APPENDIX 1-K

Geochemical Characterization of Metallurgical Tailings

Red Mountain Underground Gold Project – Geochemical Characterization of Metallurgical Tailings

Prepared for

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1 Introduction

The Red Mountain Underground Gold Project (the Project) is a proposed gold project located near Stewart, British Columbia. SRK Consulting was retained by IDM Mining Ltd. to assess the metal leaching and acid rock drainage (ML/ARD) potential of detoxified tailings from the Marc, AV and JW ore zones in support of the environmental assessment. The findings of this report are based on geochemical characterization of metallurgical tailings produced in 2017. The testing program included: acid-base accounting tests (ABA), trace element analyses, mineralogy, process water chemistry, humidity cell tests and aging tests.

2 Geochemical Test Program

2.1 Sample Selection and Preparation

Whole ore leaching of Project ore will result in one tailings stream, which will be disposed of in the Tailings Management Facility (TMF) near Bromley Humps. The tailings geochemical characterization program was designed to include representative samples of detoxified tailings from the Marc, AV and JW ore zones. Tailings samples were generated in a number of metallurgical testing rounds followed by cyanide detoxification at Base Metallurgical Laboratories (Base Met) in Kamloops, BC, and includes samples from different stages of the metallurgical program. SRK relied on the Project geologists and metallurgists to determine which samples were representative of each respective ore zone and final process design. Samples for geochemical characterization were provided as either detoxified tailings slurry (combined solids and supernatant) or detoxified and dried filter cakes. Samples were shipped from Base Met to SGS Canada in Burnaby, BC. All geochemical characterization test work was conducted at SGS, with the exception of the analysis of process water and aging tests aliquots. SGS operated the aging tests and submitted these samples and the process water samples to ALS Environmental in Vancouver, BC for subsequent analysis.

The geochemical characterization program was initiated in Spring 2017 and some aspects are still in progress. Table 2-1 provides an inventory of detoxified tailings samples and associated geochemical test work. The characterization program design was constrained by sample availability and volume, and some samples are not representative of the final grind size or cyanidation rates that are now anticipated for the project. For clarity, the 25 µm grind size has now been established for the project. Additionally, the first set of 25 µm samples were tested for gold recovery using an unrepresentatively high level of cyanide. The process has since been optimized and testing has been initiated on a more representative sample to address this issue.

ABA, trace element analysis and process water chemistry was determined for samples from all ore zones. Marc zone is the primary ore zone, and has therefore been the focus of the tailings characterization test work. The following additional test methods were completed on the Marc zone tailings sample: humidity cell test (HCT), aging tests, and mineralogy. Process water chemistry and the aging test samples were obtained from the tailings slurry samples whereas the dried filter cake tailings material was used for ABA, trace element analysis, HCT and mineralogy.

Analytical methods are presented in subsequent sections. Test work denoted by the asterisk (*) in Table 2-1 was initiated in June 2017 and results were not available for inclusion in this report.

Furthermore, the HCT and aging tests results on the March 2017 composite are still in progress, and interim results are presented in this report.

An existing humidity cell test containing a metallurgical sample of Marc zone ground ore was operated as part of the MDAG (1996) kinetic test program. The results of the MDAG kinetic test program, including this metallurgical samples, are presented and discussed in Appendix 1-B: Geochemical Characterization of Waste Rock, Ore and Talus, and were used as inputs for the tailings beach source term water quality estimates presented in Appendix 14-B: Water and Load Balance. Once sufficient data is available, the tailings source term estimates will be updated with the data from the humidity cell test samples presented in Table 2-1.

Table 2-1: Inventory of Geochemical Test Work on Detoxified Tailings Samples

Ore Zone	Grind Size (µm)	Sample ID	ABA	ICP	HCT	QXRD	Process Water	Aging Test	Comment
Marc	25	MARC MASTER DETOX (May 2017)	*	*	*	*	√	*	Test work initiated June 2017. Results are pending and will be presented at a later date.
	25	BL184 MARC MASTER COMPOSITE DETOX TAILING (April 2017)					√		Cyanidation rates used for this sample are considered to be unrepresentatively high.
	40	Marc Master Detox (March 2017)	√	√	√	√	√	√	HCT and aging tests in progress. Interim results presented.
AV	25	AV MASTER DETOX SLURRY 25UM (April 2017)					√		Cyanidation rates used for this sample are considered to be unrepresentatively high.
	40	AV Master Detox Filter Cake (March 2017)	√	√					
JW	25	JW MASTER DETOX SLURRY 25UM (April 2017)					√		Cyanidation rates used for this sample are considered to be unrepresentatively high.
	40	JW Master Detox Filter Cake (March 2017)	√	√					

Notes:

*Denotes test work in progress and data not yet available.

2.2 Mineralogy

Bulk mineralogy was determined at SGS in Lakefield, Ontario by quantitative phase X-Ray diffraction (QXRD) using Rietveld refinement and whole pattern fitting.

2.3 Static Test Work

Static tests consisted of acid-base accounting (ABA) including paste pH, total sulphur by Leco, sulphate sulphur by HCl leach, fizz test and neutralization potential (NP) by the modified Sobek

method (MEND 1991), total inorganic carbon (TIC) and trace element content by ICP-MS following an aqua regia digestion (ICP).

2.4 Kinetic Test Work

Two humidity cell tests of the Marc Zone detoxified tailings (Table 2-2) were set up using the MEND (2009) method. Each humidity cell test is leached weekly with the following analytical schedule:

- Weekly analysis: pH, EC, acidity, alkalinity, sulphate
- Weekly until cycle 12 and then every 4 cycles: fluoride, 35-element suite by ICP-MS[1]; total cyanide, WAD cyanide, thiocyanate, cyanate, nitrate, nitrite, and ammonia.

To date test T1 has been operating for 11 cycle, with complete data available until cycle 8.

Table 2-2: Inventory of Marc Zone Tailings Humidity Cell Tests

HCT ID	Sample ID	Grind Size (µm)	Date Initiated	No. of Cycles
T1	Marc Master Detox (March 2017)	40	March 20, 2017	11
T2	MARC MASTER DETOX (May 2017)	25	June 2017	0

2.5 Process Water Analysis

Decanted tailings process water was sampled by SGS from the tailings slurry and shipped to ALS, Vancouver for analysis of included pH, conductivity, alkalinity, sulphate, total cyanide, WAD cyanide, thiocyanate, cyanate, nitrate, nitrite, ammonia and fluoride. Samples were also filtered and analyzed for dissolved metals by ICP-MS including major ions (Na, Ca, Mg, K).

2.6 Aging Tests

Tailings slurry generated during metallurgical testing was subjected to oxic and anoxic aging tests to assess chemical changes to the process water over time. The method is presented in Appendix A.

In summary, the slurry sample was mixed to bring the tailings into suspension then sub-divided into ten aliquots; half of which were subjected to anoxic aging test and half to anoxic aging tests. The oxic tests were analyzed at week 2, week 4, week 8, week 12 and week 16 aging intervals, whereas the anoxic tests were analyzed at month 1, month 2, month 4, month 6 and month 8 aging intervals. The process water analysis described in Section 3.4 represents the initial chemistry of the aging tests. Table 2-3 presents an inventory of the parameters analyzed in each of the aging tests.

[1] Al, Sb, As, Ba, Be, Bi, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Li, Mg, Mn, Hg, Mo, NI, P, K, Se, Si, Ag, Na, Sr, S, Tl, Sn, Ti, U, V, Zn, Zr

Table 2-3: Oxic and Anoxic Aging Test Analytes for the Marc Zone Detoxified Tailings Sample

Test	Max DL	Units
pH (unfiltered)	0.5	pH Units
Eh (unfiltered)	50	mV
pH (filtered)	0.5	pH Units
EC	0.5	µS/cm
Total alkalinity	0.5	mg $CaCO_3$/l
Sulphate	1	mg/l
Trace elements by ICP-MS	as per std HCT suite	
Hg by CVAF	0.02	ug/l
Chloride	0.2	mg/l
Acidity	0.5	mg $CaCO_3$/l
Fluoride	0.4	mg/l
Bromide	1	mg/l
Nitrate (NO_3-N)	0.02	mg/l
Nitrite (NO_2-N)	0.002	mg/l
Ammonia (NH_3-N)	0.01	mgN/l
Total CN	0.01/0.002	mg/l
WAD-CN	0.01/0.002	mg/l
SCN (Thiocyanate)	0.02	mg/l
CNO (Cyanate)	1	mg/l

Notes:

Measurements of pH and Eh were taken prior to filtration plus an additional pH measurement was taken after filtration. All other parameters were measured after filtration.

2.7 Data QA/QC

A number of Quality Assurance and Quality Control (QAQC) checks for the different test-work datasets were performed as outlined in the SRK Expectations for Laboratory Geochemical Quality (updated in April 2017). A summary of the QA/QC checks is presented in Table 2-4 to Table 2-6. There is one recheck pending for the humidity cell test (Table 2-5). All other data were deemed acceptable.

Table 2-4: Summary of QA/QC Checks for Static Test Work

QC Test	SRK QC Criteria	Results
Paste pH		
Lab Duplicate (n=1)	For any samples, +/- 0.5 difference pH unit	All passed.
TIC		
Lab Blank (n=1)	<2X detection limit (DL)	All passed.
Lab Duplicate (n=1)	For samples > 10X the detection limit (DL), % RPD within +/-20%	All passed.
Standard Reference Material (n=1)	Within specified tolerance ranges	All passed.
Total S & Total Sulphate		
Lab Blank (n=1 for Total S, n=1 for Total Sulphate)	<2X detection limit (DL)	All passed.
Sulphur balance (Total S > Sulphate S) (n=3)	For samples > 10X the detection limit (DL), Total Sulphur should be greater than Total Sulphate, if not the % difference should be within +/-20%	All passed.
Lab Duplicate (n=1 for Total S, n=1 for Total Sulphate)	For samples > 10X the detection limit (DL), % RPD within +/-20%	All passed.
Standard Reference Material (n=1) for Total S, (n=1) for Total Sulphate	Within specified tolerance ranges	All passed.
Modified NP		
NP consistent with paste pH (n=3)	Negative NP has paste pH <= 5	All passed.
Lab Duplicate (n=1) for NP, (n=1) for fizz test	% RPD better than +/-15% for NP>20 kg/t, % RPD better than +/-20% for 20 kg/t<NP>10 kg/t; Difference within +/-5 kg/t for NP<10 kg/t; Fizz test rating same.	All passed.
Fizz test rating with NP (n=3)	Max NP does not exceed fizz test rating	All passed.
Modified NP and TIC		
Comparison between Modified NP and TIC (n=2)	Check for trends/co-relation	NP generally higher than TIC.
Total S-Leco and S-ICP		
Comparison between Total S-Leco and S-ICP (n=3)	For samples >10X detection limit (DL), % RPD within +/-20%	All passed.
Aqua Regia Metals		
Lab Blank (n=1)	<5X Detection Limit	All passed.
Lab Duplicate (n=1)	For samples >10X detection limit (DL), % RPD within +/- 20%, ok 10% of metal scan failing	All passed.
Standard Reference Material (n=1)	Within specified tolerance ranges	All passed.

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Table 2-5: Summary of QA/QC Checks for Humidity Cell Test Work

QC Test	SRK QC Criteria	Results
Trend Analysis		
Tailings sample (n=1)	Within +/-Deviation Limits = 4*Std. Dev.(Xn-4…Xn-1, Xn+1….Xn+4) +/- Average(Xn-4…Xn-1, Xn+1….Xn+4), random spiking, unusual trends are flagged	T1, cycle 6 for NO_3 is anomalously high - recheck pending.
Ion Balance		
Tailings sample (n=1)	EC>100 uS/cm, imbalance not greater than 10%	All passed.
Travel Blank		
Travel Blank	<5X DL	All passed.

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Table 2-6: Summary of QA/QC Checks for Process Water and Aging Test Samples

QC Test	SRK QC Criteria	Results
(SO4-S + SCN-S) = ICP-S		
Process Water Sample (n=4), Aging test (7)	The sum of SO4-S and SCN-S should be within 20% of ICP-S.	1 sample BL 184 MARC Master Composite Detox Tailing failed (SO_4+SCN < ICP-S by 37%). Lab reran all parameters and results confirmed. Data accepted as is.
Ion Balance		
Process Water Sample (n=4), Aging Test (7)	EC>100 uS/cm, ion balance not greater than 10%.	Aging Text Oxic-1 & 2, Aging Test Anoxic 1 failed due to sample heterogeneity, i.e. presence of suspended sediments. Alkalinity was rerun on a filtered sample by colourimetric method, resulting in acceptable ion balances.
Travel Blank		
Travel Blank (n=4)	<2X detection limit (DL)	All passed.
TDS		
Process Water Sample (n=1)	Comparison between TDS calc. and TDS measured is +/-20% RPD	All passed.

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3 Results and Discussion

Table 2-1 presents the analytical program for the tailings samples. For the Marc Zone samples of 25 µm grind size, only the process water data is available and presented. Additional test work that was recently initiated for the 25 µm Marc zone sample includes ABA, elemental analysis, HCT and aging tests. Results will be presented at a later date once the data are available.

3.1 Mineralogy

QXRD results for the Marc zone tailings sample (grind size 40 µm) are presented in Table 3-1.

The composition of the Marc zone sample is predominantly muscovite and quartz, with levels >25%. Other major minerals (>5%) include chlorite, feldspars (albite and microcline) and pyrite. Grunerite is present at trace levels (2%).

Pyrite (FeS_2) is the dominant sulphide mineral (10%) with pyrrhotite ($Fe_{(1-x)}S$) present at lower levels (2%). Calcite ($CaCO_3$) was the only carbonate detected at trace levels (2%).

Table 3-1: Quantitative Phase XRD Results for Marc Sample (40 µm)

Mineral/Compound	Formula	Marc Master Detox Filter Cake
		MAR4523-01
		(wt %)
Quartz	SiO_2	27
Chlorite	$(Fe(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$	6
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	29
Albite	$NaAlSi_3O_8$	12
Microcline	$KAlSi_3O_8$	11
Calcite	$CaCO_3$	2
Pyrrhotite	$Fe_{(1-x)}S$	2
Pyrite	FeS_2	10
Grunerite	$Fe_7Si_8O_{22}(OH)_2$	2
TOTAL		100

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3.2 Static Test Work

3.2.1 Acid-Base Accounting

ABA data for AV, JW and Marc detox tailings samples at 40 µm grind size, are presented in Table 3-2. The complete ABA data set is presented in Appendix B.

Paste pH for the three samples is slightly alkaline ranging from 8.6 to 9.0 s.u.

Total sulphur content was highest in the JW zone tailings sample (11%) and lowest in the Marc zone tailings sample (8.5%). The AV zone sample reported a total sulphur content of 10%. In all three samples the majority of total sulphur is present as sulphide sulphur (Figure 3-1) with very little sulphate sulphur reported. Sulphide sulphur was used to calculate the acid potential (AP) for each sample.

Modified NP was typically low for all three samples ranging from 15 kg CaCO3/t in the Marc zone sample to 27 kg CaCO3/t in the JW zone sample (Figure 3-2). Total inorganic carbon was also

consistently low ranging from 10 kg CaCO3/t in the Marc zone sample to 23 kg CaCO3/t in the JW zone sample. TIC levels are consistent with the mineralogy for the Marc zone tailings (2% calcite). There is near parity between NP and TIC values (Figure 3-2).

Table 3-2, Figure 3-3, and Figure 3-4 present the ARD classifications of the tailings sample where AP is calculated from sulphide sulphur. ARD classifications were consistent using both NP/AP and TIC/AP methods, with the three detoxified tailings classified as potentially acid generating (PAG).

Table 3-2: ABA Results for AV, JW, and Marc Detox Tailings Samples

Parameter	Units	AV Master Detox Filter Cake (40 µm)	JW Master Detox Filter Cake (40 µm)	Marc Master Detox Filter Cake (40 µm)
Paste pH	Std. Units	8.9	8.6	9
Total Sulphur	%S	10	11	8.5
Sulphate	%S	0.09	0.09	0.06
Sulphide	%S	10	11	8.4
AP	kg $CaCO_3$/t	310	330	260
TIC	% C	0.25	0.27	0.12
TIC	kg $CaCO_3$/t	21	23	10
Modified NP	kg $CaCO_3$/t	22	27	15
NP/AP	-	0.069	0.08	0.056
TIC/AP	-	0.067	0.067	0.038
Fizz Test	-	Slight	Slight	None

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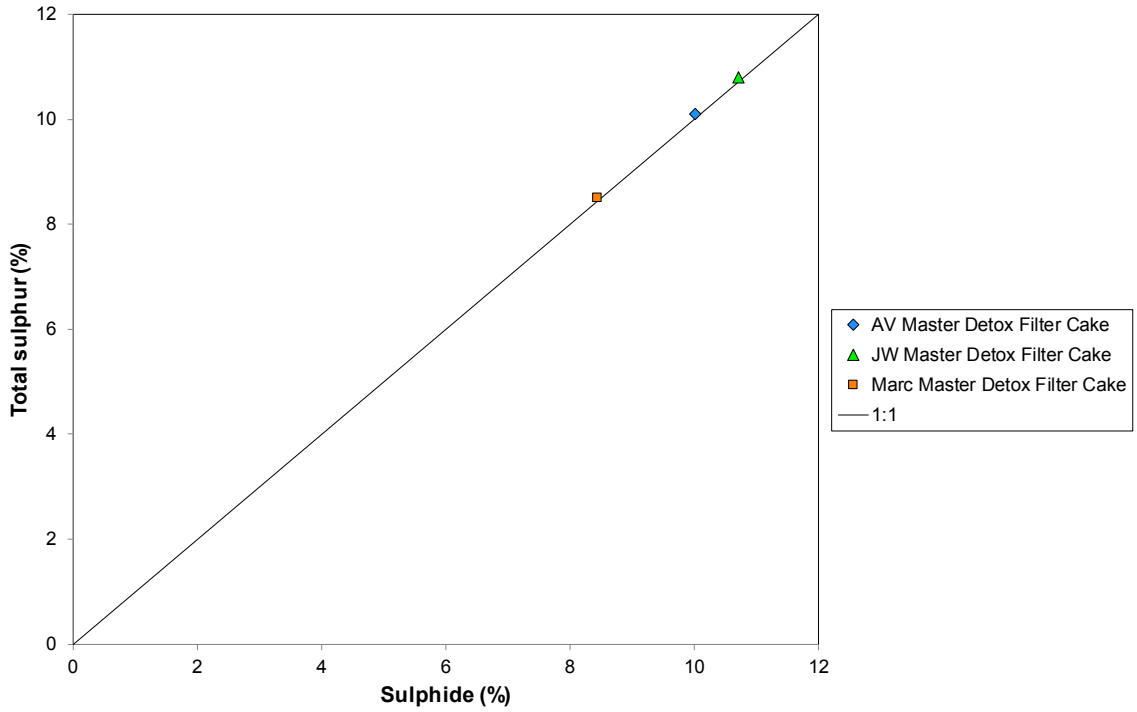

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Figure 3-1: Comparison of Total Sulphur and Sulphide Sulphur for Tailings Samples

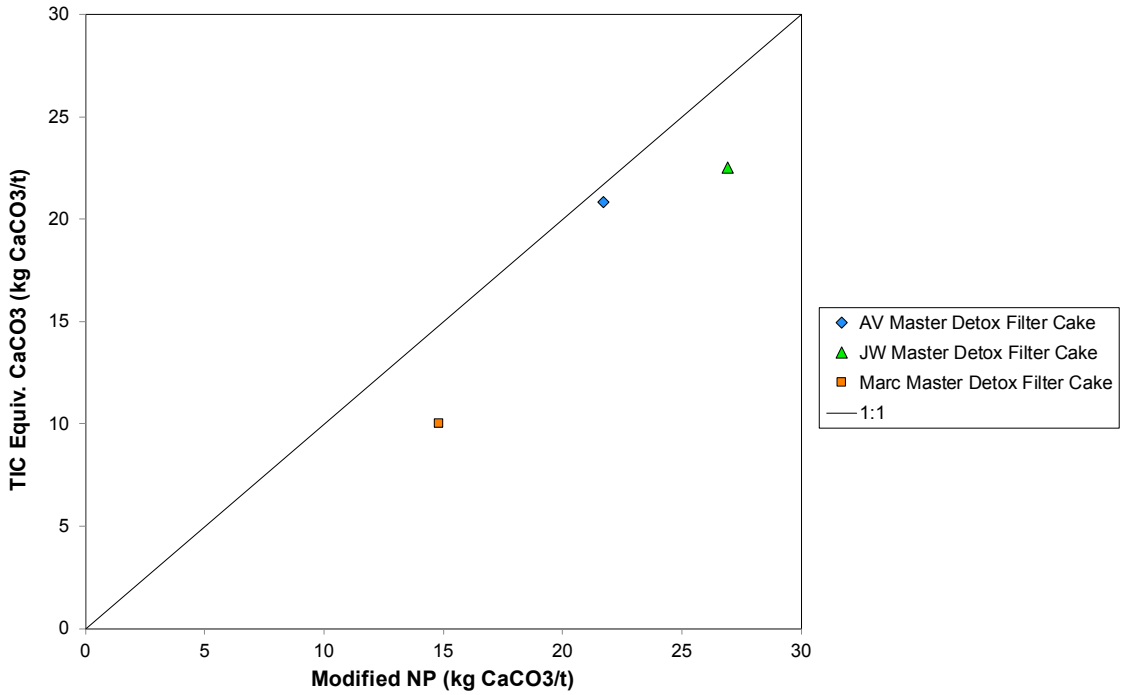

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Figure 3-2: Comparison of TIC and Modified NP for Tailings Samples

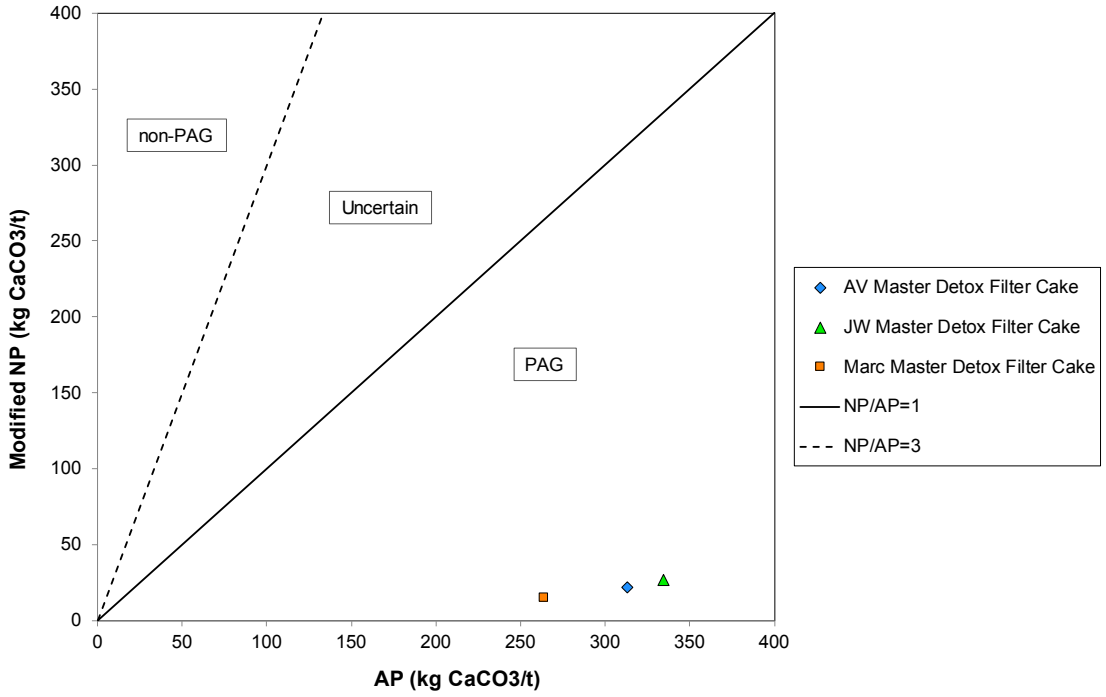

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Figure 3-3: ARD Classifications Using Modified NP for the Tailings Samples

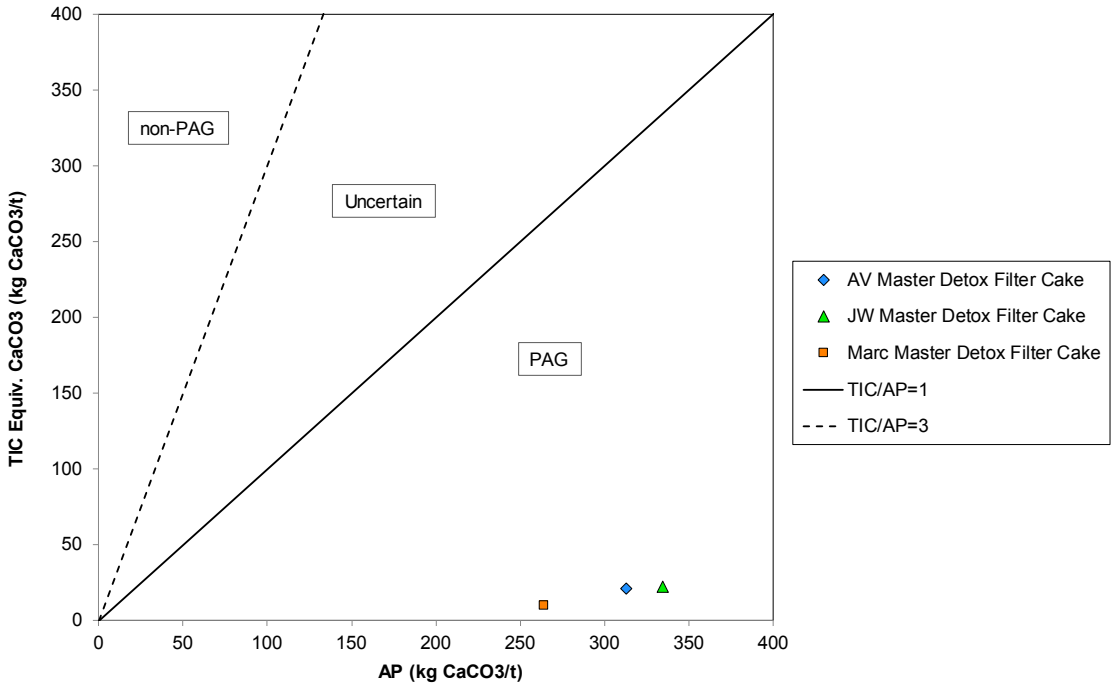

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Figure 3-4: ARD Classifications Using TIC for the Tailings Samples

3.2.2 Elemental Content

Trace element content in the tailings samples was analyzed to quantify the bulk geochemical composition. Trace element content was compared to ten times the crustal abundance for low- and high-calcium granite (Price 1997) to indicate related enrichment. Selected trace element data for the tailings samples are presented in Table 3-3, with bold values indicating values that were greater than ten times the concentration of typical low- and high-calcium granite. Complete results are reported in Appendix C.

The following elements were enriched in all three tailings samples: silver, gold, arsenic, bismuth, cadmium, cobalt, copper, lead, sulphur, antimony, selenium and zinc. All other levels were below ten times the crustal abundance threshold values indicating no appreciable enrichment for these parameters.

Table 3-3: Selected Trace Element Data for AV, JW and Marc Detox Tailings Samples (40 µm)

Parameter	Units	Tailings Sample			Crustal Abundance for Granite (Price 1997)	
		Marc Zone	JW Zone	AV Zone	High Calcium	Low Calcium
Ag	ppb	3300	2900	4000	0.051	0.037
Al	%	0.99	0.81	0.74	8.2	7.2
As	ppm	460	310	480	51	37
Au	ppb	490	1300	5100	4	4
B	ppm	<20	<20	<20	9	10
Ba	ppm	34	15	40	420	840
Bi	ppm	4.2	4.8	5.9	--	0.01
Ca	%	0.7	1.2	0.98	2.53	0.51
Cd	ppm	33	8.5	18	0.13	0.13
Co	ppm	19	19	18	7	1
Cr	ppm	38	25	27	22	4.1
Cu	ppm	740	1600	1200	30	10
Fe	%	9.7	11	11	2.96	1.42
Ga	ppm	3.4	2.1	2.1	17	17
Hg	ppb	130	71	180	80	80
K	%	0.19	0.18	0.17	2.5	4.2
La	ppm	5.9	2.7	3.4	45	55
Mg	%	0.95	0.68	0.63	0.94	0.16
Mn	ppm	760	390	410	540	390
Mo	ppm	3.4	2.6	2.6	1	1.3
Na	%	0.1	0.11	0.13	2.84	2.58
Ni	ppm	34	26	27	15	4.5
P	%	0.14	0.12	0.13	0.092	0.06
Pb	ppm	340	230	270	15	19
S	%	8	9.9	9.6	0.03	0.03
Sb	ppm	58	86	270	0.2	0.2
Sc	ppm	3.4	2.5	3.4	14	7
Se	ppm	13	20	22	0.05	0.05
Sr	ppm	34	36	47	440	100
Te	ppm	55	30	33	--	--
Th	ppm	1.4	1.4	1.4	8.5	17
Ti	%	0.022	0.045	0.048	0.34	0.12
Tl	ppm	0.25	0.12	0.1	0.72	2.3
U	ppm	0.5	0.5	0.5	3	3
V	ppm	47	32	35	88	44
W	ppm	0.7	1.3	1.5	1.3	2.2
Zn	ppm	2400	600	1200	60	39

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3.3 Kinetic Test Work

There are two Marc zone detoxified tailings sample in the humidity cell program (Table 2-2). Currently data for test T1 only is available. The characteristics of the solids of T1 are presented in Sections 3.1and 3.2. T1 has been operating for 11 cycles, with complete data available until cycle 8. Laboratory results for the humidity cell tests are provided in Appendix D.

3.3.1 Comparison to Historic Humidity Cell Test

As previously mentioned, source term water quality estimates for the tailings beach were based on a historic humidity cell test containing a ground metallurgical sample of Marc zone ore. A comparison of the static data for T1 (Table 3-2) and the historic humidity cell test (4) suggest that sample “Marc Composite” is a reasonable surrogate sample for source term estimates. As summarized in SRK (2017b), the historic humidity cell test operated for 50 weeks and went acidic after 34 weeks.

3.3.2 Interim Leachate Results

After 11 cycles, the leachate of T1 is neutral to alkaline with pH ranging from 7.4 to 8.4. Sulphate levels are starting to stabilize around 400 mg/L, which is equivalent to levels exhibited by the March Composite historic humidity cell test (300 to 400 mg/L) prior to going acidic. The process water for T1 has been flushed from the sample, with total cyanide and thiocyanate levels of 0.02 and 19 mg/L, respectively.

Complete interpretation of the 2017 tailings humidity cell tests will be provided at a later date. These data will be used to provide predictions for onset to acidity and update the source term water quality estimates for the TMF tailings beach (SRK 2017b).

Table 3-4: Summary of Selected Results for Historic Humidity Cell Test Sample

Parameter	Marc Composite
Total Sulphur (%)	10
NP ($kgCaCO_3/t$)	19
TIC ($kgCaCO_3/t$)	4.5

3.4 Process Water Analysis

Analysis of the tailings process water or supernatant produced during metallurgical testing is provided in Table 3-5 for selected parameters. The complete analysis results are provided in Appendix E. The process water data were the basis for the process water source term water quality estimate (SRK 2017b), for inclusion in the water and load balance.

As indicated previously, the 25 um Marc, AV and JW tailings samples generated in April 2017 were subjected to unrepresentatively high rates of sodium cyanide addition in the gold recovery step of the process, and the resulting data are not considered to be representative for cyanide species, cyanide degradation products (SCN, CNO, NH_3, NO_2 or NO_3), sodium (which is introduced as NaCN), or sulphate (which is more soluble in the presence of high sodium

concentrations). Additionally, adequate detoxification was not attained for the April 2017 Marc Zone 25 µm sample, leading to unrepresentatively high concentrations of cyanide and also specific metals that form strong complexes with cyanide. Specific parameters affected by these issues are highlighted in grey in Table 3-5, and are excluded from consideration in the following discussion.

The metallurgical process data are summarized as follows:

- In all solutions, pH conditions were slightly alkaline.
- Sulphate concentrations were lowest in the June 2017 Marc Zone 25 µm detoxified tailings solution (990 mg/L) and highest in the March 2017 Marc Zone 40 µm detoxified tailingssolution (1800 mg/L).
- Total and WAD cyanide were highest in process water from the Marc Zone 25 µm detoxified tailings (6.5 mg/L total CN, 0.15 mg/L WAD CN), and are indicative of incomplete detoxification. Maximum concentrations for total and WAD cyanide for all other samples 0.89 and 0.11 mg/L, respectively.
- Copper concentrations were highest in the April 2017 JW Zone process waters at 1.3 mg/L and lowest in the various Marc Zone process waters across a range of 0.14 mg/L to 0.46 mg/L.
- Selenium concentrations were highest in the April 2017 AV zone process waters at 0.051 mg/L compared to 0.0085 mg/L in the April 2017 JW Zone process waters.
- Concentrations of antimony range from 0.89 mg/L in the April 2017 Marc Zone 25 µm process water to 2.4 mg/L in the April 2017 AV Zone process water. Concentrations of antimony greater than 1 mg/L are reported in three of the five samples and from all ore zones (Table 3-5).
- Cobalt concentrations are higher in the three Marc Zone process waters, concentrations ranging between 0.038 mg/L to 0.084 mg/L, waters at compared to 0.03 mg/L and 0.0069 mg/L for the April 2017 AV Zone and JW Zone samples, respectively.
- Zinc concentrations are highest in the April 2017 AV Zone sample at 0.085 mg/L compared to 0.0074 mg/L in the April 2017 Marc Zone 25 µm sample.
- The following parameters were consistently reported at concentration less than the analytical limits of detection: fluoride, boron, chromium, nickel, phosphorous, tin and vanadium.

Table 3-5: Summary of Analytical Results of Detox Tailings Process Water

Parameter	Units	Marc Zone, 40 µm March 2017	Marc Zone, 25 µm April 2017	Marc Zone 25 µm June 2017	JW Zone, 25 µm April 2017	AV Zone, 25 µm April 2017
pH	s.u.	8.1	8.5	8.1	8.1	8.1
EC	uS/cm	4700	7700	3800	9200	10000
Alkalinity	$mgCaCO_3/L$	100	220	100	200	260
SO_4	mg/L	1800	2800	990	4000	4300
NH_3	mg/L	88	230	120	240	330
NO_3	mg/L	9.9	15	12	18	21
NO_2	mg/L	0.39	0.8	0.79	0.9	0.96
WAD CN	mg/L	0.022	0.15	0.038	0.0077	0.11
Total CN	mg/L	0.07	6.5	0.89	0.021	0.15
CNO-	mg/L	400	780	380	800	930
SCN-	mg/L	200	410	150	180	320
Al	mg/L	0.039	0.055	0.046	0.026	0.036
Sb	mg/L	1.2	0.89	0.99	1.1	2.4
As	mg/L	0.012	0.014	0.013	0.0042	0.0096
B	mg/L	<0.05	<0.1	<0.05	<0.1	<0.1
Cd	mg/L	<0.001	0.0012	0.00047	0.0013	0.0013
Cr	mg/L	<0.0005	<0.001	<0.0005	<0.001	<0.001
Co	mg/L	0.038	0.084	0.067	0.0069	0.03
Cu	mg/L	0.46	0.14	0.16	1.3	0.71
Fe	mg/L	<0.05	2.5	0.35	<0.1	<0.1
Pb	mg/L	0.0011	0.0016	<0.00025	0.00088	<0.0005
Mn	mg/L	0.059	0.058	0.044	0.23	0.2
Hg	mg/L	0.00015	<0.0005	<0.0001	<0.0005	<0.0005
Mo	mg/L	0.12	0.16	0.1	0.08	0.067
Ni	mg/L	<0.0025	<0.005	<0.0025	<0.005	<0.005
Se	mg/L	0.019	0.011	0.034	0.0085	0.051
Ag	mg/L	0.0031	0.00089	0.00084	0.00026	0.00026
Na	mg/L	850	1800	670	2000	2500
U	mg/L	0.00075	0.0019	0.00071	0.00064	0.0024
V	mg/L	<0.0025	<0.005	<0.0025	<0.005	<0.005
Zn	mg/L	0.026	0.021	0.0074	0.079	0.085

Source: P:\01_SITES\Red_Mountain_BC\1CI019.001_2015_2016_EA\Geochemistry\Tailings\6. Working files\[RM_ProcessWater_1CI019-001_Rev00_lmc_lnb.xlsx

Notes:

1. All metals are dissolved.
2. Grey highlight indicates parameter is considered to be unrepresentative for reasons explained in text.

3.5 Aging Tests

Due to sample constraints, aging tests were completed on process water from the March 2017 Marc Zone 40 µm tailings sample only. The raw data from the oxic and anoxic tailings aging tests are presented in Appendix F. A summary of the results to date is presented in Table 3-6.

Apparent trends observed in the oxic and anoxic aging test data are outlined as follows:

- Oxic
  - pH declined slightly from 8.1 to 7.9.
  - WAD cyanide levels decreased to below detection (0.05 mg/L) while thiocyanate levels increased. These trends indicate the degradation of cyanide.
  - Antimony concentrations decreased from 1.2 mg/L to 0.27 mg/L.
  - Arsenic concentrations decreased from 0.012 mg/L to 0.003 mg/L.
- Anoxic
  - pH increased slightly from 8.1 to 8.3.
  - EC decreased from 4,700 to 2,600 µS/cm.
  - The same trends for WAD cyanide and thiocyanate in the oxic test are occurring, indicating that degradation of cyanide is occurring.
  - Antimony concentrations decreased from 1.2 mg/L to 0.39 mg/L.
  - Arsenic concentrations decreased from 0.012 mg/L to 0.0075 mg/L.
  - Selenium concentrations increased slightly from 0.019 mg/L to 0.026 mg/L.

Table 3-6: Summary of Aging Test Results

Parameter		OXIC AGING TEST Marc Zone, 40 µm (March 2017)				ANOXIC AGING TEST Marc Zone, 40 µm (March 2017)		
Week		0	1	2	3	0	1	2
EC	uS/cm	4700	4900	4800	4300	4700	3800	2600
pH	pH	8.1	8.1	8	7.9	8.1	8.1	8.3
Alkalinity	mg/L	100	190	190	200	100	180	170
NH_3	mg/L	88	85	79	70	88	80	72
NO_3	mg/L	9.9	9.9	9.9	10	9.9	9.7	9.9
NO_2	mg/L	0.39	0.24	0.1	<0.02	0.39	0.025	<0.02
SO_4	mg/L	1800	1800	1800	2000	1800	1800	1900
WAD CN	mg/L	0.022	<0.005	<0.05	<0.005	0.022	0.11	<0.05
Total CN	mg/L	0.07	0.048	0.14	0.13	0.07	4.1	1.5
NCO-	mg/L	400	140	270	210	400	260	240
SCN-	mg/L	200	240	260	280	200	270	280
Al	mg/L	0.039	0.023	0.015	0.011	0.039	0.014	0.041
Sb	mg/L	1.2	0.53	0.46	0.27	1.2	0.46	0.39
As	mg/L	0.012	0.0054	0.0055	0.003	0.012	0.0074	0.0075
B	mg/L	<0.05	0.3	1.1	0.1	0.05	0.56	0.41
Cd	mg/L	<0.001	0.00055	0.0012	0.00035	0.001	0.00009	0.00009
Ca	mg/L	200	200	180	170	200	170	150
Cr	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.00075
Co	mg/L	0.038	0.049	0.019	0.012	0.038	0.02	0.02
Cu	mg/L	0.46	1.8	0.13	0.018	0.46	0.017	0.014
Fe	mg/L	<0.05	0.78	0.12	0.11	<0.05	0.44	0.47
Pb	mg/L	0.0011	0.00052	0.00026	0.00029	0.0011	0.00028	0.0019
Mn	mg/L	0.059	0.11	0.15	0.13	0.059	0.12	0.042
Hg	mg/L	0.00015	<0.00005	<0.00025	<0.0001	0.00015	0.00025	0.0001
Mo	mg/L	0.12	0.091	0.11	0.086	0.12	0.11	0.11
Ni	mg/L	<0.0025	0.4	<0.0025	0.0026	<0.0025	<0.0025	0.004
Se	mg/L	0.019	0.01	0.0047	0.0051	0.019	0.0035	0.026
Ag	mg/L	0.0031	0.00036	0.00093	<0.00005	0.0031	0.000064	<0.00005
U	mg/L	0.00075	0.00074	0.00046	0.00069	0.00075	0.00018	0.00026
V	mg/L	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Zn	mg/L	0.026	0.014	0.034	0.016	0.026	0.0072	0.011

Source: P:\01_SITES\Red_Mountain_BC\1CI019.001_2015_2016_EA\Geochemistry\Tailings\6. Working files\[RM_Tailings_AgingTestData_1CI019-001_Rev01_rtc.xlsx]

4 Conclusions and Implications for Management

Conclusions from the geochemical characterization program for metallurgical tailings from the AV, JW and Marc zones are as follows:

- Tailings for geochemical characterization were produced by whole ore leach followed by cyanide detoxification.
- Tailings samples from all zones are classified as PAG.
- Elemental analysis indicates enrichment of silver, gold, arsenic, bismuth, cadmium, cobalt, copper, lead, sulphur, antimony, selenium and zinc relative to ten times the crustal abundance for low- and high-calcium granite.
- Humidity cell test work on the Marc zone tailings has been initiated. After 11 cycles, the leachate is neutral to alkaline and sulphate is starting to stabilize.
- Ongoing humidity cell test work will define the time frame to the onset of acidic conditions for the tailings and metal leaching, if present. Furthermore, the humidity cell test data will be used to update the tailings beach source term water quality estimates that were included in the water and load balance (SRK 2017b).
- Copper, antimony, cobalt, selenium and zinc levels were high in the AV, JW and Marc zone process water samples. Aging tests indicate that with time, levels for these aforementioned parameters, and also WAD cyanide, are decreasing. The process water and selected cycles of the aging test data set were used to develop source term water quality estimates of process water from the mill (SRK 2017b).

Tailings from the Project will be disposed in a TMF near Bromley Humps. On the basis of the results of the geochemical program, recommendations for the management of tailings are described as follows:

- Tailings are classified as PAG, therefore, appropriate management plans are required to minimize ML/ARD and control drainage from the TMF.
- ARD is not expected to develop during operations, owing to the rapid deposition rate of the tailings (exposure times are expected to be on the order of weeks).
- During closure years 1 and 2, a cover consisting of a geomembrane liner coupled with rock cover will be placed on the TMF. With the exception of the uppermost layer (projected to be approximately 20 cm), the tailings will be saturated and are not expected to oxidize. The cover is expected to limit infiltration and flushing of the underlying tailing. The potential effects of infiltration resulting from imperfections in the liner were considered in developing post-closure source terms for the tailings (SRK 2017b).

This report, Red Mountain Underground Gold Project - Geochemical Characterization of Metallurgical Tailings, was prepared by

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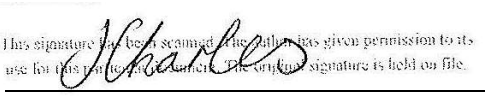

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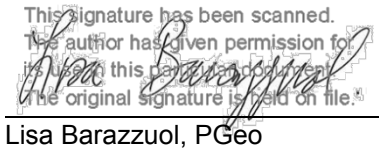

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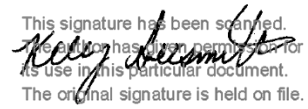

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

5 References

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Appendix A – Aging Test Method

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Memo

To:	Carolyn Jones, SGS	**Client:**	IDM Mining
From:	Lisa Barazzuol, SRK	**Project No:**	1CI019.002.405
Cc:	Kelly Sexsmith, SRK Lee Christoffersen, SRK	**Date:**	March 8, 2017
Subject:	Aging Test Procedure – Red Mountain Tailings		

1 Introduction

This memo provides detailed instructions for the oxic and anoxic aging tests to be conducted on the Marc Zone detoxified tailings sample from the Red Mountain Project.

The aging tests should be completed on the sample sent from Base Metallurgical Laboratories (Base Met) that arrived at SGS on March 2, and that was labelled Marc Master Detox Slurry. According to Base Met, the Marc detoxified slurry sample contains 15 L of supernatant and 10 kg of solids from an ore head sample ground to 40 µm. We understand that this has been held under refrigeration since arrival.

2 Methods

2.1 Initial Process Water Analysis

Due to project schedule constraints, an aliquot of the process water was decanted from the slurry sampled on March 6 for the analyses outlined in Table 3, except for unfiltered pH and ORP.

2.2 Sample aliquot preparation

The Marc Zone slurry should be thoroughly mixed to bring the tailings into suspension and then split into ten aliquots each with approximately 1.4 L of supernatant, and should be placed in 2 litre beakers. The splitting protocol must ensure that all replicates are as similar as possible. Five of these samples will be subjected to anoxic aging tests and five will be subjected to oxic aging tests.

2.3 Anoxic Aging Tests

The five samples destined for anoxic aging tests are to be purged by with nitrogen for one hour while in a glove bag that is also purged. Purged samples are to be sealed, gently swirled, allowed to sit for one hour, then purged again for one hour.

After purging, the five replicates for anoxic tests will be transferred to 1.5 L airtight vessels under a nitrogen atmosphere to ensure anoxic conditions are maintained. These samples will then be placed in a glove bag that is continuously purged with nitrogen. Once a month, all of the replicates should be gently mixed to bring the tailings into suspension. The use of a continuous nitrogen purge will alleviate the need to periodically monitor the glove box for oxygen intrusion. Evaluation of oxygen intrusion is required if a monthly nitrogen purge is used. Commercially available oxygen absorber and indicator products can be used to facilitate and monitor low oxygen concentrations, respectively.

Tailings samples will be removed and analyzed at regular intervals. A schedule for each of the time steps is provided in Table 1. Section 2.5 below outlines the sampling procedure and the list of analytes.

Table 1. Sampling and Analysis Schedule for the Anoxic Aging Test

Aliquot Label	Approx. Time Elapsed (months)
Anoxic-1	1
Anoxic-2	2
Anoxic-3	4
Anoxic-4	6
Anoxic-5	8

2.4 Oxic Aging Tests

The five replicates destined for oxic tests should be covered with a parafilm or an equivalent transparent seal, and placed in a window where they are exposed to natural light.

Tailings samples will be removed and analyzed at regular intervals. A schedule for each of the time steps is provided in Table 2. Section 2.5 below outlines the sampling procedure and the list of analyses.

Table 2 Sampling and Analysis Schedule for the Oxic Aging Test

Aliquot Label	Approx. Time Elapsed (months)
Oxic-1	0.5
Oxic-2	1
Oxic-3	2
Oxic-4	3
Oxic-5	4

2.5 Sampling and Analyses

Measurements of pH and Eh measurements should be completed on the initial sample and on each of the sample aliquots prior to sample filtration, and then the filtered leachate should be analyzed for the parameters listed in Table 3. Samples should be labelled with their original name plus a modifier indicating the exact date of filtration (eg. “Oxic 1 - filtered 20-Mar-2017”).

The moist solids from these samples should be retained in a sealed container and stored under refrigeration until further notice. Do not air dry the samples. The samples should be labelled with their original name plus the time of filtration.

Table 3 Analyses

Test	Max DL	Units
pH (unfiltered)	0.5	pH Units
Eh (unfiltered)	50	mV
pH (filtered)	0.5	pH Units
EC	0.5	µS/cm
Total alkalinity	0.5	mg CaCO3/l
Sulphate	1	mg/l
Trace elements by ICP-MS	as per std HCT suite	
Hg by CVAF	0.02	ug/l
Chloride	0.2	mg/l
Acidity	0.5	mg CaCO3/l
Fluoride		mg/l
Bromide		mg/l
Nitrate (NO3-N)	0.02	mg/l
Nitrite (NO2-N)	0.002	mg/l
Ammonia (NH3-N)	0.01	mgN/l
Total CN	0.01/0.002	mg/l
WAD-CN	0.01/0.002	mg/l
SCN (Thiocyanate)	0.02	mg/l
CNO (Cyanate)	1	mg/l

Appendix B – Acid Base Accounting Data

CLIENT : **SRK Consulting**
PROJECT : **Red Mountain (SRK Project # 1CI019.002)**
SGS Project # : **1640**
Test : **Modified Acid-Base Accounting**
Date : **April 4, 2017**

Sample ID	**Paste pH Std. Units**	**TIC % C**	**Equiv. CaCO3 kg CaCO3/t**	**S(T) %S**	**S(SO4) %S**	**S(S-2) %S**	**AP kg CaCO3/t**	**Modified NP kg CaCO3/t**	**Net NP kg CaCO3/t**	**Fizz Test**
Method Code	Sobek	CSB02V	Calc.	CSA06V	CSA07V	Calc.	Calc.	Modified NP	Calc.	Sobek
LOD	0.20	0.01	#N/A	0.005	0.01	#N/A	#N/A	0.5	#N/A	#N/A
AV Master Detox Filter Cake	8.89	0.25	20.8	10.1	0.09	10.01	312.8	21.7	-291.1	Slight
JW Master Detox Filter Cake	8.60	0.27	22.5	10.8	0.09	10.71	334.7	26.9	-307.8	Slight
Marc Master Detox Filter Cake	8.99	0.12	10.0	8.5	0.06	8.44	263.8	14.8	-249.0	None
Duplicates										
AV Master Detox Filter Cake	8.88							21.5		Slight
Marc Master Detox Filter Cake		0.12		8.53	0.09					
QC										
GTS-2A				0.333						
RTS-3A					1.07					
SY-4		0.9								
NBM-1								39.5		Slight
Blank		<0.01		<0.005	<0.01					
Certified Values		0.95		0.341	0.98			42.0		Slight
Tolerance +/-		0.06		0.01	0.12			4.0		

Note:

Appendix C – Trace Element Data

CLIENT : **SRK Consulting**
PROJECT : **Red Mountain (SRK Project # 1CI019.002)**
SGS Project # : **1640**
Test : **Low-Level Metals by Aqua Regia Digestion with ICP-MS Finish**
Date : **April 4, 2017**

Sample ID	**Mo ppm**	**Cu ppm**	**Pb ppm**	**Zn ppm**	**Ag ppb**	**Ni ppm**	**Co ppm**	**Mn ppm**	**Fe %**	**As ppm**	**U ppm**	**Au ppb**	**Th ppm**	**Sr ppm**	**Cd ppm**	**Sb ppm**	**Bi ppm**	**V ppm**	**Ca %**
Method Code	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250
LOD	0.01	0.01	0.01	0.1	2	0.1	0.1	1	0.01	0.1	0.1	0.2	0.1	0.5	0.01	0.02	0.02	2	0.01
AV Master Detox Filter Cake	2.57	1187.19	268.82	1164.3	3962	27.4	17.6	411	11.25	481.7	0.5	5069.8	1.4	46.8	18.2	272.32	5.88	35	0.98
JW Master Detox Filter Cake	2.6	1592.72	229.98	602.4	2890	25.5	18.5	389	11.37	308.1	0.5	1272.5	1.4	36.1	8.5	85.64	4.84	32	1.24
Marc Master Detox Filter Cake	3.43	739.86	336.56	2401.3	3323	34.3	19.3	755	9.68	458.7	0.5	488.7	1.4	34.3	33.1	58.19	4.16	47	0.7
QC																			
DS10	15.25	158.56	151.96	339.5	1861	67.6	12.3	822	2.65	44.5	2.6	75	7.5	70.9	2.76	8.44	12.56	45	1.08
Blank	<0.01	<0.01	<0.01	<0.1	<2	<0.1	<0.1	<1	<0.01	<0.1	<0.1	<0.2	<0.1	<0.5	<0.01	<0.02	<0.02	<2	<0.01
Certified Values	13.6	154.61	150.55	370	2020	74.6	12.9	875	2.72	46.2	2.59	91.9	7.5	67.1	2.62	9.0	11.65	43	1.06
Tolerance (%)	25	15	20	15	25	15	18	15	11	20	30	300	26	30	20	30	30	20	15

Sample ID	**P %**	**La ppm**	**Cr ppm**	**Mg %**	**Ba ppm**	**Ti %**	**B ppm**	**Al %**	**Na %**	**K %**	**W ppm**	**Sc ppm**	**Tl ppm**	**S %**	**Hg ppb**	**Se ppm**	**Te ppm**	**Ga ppm**
Method Code	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250
LOD	0.001	0.5	0.5	0.01	0.5	0.001	20	0.01	0.001	0.01	0.1	0.1	0.02	0.02	5	0.1	0.02	0.1
AV Master Detox Filter Cake	0.133	3.4	26.7	0.63	40.1	0.048	<20	0.74	0.131	0.17	1.5	3.4	0.1	9.61	180	21.6	33.27	2.1
JW Master Detox Filter Cake	0.12	2.7	24.5	0.68	15.4	0.045	<20	0.81	0.111	0.18	1.3	2.5	0.12	9.85	71	19.7	29.86	2.1
Marc Master Detox Filter Cake	0.139	5.9	37.9	0.95	33.6	0.022	<20	0.99	0.102	0.19	0.7	3.4	0.25	7.99	130	13.3	54.5	3.4
QC																		
DS10	0.073	18.8	55.1	0.81	407.6	0.082	23	1.05	0.072	0.34	2.8	3	5.11	0.29	289	1.8	4.63	4.6
Blank	<0.001	<0.5	<0.5	<0.01	<0.5	<0.001	<20	<0.01	<0.001	<0.01	<0.1	<0.1	<0.02	<0.02	<5	<0.1	<0.02	<0.1
Certified Values	0.0765	17.5	54.6	0.78	412	0.082	#N/A	1.03	0.067	0.34	3.32	2.8	5.1	0.29	300	2.3	5.01	4.3
Tolerance (%)	20	30	20	12	20	28	#N/A	15	20	15	35	24	20	15	30	40	25	20

Appendix D – Kinetic Data, Humidity Cell Tests

T1

CONFIDENTIAL DRAFT

Sample = Marc Master Detox Filter Cake

Date	Cycle No.	Volume mL		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Total Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia	Nitrate	Nitrite	Fluoride	Hardness CaCO3	Al	Sb	As	Ba	Be	Bi
		Input	Output		umhos/cm	mgCaCO3/L	mgCaCO3/L	mgCaCO3/L	mg/L	mg/L	mg/L	mg/L	mg/L	Nmg/L	Nmg/L	Nmg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
20-Mar-17	1	750	345	8.41	6402	#N/A	#N/A	57.0	2026	0.46	0.01	270	290	97.6	9.82	0.97	0.46	100	0.0598	0.358	0.00768	0.031	-0.00005	-0.000025
27-Mar-17	2	500	430	8.31	2287	#N/A	#N/A	135.0	587	1.94	0.02	140	47	17.4	2.16	-0.03	0.27	78.3	0.0582	0.193	0.00503	0.0422	-0.00001	0.00001
3-Apr-17	3	500	420	8.22	1449	#N/A	-1.0	93.3	446	0.86	-0.01	68	14	6.5	0.46	0.04	0.3	122	0.019	0.109	0.0024	0.0223	-0.00001	-0.000005
10-Apr-17	4	500	440	7.82	968	#N/A	3.7	58.7	317	0.13	0.01	2.9	36	1.9	-0.06	0.05	0.17	168	0.0173	0.0474	0.00144	0.0251	-0.00001	-0.000005
17-Apr-17	5	500	410	7.88	1354	#N/A	2.9	47.4	517	0.01	-0.01	28	-1	1.3	-0.06	-0.03	0.11	443	0.00668	0.0284	0.00112	0.0337	-0.00001	-0.000005
24-Apr-17	6	500	420	7.76	1499	#N/A	4.3	41.8	590	0.05	-0.01	17	-1	1.5	11.4	0.06	0.075	581	0.0133	0.0153	0.00076	0.0253	-0.00005	-0.000025
1-May-17	7	500	425	7.56	935	#N/A	2.5	24.1	402	0.02	-0.01	17	-1	0.8	2.70	-0.03	0.05	344	0.00571	0.0105	0.000745	0.0133	-0.00001	-0.000005
8-May-17	8	500	435	7.38	950	#N/A	4.0	25.2	498	0.02	-0.01	19	-1	0.8	1.55	-0.03	0.047	449	0.00393	0.00987	0.000748	0.014	-0.00001	-0.000005
15-May-17	9	500	370	7.36	2605			43.3																
22-May-17	10	500	480	7.63	1157				480					1.0										
29-May-17	11	500	435	7.35	904																			

Apr 17/17. Cell repaired due to hole in the Sharkskin filter paper.

Apr 24/17. Nitrate sample being re-analyzed. Original 11.4, recheck 11.5, accepted.

T1
Sample = Marc Master Detox Filter Cake

Date	Cycle No.	Volume mL		B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S
		Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
20-Mar-17	1	750	345	0.208	0.000181	31.6	-0.0005	0.00899	0.0863	0.139	0.000201	0.0099	5.13	0.0425	-0.01	0.0811	0.00023	0.038	92	0.0224	1.39	0.000281	1220	0.616	1010
27-Mar-17	2	500	430	0.08	0.000283	25.1	-0.0001	0.00792	0.0232	0.552	0.00073	0.00517	3.78	0.0339	0.013	0.0367	0.000178	0.0071	39.7	0.00483	1.42	0.000242	359	0.446	323
3-Apr-17	3	500	420	0.049	0.000403	40.3	-0.0001	0.00693	0.0109	0.306	0.000034	0.00441	5.2	0.0687	-0.01	0.0377	0.000262	0.0074	27.8	0.00411	1.32	0.000067	233	0.538	205
10-Apr-17	4	500	440	0.033	0.000459	56.2	-0.0001	0.00232	0.00484	0.045	0.0000442	0.00531	6.66	0.116	-0.01	0.0174	0.000395	0.0032	24.1	0.00276	0.903	0.0000371	117	0.577	133
17-Apr-17	5	500	410	0.033	0.00138	152	-0.0001	0.00162	0.00321	0.0025	0.0000248	0.00932	15.3	0.563	-0.01	0.00747	0.00117	0.0028	33.6	0.00239	1.16	-0.000005	83.3	1.29	216
24-Apr-17	6	500	420	-0.05	0.00133	206	-0.0005	0.00114	0.00274	-0.005	0.000053	0.0112	15.9	0.801	-0.05	0.004	0.00242	-0.01	37.2	0.00304	1.36	-0.000025	39.5	1.5	238
1-May-17	7	500	425	0.026	0.00104	124	-0.0001	0.000779	0.00265	0.0046	0.000022	0.00603	8.53	0.609	-0.01	0.00195	0.00163	0.0045	19.4	0.00142	1.22	-0.000005	16.8	0.911	125
8-May-17	8	500	435	0.022	0.00174	163	-0.0001	0.00122	0.00319	0.0015	0.0000286	0.00681	9.91	0.913	-0.01	0.00144	0.00232	-0.002	19.3	0.00193	1.27	-0.000005	14.7	0.958	173
15-May-17	9	500	370																						
22-May-17	10	500	480																						
29-May-17	11	500	435																						

Apr 17/17. Cell repaired due to hole in the
Sharkskin filter paper.

Apr 24/17. Nitrate sample being re-analyzed.
Original 11.4, recheck 11.5, accepted.

T1
Sample = Marc Master Detox Filter Cake

Date	Cycle No.	Volume mL		Tl	Sn	Ti	U	V	Zn	Zr	Maxxam Sample ID	Maxxam File #	SGS File #		Major Anions	Major Cations	Diff	Diff (%)
		Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L								
20-Mar-17	1	750	345	0.000048	-0.001	-0.0025	0.00117	-0.001	0.00559	-0.0005	QT3621	B720669V1	CA15489-MAR17		56.90	57.47	0.58	0.5%
27-Mar-17	2	500	430	0.000025	-0.0002	-0.0005	0.000552	-0.0002	0.00318	-0.0001	QU4134	B722848V1	CA15673-MAR17		18.84	18.25	-0.59	-1.6%
3-Apr-17	3	500	420	0.000019	-0.0002	-0.0005	0.000296	-0.0002	0.00357	-0.0001	QV3309	B724715V1	CA15076-APR17		12.77	13.32	0.55	2.1%
10-Apr-17	4	500	440	0.0000154	-0.0002	-0.0005	0.00014	-0.0002	0.00533	-0.0001	QW2561	B726779V1	CA15261-APR17		8.85	9.08	0.23	1.3%
17-Apr-17	5	500	410	0.0000201	-0.0002	-0.0005	0.000148	-0.0002	0.0198	-0.0001	QX2020	B728810V1	CA15381-APR17		12.21	13.36	1.16	4.5%
24-Apr-17	6	500	420	0.000024	0.0124	-0.0025	0.000134	-0.001	0.0202	-0.0005	QY0955	B730589V1	CA14502-APR17		14.24	14.28	0.04	0.1%
1-May-17	7	500	425	0.000016	0.00123	-0.0005	0.00005	-0.0002	0.0137	-0.0001	QZ3658	B733260V1	CA14105-MAY17		9.35	8.17	-1.18	-6.7%
8-May-17	8	500	435	0.0000159	0.00068	0.00216	0.0000467	0.00045	0.0268	-0.0001	RA5105	B735460V1	CA14277-MAY17		11.32	10.14	-1.18	-5.5%
15-May-17	9	500	370															
22-May-17	10	500	480										CA15456-MAY17					
29-May-17	11	500	435															

Apr 17/17. Cell repaired due to hole in the Sharkskin filter paper.

Apr 24/17. Nitrate sample being re-analyzed. Original 11.4, recheck 11.5, accepted.

Appendix E – Process Water Data

Author: LMC
Date: 3/28/2017

Parameter	Detection Limit	Units	Marc Zone 2, 25 µm	Marc Zone, 25 µm	JW Zone, 25 µm	AV Zone, 25 µm	Marc Zone, 40 µm
Physical Parameters							
Conductivity	2	uS/cm	3760	7720	9180	10400	4730
pH	0.1	pH	8.06	8.54	8.05	8.14	8.07
Total Suspended Solids	3		83.1	--	--	--	--
Total Dissolved Solids	20		2880	--	--	--	--
Turbidity	0.1		139	--	--	--	--
Anions and Nutrients							
Acidity (as CaCO3)	1	mg/L	1.9	<1.0	3	2.6	1.8
Alkalinity, Total (as CaCO3)	1	mg/L	102	222	197	258	104
Ammonia, Total (as N)	2.5	mg/L	122	231	240	327	87.8
Bromide (Br)	2.5	mg/L	<1.0	<2.5	<2.5	<2.5	<1.0
Chloride (Cl)	25	mg/L	16	<25	<25	<25	22
Fluoride (F)	1	mg/L	<0.40	<1.0	<1.0	<1.0	<0.40
Nitrate (as N)	0.25	mg/L	12.3	14.8	18.3	20.9	9.9
Nitrite (as N)	0.05	mg/L	0.79	0.801	0.897	0.956	0.394
Sulfate (SO4)	15	mg/L	988	2750	4010	4340	1750
Dissolved Organic Carbon	1	mg/L	42.7	--	--	--	--
Total Organic Carbon	1	mg/L	48.9	--	--	--	--
Cyanide							
Cyanide, Weak Acid Diss	0.005	mg/L	0.038	0.148	0.0077	0.107	0.0224
Cyanide, Total	0.005	mg/L	0.889	6.45	0.0209	0.146	0.0702
Cyanate	10	mg/L	381	776	795	930	399
Thiocyanate (SCN)	5	mg/L	151	408	181	317	200
Dissolved Metals							
Aluminum (Al)-Dissolved	0.01	mg/L	0.0456	0.055	0.026	0.036	0.0393
Antimony (Sb)-Dissolved	0.001	mg/L	0.994	0.891	1.13	2.35	1.17
Arsenic (As)-Dissolved	0.001	mg/L	0.0125	0.0143	0.0042	0.0096	0.012
Barium (Ba)-Dissolved	0.0005	mg/L	0.088	0.0317	0.0223	0.0529	0.0607
Beryllium (Be)-Dissolved	0.001	mg/L	<0.00050	<0.0010	<0.0010	<0.0010	<0.00050
Bismuth (Bi)-Dissolved	0.0005	mg/L	<0.00025	<0.00050	<0.00050	<0.00050	<0.00025
Boron (B)-Dissolved	0.1	mg/L	<0.050	<0.10	<0.10	<0.10	<0.050
Cadmium (Cd)-Dissolved	0.00005	mg/L	0.000474	0.00117	0.00125	0.00129	<0.0010
Calcium (Ca)-Dissolved	0.5	mg/L	119	76	179	105	197
Cesium (Cs)-Dissolved	0.0001	mg/L	0.000063	<0.00010	<0.00010	<0.00010	0.000058
Chromium (Cr)-Dissolved	0.001	mg/L	<0.00050	<0.0010	<0.0010	<0.0010	<0.00050
Cobalt (Co)-Dissolved	0.001	mg/L	0.0667	0.0842	0.0069	0.0297	0.038
Copper (Cu)-Dissolved	0.002	mg/L	0.164	0.136	1.34	0.709	0.461
Iron (Fe)-Dissolved	0.1	mg/L	0.35	2.52	<0.10	<0.10	<0.050
Lead (Pb)-Dissolved	0.0005	mg/L	<0.00025	0.00162	0.00088	<0.00050	0.00114
Lithium (Li)-Dissolved	0.01	mg/L	0.0082	<0.010	0.023	<0.010	0.0062
Magnesium (Mg)-Dissolved	0.05	mg/L	5.74	7.62	12.9	13.7	7.29
Manganese (Mn)-Dissolved	0.001	mg/L	0.0444	0.0578	0.229	0.201	0.0592
Mercury (Hg)-Dissolved	0.0005	mg/L	<0.00010	<0.00050	<0.00050	<0.00050	0.000152
Molybdenum (Mo)-Dissolved	0.0005	mg/L	0.103	0.163	0.0795	0.0666	0.115
Nickel (Ni)-Dissolved	0.005	mg/L	<0.0025	<0.0050	<0.0050	<0.0050	<0.0025
Phosphorus (P)-Dissolved	0.5	mg/L	<0.25	<0.50	<0.50	<0.50	<0.25
Potassium (K)-Dissolved	0.5	mg/L	120	73.8	109	92.7	94.7
Rubidium (Rb)-Dissolved	0.002	mg/L	0.026	0.014	0.0056	0.0204	0.0138
Selenium (Se)-Dissolved	0.0005	mg/L	0.0337	0.0107	0.0085	0.0512	0.019
Silicon (Si)-Dissolved	0.5	mg/L	1.36	1.22	1.57	1.29	1.35
Silver (Ag)-Dissolved	0.0001	mg/L	0.00084	0.00089	0.00026	0.00026	0.00309
Sodium (Na)-Dissolved	0.5	mg/L	665	1800	2040	2490	852
Strontium (Sr)-Dissolved	0.002	mg/L	1.69	1.32	1.58	1.44	2.19
Sulfur (S)-Dissolved	5	mg/L	600	1410	1690	1900	867
Tellurium (Te)-Dissolved	0.002	mg/L	<0.0010	<0.0020	<0.0020	<0.0020	<0.0010
Thallium (Tl)-Dissolved	0.0001	mg/L	<0.000050	0.00013	<0.00010	<0.00010	<0.000050
Thorium (Th)-Dissolved	0.001	mg/L	<0.00050	<0.0010	<0.0010	<0.0010	<0.00050
Tin (Sn)-Dissolved	0.001	mg/L	<0.00050	<0.0010	<0.0010	<0.0010	<0.00050
Titanium (Ti)-Dissolved	0.003	mg/L	<0.0015	<0.0030	<0.0030	<0.0030	<0.0015
Tungsten (W)-Dissolved	0.001	mg/L	0.00051	0.002	<0.0010	<0.0010	0.00252
Uranium (U)-Dissolved	0.0001	mg/L	0.000714	0.00194	0.00064	0.00244	0.000752
Vanadium (V)-Dissolved	0.005	mg/L	<0.0025	<0.0050	<0.0050	<0.0050	<0.0025
Zinc (Zn)-Dissolved	0.01	mg/L	0.0074	0.021	0.079	0.085	0.0256
Zirconium (Zr)-Dissolved	0.003	mg/L	<0.00030	<0.0030	<0.0030	<0.0030	<0.0015

Appendix F – Aging Tests Data

Appendix F - Aging Tests Data

Test		Oxic				Anoxic		
Week		0	1	2	3	0	1	2
Date		3/6/2017	3/24/2017	4/7/2017	5/5/2017	3/6/2017	4/7/2017	5/7/2017
Lab Sample ID		L1897847-1	L1905264-1	L1910659-1	L1922401-1	L1897847-1	L1910659-2	L1922401-2
EC	uS/cm	4700	4900	4800	4300	4700	3800	2600
pH	pH	8.1	8.1	8	7.9	8.1	8.1	8.3
Alkalinity	mg/L	100	190	190	200	100	180	170
NH3	mg/L	88	85	79	70	88	80	72
F	mg/L	<0.4	<0.4	0.28	<0.4	<0.4	<0.4	<0.4
NO3	mg/L	9.9	9.9	9.9	10	9.9	9.7	9.9
NO2	mg/L	0.39	0.24	0.1	<0.02	0.39	0.025	<0.02
SO4	mg/L	1800	1800	1800	2000	1800	1800	1900
WAD CN	mg/L	0.022	<0.005	<0.05	<0.005	0.022	0.11	<0.05
Total CN	mg/L	0.07	0.048	0.14	0.13	0.07	4.1	1.5
NCO-	mg/L	400	140	270	210	400	260	240
SCN-	mg/L	200	240	260	280	200	270	280
Al	mg/L	0.039	0.023	0.015	0.011	0.039	0.014	0.041
Sb	mg/L	1.2	0.53	0.46	0.27	1.2	0.46	0.39
As	mg/L	0.012	0.0054	0.0055	0.003	0.012	0.0074	0.0075
Ba	mg/L	0.061	0.051	0.045	0.096	0.061	0.048	0.1
B	mg/L	<0.05	0.3	1.1	0.1	0.05	0.56	0.41
Cd	mg/L	<0.001	0.00055	0.0012	0.00035	0.001	0.00009	0.00009
Ca	mg/L	200	200	180	170	200	170	150
Cr	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.00075
Co	mg/L	0.038	0.049	0.019	0.012	0.038	0.02	0.02
Cu	mg/L	0.46	1.8	0.13	0.018	0.46	0.017	0.014
Fe	mg/L	<0.05	0.78	0.12	0.11	<0.05	0.44	0.47
Pb	mg/L	0.0011	0.00052	0.00026	0.00029	0.0011	0.00028	0.0019
Li	mg/L	0.0062	<0.005	<0.005	<0.005	0.0062	<0.005	<0.005
Mg	mg/L	7.3	15	14	12	7.3	12	9.7
Mn	mg/L	0.059	0.11	0.15	0.13	0.059	0.12	0.042
Hg	mg/L	0.00015	<0.00005	<0.00025	<0.0001	0.00015	0.00025	0.0001
Mo	mg/L	0.12	0.091	0.11	0.086	0.12	0.11	0.11
Ni	mg/L	<0.0025	0.4	<0.0025	0.0026	<0.0025	<0.0025	0.004
P	mg/L	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
K	mg/L	95	81	84	83	95	79	91
Se	mg/L	0.019	0.01	0.0047	0.0051	0.019	0.0035	0.026
Si	mg/L	1.4	1.8	1.7	1.6	1.4	1.6	1.2
Ag	mg/L	0.0031	0.00036	0.00093	<0.00005	0.0031	0.000064	<0.00005
Na	mg/L	850	770	710	770	850	660	750
Sr	mg/L	2.2	2.2	2	2	2.2	1.8	1.7
S	mg/L	870	790	720	800	870	780	790
Sn	mg/L	<0.0005	<0.0005	0.0019	<0.0005	<0.0005	<0.0005	<0.0005
W	mg/L	0.0025	<0.0005	<0.0005	<0.0005	0.0025	<0.0005	<0.0005
U	mg/L	0.00075	0.00074	0.00046	0.00069	0.00075	0.00018	0.00026
V	mg/L	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Zn	mg/L	0.026	0.014	0.034	0.016	0.026	0.0072	0.011