds Listed in the Atlas Square in Which Wetland 5 is Located

Common Name	Species Name	Breeding Status in Atlas Square
Common Loon	*Gavia immer*	Possible
Canada Goose	*Branta canadensis*	Probable
American Black Duck	*Anas rubripes*	Probable
Ring-Necked Duck	*Aythya collaris*	Confirmed
Common Merganser	*Mergus merganser*	Confirmed
Sharp-Shinned Hawk	*Accipiter striatus*	Possible
Broad-Winged Hawk	*Buteo platypterus*	Probable
American Kestrel	*Falco sparverius*	Possible
Common Nighthawk	*Chordeiles minor*	Confirmed
Chimney Swift	*Chaetura pelagica*	Possible
Belted Kingfisher	*Ceryle alcyon*	Possible
Hairy Woodpecker	*Picoides villosus*	Confirmed
Northern Flicker	*Colaptes auratus*	Confirmed
Pileated Woodpecker	*Dryocopus pileatus*	Possible
Olive-sided Flycatcher	*Contopus borealis*	Possible
Eastern Wood-pewee	*Contopus virens*	Possible
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Confirmed
Alder Flycatcher	*Empidonax alnorum*	Possible
Least Flycatcher	*Empidonax minimus*	Probable
Tree Swallow	*Tachycineta bicolor*	Confirmed
Barn Swallow	*Hirundo rustica*	Confirmed
Gray Jay	*Perisoreus canadensis*	Confirmed
Blue Jay	*Cyanocitta cristata*	Possible
American Crow	*Corvus brachyrhynchos*	Confirmed
Common Raven	*Corvus corax*	Possible
Black-capped Chickadee	*Poecile atricapillus*	Confirmed
Boreal Chickadee	*Poecile hudsonicus*	Confirmed
Red-breasted Nuthatch	*Sitta Canadensis*	Confirmed
Winter Wren	*Troglodytes troglodytes*	Confirmed
Golden-crowned Kinglet	*Regulus satrapa*	Confirmed
Ruby-crowned Kinglet	*Regulus calendula*	Confirmed
Swainson's Thrush	*Catharus ustulatus*	Confirmed
Hermit Thrush	*Catharus guttatus*	Confirmed
American Robin	*Turdus migratorius*	Confirmed

Table 2. Breeding Status of Birds Listed in the Atlas Square in Which Wetland 5 is Located

Common Name	Species Name	Breeding Status in Atlas Square
Cedar Waxwing	*Bombycilla cedrorum*	Probable
Blue-headed Vireo	*Vireo solitarius*	Confirmed
Red-eyed Vireo	*Vireo olivaceus*	Probable
Tennessee Warbler	*Vermivora peregrine*	Possible
Nashville Warbler	*Vermivora ruficappilla*	Confirmed
Northern Parula Warbler	*Parula americana*	Confirmed
Chestnut-sided Warbler	*Dendroica pensylvanica*	Confirmed
Magnolia Warbler	*Dendroica magnolia*	Confirmed
Black-throated Blue Warbler	*Dendroica caerulescens*	Possible
Yellow-Rumped Warbler	*Dendroica coronata*	Confirmed
Black-throated Green Warbler	*Dendroica virens*	Confirmed
Blackburnian Warbler	*Dendroica fusca*	Confirmed
Palm Warbler	*Dendroica palmarum*	Confirmed
Bay-breasted Warbler	*Dendroica castanea*	Confirmed
Black-and-white Warbler	*Mniotilta varia*	Confirmed
American Redstart	*Setophaga ruticilla*	Confirmed
Ovenbird	*Seiurus aurocapillus*	Confirmed
Mourning Warbler	*Oporinis philadelphia*	Confirmed
Common Yellowthroat	*Geothlypis trichas*	Confirmed
Canada Warbler	*Wilsonia canadensis*	Confirmed
Song Sparrow	*Melospiza melodia*	Confirmed
Lincoln's Sparrow	*Melospiza lincolnii*	Confirmed
Swamp Sparrow	*Melospiza georgiana*	Confirmed
White-throated Sparrow	*Zonotrichia albicollis*	Confirmed
Dark-eyed Junco	*Junco hyemalis*	Confirmed
Red-winged Blackbird	*Agelaius phoeniceus*	Possible
Rusty Blackbird	*Euphagus carolinus*	Confirmed
Common Grackle	*Quiscalus quiscula*	Confirmed
Pine Grosbeak	*Pinicola enucleator*	Probable
Purple Finch	*Carpodacus purpureus*	Possible
White Winged Crossbill	*Loxia leucoptera*	Probable
Pine Siskin	*Carduelis pinus*	Possible
American Goldfinch	*Carduelis tristis*	Possible
Evening Grosbeak	*Coccothraustes vespertinus*	Probable

None of these bird species were observed in Wetland 5 during the field survey on September 13, 2006. Wetland 5 is not considered to be critical breeding habits for any of these species. During the field survey for Wetland 5 on September 13 2006, three bird species were observed in vicinity of the wetland. These were Spruce Grouse, Pileated Woodpecker and Common Crow. None of these birds are expected to breed in tall shrub swamp. A breeding bird survey is planned in this wetland for spring 2007.

A review of the ACCDC database of rare species records revealed fourteen NSDNR- listed species reported in the region. (The complete list of rare animals is available in Appendix H).

Three red-listed and eleven yellow-listed bird species were listed within 100 km by the ACCDC search. Each species' habitat preference was determined based on Erksine's 1990 data, and the likelihood of their presence on site was determined based on comparison of known habitat preferences with habitats present in the wetland. A summary of the rare bird species, their provincial status and their habitat preferences is provided in Table 3.

Table3. Habitat Preferences of NSDNR-Listed Bird Species Reported Within 100 km of Wetland 5

NSDNR Status	Common Name	Binomial	Habitat Preference
Red	Roseate Tern	*Sterna dougallii*	Coast
Red	Peregrine Falcon	*Falco peregrinus*	Rocky cliffs
Red	Piping Plover	*Charadrius melodus*	Sandy Beaches
Yellow	Common Tern	*Sterna hirundo*	Coast
Yellow	Arctic Tern	*Sterna paradisea*	Coast
Yellow	Barrow's Goldeneye	*Bucephala islandica*	Small clear lakes and ponds
Yellow	Northern Goshawk	*Accipiter gentiles*	Mature woods
Yellow	Semipalmated Sandpiper	*Calidris pusilla*	Beaches, mudflats, shallow estuaries, and inlets.
Yellow	Eastern Meadowlark	*Sturnella magna*	Grassy fields, pastures, cultivated areas
Yellow	Razorbill	*Alca torda*	Coastal islands
Yellow	Eastern Bluebird	*Sialia sialis*	Areas with scattered trees and short ground cover.
Yellow	Vesper Sparrow	*Poecetes gramineus*	Areas with short grass or low shrubs
Yellow	Sharp-tailed Sparrow	*Ammodramus Caudacutus*	Breed in meadows adjacent to salt marshes
Yellow	Bobolink	*Dolichonyx Oryzivorus*	Grasslands

Arctic Terns, Common Terns, and Razorbills are coastal species, and so should not be present in Wetland 5. Sharp-tailed Sparrows breed in meadows adjacent to salt marshes. Vesper Sparrows are characteristic of areas with short grass or low shrubs, such as sandy pastures, blueberry fields, and clearings. Goshawks prefer heavily wooded areas, and prefer to breed in mature mixed woods. Eastern Bluebirds, (*Sialis sialis*) nest in clear-cut areas, which are adjacent to the wetland, and in woodpecker cavities. Eastern Meadowlarks and Bobolinks are grassland/meadow species. Semipalmated Sandpipers and Barrow's Goldeneyes inhabit areas near large bodies of water. None of these three red-listed species or the eleven yellow-listed bird species is expected to be present in the Wetland 5 or to use Wetland 5 due to the lack of suitable habitat (Table 3). None of the birds listed in the ACCDC search were observed during the wetland survey and the area is not critical habitat for any of these species. A breeding bird survey will be conducted in spring of 2007. The environmental screening conducted by the

NSM found no records of rare or endangered birds on the Project site (available in Appendix H).

Mammals

Evidence of black bear (*Ursus americana*), red squirrel (*Tamiasciurius hudsonicus*) and eastern chipmunk (*Tamias striatus*) was noted in Wetland 5 during the September 13 2006 wetland survey.

Four uncommon to rare mammals were listed in the ACCDC 100 km database search. Two species of rare bat, the hoary bat, (*Lasiurus cinereus*), and the eastern pipistrelle (*Pipstrellus subflavus*), were reported within 100 km; however, bats are not expected to make use of any habitat in this wetland. The eastern moose (A*lces alces americana*) is listed as endangered in Nova Scotia and was listed on the ACCDC database search for this area. The low density of moose in the area, and the tiny size of the portion of Wetland 5 to be impacted results in the removal of this wetland having very low potential to affect moose. A Moose Mitigation Plan has been developed for the Touquoy Gold Project (see section 9).

The fourth rare mammal listed by the ACCDC request is the long-tailed shrew (*Sorex dispar*), which lives only on talus slopes, thus they would be not be expected to occur within this wetland. Additional mammal observations will be taken concurrently with the spring botany surveys in 2007. The environmental screening conducted by the NSM found no records of rare or endangered mammals on the Project site (Appendix H).

Reptiles and Amphibians

No reptiles or amphibians were observed during the wetland survey. The ACCDC request and the environmental screening conducted by the NSMNH both noted the presence of wood turtles and four-toed salamanders within 100 km of the site. Wood turtles (*Glyptemys insculpta*) are listed as yellow by NSDNR. There is no hibernating or breeding habitat for turtles in the relevant portion of this wetland, as they require deep sections of rivers in which to hibernate, and sandy or gravelly banks for nesting. Four-toed salamanders (*Hemidactylium scutatum*) were previously yellow-listed by NSDNR; however, their status has been recently changed to green, indicating they are not considered to be sensitive or at-risk in Nova Scotia. There is no suitable habitat for any rare or endangered reptiles or amphibians in the 0.20 ha portion of Wetland 5 to be removed Additional herpetile observations will be taken concurrently with the spring botany surveys in 2007.

Odonates

The ACCDC search reported several rare odonates within a 100 km radius of Wetland 5. (The complete list of rare animals is available in Appendix H). Most odonates (dragonflies and damselflies) lay their eggs in bodies of water, where they hatch and develop through several larval stages before emerging from the water and metamorphosing into the adult form. In most species, this larval stage lasts for about one year. The fact that the portion of Wetland 5 to be impacted is a tall shrub swamp which contains no pools of water in summer indicates that most odonate species would be unable to complete larval development in this environment. As seen in Table 4, most rare odonates listed in the ACCDC 100 km search inhabit areas near streams or rivers or in sphagnum bogs, and thus are not expected to occur in the relevant portion of Wetland 5. None of these rare odonates, with the exception of the Harlequin darner (*Gomphaeschna furcillata)* are expected to breed in the portion of Wetland 5 to be impacted.

Table 4. Rare Odonates Reported Within 100 km of Wetland 5

Scientific Name	Common Name	Status	Preferred Habitat
Ophiogomphus rupinsulensis	Rusty Snaketail	Red	Large clear flowing streams and rivers
Gomphus ventricosus	Skillet Clubtail	Red	Slow-moving rivers
Coenagrion resolutum	Taiga Bluet	Red	Small ponds with grassy or marshy borders, often shaded
Ophiogomphus mainensis	Twinhorned Snaketail	Red	Streams and small rivers
Williamsonia fletcheri	Ebony Boghaunter	Red	Small pools in sphagnum bogs
Gomphaeschna furcillata	Harlequin Darner	Yellow	Sphagnum bogs and wooded swamps
Lanthus parvulus	Zorro Clubtail	Yellow	Mountain streams with muddy substrate

Hydrological Characterization

This wetland is fed by a an unnamed tributary of Moose River which runs from north to south through the centre of the project site. It lies within the Moose Rover watershed (IEL-5P). Calculations by CRA indicate that this particular wetland is fed by a drainage basin of 150 ha in area. The wetland is expected to flood during periods of high surface water flow, and thus plays a role in surface water regulation within its watershed. The very small portion (<4%) of the wetland to be impacted will not result in significant adverse effects to the wetland as a whole.

Hydrogeological Characterization

This wetland lies in an area with a thin layer of coarse till overlying the bedrock. The bedrock consists of quartzite and slate, and thus is relatively impermeable. The till tends to be coarse-grained and thus the layer is moderately conductive. The groundwater level is likely very shallow (<2m depth) in this area. General movement of groundwater is from north to south over the project site, mirroring surface water patterns. There are no seeps or springs visible, and this wetland is not expected to be a strong recharge or discharge area for groundwater.

Reason for the Alteration

A small portion (4%) of the wetland will be altered due to the construction of a tailings management facility for an adjacent open-pit gold mine being constructed in the area.

Nature of the Proposed Alteration

A small portion (0.25 ha, or 4%) of Wetland 5 will be removed due to the construction of a tailings management facility for an adjacent open-pit gold mine being constructed in the area. A containment dam for the tailings management facility will be constructed over the easternmost lobe of this wetland.

Alternatives That Have Been Considered

Alternative positions for the tailings management facility have been considered, however, positions either to the east or west of the proposed location would have significant impacts on Moose River or Fish River with their sensitive fish habitat, and would impact additional wetlands. Moving the tailings management facility north could result in impacts to Square Lake, while moving it south might impact Scraggy Lake, which is considered significant habitat for brook trout, Atlantic salmon, and gaspereau by NSDNR. The project boundary has already been adjusted to avoid the wetland complex located southeast of the Project site, and to avoid impacting Moose River. Geotechnical and engineering aspects of the tailings management facility design make it difficult to move the dam any further eastward at this particular location.

Mitigation

During construction of the dam, standard Nova Scotia Environment and Labour sedimentation and erosion control guidelines will be adhered to (Nova Scotia Sediment and Erosion Control Handbook for Construction Sites). This will prevent negative impacts to the rest of this wetland. This section of the wetland is located at the eastern boundary of its watershed, and so likely provides very little surface runoff to Wetland 5. Thus removal of this portion of Wetland 5 will not interfere with water supply to the wetland as a whole.

There are no species at risk or species of conservation concern known to be present in this wetland. Additional plant and wetland surveys will be conducted in spring of 2007, as well as a breeding bird survey. Additional mammal and herpetile surveys will be conducted concurrently.

The project footprint has been adjusted so as to minimize impacts to wetlands and watercourses in the area. DDV Gold Limited (DDVG) will work with NSDNR to develop the required mitigation measures including wetland compensation and the preferred compensation ratio. DDVG is considering various approaches to the wetland compensation issue. The first approach, preferred by NSDNR, is to create wetland habitat within the same watershed as the wetland which is to be altered. DDVG is considering creating wetland habitat onsite once mine operations are completed by ensuring that the flooded quarry pit has sufficiently shallow edges to support a marsh-type wetland. If this is not possible, the proponent will consider a wetland enhancement or creation project outside of the local watershed. Contribution to wetland education and/or protection programs may also be considered.

Summary

In summary, assuming that the proposed mitigation measures are applied, and that existing site drainage conditions are maintained, the Touquoy Gold Project is not likely to have significant effects on wetland functional attributes in the area. At this point in time, removal of 4% of Wetland 5 is not expected to have negative impacts on any rare or endangered species in the area, although additional plant and animal surveys will be conducted in spring 2007.

Evaluation Expertise

Conestoga-Rovers & Associates is a multi-disciplinary engineering, environmental consulting, construction, and information technology (IT) services firm. Since its inception in 1976, CRA has provided practical, innovative, and effective services in the areas of environmental site assessment, impact assessment, environmental remediation, regulatory compliance and permitting, risk assessment, hydrology, solid and hazardous waste management, air quality management, and municipal infrastructure planning and design. We are an established, reputable company with a strong history of solving engineering and environmental challenges in a responsive and cost-efficient manner.

The CRA Family of Companies employs more than 2,600 professional and support staff in over 70 offices located throughout North America, with additional offices in Brazil and England. Our headquarter office is located in Waterloo, Ontario, Canada.

Aerial photography of the site dating from 1964, 1974, 1982, 1993, and 2003 was reviewed to provide information on historical forestry activities in the area.

Beth Cameron, B.Sc. M.Sc., is a Terrestrial Ecologist with Conestoga-Rover & Associates' Halifax office. She has significant experience conducting surveys for flora and fauna, as well as wetland surveys, and has worked on federal and provincial environmental screenings involving wetland alterations.

Kristen Nyborg is an Environmental Technologist with Conestoga-Rover & Associates' Halifax office. She holds an Ontario Wetland Evaluation System Certificate, and has significant wetland field experience. She also has gained hydrological and hydrogeological work experience with CRA.

Susan Belford, B.Sc., M.Sc., is a Senior Project Manager with Conestoga-Rovers & Associates' Halifax office. She is very familiar with wetland legislation, having worked on many environmental assessment projects involving provincial and federal regulations and processes.

Dave Strajt, M. Eng., is a Water Resources Engineer/Hydrologist with Conestoga-Rovers & Associates' Halifax office. He is very familiar with surface water processes as they relate to mining process.

Peter Oram, CESA, P.Geo. is a Geologist with Conestoga-Rovers & Associates' Halifax office. He has assisted with ten wetland alteration permits, providing hydrogeological advice. He is very familiar with wetland legislation, having worked on many environmental assessment projects involving provincial and federal legislative processes.

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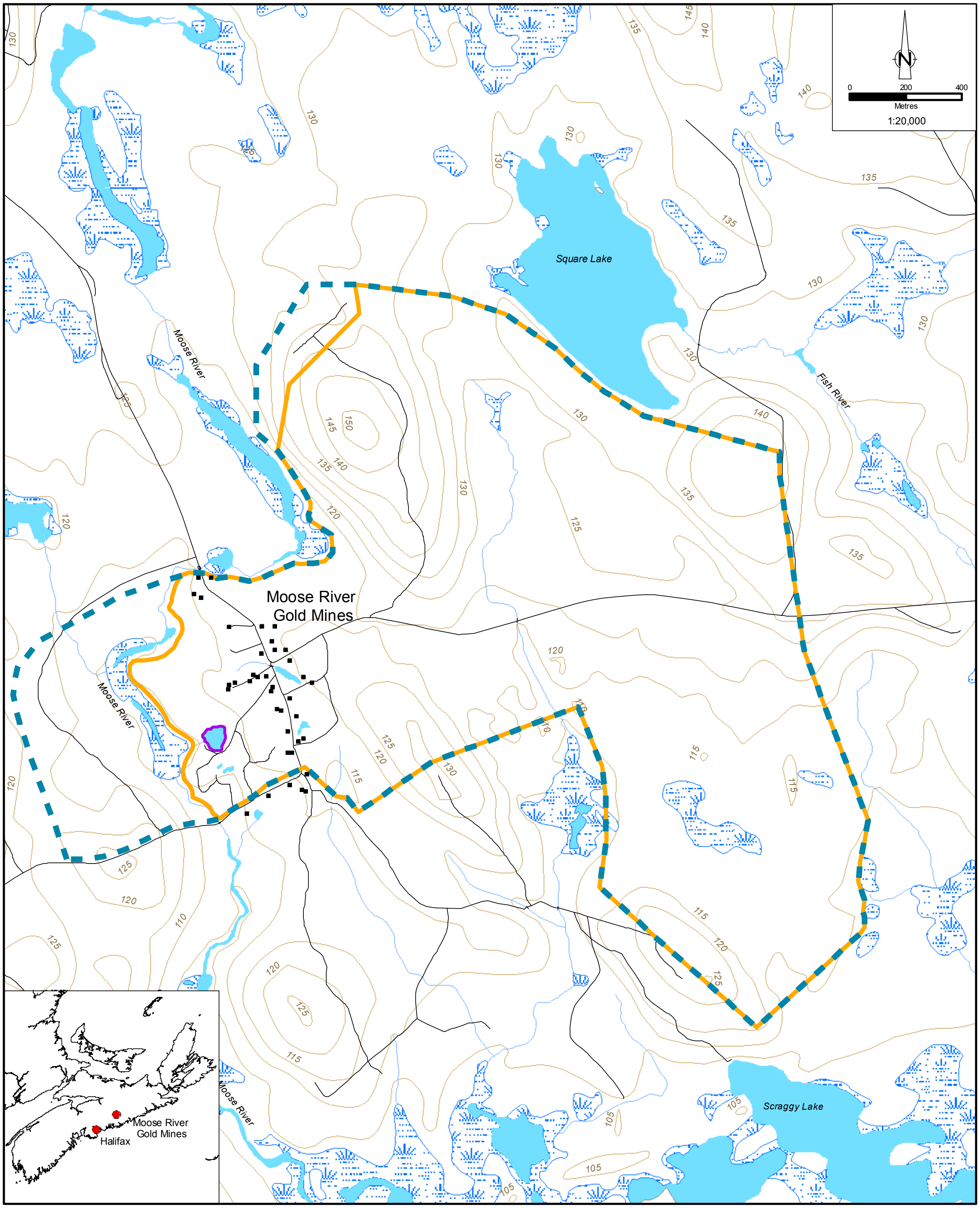
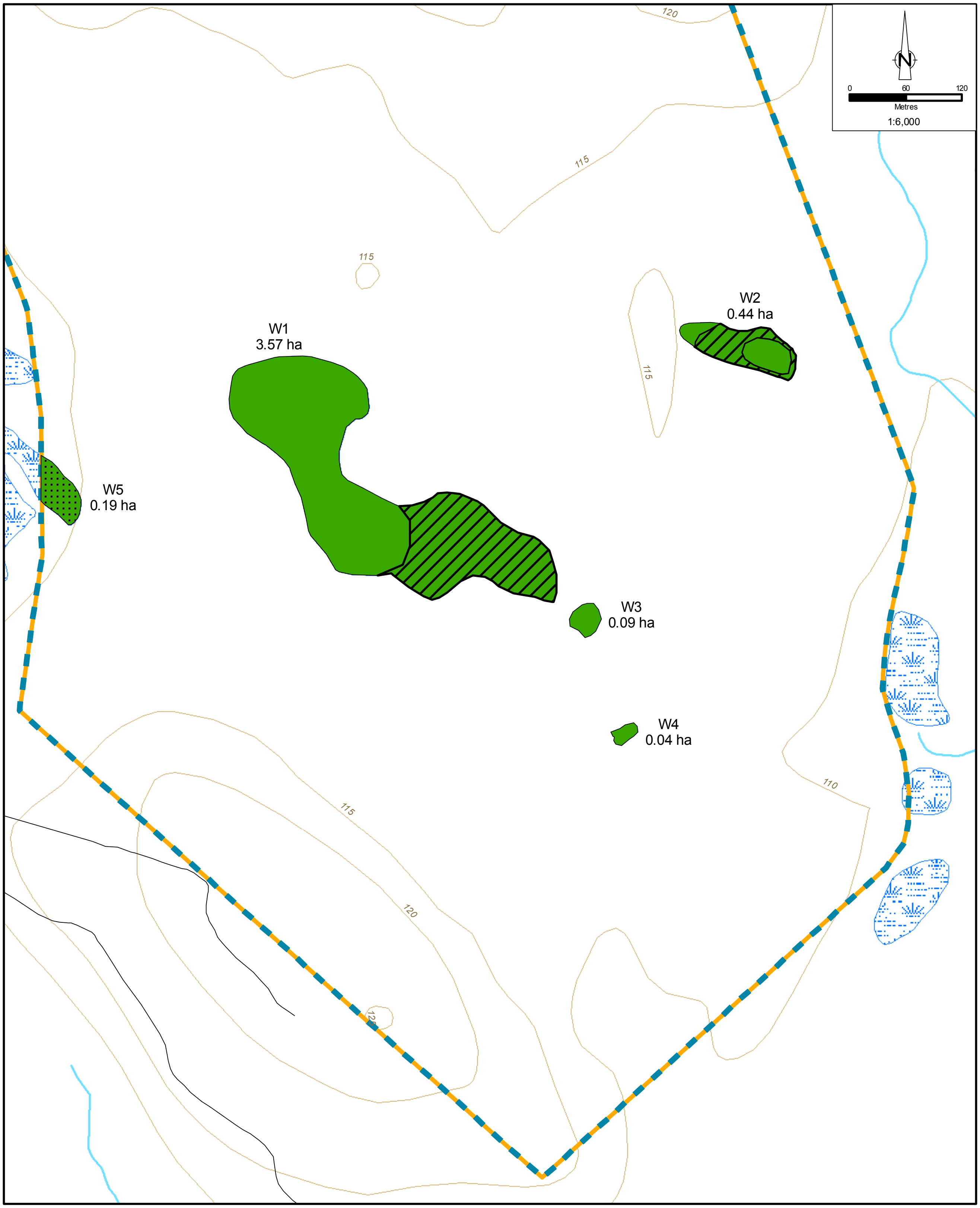


- Building
- Road
- Rivers and Streams
- Existing Pit Extent
- Surface Contour Line (10 m)
- Project Site Boundary
- Study Site Boundary
- Wetlands
- Lake

Data projected to UTM (Zone 20T) NAD83

Figure 1
LOCATION MAP
Touquoy Gold Project, DDV Gold Ltd.
Halifax County, Nova Scotia

820933(WET001)GIS-WA002 March 12, 2007



- Building
- Road
- Rivers and Streams
- Surface Contour Line (10 m)
- Shrub Bog
- Treed Bog
- Tall Shrub Swamp
- Lake
- Other Wetlands

Nova Scotia Topographic information supplied by Service Nova Scotia & Municipal Relations and copyright Her Majesty the Queen in Right of the Province of Nova Scotia.
Produced by Conestoga-Rovers & Associates under license with the Province of Nova Scotia, 2007.
Data projected to UTM (Zone 20T) NAD83

Figure 2
WETLANDS LOCATED ON PROJECT SITE
Touquoy Gold Project, DDV Gold Ltd.
Halifax County, Nova Scotia

820933(WET001)GIS-WA001 March 5, 2007

APPENDIX L

ARCHAEOLOGICAL REPORT - CULTURAL RESOURCE MANAGEMENT GROUP

DDV GOLD LIMITED

TOUQUOY GOLD PROJECT
ARCHAEOLOGICAL SCREENING
HALIFAX REGIONAL MUNICIPALITY

2005 ARCHAEOLOGICAL SCREENING REPORT
WITH APPENDIX FOR 2006 SCREENING

Submitted to:
DD Gold Limited
and the
Special Places Program - Heritage Division

Prepared by:
Cultural Resource Management Group Limited
6040 Almon Street
Halifax, Nova Scotia
B3K 1T8

Consulting Archaeologist: W. Bruce Stewart
Report Preparation: Mike Sanders & W. Bruce Stewart

Heritage Research Permit Numbers A2005NS42 & A2006NS60

CRM Group Project Number: 2004-0004

NOVEMBER 2006

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1.0 INTRODUCTION

DDV Gold Limited (DDV) is planning to undertake a surface gold mine project in Moose River Gold Mines, Halifax Regional Municipality. In preparation for permitting, MGI Limited, now Conestoga-Rovers and Associates (CRA) directed an environmental screening of the proposed impact area. Cultural Resource Management (CRM) Group was retained by CRA to undertake an archaeological screening as part of the overall environmental screening. The goal for CRM Group was to evaluate archaeological potential within the proposed development limits by conducting archival research and on-site visual assessment.

The archaeological screening was conducted according to the terms of Heritage Research Permit A2005NS42 (Category "C"), issued by the Heritage Division to W. Bruce Stewart, CRM Group President and Senior Consultant. This report describes the screening, presents its results and offers resource management recommendations.

2.0 STUDY AREA

DDV's proposed development area is located at the village of Moose River Gold Mines, approximately midway between Upper Musquodoboit and the head of Ship Harbour, near the geographic centre of HRM (***Figure 1***). This area overlies the Touquoy Gold deposit and includes the site of former mine works, a number of residences and a portion of the Moose River Gold Mines Provincial Park.

The proposed development area consists of a complex network of land parcels covering an area of approximately 400 hectares. This network lies east of Moose River and south to east of the intersection between Moose River Mines Road and the Moose River and Mooseland Road. Its principal components, as identified on a plan prepared by MGI Limited in June of 2004, are "Pit A", a "Mill Site", a "Tailings Dam" and a "Waste Dump" (***Figure 2***).

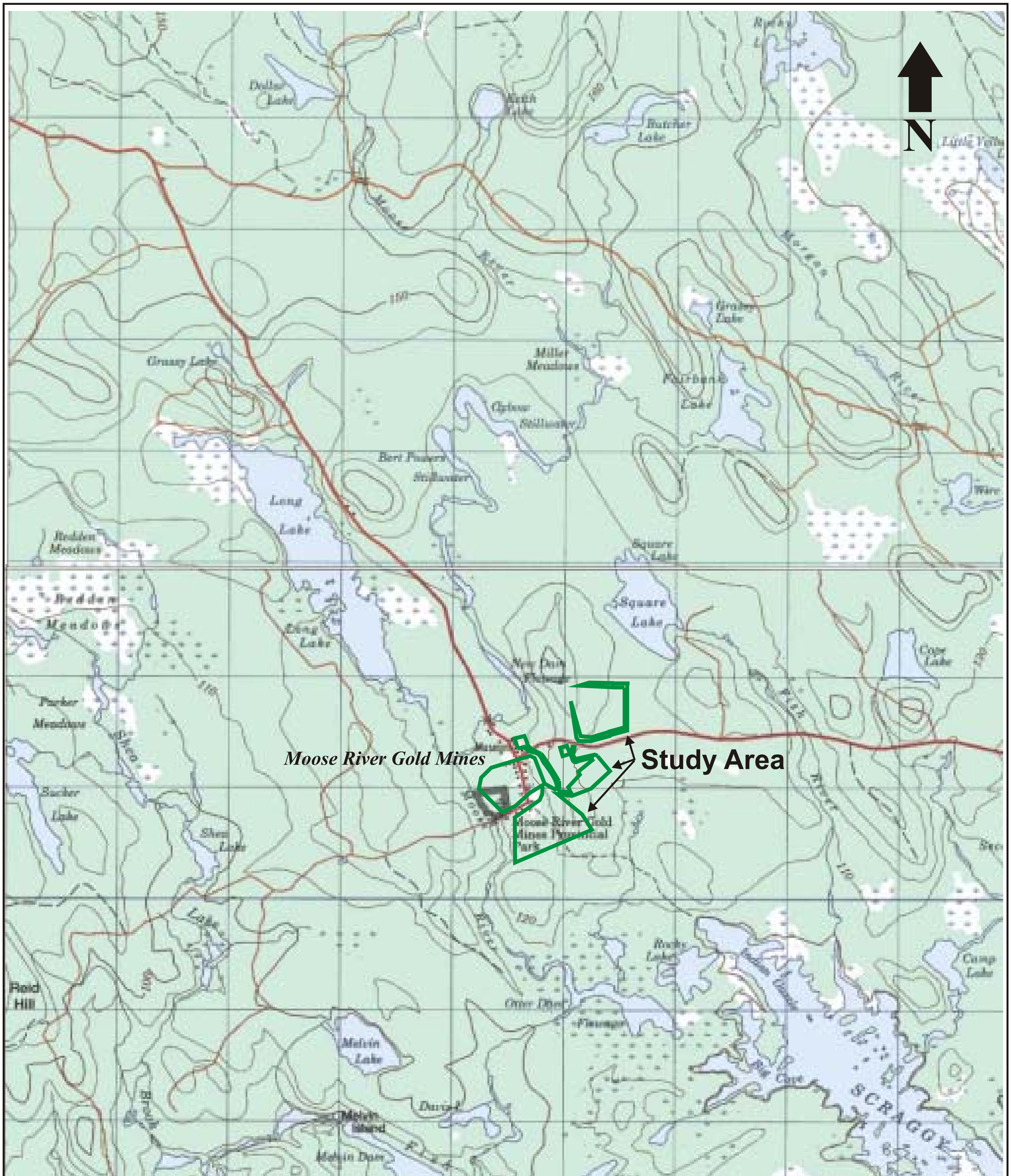
The footprint for Pit A is approximately 500 metres long (east/west) and 350 metres wide (north/south) and encompasses residential properties on either side of Moose River Mines Road and on the north side of Higgins Mine Road. It also includes the eastern end of the Moose River Gold Mines Provincial Park and most of the village's abandoned mine works.

The proposed Mill Site lies uphill from Pit A, east of Moose River Mines Road and south of the Moose River and Mooseland Road. Approximately 200 metres long (northeast/southwest) and 170 metres wide (northwest/southeast), it includes portions of woodlots in various stages of re-growth following commercial harvesting.

The proposed Tailings Dam site is located northeast of Pit A, on the north side of the Moose River and Mooseland Road. This site is approximately 600 metres long (east/west) and 450 metres wide and is covered by mixed forest.

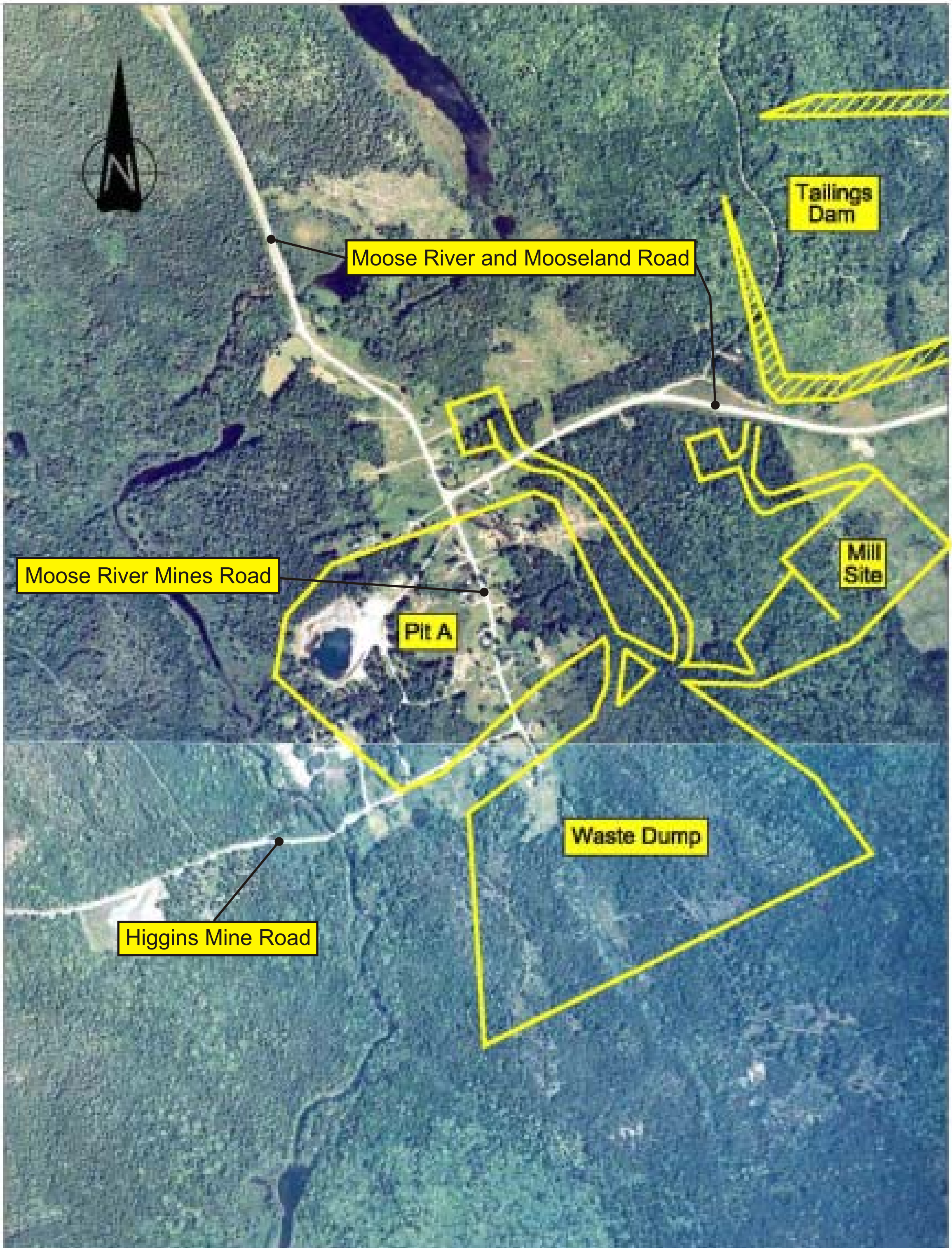
The proposed Waste Dump site lies south of Pit A and southwest of the proposed Mill Site. It is approximately 600 metres long (east/west) and 400 metres wide (north/south). Although it includes a residence at its north end (southwest of the Moose River Mines Road / Higgins Mine Road intersection), the majority of this site is a segment of a recently harvested wood lot.

The remainder of the study area consists of a proposed network of roads and parking areas to connect these principal facilities (***Figure 2***).



2005 Location of Study Area	Figure 1
TOUQUOY GOLD PROJECT ARCHAEOLOGICAL SCREENING REPORT HALIFAX REGIONAL MUNICIPALITY	September 2005 Scale 1:50 000

CRM Group
Cultural Resource Management Group Ltd.



CRM Group
Cultural Resource Management Group Ltd.

2005 Study Area and Site Layout

Figure 2

TOUQUOY GOLD PROJECT
ARCHAEOLOGICAL SCREENING REPORT
HALIFAX REGIONAL MUNICIPALITY

September 2005

Scale 1:10 000

3.0 METHODOLOGY

The archival research component of the archaeological screening was designed to explore the land use history of the study area and its environs, providing the information necessary to evaluate the property's archaeological potential. To achieve this goal, CRM Group utilized the resources of several provincial facilities in Halifax. Copies of historic maps were obtained from the Department of Natural Resources Library and the Public Archives of Nova Scotia (PANS). Historic documents and written histories examined at PANS also proved to be useful. Records of previous archaeological discoveries near the Moose River Gold Mines area were noted using Maritime Archaeological Resource Inventory information provided by the Nova Scotia Museum. Modern maps (1:10 000 and 1:50 000 topographic) and aerial photographs (1992) were obtained at the Provincial Land Information Centre. Earlier aerial photographs (1931) were examined at the Department of Natural Resources Library.

The Moose River Gold Mines Museum, located in the village of Moose River Gold Mines, was closed at the time of the screening - May being part of the off-season. However, staff of the Musquodoboit Valley Tourism Association made special arrangements for CRM Group personnel to examine and print scanned copies of museum documents, photographs and written histories at the Musquodoboit Valley Tourism Association office in Middle Musquodoboit.

Fieldwork consisted of a brief visual inspection of the study area conducted on May 5, 2005 by CRM Group archaeologists Mike Sanders and Ben Pentz. This limited pedestrian survey utilized the network of existing roads (permanent and abandoned) that criss-crosses the study area, but also involved following compass transects across wooded and harvested areas. The ground search did not involve sub-surface testing. The researchers were watchful for topographic or vegetative anomalies that might indicate the presence of buried archaeological resources. The process and the results were documented in field notes and photographs.

4.0 RESULTS

4.1 Background Research

HD-NSM records indicated that there are no recorded archaeological sites within the study area. The closest registered site is a Mi'kmaq habitation site at the north end of Lake Charlotte, approximately 10 kilometres southwest of the study area. This lack of archaeological data for the Moose River Gold Mines area is believed to reflect a lack of archaeological investigation, rather than an absence of archaeological sites. Moose River and its associated lake system would have been a travel-way, a resource base and a home to the Mi'kmaq and their ancestors for millennia prior to the arrival of European settlers. Place-names such as Indian Guzzle (at the north end of Scraggy Lake), Portage Road (now Higgins Mine Road from Moose River to Fish River) and Cope Lake are indicative of Mi'kmaq heritage near the study area (***Figure 1***). However, the land within the study area, being set back from Moose River and other waterways by a distance of at least 70 metres, is considered to have low potential for either Precontact or early historic First Nations archaeological resources.

By the mid 1860s, the Moose River area had become recognized as a logging district (Stevens 1973:12), but had still not been "opened up" for European settlement. Available maps dating to 1865 and earlier show no buildings or even roads in the area (Anonymous 1787; Lockwood 1819; Church 1865). Consequently, it is considered unlikely that the study area has Euro-Canadian features that are old enough to be considered archaeological.

In 1866, gold was discovered in the bed of Moose River. There is debate as to whether this was a chance discovery made by lumbermen during a log drive or the result of careful prospecting inspired by previous discoveries in the Tangier and Mooseland areas (Higgins 2002:65-66). In any case, the discovery prompted a "rush" of local surface prospecting and applications for land grants. The majority of the Pit A property was granted to Robert Higgins III (a Middle Musquodoboit farmer) in 1866 (Grant Book 36, page 27 and 28). The remainder, consisting of the eastern end and southern edge, was granted in 1874 to Benjamin Young (a merchant from Calais, Maine) and John N. Hill (a Merchant from Ship Harbour, Halifax County) (Grant Book 48, pages 451-452).

The gold mines that became the namesake and the mainstay of Moose River Gold Mines developed primarily within the limits of the proposed Pit A area (Faribault 1898). This mining, however, did not begin in earnest until 1876, when the area was surveyed and subdivided as the Moose River Gold District (Stevens 1973:12; Higgins 2002:66).

The boom time for Moose River Gold Mines was between 1890 and 1909. During this time, the mines employed several hundred people (Higgins 2002:68). In 1898, the Moose River Gold Mining Company was operating in the northeast corner of the Pit A area, while the Touquoy

Gold Mining Company was operating in the southwest corner (Faribault 1898). The Guilford & Kelly Gold Mining Company was established in 1904 and operated a large 40-stamp mill on the present site of the Moose River Gold Mines Provincial Park, at or near the southwest corner of the Pit A area (Higgins 2002:66).

The mine works were essentially abandoned in the decade between 1910 and 1920, but, in 1928, some holdings were purchased by John A. Grant of Antigonish. The Moose River Gold Syndicate was formed in 1934, with John Grant maintaining a share, along with Dr. David Edwin Robertson and principal owner Herman Russell Magill (both from Ontario). A shaft known as the Meyer Shaft was pumped out and re-opened in January of 1936. This shaft collapsed on April 12,1936, trapping Robertson and mine time-keeper Charles Alfred Scadding for 10 days and killing Herman Russell Magill (Stevens 1973:13). The events leading up to and including the rescue of Robertson and Scadding were the subject of a sequence of live radio broadcasts that reached all 58 CRBC stations in Canada, as well as 650 other radio stations in the United States (Stevens 1973:71). This unprecedented level of radio coverage made Moose River's tragedy and rescue a renowned part of Canadian history. In recognition, the Province erected a stone monument on the site and later established the Moose River Gold Mines Provincial Park. Public interest in the collapse and rescue was the impetus for the creation of the Moose River Gold Mines Museum, and the story remains a focal point in the museum's interpretive displays.

Since the 1936 collapse, there have only been small, short-lived mining operations at Moose River Gold Mines (Higgins 2002:80). Many of the miner's residences remain, but the mine superstructures and equipment are now gone. Commercial buildings that once stood within the Pit A area, such as the Moose River General Store / Post Office and Herb Murphy's Dance Hall, have been torn down (Higgins 2002:50, 51). Other buildings that had a central role in the life of the community, such as the Moose River School (built in the late 1800s and now the Moose River Gold Mines Museum), the Moose River Mines United Church (constructed from 1909 to 1910 and still opened for special functions) and the Wayside Inn (operated from 1920 to 1960 and now vacant) are still standing (***Plates 1 & 2***), but not within the study area (Hilchey 1982; Higgins 2002; Annand 2004).

Consultation with senior residents and researchers indicates that no cemetery was ever established in Moose River Gold Mines due to the threat of disturbance by mining operations and subsidence (Castle 2005). Instead, the dead were interred in neighbouring communities, such as Higginsville, located 12.5 kilometres to the northwest.

PLATE 1: **Moose River Gold Mines School, built in the late 1800s. On east side of Moose River and Mooseland Road. Facing northeast.**

PLATE 2: **Moose River Gold Mines United Church, built beginning in 1909. On east side of Moose River and Mooseland Road. Facing northeast.**

4.2 Field Investigations

Field reconnaissance within the Pit A section of the study area revealed an abundance of roads, trails, mine pits, shafts, houses and outbuildings dating from approximately 1866 (the date of the initial gold strike) to the present (***Plates 3 & 4***). These features were judged on the basis of background research and cursory inspection to be too recent to have archaeological components, and were not investigated in detail. Likewise, a century-old residence at the north end of the proposed Waste Dump and a slightly younger residence at the west edge of the proposed access road north of Pit A were examined, but considered too recent to be archaeological sites. Inspection of the remainder of the study area also failed to reveal areas of high archaeological potential - only rough-surfaced wood lots laced with modern logging roads.

As a result of the field investigation, the entire study area was ascribed low archaeological potential.

PLATE 3: **Stone monument at southwest edge of proposed Pit A area. Facing northeast.**

PLATE 4: **Vernon Higgins Residence at north edge of proposed Pit A area. One of the oldest buildings in Moose River Gold Mines. Facing west.**

5.0 CONCLUSIONS AND RECOMMENDATIONS

On the basis of the archaeological screening program, which combined archival research and limited field reconnaissance, the entire Moose River Gold Mines study area, as defined in this report, is ascribed low archaeological potential. Moose River Gold Mines' surviving mine features, its standing buildings and the buried remains of those that are no longer standing, are not old enough to be considered archaeological features. They are, however, of considerable historical interest, as demonstrated by the existence of the Moose River Mines Museum.

Based on those conclusions, CRM Group offers the following management recommendations for the study area:

1. Given the low archaeological potential ascribed to the study area, it is recommended that the entire area be cleared of any further archaeological investigation prior to development.

2. In the event that archaeological deposits or human remains are encountered during construction, all work in the associated area(s) should be halted and immediate contact should be made with the Nova Scotia Museum (David Christianson: 424-6461).

3. Given the historical significance of Moose River Gold Mines, it is recommended that DDV work with the provincial Heritage Division to develop a strategy for the documentation of the community before it is impacted by mine development.

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APPENDIX A

2006 ARCHAEOLOGICAL SCREENING

TOUQUOY GOLD PROJECT
2006 ARCHAEOLOGICAL SCREENING

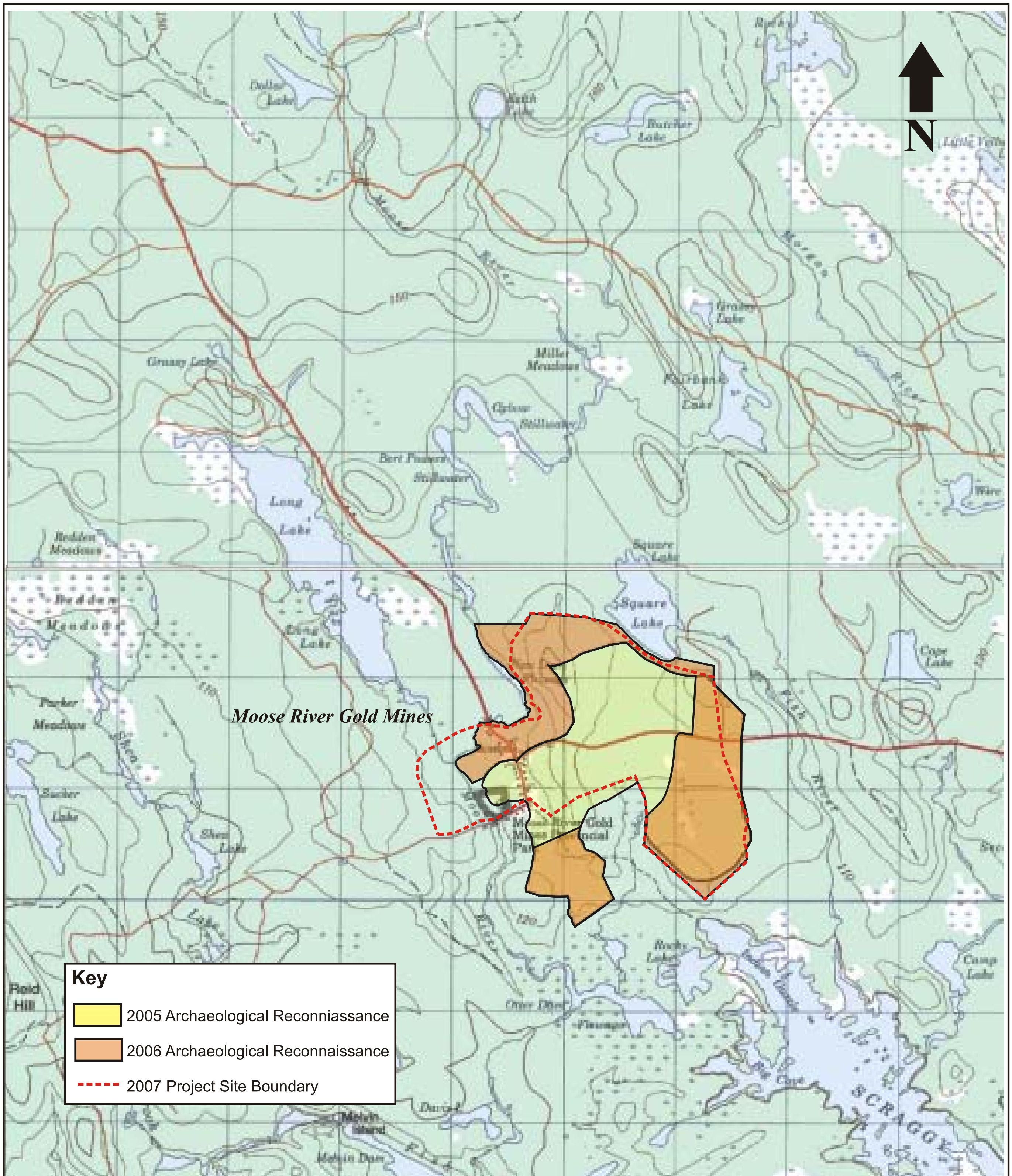
Subsequent to the completion of the Moose River Gold Mines archaeological screening in 2005 (Sanders & Stewart 2005), the area of interest for the proposed Touquoy Gold Project at Moose River Gold Mines was revised. Consequently, CRM Group was retained by Conestoga-Rovers & Associates (CRA) in July, 2006 to undertake archaeological screening of the additional areas of possible disturbance.

The additional areas proposed in 2006 are situated at the periphery of the broad area addressed by archaeological screening in 2005 (***Figures 1 & 2***), and each is described in detail below. CRM Group's archaeological screening of those areas was conducted according to the terms of Heritage Research Permit A2006NS60 (Category C), issued by the Special Places Program – Heritage Division (SPP-HD) to W. Bruce Stewart, CRM Group President and Senior Consultant.

Northwestern Area
The northwestern 2006 study area lies northwest of the intersection between the Higgins Mines Road and the Moose River and Mooseland Road (***Figure 2***). It extends north from the proposed open pit area addressed in 2005 and is bounded on the east by the Moose River and Mooseland Road, on the west by Moose River and on the north by private residential property.

Reconnaissance of the land within the northwestern 2006 area was conducted on September 19 by CRM Group archaeologist Mike Sanders. This survey revealed that the western edge of the study area consists of a 10 to 15 metre wide strip of relatively flat and dry riverside land bordering Moose River. An abandoned road largely blocked by tree growth runs north/south along the top of this surface through the study area (***Plates 1 & 2***). Due to the relatively flat and dry surface condition, the presence of the old road, and the proximity of the waterway, the narrow riverside strip was ascribed high archaeological potential.

Along the stillwater upstream from the confluence with the Long Lake outflow, the land on the east side of the old road rises steeply and is ascribed low archaeological potential (***Plate 1***). Further south, downstream from the confluence, the land on the east side of the old road slopes slightly downward, becoming an alder bog with low archaeological potential (***Plate 2***).



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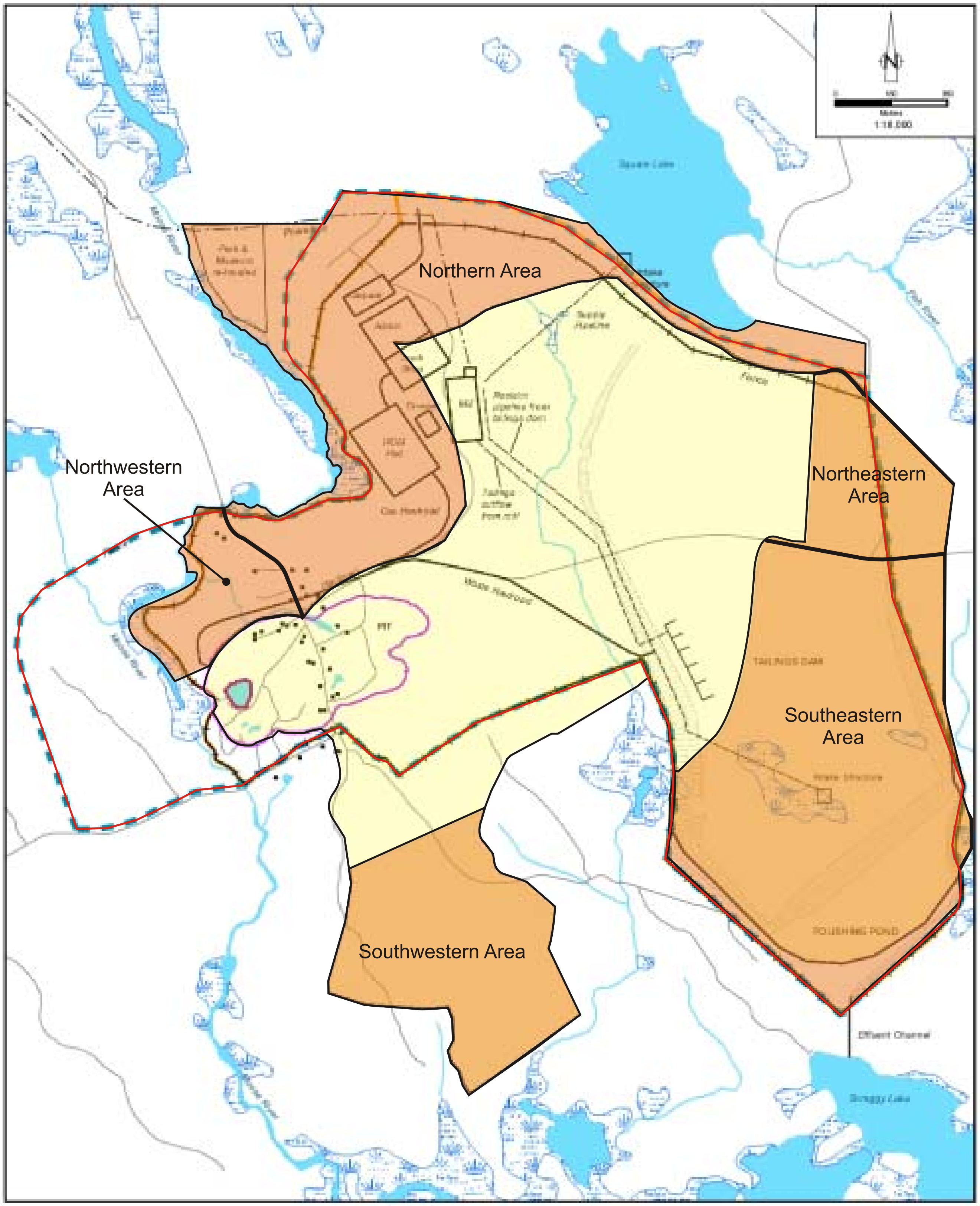
2006 Study Area

Figure 1

TOUQOUY GOLD PROJECT
2006 ARCHAEOLOGICAL SCREENING
HALIFAX REGIONAL MUNICIPALITY

March 2007

Scale 1:50 000



- Building
- Existing Pit Extent
- Proposed Pit Extent
- Supply Pipeline
- Power Line
- Site Fence
- Road
- Rivers and Streams
- Project Site Boundary
- Study Site Boundary
- Wetlands
- Lake
- 2005 Archaeological Reconnaissance
- 2006 Archaeological Reconnaissance

CRM Group
Cultural Resource Management Group Ltd.

Detail of 2006 Study Areas

Figure 2

TOUQUOY GOLD PROJECT
2006 ARCHAEOLOGICAL SCREENING
HALIFAX REGIONAL MUNICIPALITY

March 2007

Although the remainder of the study area is relatively dry and gently sloped (***Plate 3***), it is comparatively distant from the Moose River/New Dam Flowage waterway and, consequently, is ascribed low archaeological potential.

PLATE 1: **Overgrown road beside New Dam Flowage stillwater. Facing northeast. Note steep rise to the right.**

PLATE 2: **Road beside Moose River at south end of study area. Facing north. Note area of alder bog to the right.**

PLATE 3: **Clear cut at centre of study area. Facing southeast.**

Northeastern Area

The northeastern 2006 area lies on the north side of the Moose River and Mooseland Road, southeast of Square Lake (***Figure 2***). It is bounded on the south by the Moose River and Mooseland Road, on the west by the proposed tailings management area addressed in 2005, and on the north and east by the summits of hills adjacent to Fish River. In current mapping, it is identified as the eastern half of Subcatchment Area 6.

The entire area of the northeastern 2006 area was quickly determined to have low archaeological potential, either being too wet, steeply sloped or distant from potable water and historic roads to have high archaeological potential. This determination was made based on a review of background information acquired during the original archaeological screening, examination of modern topographic maps and aerial photographs and on-site reconnaissance.

The reconnaissance was conducted on July 27, 2006 by W. Bruce Stewart, with the assistance of Kathryn Stewart. The team paid particular attention to the relatively flat and dry uplands located along the Moose River and Mooseland Road and at the northeast edge of the study area. No exposed archaeological features or indications of high archaeological potential were encountered.

Southeastern Area

The southeastern 2006 area lies on the south side of the Moose River and Mooseland Road, northwest of Scraggy Lake (***Figure 2***). It is bounded on the north by the Moose River and Mooseland Road on the west by the 2005 proposed polishing pond area addressed in 2005, and on the south and east by the hills adjacent to Fish River. In current mapping, it is depicted within Subcatchment Areas 7 and 8.

The entire area of the northeastern 2006 area was quickly determined to have low archaeological potential, either being too wet, steeply sloped or distant from potable water and historic roads to have high archaeological potential. This determination was made based on a review of background information acquired during the original archaeological screening, examination of modern topographic maps and aerial photographs and on-site reconnaissance.

Reconnaissance was conducted on July 27 by W. Bruce Stewart and Kathryn Stewart and on September 13 by Mike Sanders. The team paid particular attention to the relatively flat and dry uplands located along the Moose River and Mooseland Road and at the southwest edge of the study area. No exposed archaeological features or indications of high archaeological potential were encountered.

Southwestern Area

The southwestern 2006 area lies between the proposed processing plant area and Otter Dam Flowage, east of Moose River. It is bounded on the north by the portion of the proposed waste rock storage area addressed in 2005 and by hills on the east and west. The southern limit is set back from a Moose River tributary that enters the north side of Otter Dam Flowage. In current mapping, it is identified as the south end of the formerly proposed waste rock storage area occupying portions of Subcatchment Areas 4 and 5.

The entire area of the northeastern 2006 area was quickly determined to have low archaeological potential, either being too wet, steeply sloped or distant from potable water and historic roads to have high archaeological potential. This determination was made based on a review of background information acquired during the original archaeological screening, examination of modern topographic maps and aerial photographs and on-site reconnaissance.

Reconnaissance was conducted on July 27 by W. Bruce Stewart and Kathryn Stewart. The team paid particular attention to relatively flat and dry upland areas along established logging roads crossing the study area. No exposed archaeological features or indications of high archaeological potential were encountered.

Northern Area

The northern 2006 study area extends northward from the other Touquoy Gold Project study areas examined in 2005 and 2006 and consists of the area between Moose River and Square Lake (***Figure 2***). It is bounded as follows: on the south by the 2005 study area and, also, the northwestern and northeastern 2006 study areas; on the west by Moose River; on the east by Square Lake and a logging road that crosses Fish River to its southeast; and, on the north by an east/west line between Moose River and the approximate centre of Square Lake. Although the majority of the northern 2006 study area lies on the northeast side of the Moose River and Mooseland Road, the area also includes a small parcel of land on the west side of the road, north of the northwestern 2006 study area.

Reconnaissance of the land within the northern 2006 area was conducted on November 28 by CRM Group archaeologist Mike Sanders. Particular attention was paid to the Moose River and Square Lake shores and to hill-tops near the study area's centre and east end.

This survey revealed that the majority of the shore areas, both along Moose River and Square Lake (***Plates 4 & 5***), were relatively flat and dry, with high archaeological potential within 30 metres of the shorelines. Only two exceptions were identified. Both were situated along Moose River upstream from the Moose River and Mooseland Road bridge. Low archaeological potential was ascribed to a boggy area east of the major river-bend between 350 and 500 metres upstream from the bridge and to a steep area east of the New Dam Flowage, between 650 and 800 metres upstream from the bridge. The remainder of the study area, including the hill tops, was quickly determined to have low archaeological potential, either being too wet, steeply sloped or distant from potable water and historic roads to have high archaeological potential. This determination was made based on a review of background information acquired during the original archaeological screening and on examination of modern topographic maps and aerial photographs, as well as on on-site reconnaissance.

PLATE 4: **New Dam Flowage section of Moose River, looking northwest (upstream).**

PLATE 5: **Cove at south end of Square Lake, looking northwest.**

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the archaeological screening, CRM Group offers the accompanying management recommendations:

1. After screening of the northwest area, it is recommended that no ground impacts occur within 50 metres of Moose River or Square Lake. Any unavoidable ground impacts within that area should be preceded by archaeological assessment, including shovel testing.

2. It is recommended that the remainder of the proposed 2006 areas, as depicted in Figure 2, be cleared of any further archaeological investigation prior to development.

3. In the event that archaeological deposits or human remains are encountered during construction, all work in the associated area(s) should be halted and immediate contact should be made with the SPP-HD (Stephen Powell: 424-6468).

APPENDIX M

MI'KMAQ KNOWLEDGE STUDY – CONFEDERACY OF MAINLAND MI'KMAQ

MI’KMAQ KNOWLEDGE STUDY

Touquoy Gold Project
Moose River Gold Mines, Nova Scotia

Prepared for CRA Ltd.

Mi’kmaq Environmental Services
The Confederacy of Mainland Mi’kmaq
P.O. Box 1590
57 Martin Crescent, Truro, Nova Scotia, B2N 5V3
Tel: (902) 895-6385
Fax: (902) 893-1520

December 2005

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1.0 INTRODUCTION

1.1 Mi'kmaq Environmental Services

Mi'kmaq Environmental Services (MES) is a program operated by the Lands, Environment, and Natural Resources directorate of The Confederacy of Mainland Mi'kmaq (CMM) that provides fee for service environmental consulting services. CMM provides advisory services to six Mi'kmaw communities in the province of Nova Scotia – Paq'tnkek First Nation, Annapolis Valley First Nation, Bear River First Nation, Glooscap First Nation, Millbrook First Nation, and Pictou Landing First Nation.

Mi'kmaq Environmental Services Contact Information:

Michael Cox
The Confederacy of Mainland Mi'kmaq
P.O. Box 1590
57 Martin Crescent
Truro NS, B2N 5V3
(902) 895-6385 ext. 237
(902) 893-1520
environment@cmmns.com

1.2 Project Description

Diamond Ventures NL (DDV) is planning to undertake a surface gold mine and reclamation project in Moose River Gold Mines, Halifax Regional Municipality. The development area overlies the Touquoy gold deposit and includes former mine workings, a number of residences, and a portion of the Moose River Gold Mines Provincial Park.

The proposed development area consists of a complex network of land parcels covering an area of approximately 200 hectares. This network lies east of Moose River and southeast of the intersection between Moose River Mines Road and the Moose River and Mooseland Road.

The mine is of open pit construction. Materials will be processed at the mill site using gravity separation and cyanide polishing. Waste will be managed through a waste dump and tailings pond.

Initial annual production is estimated at 88 to 90 koz with a total production of 440 to 630 koz over the five to seven year life of the mine.

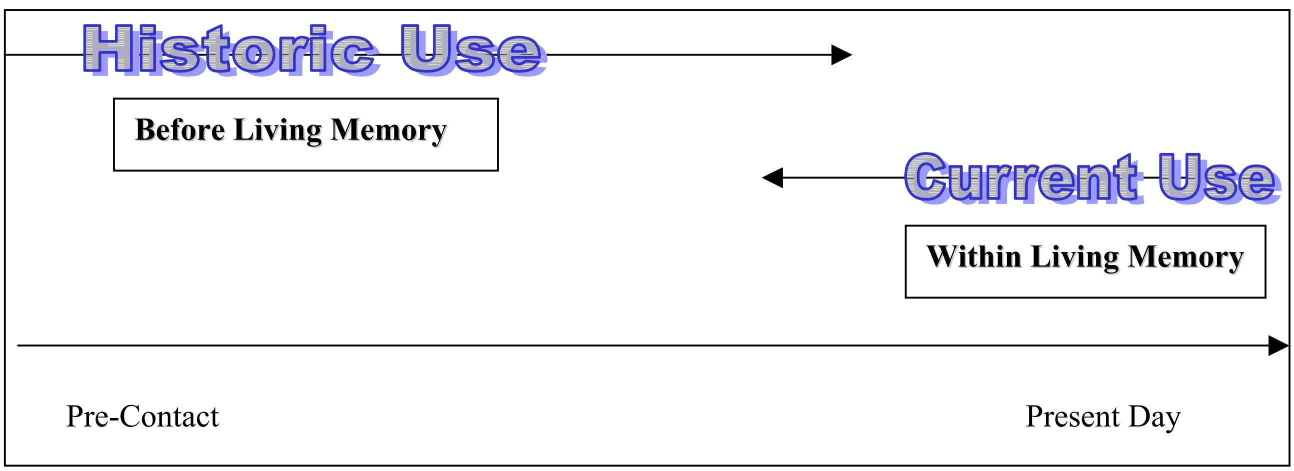
2.0 DEFINITION OF TERMS

Living Memory is the memory of living Mi'kmaw. The period of time included in living memory varies from knowledge holder to knowledge holder. Living memory often extends to the father and grandfather of the knowledge holder and can be estimated at three to four generations.

Current Mi'kmaq Land and Resource Use occurred within living memory or is occurring at the present day (Figure 1).

Historic Mi'kmaq Land and Resource Use occurred before living memory (Figure 1).

Figure 1: Historic and Current Use Timeline



Mi'kmaw Ecological Knowledge is the collective body of knowledge which Mi'kmaq possess based on their intimate relationship with their natural surroundings, which involves exploitation, conservation and spiritual ideologies, and has been passed on from generation to generation, "*kisaku kinutemuatel mijuijij*", elder to child.

Mi'kmaq Land and Resource Use Sites are locations where Mi'kmaq land and resource use activities have taken place or are taking place at present day. These sites may or may not display physical evidence of Mi'kmaq use.

Mi'kmaq/Mi'kmaw - *Mi'kmaq* means the Family and is an undeclined form. The variant form, *Mi'kmaw,* plays two grammatical roles: 1) it is the singular of Mi'kmaq and 2) it is an adjective in circumstances where it precedes a noun.

Mi'kma'ki is the Mi'kmaw homeland (Atlantic provinces and Gaspé peninsula)

Specific Land Claim arises when a First Nation alleges that the federal government has not honoured its treaties, agreements or legal responsibilities. According to federal policy, a valid specific claim exists when a First Nation can prove the government has an "outstanding lawful obligation". The Mi'kmaq are currently pursuing several specific land claims in Nova Scotia.

Comprehensive Claim is based on underlying Aboriginal Title to traditional territory that has not been dealt with by treaty or other means. Aboriginal Title to lands exists as a legal right derived from First Nations historical occupation and possession of their tribal lands. The process of negotiating the settlement of comprehensive claims, which is known as modern-day treaty making, clarifies access and ownership to land and resources. Currently, the Mi'kmaq have a comprehensive claim to all lands within the province of Nova Scotia including all inland and adjacent waters.

3.0 PURPOSE AND SCOPE OF THE MI'KMAQ KNOWLEDGE STUDY

3.1 Purpose of the Mi'kmaq Knowledge Study

The purpose of the Mi'kmaq Knowledge Study is to support the integration of Mi'kmaq knowledge of use and occupation of Mi'kma'ki into development decisions via the environmental assessment process.

3.2 Scope of the Mi'kmaq Knowledge Study

The MKS includes:

1) a study of historic and current Mi'kmaq land and resource use;
2) an evaluation of the potential impacts of the Project on Mi'kmaq use and occupation and constitutionally based rights;
3) an evaluation of the significance of the potential impacts of the Project on Mi'kmaq use and occupation; and
4) recommendations to proponents and regulators that may include recommendations for mitigation measures, further study, or consultation with Mi'kmaq.

3.3 Not included in the scope of the Mi'kmaq Knowledge Study

3.3.1 Section 35 Consultation

This study is not consultation for justification of the infringement of constitutionally protected aboriginal and treaty rights. If the project involves possible infringements of Mi'kmaq constitutional rights, the MKS recommends further action.

3.3.2 Archaeological Screening and Resource Impact Assessment

The study is not an Archaeological Screening or Archaeological Resource Impact Assessment. Results presented in the study can inform and be informed by archaeological screenings and assessments.

3.3.3 Notification of Mi'kmaw individuals or communities of the Project

The study is not intended to inform or notify Mi'kmaw individuals or communities of the Project, solicit the opinions or concerns of Mi'kmaw individuals or communities on the Project, or promote the Project to Mi'kmaw individuals or communities.

4.0 METHODOLOGY

4.1 Historic Mi'kmaq Land and Resource Use

Historic Mi'kmaq land and resource use occurred before living memory. The study of historic land and resource use paints a broad portrait of Mi'kmaq use and occupation of Mi'kma'ki in centuries past.

4.1.1 Study Area

The study area of historic Mi'kmaq land and resource use is the Musquodoboit Valley and Shubenacadie region, located in the Mi'kmaq district of *Sipeknekatik*.

4.1.2 Methods

Comprehensive research into secondary resources pertaining to Mi'kmaq history in the study area was completed. Research was undertaken at the Nova Scotia Public Archives, Saint Mary's University, Dalhousie University, Mount Saint Vincent University, King's College, CMM Research Department, as well as local libraries in the study area.

4.1.3 Limitations

Recorded documents are the primary source of information for the study of historic Mi'kmaq land and resource use. There are no recorded documents in the pre-contact period and recorded documents in the post-contact period are not comprehensive. Furthermore, existing documentation has largely been written by people of a different culture. This means that information may either not be completely accurate or may be incomplete.

4.2 Current Mi’kmaq Land and Resource Use

Current Mi’kmaq land and resource use occurred within living memory or is presently occurring. The MKS includes a study of:

1) Current Mi’kmaq land and resource use sites
2) Plants of significance to Mi’kmaq
3) Mi’kmaw Communities

4.2.1 Study Areas

The study areas are described in Figure 2.

4.2.1.1 Current Mi’kmaq Land and Resource Use Sites

The study area for current Mi’kmaq land and resource use sites is a 5 km radius surrounding the project area.

4.2.1.2 Plants of Significance to Mi’kmaq

Plants of significance to Mi’kmaq were studied in three areas covering the entire development area of the project Study areas are marked on Figure 2.

4.2.1.3 Mi’kmaw Communities

The study area for Mi’kmaw communities is a 5 km area surrounding the project area.

4.2.2 Methods

4.2.2.1 Current Mi'kmaq Land and Resource Use Sites

Mi'kmaq Knowledge on current land and resource sites was gathered through a review of information collected during the Aboriginal Title Project and through oral interviews with Mi'kmaw knowledge holders.

All individuals who were interviewed signed consent forms. Knowledge was gathered in accordance with the *Mi'kmaq Ecological Knowledge Protocol* and an application to complete research was submitted to Mi'kmaw Ethics Watch.

Knowledge collected is reported in a general format only. No names or specific locations are published.

Collected knowledge was digitized and compiled to allow for an analysis of potential impacts of the project on current Mi'kmaq land and resource use.

4.2.2.2 Plants of Significance to Mi'kmaq

A system of stratified random sampling was employed to identify plants present in the study areas of significance to Mi'kmaq. Plants were surveyed in June 2005 and October 2005. Information collected is reported in a general format only. The names of the species are not recorded.

4.2.2.3 Mi'kmaw Communities

A review of reserves and specific land claims in the study area was undertaken. The record of outstanding specific land claims in no way infers that specific land claims may not arise in the future.

4.2.3 Limitations

While every attempt was made to document all available Mi'kmaw knowledge, the knowledge gathering process may not have captured some available Mi'kmaw knowledge. It is also recognized that over generations of cultural and political suppression, much Mi'kmaq knowledge has been irretrievably lost.

5.0 RESULTS

Results of the study are divided into two categories:

1) historic land and resource use, that is, use that occurred before living memory, and
2) current land and resource use, or use that occurred within living memory or is occurring at the present day

Land and resource use may be for hunting, burial/birth, ceremonial, gathering, or habitation purposes.

5.1 Historic Mi'kmaq Land and Resource Use

5.1.1 Pre-Contact

There are many Mi'kmaq place names in the study area, some of which are still in use, that are evidence of historic Mi'kmaq land and resource use. The Musquodoboit River was so named by the Mi'kmaq, who used the area as hunting grounds. The name Musquodoboit was originally pronounced *Mooskudoboogwek*, meaning "suddenly widening out after a narrow entrance at the mouth; flowing out square and plump" or *Muskoodeboogwek,* which means, "rolling out in foam." Middle Musquodoboit was given the name *Natkamkik*, which means, "the river extends uphill." A branch of the Musquodoboit River was called *Kesogwedek*, meaning "a road running high up.'[1]

The Shubenacadie River was named *Agekade*, and Shubenacadie was named *Segebunakade*, meaning "the place where the native potato or ground nut, *segebun,* grew abundantly." There was a place above the Shubenacadie River named *Sasooguloomin,* meaning, "abounding in Quartz crystals."[2]

[1] Rev. Silas T. Rand, **Micmac Place Names,** p. 52, p. 56, p. 34.
[2] Rev. Silas T. Rand, **Micmac Place Names,** p. 12, p. 73, p. 72.

Ship Harbour was called *Tedumunaboogwek*, meaning "a water worn rock, or blunt harbour." Ship Harbour Lake was called *Wagwosk*, meaning "the end." The streams entering Ship Harbour Lake were also once called *Wejomkek*. [3] Sheet Harbour was named *Weijooik*, meaning "running crazily, spreading off every way." Sheet Harbour Lake was named *Punakade*, meaning "the place bringing forth." There was also a spot near Sheet Harbour, which was named *Noogumkigawaachk*, which means "Sandy and soft, near the Clam Harbour area."[4] One of the streams flowing into Sheet Harbour was named *Kajoogwajek*, which means, "place where gold thread grows," and there is also a branch of Sheet Harbour, which was named *Ukchipkoodapskook*, which meant "the largest pool."[5]

5.1.2 Post-Contact

There are European accounts that mention Mi'kmaq in the study area, and it can therefore be inferred that the project area was also used historically by the Mi'kmaq.

The 1708 census indicated that there was a band of Mi'kmaq living at Musquodoboit on the eastern coast. Comparison between the 1708 nominal census and the 1722 census, which gives the names of chiefs for each band, suggests a linkage between the Musquodoboit band and the Shubenacadie village mentioned in 1722. In 1708, Joseph Bemgabouides, age 48, is listed as living at Musquodoboit while in 1722, a Joseph Bemgabouides is listed as Chief of Shubenacadie. This is likely the same person, suggesting a connection between the two settlements. This linkage is confirmed by 18th century European correspondence, which refers to Mi'kmaq trading with English fisherman in this region. Occupation of the Atlantic coastline is also suggested by the presence of French speaking peoples at Musquodoboit and by English records from 1760, which list "Claude Renee" as chief of the Indians at Musquodoboit and Shubenacadie. After 1760, families from Shubenacadie inhabited areas surrounding Musquodoboit and Jeddore Harbours.[6]

The 1722 and 1735 censuses pinpointing Shubenacadie as the location of a Mi'kmaq village reflects alterations in settlement patterns occasioned by conflict with New

[3] Rev. Silas T. Rand, **Micmac Place Names,** p. 78, p. 83, p. 86.
[4] Rev. Silas T. Rand, **Micmac Place Names,** p. 86, p. 71, p. 59.
[5] Rev. Silas T. Rand, **Micmac Place Names,** p. 30, p. 80.
[6] William C. Wicken, **Encounters with Tall Sails and Tall Tales,** p. 106.

England between 1722 and 1725, which were reinforced by the establishment of a Catholic mission at Shubenacadie in 1722. Seventeenth century map and census data show Mi'kmaq settlements along the eastern coast between Saint Margaret's Bay and Jeddore. This area was occupied before the year 1600 as shown by archaeological excavations done on the eastern arm of Jeddore Harbour. The Shubenacadie river system was perhaps used for winter hunting but as a result of conflict with New England became a location of more permanent settlement. From 1722, this village was located approximately 27.8 km from the mouth of the Shubenacadie River. With the restoration of peace, hunting and fishing continued along the eastern coast during the spring, summer, and fall.[7]

Beginning in the year 1706, there was at least one missionary working exclusively among the Mi'kmaq population. A church was built adjacent to the Mi'kmaq village at Shubenacadie in 1722.[8] In making the transition to life in Nova Scotia, one of the problems the missionaries encountered was maintaining contact with the Mi'kmaq throughout the year. In warm weather months when Mi'kmaq people lived along coastal regions this was less of a problem as there were trading posts or settlements nearby where the missionaries could lodge. The Mi'kmaq visited the posts during the autumn when family heads obtained credit for their winter hunt and during the early spring when furs were exchanged. Since the Mi'kmaq population was larger and more sedentary south of Shubenacadie River, contact with the missionaries would have been greater in this area than in areas to the north. Mi'kmaq not living near European posts would have had less contact with the missionaries. This would have included peoples living at Musquodoboit.[9]

Louis Le Loutre is said to have been associated with the Mi'kmaq of the Shubenacadie and Musquodoboit area in the mid 1700s. He arrived in Cape Breton in 1737 from the Paris based Semenaire des Missions Étrangeres, and was sent to Nova Scotia to Minister to the Mi'kmaq. He settled in Chigabenakady (Shubenacadie) where he erected a church and presbytery, traveling widely to visit the Mi'kmaq who, as he explained, "lived in scattered communities widely separated from each other."[10]

[7] William C. Wicken, **Encounters with Tall Sails and Tall Tales,** p. 107.
[8] William C. Wicken, **Encounters with Tall Sails and Tall Tales,** p. 234.
[9] William C. Wicken, **Encounters with Tall Sails and Tall Tales,** p. 321.
[10] Stephen E. Patterson, **Indian-White Relations in Nova Scotia,** p. 33.

After the war in 1744 between Britain and France, Louisburg officials, alarmed that the Maliseet had signed a treaty and taken British presents, ordered Le Loutre to remove his headquarters from Shubenacadie and go to Beausejour and take with him "the Indians from Shubenacadie and the other tribes dependent on it as far away as Cape Sable, as they were too near Halifax." Yet again the Mi'kmaq divided, some following Le Loutre and others declining.[11] Those who did not want to follow Le Loutre and serve the French interest withdrew to lands on the eastern shore near Musquodoboit, which had traditionally been within the territory of the Shubenacadie band.

Jean-Baptiste Cope was one of the Mi'kmaw who stayed in the Musquodoboit/Shubenacadie area instead of following Le Loutre. The Mi'kmaq along the eastern shore considered Cope their chief and they numbered 90 persons including men, women, and children.[12] The Shubenacadie River and a series of lakes and streams traverse the province from Minas Basin to Musquodoboit, and this waterway was used as a travel route for seasonal migrations of the band, which was sometimes called the Shubenacadie-Musquodoboit "tribe."

Moving forward one hundred years in time to the 1840s, there are accounts of the Mi'kmaq in the Musquodoboit area by the Rev. John Sprott. Sprott refers to the Indians in the area in his book, which confirms that there were encampments in the area.[13] Sprott records that the older settlers remembered when the moose and deer were as plentiful on the river as the tame cattle. However, during the 1840s they seldom saw either a moose or an Indian. According to Sprott, the Mi'kmaq had moved to the outskirts of the settlements and derived a precarious subsistence from hunting, fishing, and selling baskets "but were still too independent to beg unless they were hungry."[14]

The following is an excerpt from a letter written by the Rev. John Sprott to the editor of the Stanraer Free Press in 1845 which notes a claim by Chief Isidore, the Chief of Musquodoboit at that time, that the Mi'kmaq were the rightful owners of all of the Musquodoboit area:[15]

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[11] Stephen E. Patterson, **Indian-White Relations in Nova Scotia,** p. 33.
[12] Stephen E. Patterson, **Indian-White Relations in Nova Scotia,** p. 37.
[13] George A. Morton, **Memorials of the Rev. John Sprott,** p. 80.
[14] George A. Morton, **Memorials of the Rev. John Sprott,** p. 80.
[15] George A. Morton, **Memorials of the Rev. John Sprott,** p. 81.

Isidore, the chief of Musquodoboit, died lately, and his ten sons had all crossed the dark lake, and gone to the pleasant mountains before him. This venerable old hemlock, through whose branches the storms of ninety years had whistled, often visited me, kissed my hand, and called me his father. I was sorry that I had such a slender claim to such an honourable appellation, for his knowledge of divine things was imperfect and confused. He had been a thirsty soul in his earlier years, and when he got a glass of rum too much, a dream of dominion came over his mind. He still claimed sovereignty of the soil, for all the land of Musquodoboit belonged to him, and we were all intruders.

In 1860 a case of smallpox broke amongst a band in Musquodoboit and there were 12 deaths; five of the victims were children and five were adults over forty. Fifteen persons, all but one less than twenty years old, caught the disease and survived. The doctor William Pearson had the survivors thoroughly washed, fumigated, and disinfected with chlorine gas before allowing them to leave the area. They were given new clothes, and their old ones, along with their camp were burned.[16]

In 1867, it is suggested in a letter by a Captain L'Estrange from Halifax that the Mi'kmaq began a search for gold in the area of Caribou Mines, which may have been called *Kalchoonkade* by the Mi'kmaq, meaning "caribou place." The following is excerpted from L'Estrange's letter:[17] [18]

Dear Sir, - In answer to your communication of the 15th inst. I have much pleasure in informing you of my discovery of Gold in the Province in 1858. The circumstances are as follows: During a hunting trip on the Tangier River, in September, 1858, accompanied by the late Mr. Gilbert Elliot of H.M.S. "Indus," attended by three Indians, Noel Louis alias Plowitch, Joe Paul and Frank Cope, I found unmistakable traces of gold in the quartz of the district. I, with great difficulty, having no hammer, procured some specimens, shewing a trace of some metal, but was not chemist enough at the time to test them. However, I shewed them to Colonel Nelson, R.E., who sais that such traces may be found anywhere, to Dr. Cogswell and others, but was discouraged from prosecuting my discovery by the ridicule of the 'savans' in mineralogy. The only exception was Mr. Campbell who had also told me that he had discovered gold even in Halifax Harbour, on the sea-line of the province. Soon after this, I met with an accident when moose hunting, which again prevented me from going to this district, and it was not until my arrival in the Mauritius in

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[16] L.F.S. Upton, **Micmacs and Colonists,** p. 128.
[17] Musquodoboit Valley Bicentennial 1783-1983, **Caribou Gold Mines**, p. 2.
[18] Eleanor M. Belmore, **Caribou Gold Mines: 1864-1900**, p. 3.

> *1868, that I saw a newspaper account of the discovery of Gold in Tangier, N.S. I believe that it was the Indians above-mentioned that started the search that ultimately led to such golden results.*

There were four Indian Camps along the Murchyville Road between Murchyville and Shaw Big Lake. One of them was at "Little Watering Bridge," so called because it was a watering place for horses.[19] There was an Indian settlement across from Bob Collings place in a field, nearby there were two saw-mills, a grist mill, and a shingle mill along with a Halfway House, and another settlement which was very near Shaw Big Lake.[20]

5.2 Current Mi'kmaq Land and Resource Use

The study of current Mi'kmaq land and resource use is comprised of a study of current Mi'kmaq land and resource use sites, plants of significance to Mi'kmaq, and Mi'kmaw communities.

5.2.1 Current Mi'kmaq Land and Resource Use Sites

Current Mi'kmaq land and resource use activities are divided into five categories:

1) Kill/hunting
2) Burial/birth
3) Ceremonial
4) Gathering food/ medicinal
5) Occupation/habitation

Table 1 provides a description of activities undertaken at the sites.

[19] Upper Musquodoboit Valley Bicentennial 1783-1938, **Upper Musquodoboit,** p.12.
[20] Upper Musquodoboit Valley Bicentennial 1783-1938, **Upper Musquodoboit,** p. 7.

Table 1: Description of Activities Undertaken in Current Mi'kmaq Land and Resource Use Sites

TYPE OF SITE	DESCRIPTION OF ACTIVITIES IN STUDY AREA
KILL/HUNTING	33 sites, including trout, rabbit, deer, and partridge
BURIAL/BIRTH	
CEREMONIAL	
GATHERING	1 log harvesting site
HABITATION	

Current Mi'kmaq land and resource use sites are concentrated in the Moose River and in and around Scraggy Lake. There is also a concentration of deer kill sites in the proposed tailings pond area.

5.2.2 Plants of Significance to Mi'kmaq present in study area

Plants of significance to Mi'kmaq in the study area are divided into three categories:

1) Medicinal
2) Food/Beverage
3) Craft/Art

The following table describes the number of plants of significance present in the study areas during the spring and fall surveys.

Table 2: Number of Plants of Significance to Mi'kmaq Present in the Study Areas June 2005

TYPE OF USE	NUMBER OF SPECIES PRESENT JUNE 2005
MEDICINAL	39
FOOD/BEVERAGE	10
CRAFT/ART	8

Table 3: Number of Plants of Significance to Mi'kmaq Present in the Study Areas October 2005

TYPE OF USE	NUMBER OF SPECIES PRESENT OCTOBER 2005
MEDICINAL	51
FOOD/BEVERAGE	22
CRAFT/ART	11

Plants of significance Study Area 1 contained the largest concentration of plants of significance to Mi'kmaq. In Study Area 2, specimens were concentrated near ponds created by former mining operations. Owing to the recent clear cut, Study Area 3 contained the lowest concentration of plants of significance to Mi'kmaq.

5.2.3 Mi'kmaw Communities

The Beaver Lake Reserve, IR 17, which belongs to the Millbrook First Nation, is located outside of the current use study area, approximately 15 km from the project area. 100 acres were set-aside for Simon Francis in 1852 on the Sheet Harbour Road at the outlet of Beaver Lake. In 1867 this reserve was turned over to the federal government and is included in Samuel Fairbanks' return. He states that the reserve was a lot in "Halifax County, consisting of one hundred acres situated in the Sheet harbour Road at the outlet of Beaver Lake occupied by one Indian family." When the Indian Bands were created in 1959-60 the Mi'kmaq were divided into several bands and the Truro band was allotted Beaver Lake I.R. #17 consisting of 120 acres of land. In 1973 a re-survey conducted by John Colvert of Energy Mines and Resources, Beaver lake Reserve No.17 increased in size from 120.4 acres to 122 acres because of the change in the high water mark.[21]

There is an outstanding specific land claim entitled "Halifax Country Claims" for an approximately 700 acre area of land located at the north end of Lake Charlotte outside of the current use study area, approximately 10 km from the project area.

[21] The Confederacy of Mainland Mi'kmaq, **Research Department,** 2005.

6.0 POTENTIAL PROJECT IMPACTS ON MI'KMAQ LAND AND RESOURCE USE

The following table presents potential project impacts on historic and current Mi'kmaq land and resource use.

Table 3: Potential Project Impacts on Mi'kmaq Land and Resource Use

POTENTIAL IMPACTS ON MI'KMAQ LAND AND RESOURCE USE	
6.01	The historic review of Mi'kmaq use and occupation documents considerable historic Mi'kmaq use and occupation in the study area, and potentially the project area. A potential impact of the project is the disturbance of archaeological resources.
6.02	Several species of significance to Mi'kmaq have been identified in the study areas. Permanent loss of some specimens is an impact of the Project.

7.0 SIGNIFICANCE OF POTENTIAL PROJECT IMPACTS ON MI'KMAQ LAND AND RESOURCE USE

The concept of significance in the Mi'kmaq Knowledge Study is distinct from the concept of significance under the *Canadian Environmental Assessment Act* or the *Nova Scotia Environmental Assessment Regulations*. Significance to Mi'kmaq is evaluated only in accordance with the criteria listed below. The MKS evaluation of the significance of the potential project impacts on Mi'kmaq should be used by regulators to inform their determination of the significance of the environmental effects of the Project.

7.1 Significance Criteria

The following criteria are used to analyze the significance of the potential project impacts on Mi'kmaq use:

1) Uniqueness of land or resource
2) Culture or spiritual meaning of land or resource
3) Nature of Mi'kmaq use of land or resource
4) Mi'kmaq constitutionally protected rights in relation to land or resource

7.2 Evaluation of Significance

Table 4: Significance of Potential Project Impacts on Mi'kmaq Land and Resource Use

POTENTIAL IMPACT	EVALUATION OF SIGNIFICANCE
6.01 The historic review of Mi’kmaq use and occupation documents considerable historic Mi’kmaq use and occupation in the study area, and potentially the project area. A potential impact of the project is the disturbance of archaeological resources.	7.2.01 Mi’kmaq archaeological resources are extremely important to Mi’kmaq as a method of determining Mi’kmaq use and occupation of Mi’kma’ki and as an enduring record of the Mi’kmaq nation and culture across the centuries. Archaeological resources are irreplaceable. Any disturbance of Mi’kmaq archaeological resources is significant.
6.02 Several species of significance to Mi’kmaq have been identified in the study areas. Permanent loss of some specimens is an impact of the Project.	7.2.02 The plant species of significance to Mi’kmaq identified within the study areas exist within the surrounding area. The destruction of some specimens within the study areas does not pose a threat to Mi’kmaq use of the species. The impact of the permanent loss of some specimens of plant species of significance to Mi’kmaq is evaluated as not likely significant.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.01 In the event that Mi'kmaw archaeological deposits are encountered during construction or operation of the Project, all work should be halted and immediate contact should be made with David Christianson at the Nova Scotia Museum and with Donald M. Julien at The Confederacy of Mainland Mi'kmaq.

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