Appendix 7.

Geochemical Characterisation of Fountain Head CIL Tailings

Environmental
Geochemistry
International

ENVIRONMENTAL GEOCHEMISTRY
INTERNATIONAL PTY LTD

ABN 48 600 298 271

81A COLLEGE STREET
BALMAIN, NSW 2041 AUSTRALIA

T +61 2 9810 8100
E EGI@GEOCHEMISTRY.COM.AU
W WWW.GEOCHEMISTRY.COM.AU

TECHNICAL MEMORANDUM

TO:	ERIAS Group Pty Ltd
ATTENTION:	David Browne and Kate Sinai
FROM:	Russell Schumann
DATE:	27 May 2021
DOCUMENT NO:	S1316 / J000588 / R1418 Rev1
SUBJECT:	Geochemical Characterisation of Fountain Head CIL Tailings

1. INTRODUCTION

At the time of previous geochemical testing (EGi Document Number: S1316/J000373/R1369, July 2020), the Fountain Head Gold project included heap leaching of the ore. Subsequently, the project has been updated to include processing of ore using a CIL process. Based on the results of the initial test programme and with the proposed changes to ore processing, a second stage of geochemical testing was required. The second stage test work is based on the following assumptions about the expected mine plan:

- PAF waste rock will be segregated and stockpiled next to the Fountain Head pit during operation and post operation will be placed back into the pit where it will be inundated either through natural groundwater recharge or by pumping of mine water from the mine water dam back to the pit.
- NAF and PAF-LC waste rock will be placed in the existing WRD and the expanded WRD will be constructed such that waste rock will form a “donut” shaped structure around tailings paste.
- Tailings from the CIL processing plant will be press filtered to produce a tailings paste at around 10 - 15% moisture content. This material will be dry stacked within the internal part of the WRD and will be covered with ROM NAF waste rock at closure.

Due to lack of available samples, previous geochemical testing of tailings samples from the proposed Fountain Head project was restricted to a single cyanide leached ore sample which contained very little sulphur. This sample was not necessarily representative of ore in the Fountain Head deposit and further testing of tailings more representative of those likely to be produced at Fountain Head was recommended. Previous testing did, however, suggest increased arsenic solubility following cyanide leaching, may lead to drainage containing elevated arsenic concentrations from heap leach pads after closure. It was recommended that the water solubility of arsenic in cyanide leached ores should be further investigated to determine the leachability of arsenic in drainage from tailings.

EGi received five cyanide leached ore samples which provide a set of samples representing the tailings which will be produced during this project (Table 1). Initial static testing conducted on these five samples included:

- pH/EC 1:2 Extracts
- ANC
- ABCC
- Total S
- CRS
- Total C and Organic C

- Single Addition NAG
- Sequential NAG
- Multi-element scan of solids
- Water extractable elements
- Peroxide extractable elements

This memo describes the results of the initial static testing detailed above. Based on these results, a sample representing a typical tailings material (either as an individual sample or as a blended sample) will be identified for kinetic testing, which will provide information on the likely longer-term drainage quality of tailings stored in the WRD.

Table 1 – Composition of Tailings samples from Fountain Head used for geochemical characterisation.

HOLE ID	TYPE	FROM (m)	TO (m)	INTERVAL	Au (g/t)	COMPOSITE	DESCRIPTION
FHRC060	RC	58.00	60.00	2.00	2.00	#1	North-west pit extensions
FHRC067	RC	65.00	66.00	1.00	2.41		
FHRC070	RC	83.00	84.00	1.00	28.00		
FHRC070	RC	94.00	95.00	1.00	1.01		
FHRC071	RC	69.00	71.00	2.00	1.35		
FHRC075	RC	47.00	48.00	1.00	1.01		
FHRC061	RC	8.00	10.00	2.00	1.29	#2	North-west pit extensions
FHRC062	RC	37.00	38.00	1.00	1.06		
FHRC063	RC	15.00	16.00	1.00	1.99		
FHRC065	RC	36.00	38.00	2.00	2.53		
FHRC070	RC	20.00	21.00	1.00	2.53		
FHRC070	RC	28.00	29.00	1.00	1.21		
FHRC072	RC	29.00	30.00	1.00	10.87		
FHRC072	RC	38.00	39.00	1.00	1.45		
FHRC073	RC	2.00	8.00	6.00	2.05		
FHRC073	RC	30.00	31.00	1.00	1.29		
FHRC074	RC	39.00	40.00	1.00	3.68		
FHRC075	RC	3.00	5.00	2.00	1.46		
FHRC076	RC	10.00	23.00	13.00	0.93	#3	In-pit Ladder Vein and Tally Ho extension
FHRC076	RC	107.00	112.00	5.00	3.96	#4	In-pit Ladder Vein and Tally Ho extension
FHRC085	RC	2.00	8.00	6.00	0.98	#6	Exploration – follow up RAB geochem

2. ACID FORMING CHARACTERISTICS

The results of static geochemical testing conducted on the five tailings samples are provided in Table 2 (Acid Base Accounting) and Table 3 (NAG testing). Total S content of the five samples ranged from 0.01 to 1.37% S, with a good distribution of Total S within this range. Neutralising capacity of the samples ranged from 11 – 58 kg H_2SO_4/t. ANC calculated from Total C and ABCC (2 samples only) provided good agreement with the standard ANC test results, suggesting the standard ANC test provided a reasonable estimate of the readily available neutralising capacity of these materials. ANC derived from carbonate C appears to underestimate the neutralising capacity, possibly because of positive interference in the organic C analysis.

All tailings samples gave elevated pH (circa pH 9) in 1:2 solid to liquid water extracts (Table 2). Elevated pH reflects the conditions of the CIL process in which lime is added to produce high pH (>10) conditions during cyanide leaching. The high S (1.37% S) tailings sample Comp #1 gave a positive NAPP value and low NAG pH (Table 3), suggesting that this material is likely to produce acidic drainage during surface storage. Two further samples, Comp #2 and Comp #6, with the lowest Total S (0.12 and 0.01 % S) gave negative NAPP values and neutral pH NAG liquors, indicating these materials are unlikely to produce low pH drainage during surface storage. The remaining two samples Comp #3 and Comp #4 with intermediate S content (0.62 and 0.49% S), have a much closer balance between their acid producing and acid neutralising potentials. Comp #4 gave slightly positive NAPP and NAG pH of 4 suggesting possible low pH drainage on exposure to the atmospheric conditions, but the amount of acidity will likely be low. Sample Comp #3 gave a slightly negative NAPP and neutral pH NAG liquor during the first stage of NAG testing. However, a second stage of NAG testing gave a liquor with pH 4.2 suggesting that despite the relatively low S content (0.62%), not all sulphide was oxidised during the initial stage of NAG testing and that further reaction during the second stage produced a slight excess of acid. These results suggest that this material is unlikely to produce significant acidity in drainage during surface storage.

The results of these tests demonstrate that the tailings samples examined here cover a range of acid producing and acid neutralising capacities and consequently acid forming potentials ranging from acid consuming to acid forming. The overall acid generating behaviour of the tailings produced at Fountain Head will therefore depend on the balance of the range of ore types processed.

These results suggest it may be possible to manage storage of tailings paste based on the S content, where higher S content tailings are stored so that there is minimal infiltration of precipitation into these materials, with tailings with lower S content used to form part of a barrier to water infiltration. However, while S content may constitute a major control on the acid forming characteristics of the tailings, S content may not indicate the propensity of these materials to leach metals and metalloids of environmental concern and therefore further investigations into the metal(loid) leaching of the tailings samples were investigated. The results of these tests are described in the next section.

Table 2 – Acid forming characteristics of Tailings samples from Fountain Head.

EGi Code	**Sample ID**	**Description**	**pH1:2**	**EC1:2**	**ACID-BASE ANALYSIS**						
					Total %S	**CRS %**	**Total %C**	**Org %C**	**Inorganic %C**	**MPA**	**MPA***
20703	COMP #1	Post Roll Solids	8.8	0.721	1.37	-	0.12	0.10	0.02	42	-
20704	COMP #2	Post Roll Solids	9.2	0.225	0.12	-	0.19	0.12	0.07	4	-
20705	COMP #3	Post Bottle Roll - Washed	9.1	0.312	0.62	0.44	0.25	0.11	0.14	19	13
20706	COMP #4	Post Roll Solids	9.0	0.476	0.49	0.43	0.15	0.09	0.06	15	13
20707	COMP #6	Post Bottle Roll - Washed	9.2	0.211	0.01	-	0.65	0.05	0.60	0	-

KEY
pH1:2 = pH of 1:2 extract
EC1:2 = Electrical Conductivity of 1:2 extract (dS/m)
MPA (Maximum Potential Acidity) = Total S x 30.6 (kgH_2SO_4/t)
MPA* = CRS x 30.6 (kgH_2SO_4/t)

EGi Code	**Sample ID**	**Description**	**ACID-BASE ANALYSIS**							
			ANC	**$ANC_{Carb\ C}$**	**$ANC_{Total\ C}$**	**ABCC**	**NAPP**	**$NAPP_{Carb\ C}$**	**$NAPP_{Total\ C}$**	**$NAPP_{ABCC}$**
20703	COMP #1	Post Roll Solids	11	2	10		31	40	32	-
20704	COMP #2	Post Roll Solids	16	6	16		-12	-2	-12	-
20705	COMP #3	Post Bottle Roll - Washed	23	11	20	24	-4	8	-1	-5
20706	COMP #4	Post Roll Solids	14	5	12	15	1	10	3	0
20707	COMP #6	Post Bottle Roll - Washed	58	49	53		-58	-49	-53	

KEY
ANC = Acid Neutralising Capacity (kgH_2SO_4/t)
$ANC_{Carb\ C}$ = Inorganic C x 81.7 (kgH_2SO_4/t)
$ANC_{Total\ C}$ = Total C x 81.7 (kgH_2SO_4/t)
ABCC = Acid Buffering Characteristic Curve. Reported value is ANC available to pH 4 (kgH_2SO_4/t)
NAPP = Net Acid Producing Potential (kgH_2SO_4/t)

Table 2 Cont. – Acid forming characteristics of Tailings samples from Fountain Head.

EGi Code	Sample ID	Description	ACID-BASE ANALYSIS				ARD Classification
			ANC/MPA	ANC$_{Carb\ C}$/ MPA	ANC$_{Total\ C}$/ MPA	ANC$_{ABCC}$/ MPA	
20703	COMP #1	Post Roll Solids	0.3	0.04	0.2	-	PAF
20704	COMP #2	Post Roll Solids	4.4	1.6	4.2	-	NAF
20705	COMP #3	Post Bottle Roll - Washed	1.2	0.6	1.1	1.1	UC (PAF-LC)
20706	COMP #4	Post Roll Solids	0.9	0.3	0.8	0.8	PAF-LC
20707	COMP #6	Post Bottle Roll - Washed	190	160	174	-	NAF

Table 3 – NAG test results for Tailings samples from Fountain Head.

EGi Code	Sample ID	Description	NAG TEST - Stage 1			NAG TEST - Stage 2			NAG TEST - Stage 3		
			NAGpH	NAG(pH4.5)	NAG(pH7.0)	NAGpH	NAG(pH4.5)	NAG(pH7.0)	NAGpH	NAG(pH4.5)	NAG(pH7.0)
20703	COMP #1	Post Roll Solids	2.8	13	21						
20704	COMP #2	Post Roll Solids	7.7	0	0						
20705	COMP #3	Post Bottle Roll - Washed	7.6	0	0	4.2	0.1	1.4	5.1	0	1.3
20706	COMP #4	Post Roll Solids	4.0	1	3						
20707	COMP #6	Post Bottle Roll - Washed	7.6	0	0						

NAGpH = pH of NAG liquor

NAG(pH4.5) = Net Acid Generation capacity to pH 4.5 (kgH_2SO_4/t)

NAG(pH7.0) = Net Acid Generation capacity to pH 7.0 (kgH_2SO_4/t)

Table 3 Cont. – NAG test results for Tailings samples from Fountain Head.

EGi Code	**Sample ID**	**Description**	**NAG TEST - Stage 4**			**Cumulative NAG**	
			NAGpH	**NAG(pH4.5)**	**NAG(pH7.0)**	**NAG(pH4.5)**	**NAG(pH7.0)**
20703	COMP #1	Post Roll Solids					
20704	COMP #2	Post Roll Solids					
20705	COMP #3	Post Bottle Roll - Washed	5.7	0	1.1	0	4
20706	COMP #4	Post Roll Solids					
20707	COMP #6	Post Bottle Roll - Washed					

NAGpH = pH of NAG liquor

NAG(pH4.5) = Net Acid Generation capacity to pH 4.5 (kgH_2SO_4/t)

NAG(pH7.0) = Net Acid Generation capacity to pH 7.0 (kgH_2SO_4/t)

3. LEACHING CHARACTERISTICS

To investigate the leachability of metals/metalloids and major cations and anions from the five tailings samples, batch water and peroxide extraction tests were conducted. Batch water extraction tests provide an insight into elemental solubilities within recently mined rock. The samples were extracted with deionised water at a solid to liquid ratio of 1:2 for 16 hours, which is generally sufficient for chemical equilibrium to be established. Extract pHs were recorded after the equilibration period, then the liquors were filtered and analysed for a suite of elements.

In addition to water extractions, a series of accelerated oxidation tests based on the NAG test procedure were also carried out to provide indicative data on metals and metalloids that are likely to occur in runoff from tailings that are subject to oxidation processes following surface storage. The NAG test involves reaction of a sample with hydrogen peroxide to rapidly oxidise any sulphides that are present. Normally only the pH and acidity of the NAG solution are measured following the oxidation stage, but elemental analysis of the NAG liquor can also be carried out to provide data on the release of elements that may be of interest.

When assessing the results, it should be noted that the actual concentrations of elements in a peroxide extract are directly related to the volume of peroxide used per unit weight of sample. The method involves a leach ratio of 100 mL/g which is high in comparison to leach rates typically encountered under field conditions, as well as rates typically used in column leach tests. For example, the column leach tests routinely run by EGi typically average around 75 mL/kg/week, which over a five year period (for example) equates to a leach ratio of around 20 mL/g. As such, it can be expected that the peroxide extracts represent a diluted condition in comparison to the "average" leachate quality that might be expected from the same samples under standard column leach test conditions. Therefore, to make the results more comparable to leach column results, EGi typically apply a scaling factor of 5 to 10 to concentrations reported for peroxide extracts.

These tests represent the two extremes of the leaching process for waste rock and tailings. The results of water extraction provide an indication of chemical mobility for a material that is freshly mined and exposed to atmospheric conditions, whereas the results of the peroxide extractions provide information of metal mobility for sulphidic materials that undergo oxidation. These two tests represent the extremes of the leaching process. In practice, oxidation of waste rock or tailings stored in a waste storage facility (WRF) will progress over time, and so leachates from the WRF will be derived from contact of infiltrating water with waste rock covering the spectrum of oxidised rock.

The results of multi-element analysis of tailings 1:2 water extracts shown in Table 4 also show comparison of the measured concentrations with ANZECC default guideline values (DGV). This is done by highlighting concentrations according to the measured concentration in comparison with the DGV. Note, where measured leachate concentrations were below the limit of reporting (LOR), a value of LOR/2 was compared with the DGV. This may or may not provide a fair comparison with the DGV but is likely to be the best available comparison. Measured leachate concentrations are highlighted as either less than the DGV, 1 - 10 x DGV, 10 – 100 x DGV etc. Highlighting thus indicates the required dilution of the leachate to obtain a concentration below the DGV. The higher the required dilution, the higher the likelihood of the leachate posing an environmental risk. Note comparison of the water extract concentrations with DGV values is not meant to infer that these comparisons can be applied under field conditions but is designed to highlight elements that may be of potential concern.

As shown from the test results described in Section 2, the water extracts of these tailings provided alkaline leachates with pH around 9 and moderate alkalinity around 60 mg $CaCO_3$/L (Table 4). Water extracts contained moderate salinity (0.3 – 0.8 dS/m), comprised principally of Ca, K, Na, SO4 and Cl. Of the metals/metalloids measured in the water extracts, arsenic stands out as the element which occurs at concentrations significantly above the DGV, with samples Comp #1 – 3 giving concentrations more than 100 times above the DGV. These results indicate that even in the absence of oxidation, fresh tailings may produce leachates containing elevated arsenic concentrations on contact with water.

Table 4 – Analysis results for water extracts of CIL tailings.

Parameter	Unit	Detection Limit	Sample ID					ANZECC DGV[i]
			COMP #1	COMP #2	COMP #3	COMP #4	COMP #6	
			Post Roll Solids	Post Roll Solids	Post Bottle Roll - Washed	Post Roll Solids	Post Bottle Roll - Washed	
pH			8.9	9.2	9.1	9.0	9.2	-
EC	dS/m	0.001	0.841	0.321	0.316	0.482	0.225	-
Alkalinity	mg $CaCO_3$/L	1	61	60	61	38	67	-
Ag	mg/L	0.001	0.004	<0.001	<0.001	<0.001	<0.001	0.00005
Al	mg/L	0.01	0.08	0.02	0.02	0.08	<0.01	0.055
As	mg/L	0.001	4.4	1.36	10.1	0.191	0.256	0.013
B	mg/L	0.05	<0.05	<0.05	<0.05	0.05	<0.05	0.37
Ba	mg/L	0.001	0.205	0.247	0.258	0.247	0.202	-
Be	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Ca	mg/L	1	177	28	54	82	9	-
Cd	mg/L	0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	0.0002
Cl	mg/L	1	39	12	22	21	16	-
Co	mg/L	0.001	0.031	0.008	0.01	0.024	0.003	0.001
Cr	mg/L	0.001	<0.001	<0.001	0.003	0.002	<0.001	0.001
Cu	mg/L	0.001	0.02	0.004	0.012	0.024	0.003	0.0014
F	mg/L	0.1	0.4	1	0.5	0.9	1	-
Fe	mg/L	0.05	2.38	<0.05	<0.05	<0.05	<0.05	-
Hg	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0006
K	mg/L	1	62	14	8	58	5	-
Mg	mg/L	1	7	2	2	5	1	-
Mn	mg/L	0.001	0.005	<0.001	<0.001	0.001	<0.001	1.9
Mo	mg/L	0.001	0.038	0.008	0.036	0.022	0.002	0.034
Na	mg/L	1	28	25	29	11	31	-
Ni	mg/L	0.001	<0.001	0.009	0.009	0.003	0.002	0.011
P	mg/L	1	<1	<1	<1	<1	<1	-
Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0034
Sb	mg/L	0.001	0.027	0.003	0.017	0.005	<0.001	0.009
Se	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011
Si	mg/L	0.1	2.5	10.2	7.1	2.7	6.6	-
Sn	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
SO4	mg/L	1	491	50	90	216	9	-
Sr	mg/L	0.001	0.077	0.018	0.031	0.048	0.009	-
Th	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Tl	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.00003
U	mg/L	0.001	0.001	0.001	0.004	0.003	<0.001	0.0005
Zn	mg/L	0.005	<0.005	<0.005	<0.005	0.013	<0.005	0.008

▢	< ANZECC DGV
░	1-10 x ANZECC DGV
▒	10-100 x ANZECC DGV
▓	100-1000 x ANZECC DGV
█	>1000 x ANZECC DGV

ANZECC DGV = Default Guideline Value using 95% protection level for fresh water systems[i]. Where measured concentrations were <LOR, LOR/2 was used to calculate the ratio of leachate concentration to DGV.

Table 5 shows the results from peroxide extractions of the tailings samples following scaling by a factor of five as discussed above. As for the water extracts, the concentrations are compared with DGV by highlighting cells according to the required dilution of the extract to meet the DGV. It is noted that multiplying by a factor of five may lead to saturated conditions for some elements, which may result in precipitation of certain phases.

To investigate the likelihood of this, solution speciation analysis was conducted using the solutions in Table 5. For the Comp #1 sample (pH 2.8) calculations suggest no saturated phases in the solution. For the Comp #3 leachate solution (pH 7.5), solution speciation calculations indicate chromium (III) oxide, and barite are potentially saturated. This may mean concentrations of Cr, and Ba may be less than those shown in Table 5. The absence of iron in neutral pH peroxide leachates may mean that iron has precipitated from these solutions, possibly as amorphous or poorly crystalline iron oxyhydroxides. Calculations were therefore also conducted where hydrous ferrous oxide was added to the solution. Results indicate that in the presence of iron oxyhydroxides, arsenic, copper and zinc concentrations may also be attenuated through adsorption.

Notwithstanding the above caveats, the results of peroxide extractions suggest that leachates from oxidised tailings may contain high concentrations of a number of metals and metalloids, including arsenic, aluminium, cadmium, cobalt chromium, copper, lead and zinc. While concentrations were highest for most metals in the low pH extract from the PAF tailings sample Comp #1, arsenic was found in peroxide extracts with neutral pH. This may in part be due to reduced adsorption of arsenate by iron oxyhydroxides at higher pH.

Elevated concentrations of arsenic in water and peroxide extracts correlate with high concentrations in the tailings samples. Table 6 shows the concentrations of various elements in each of the tailings samples, together with geochemical abundance indices (GAI) for each element. GAI values above 3 indicate significant enrichment above average soil abundance. GAI values for arsenic ranged from 3 to 10 for the tailings samples demonstrating significantly elevated concentrations (up to 8600 ppm) in these materials. Figure 1 shows strong correlation between arsenic concentrations in the tailings and the Total S content of the sample with the exception of the Comp #4 sample. This suggests that arsenic is likely associated with sulphides in the tailings, probably as arsenian pyrite ($Fe(S_{1-x},As_x)_2$) and arsenopyrite. It might therefore be expected that there would be a correlation between sulphate and arsenic in peroxide solution and sulphide S (measured as Total S) during oxidative dissolution when the tailings are treated with peroxide. Figure 2 shows such a correlation does exist between sulphate in the peroxide extracts and Total S in the tailings, but no such correlation exists between arsenic concentrations measured in the peroxide extracts and Total S in the tailings (Figure 3). Evidently, factors other than oxidative dissolution control the concentration of arsenic in solutions in contact with oxidised tailings.

These results suggest that should tailings undergo oxidation during surface storage, a number of metals and metalloids, and especially arsenic, may be mobilised on contact with infiltrating water and could produce drainage which might present significant environmental risk. Kinetic column testing of the tailings will further evaluate the likely quality and associated environmental risk of drainage from tailings during long-term surface storage and help to formulate possible control measures to reduce associated risks.

Table 5 – Analysis results for hydrogen peroxide extracts of CIL tailings. Note concentrations have been multiplied by 5 to provide better comparison with kinetic leach column leachates.

Parameter	Unit	Detection Limit	Sample ID				ANZECC DGV[i]
			COMP #1	COMP #2	COMP #3	COMP #4	
			Post Roll Solids	Post Roll Solids	Post Bottle Roll - Washed	Post Roll Solids	
pH			2.8	7.6	7.5	4.1	-
EC	dS/m	0.001					-
Alkalinity	mg $CaCO_3$/L	1					-
Ag	mg/L	0.001	<0.005	<0.005	<0.005	<0.005	0.00005
Al	mg/L	0.01	61	0.7	0.1	5.2	0.055
As	mg/L	0.001	6.5	3.0	20	0.45	0.013
B	mg/L	0.05	0.6	<0.25	<0.25	0.4	0.37
Ba	mg/L	0.001	0.40	1.7	1.7	0.52	-
Be	mg/L	0.001	0.015	<0.005	<0.005	0.005	-
Ca	mg/L	1	210	160	335	240	-
Cd	mg/L	0.0001	0.19	0.0025	<0.0005	0.0045	0.0002
Cl	mg/L	1	15	<5	<5	10	-
Co	mg/L	0.001	1.9	0.035	<0.005	0.34	0.001
Cr	mg/L	0.001	0.05	0.045	0.11	0.03	0.001
Cu	mg/L	0.001	18.6	0.25	0.015	3.6	0.0014
F	mg/L	0.1	1	1.5	1	1	-
Fe	mg/L	0.05	58	0.35	<0.25	<0.25	-
Hg	mg/L	0.0001	<0.0005	<0.0005	<0.0005	<0.0005	0.0006
K	mg/L	1	50	25	15	45	-
Mg	mg/L	1	50	15	10	35	-
Mn	mg/L	0.001	2.3	0.07	0.01	2.0	1.9
Mo	mg/L	0.001	<0.005	0.01	0.03	0.02	0.034
Na	mg/L	1	100	85	85	90	-
Ni	mg/L	0.001	0.53	0.01	<0.005	0.31	0.011
P	mg/L	1	<5	<5	<5	<5	-
Pb	mg/L	0.001	1.8	0.01	<0.005	0.04	0.0034
Sb	mg/L	0.001	<0.005	0.01	0.045	<0.005	0.009
Se	mg/L	0.01	<0.05	<0.05	<0.05	<0.05	0.011
Si	mg/L	0.1	91	58	51	73	-
Sn	mg/L	0.001	<0.005	<0.005	<0.005	<0.005	-
SO4	mg/L	1	1495	120	575	680	-
Sr	mg/L	0.001	0.13	0.08	0.11	0.12	-
Th	mg/L	0.001	<0.005	<0.005	<0.005	<0.005	-
Tl	mg/L	0.001	<0.005	<0.005	<0.005	<0.005	0.00003
U	mg/L	0.001	0.01	<0.005	<0.005	<0.005	0.0005
Zn	mg/L	0.005	2.9	0.37	0.51	1.4	0.008

⬜ < ANZECC DGV
🟥 1-10 x ANZECC DGV
🟥 10-100 x ANZECC DGV
🟥 100-1000 x ANZECC DGV
🟥 >1000 x ANZECC DGV

ANZECC DGV = Default Guideline Value using 95% protection level for fresh water systems[i]. Where measured concentrations were <LOR, LOR/2 was used to calculate the ratio of leachate concentration to DGV.

Table 6 – Multi-element composition (mg/kg except where shown) and geochemical abundance indices (GAI) of tailings samples.

Element	Detection Limit	Composition					Median Soil Abundance*	GAI				
		COMP #1	COMP #2	COMP #3	COMP #4	COMP #6		COMP #1	COMP #2	COMP #3	COMP #4	COMP #6
Ag	0.01	0.88	0.69	0.49	0.5	0.11	0.05	4	3	3	3	1
Al	0.01%	6.67%	7.32%	5.37%	5.01%	8.43%	7.1%	-	-	-	-	-
As	0.2	8570	992	2810	60.2	272	6	10	7	8	3	5
Ba	10	470	700	440	300	680	500	-	-	-	-	-
Be	0.05	2.37	2.56	1.8	1.81	2.7	0.3	2	3	2	2	3
Bi	0.01	8.26	2.34	1.5	3.54	0.88	0.2	5	3	2	4	2
Ca	0.01%	0.44%	0.52%	0.92%	0.48%	0.59%	1.5%	-	-	-	-	-
Cd	0.02	4.23	0.45	1.28	0.12	0.25	0.35	3	-	1	-	-
Ce	0.01	67.7	73	58.8	48.7	80.3	50	-	-	-	-	-
Co	0.1	50.3	27.9	20.9	15.5	18.3	8	2	1	1	-	1
Cr	1	55	57	76	38	66	70	-	-	-	-	-
Cs	0.05	3.1	2.9	3.29	3.1	3.94	4	-	-	-	-	-
Cu	0.2	426	206	70.9	238	52.9	30	3	2	1	2	-
Fe	0.01%	4.79%	4.45%	3.66%	2.47%	4.22%	4.0%	-	-	-	-	-
Ga	0.05	17.8	18.6	14.2	11.85	22.1	20	-	-	-	-	-
Ge	0.05	0.13	0.15	0.12	0.1	0.16	1	-	-	-	-	-
Hf	0.01	4.1	4.5	4	3	4.2	6	-	-	-	-	-
Hg	0.005	0.016	<0.005	0.005	0.009	0.006	0.06	-	-	-	-	-
In	0.005	0.222	0.232	0.149	0.139	0.088	1	-	-	-	-	-
K	0.01%	3.52%	3.66%	2.47%	3.17%	3.50%	1.4%	1	1	-	1	1
La	0.5	33.7	37.5	28.9	26	43.6	40	-	-	-	-	-
Li	0.2	25.1	20.1	20.2	26.2	38.4	25	-	-	-	-	-
Mg	0.01%	1.18%	0.93%	0.76%	0.92%	2.71%	0.5%	1	-	-	-	2
Mn	5	463	495	410	300	373	1000	-	-	-	-	-
Mo	0.05	2.03	3.26	4.9	1.64	1.71	1.2	-	1	1	-	-
Na	0.01%	0.22%	0.26%	0.18%	0.06%	0.21%	0.5%	-	-	-	-	-

Table 6 – Multi-element composition (mg/kg except where shown) and geochemical abundance indices (GAI) of tailings samples.

Element	Detection Limit	Sample ID					Median Soil Abundance*	Sample ID				
		COMP #1	COMP #2	COMP #3	COMP #4	COMP #6		COMP #1	COMP #2	COMP #3	COMP #4	COMP #6
Nb	0.1	9.3	9.6	8.1	5.8	10.7	10	-	-	-	-	-
Ni	0.2	31	26.5	44.6	25.6	35.5	50	-	-	-	-	-
P	10	380	330	360	240	180	800	-	-	-	-	-
Pb	0.5	413	175.5	413	94.5	74.7	35	3	2	3	1	1
Rb	0.1	152.5	145.5	110.5	148	136	150	-	-	-	-	-
Re	0.002	0.009	<0.002	<0.002	<0.002	<0.002	0.2	-	-	-	-	-
S	0.01%	1.41%	0.14%	0.63%	0.52%	0.01%	0.07%	4	-	3	2	-
Sb	0.05	9.97	5.01	4.2	1.68	1.49	1	3	2	1	-	-
Sc	0.1	10.6	11.3	8.8	6.1	13.4	7	-	-	-	-	-
Se	1	1	1	1	1	<1	0.4	1	1	1	1	1
Sn	0.2	6.2	6.1	6.8	6	4.9	4	-	-	-	-	-
Sr	0.2	22.5	46.6	21.8	22.7	15.7	250	-	-	-	-	-
Ta	0.05	0.84	0.88	0.75	0.55	0.99	2	-	-	-	-	-
Te	0.05	0.58	0.07	0.05	0.4	<0.05	0.1	2	-	-	1	-
Th	0.2	13.35	14.65	11.9	8.69	16.2	9	-	-	-	-	-
Ti	0.005%	0.246%	0.259%	0.217%	0.155%	0.281%	0.50%	-	-	-	-	-
Tl	0.02	1.03	0.78	0.57	0.85	0.64	0.2	2	1	1	2	1
U	0.1	3.3	8.7	5.2	7.7	3.4	2	-	2	1	1	-
V	1	54	62	48	37	68	90	-	-	-	-	-
W	0.1	7.7	6.8	8.5	7.5	4.4	1.5	2	2	2	2	1
Y	0.1	18.6	18	14.3	11.2	17.1	40	-	-	-	-	-
Zn	2	70	79	204	42	92	90	-	-	1	-	-
Zr	0.5	129.5	140	126	95.8	129.5	400	-	-	-	-	-

*Bowen H.J.M.(1979) Environmental Chemistry of the Elements.

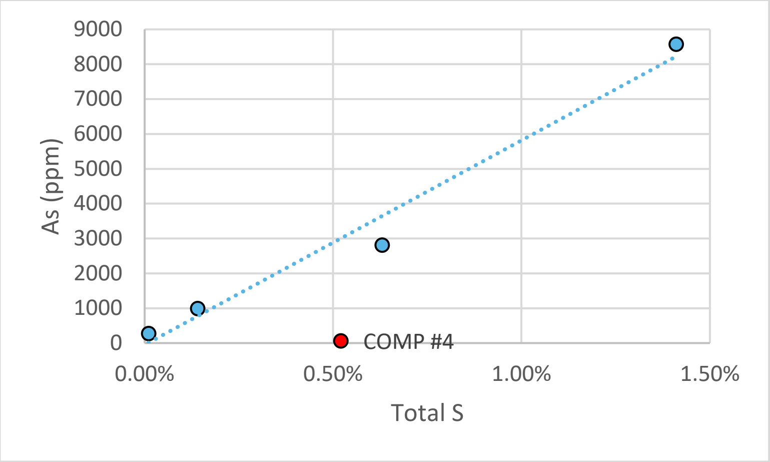

Figure 1 – Arsenic content as a function of Total S content of tailings samples

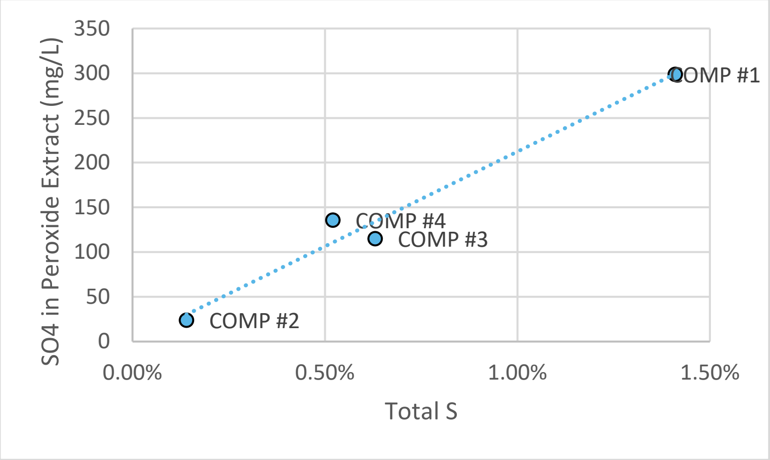

Figure 2 – Sulphate concentrations in peroxide extracts as a function of Total S content of tailings samples

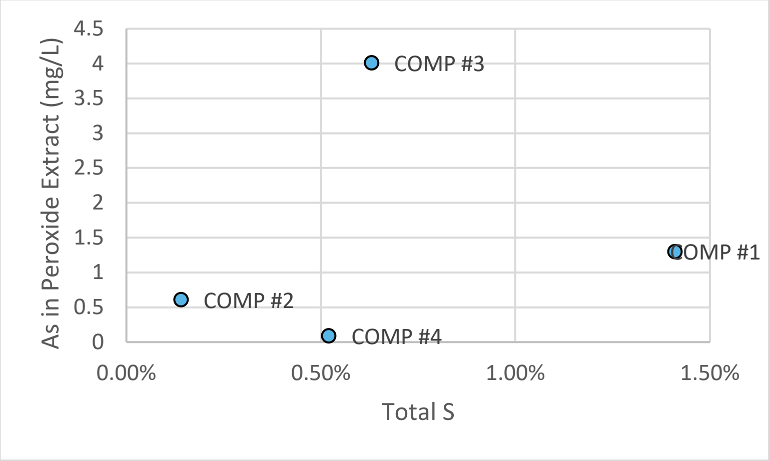

Figure 3 – Arsenic concentrations in peroxide extracts as a function of Total S content of tailings samples

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[i] Toxicant default guideline values for water quality in aquatic ecosystems, Australian & New Zealand Guidelines for Fresh & Marine Water Quality [HTTPS://WWW.WATERQUALITY.GOV.AU/ANZ-GUIDELINES/GUIDELINE-VALUES/DEFAULT/WATER-QUALITY-TOXICANTS](https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants)