Knight Piésold CONSULTING

MEMORANDUM

To:	**Savannah Resources**	**Date:**	04 November 2019
Attn:	Alan Rubio	**KP File Ref.:**	PE501-00080 EJT M19001
cc:		**From:**	Ed Tuplin

RE: MINA DO BARROSO – PRELIMINARY TAILINGS GEOCHEMISTRY ASSESSMENT

1. INTRODUCTION

Knight Piésold (KP) has been provided with tailings geochemical test data from March and April 2018. The testing consists of a basic ARD suite and a series of leaching tests on the tailings. No multi-element information on the tailings has been made available. It is understood to that a detailed assessment of the tailings geochemistry will be conducted as part of the DFS once samples are available.

2. ACID BASE ACCOUNTING

The sulfur content of the sample was reported to be below the 0.01% detection limit. As such, the sample has a negligible maximum potential acidity (MPA). Similarly, the acid neutralising capacity was below detection limits at <2 kg H_2SO_4/t. As such the sample has negligible potential to either form or buffer acid, and the net acid producing potential is 0 kg H_2SO_4/t.

The net acid generation test (NAG) was in good agreement, indicating that no acid was generated following complete oxidation of the sample, with the final NAG pH found to be circum neutral at pH 6.4.

Based on these results, the sample is considered to be Non Acid Forming (NAF), as shown in Figure 2.1. A copy of the results is provided in Appendix A.

3. LEACHING TESTWORK

3.1 AUSTRALIAN STANDARD LEACHING PROCEDURE (ASLP)

The solubility of metals and metalloids in the tailings solids was assessed using the ASLP test, which is based on the Toxicity Characteristic Leaching Procedure (TCLP) developed by the United States Environmental Protection Agency and is a procedure designed to simulate leaching of industrial wastes under acidic conditions within a putrescible landfill. The leaching agent used in the ASLP test was an acetic acid/sodium hydroxide solution with a pH of 5 and may be representative of the pH of rainwater at the site. The solution was then analysed for a basic suite of 18 metals and metalloids. A copy of the results is provided in Appendix A.

The results of the ASLP testing have been compared to European drinking water and surface water guidelines (Ref. 1 and 2). Also, given that the European surface water guidelines only offer thresholds for two of the metals analysed, the IFC guidelines for mining effluents (Ref. 3) have been referred to. These guidelines are intended for comparison purposes only. The results of the comparison are summarised in Table 1.1.

Table 1.1: ASLP Results and Reference Guidelines

Determinant	Units	EU Drinking Water	IFC Mining Effluent	EU Surface Water	Assay Result
Silver	mg/l	N/G	N/G	N/G	0.01
Aluminium	mg/l	0.2	N/G	N/G	0.2
Arsenic	mg/l	0.01	0.1	N/G	0.001
Boron	mg/l	1.0	N/G	N/G	1.1
Barium[1]	mg/l	*0.7*	N/G	N/G	0.38
Beryllium	mg/l	N/G	N/G	N/G	0.01
Cadmium	mg/l	0.005	0.05	0.00045 to 0.0015[2,3]	0.002
Cobalt	mg/l	N/G	N/G	N/G	0.01
Chromium (VI)	mg/l	N/G	0.1	N/G	0.002
Copper	mg/l	2	0.3	N/G	0.02
Mercury	mg/l	0.001	0.002	0.00007[2]	0.0002
Manganese	mg/l	0.05	N/G	N/G	0.35[4]
Molybdenum	mg/l	N/G	N/G	N/G	0.01
Nickel	mg/l	0.02	0.5	N/G	0.01
Lead	mg/l	0.01	0.2	N/G	0.01
Selenium	mg/l	0.01	N/G	N/G	0.001
Vanadium	mg/l	N/G	N/G	N/G	0.01
Zinc	mg/l	N/G	0.5	N/G	0.24

Notes:

[1] Value taken from WHO guidelines in the absence of an EU threshold

[2] Neither cadmium or mercury were detected, but as the limit of detection exceeds the surface water guideline it is not possible to determine the whether the metals are present at levels exceeding or below the surface water thresholds.

[3] Varies according to water hardness

[4] Threshold for manganese is aesthetic rather than health based.

N/G – No guideline

Values highlighted yellow exceed EU drinking water guideline

No values found to exceed IFC guidelines.

The results generally indicated the leachate to be of a reasonable quality, although boron slightly exceeded the EU drinking water guideline. However, the EU guideline is considerably lower than the WHO standard for boron of 2.4 mg/L (Ref. 4). Further, the test involves reducing the pH to 5.5 and agitating the sample for 24 hours, so the actual boron concentration emanating from the filtered tailings management facility would be expected to be lower.

The concentration of manganese was seven times the EU drinking water guideline. However, the guideline is based on aesthetic water quality rather than risk to human health. There is no EU surface water guideline for manganese, however, for reference purposes the ANZECC 95% trigger level for freshwater aquatic protection (i.e. protection for 95% of species) is 0.37 mg/L (Ref. 5).

It is recommended that the suite of metals and metalloids is increased in subsequent studies to allow a fuller assessment.

3.2 LEACHING ENVIRONMENT ASSESSMENT FRAMEWORK (LEAF)

The LEAF is a leaching evaluation system, which consists of four leaching methods designed to work individually or to be integrated to provide a description of the release of inorganic constituents of potential concern for a wide range of solid materials. Two of the four methods were adopted for the Mina Do Barroso tailings; Method 1313 (liquid-solid partitioning as a function of pH using a parallel batch procedure) and Method 1314 (liquid-solid partitioning as a function of liquid-solid ratio for constituents using an up-flow percolation column method. The findings of these tests are provided in the following sections.

3.2.1 Method 1313 (Variable pH Leach)

The pH of the extract solutions varied from pH 2 to 13 and the samples were agitated for 24 hours using a rotary tumbler. As would be expected, the metal and metalloids showed increased solubility at extremely low and high pH values, however, between pH 5.5 and 8 (i.e. the expected range at site based on the tailings acid base accounting) the majority of metals were not measured above detection limits and, those that did, were below EU drinking water guidelines. The results have been included in Appendix A.

3.2.2 Method 1314 (Up-flow Column Leach)

The concentrations of arsenic, beryllium, cadmium, chromium, lead, mercury, molybdenum, selenium, silver, cobalt and vanadium were below detection limits in all columns. However, in one column which used the lowest extract volume of 139 mL and a lower pH of 4.7 (whereas all other tests had a pH of 6.4 to 6.7 and an extract volume of 209 to 3137 mL) recorded some metals above detection limits. Of these, aluminium, manganese and nickel were found to exceed EU drinking water guidelines. The only other cell which recorded a metal concentration above detection was in a cell that used 349 mL of extractant, with manganese measured at 0.03 mg/L. However, this is below the EU drinking water value.

4. CONCLUSIONS

The tailings were found to be Non Acid Forming and essentially inert from an acid base accounting perspective (i.e. no capacity to either generate or neutralise acid). Further, the series of leaching tests performed generally indicated low levels of metal/metalloid solubility. As such, the tailings are considered to pose a low leaching potential.

Further work is required in future studies including detailed acid base accounting, total multi-element analysis of the solids and distilled water extract. Also, despite the low geochemical risk, humidity cell testing should be considered to determine the metal leaching rates in response to weathering. Consideration could also be given to adjusting the pH of the extractant used in the humidity cells to the typical rain pH at the site if it is known to be weakly acidic.

We trust that this memorandum meets your current requirements. However, please do not hesitate to contact us should you have any queries.

Yours faithfully
KNIGHT PIÉSOLD PTY LTD

ED TUPLIN
Senior Project Engineer

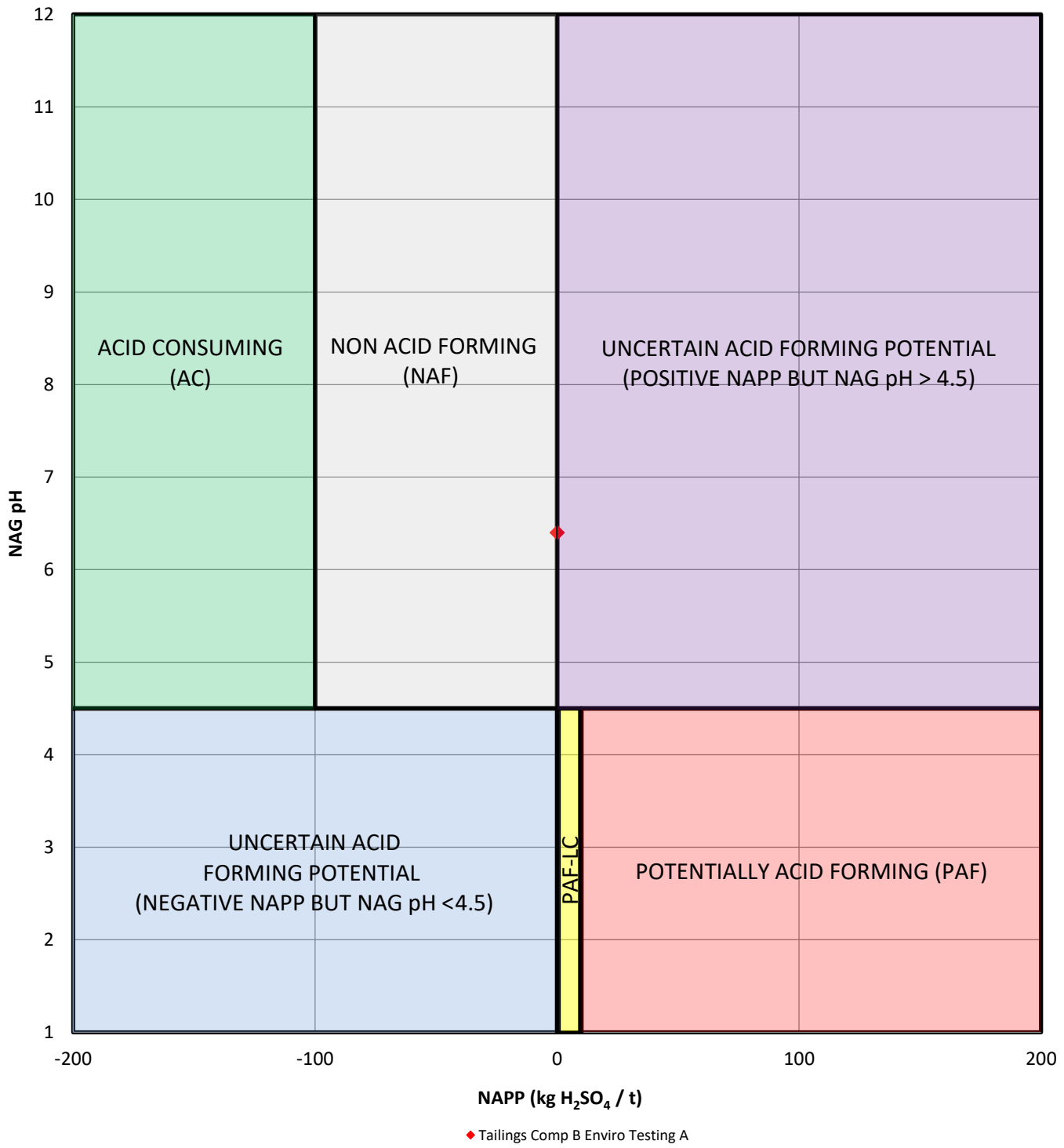
TIM ROWLES
Regional Manager, Queensland

REFERENCES

1. Official Journal of the European Communities (1998). Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption.
2. Official Journal of the European Union (2008). Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy.
3. IFC (2007). IFC Environmental, Health and Safety Guidelines for Mining.
4. World Health Organisation (2011). Guidelines for Drinking-water Quality. Fourth Edition.
5. Australian and New Zealand Environmental and Conservation Council (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

FIGURES

Acid Formation Potential



Acid Formation Potential	NAPP (kg H_2SO_4 / t)	NAG pH
Potential Acid Forming (PAF)	>10	<4.5
Potential Acid Forming - Low Capacity (PAF - LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than - 100	≥4.5
Uncertain (UC)	Positive	≥4.5
	Negative	<4.5

APPENDIX A

Laboratory Reports

ARL GROUP

LABORATORY REPORT

Job Number: 18-04621
Revision: 00
Date: 9 April 2018

ADDRESS: **Nagrom the Mineral Processor**
PO Box 66
Kelmscott WA 6991

ATTENTION: Rain Lewis

DATE RECEIVED: 26/03/2018

YOUR REFERENCE: N/A

PURCHASE ORDER:

APPROVALS:

Douglas Todd
Laboratory Manager

REPORT COMMENTS:

This report is issued by Analytical Reference Laboratory (WA) Pty Ltd
Samples are analysed on an as received basis unless otherwise noted.

METHOD REFERENCES:

ARL No. 401/403	Metals in Soil and Sediment by ICPOES/MS
ARL No. 136	Lime Equivalence in Biosolids

LABORATORY REPORT

Nagrom the Mineral Processor

ARL Job No: 18-04621 *Revision: 00* *Date:* 9 April 2018

RESULTS:

Misc. Inorganics in Soil **Sample No:** **Sample Description:** **Sample Date:**	**LOR**	**UNITS**	**18-04621-1** **Tailings Comp B Enviro Testing A** **26/03/2018**
Sulphur	0.01	% w/w	<0.01
Acid Neutralising Capacity BT (19A2)	2	kgH2SO4/t	<2
Maximum Potential Acidity	2	kgH2SO4/t	<2
Net Acid Producing Potential	2	kgH2SO4/t	<2
Net Acid Generation to pH 4.5	2	kgH2SO4/t	<2
Net Acid Generation to pH 7.0	2	kgH2SO4/t	<2
NAG pH	0.1	pH units	6.4

Result Definitions

LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting

* Denotes test conducted by in-house methodology

FOR MICROBIOLOGICAL TESTING - The data in this report may not be representative of a lot, batch or other samples and may not necessarily justify the acceptance or rejection of a lot or batch, a product recall or support legal proceedings. Tests are not routinely performed as duplicates unless specifically requested. Changes occur in the bacterial content of biological samples. Samples should be examined as soon as possible after collection, preferably within 6 hrs and must be stored at 4 degrees Celsius or below. Samples tested after 24 hrs cannot be regarded as satisfactory because of temperature abuse and variations.

Quality Control Report

Job Number: 18-04621-A

Date: 9/04/2018

Environmental and Analytical Laboratory

This report must not be reproduced except in full without prior written consent.

This Quality Control Report is issued in accordance with Section 18 of the ARL Quality Management Manual. All QC parameters are contained within the relevant ARL Method as indicated by the method reference, either on this report or the Laboratory Report.

Acceptance of Holding Times, Duplicate RPD, Spike, LCS and CRM Recoveries are determined at the time of analysis by the Signatory indicated on the Laboratory Report.

DEFINITIONS

Duplicate Analysis

A sample, chosen randomly by the analyst at the time of sample preparation, analysed in duplicate.

RPD

Relative Percent Difference is the absolute difference between the sample and a duplicate analysis compared to the average of the two analytical results. Acceptance Limits can be exceeded by matrix interference or when the result is less than 5 times the LOR.

Matrix Spike

An additional portion of sample to which known amounts of the target analytes are added before sample preparation. Acceptance Limits can be exceeded by matrix interference or when the target analytes are present in the sample.

Certified Reference Material (CRM)

A commercially available certified solution/mixture of the target analyte of known concentration.

Laboratory Control Sample (LCS)

An in-house certified solution/mixture of the target analyte of known concentration.

Analytical Reference Laboratory (WA) PTY. Ltd
46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsmile 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

Quality Control Report

Job Number: 18-04621-A

Date: 9/04/2018

Environmental and Analytical Laboratory

Ions in Water

Holding Time Criteria	Date	
Analysed	3/04/2018	
Duplicate Analysis (18-04621-A-1)	**RPD (%)**	**Limits (%)**
Chromium (VI)	0	200
Blank Analysis	**Result (mg/L)**	**Limit (mg/L)**
Chromium (VI)	<0.002	0.002
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Chromium (VI)	106	80 - 120
Blank Analysis	**Result (mg/L)**	**Limit (mg/L)**
Silver - Dissolved	<0.01	0.01
Aluminium - Dissolved	<0.1	0.1
Arsenic - Dissolved	<0.001	0.001
Boron - Dissolved	<0.05	0.05
Barium - Dissolved	<0.01	0.01
Beryllium - Dissolved	<0.01	0.01
Cadmium - Dissolved	<0.002	0.002
Cobalt - Dissolved	<0.01	0.01
Copper - Dissolved	<0.01	0.01
Manganese - Dissolved	<0.01	0.01
Molybdenum - Dissolved	<0.01	0.01
Nickel - Dissolved	<0.01	0.01
Lead - Dissolved	<0.01	0.01
Selenium - Dissolved	<0.001	0.001
Vanadium - Dissolved	<0.01	0.01
Zinc - Dissolved	<0.01	0.01
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Silver - Dissolved	109	80 - 120
Aluminium - Dissolved	92	80 - 120
Arsenic - Dissolved	101	80 - 120
Barium - Dissolved	110	80 - 120
Beryllium - Dissolved	111	80 - 120
Cadmium - Dissolved	106	80 - 120
Cobalt - Dissolved	118	80 - 120
Copper - Dissolved	106	80 - 120
Manganese - Dissolved	116	80 - 120
Nickel - Dissolved	111	80 - 120
Lead - Dissolved	108	80 - 120
Selenium - Dissolved	96	80 - 120
Vanadium - Dissolved	100	80 - 120
Zinc - Dissolved	91	80 - 120
Boron - Dissolved	107	80 - 120
Molybdenum - Dissolved	89	80 - 120
Blank Analysis	**Result (mg/L)**	**Limit (mg/L)**
Mercury - Dissolved	<0.0002	0.0002

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Quality Control Report

Job Number: 18-04621-A

Date: 9/04/2018

Certified Reference Material	Recovery (%)	Limits (%)
Mercury - Dissolved	102	80 - 120

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46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsmile 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

ARL GROUP

ASLP Laboratory Report

Job Number: 18-04621-A
Revision: 00
Date: 9 April 2018

ADDRESS: **Nagrom the Mineral Processor**
PO Box 66
Kelmscott WA 6991

ATTENTION: Lisa Allen

DATE RECEIVED: 26 March 2018

YOUR REFERENCE: N/A

PURCHASE ORDER:

APPROVALS:

Douglas Todd
Laboratory Manager

REPORT COMMENTS:

This report is issued by Analytical Reference Laboratory (WA) Pty Ltd
Extractions performed according to ARL No. 069 - Preparation of Leachates - Bottle Leaching Procedure
ASLP Extraction Fluid: pH 5 Solution
Samples are analysed on an as received basis unless otherwise noted.

METHOD REFERENCES:

ARL No. 29/402/403	Metals in Water by AAS/ICPOES/ICPMS
ARL No. 040	Arsenic by Hydride Atomic Absorption
ARL No. 316	Hexavalent Chromium in Water by Discrete Analyser
ARL No. 406	Mercury by Cold Vapour Atomic Absorption Spectrophotometry

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LABORATORY REPORT

Nagrom the Mineral Processor

ARL Job No: 18-04621-A *Revision: 00* *Date:* 9 April 2018

ASLP for Metals **Sample No:** **Sample Description:**	**LOR**	**UNITS**	**18-04621-A-1** **Tailings Comp B Enviro Testing A**
Silver - Dissolved	0.01	mg/L	<0.01
Aluminium - Dissolved	0.1	mg/L	0.2
Arsenic - Dissolved	0.001	mg/L	0.001
Boron - Dissolved	0.05	mg/L	1.1
Barium - Dissolved	0.01	mg/L	0.38
Beryllium - Dissolved	0.01	mg/L	<0.01
Cadmium - Dissolved	0.002	mg/L	<0.002
Cobalt - Dissolved	0.01	mg/L	<0.01
Chromium (VI)	0.002	mg/L	<0.002
Copper - Dissolved	0.01	mg/L	0.02
Mercury - Dissolved	0.0002	mg/L	<0.0002
Manganese - Dissolved	0.01	mg/L	0.35
Molybdenum - Dissolved	0.01	mg/L	<0.01
Nickel - Dissolved	0.01	mg/L	<0.01
Lead - Dissolved	0.01	mg/L	<0.01
Selenium - Dissolved	0.001	mg/L	<0.001
Vanadium - Dissolved	0.01	mg/L	<0.01
Zinc - Dissolved	0.01	mg/L	0.24

Result Definitions

LOR Limit of Reporting [ND] Not Detected at indicated Limit of Reporting [NR] Analysis Not Requested

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 188206

Client Details

Client	MPL Laboratories
Attention	Todd Lee
Address	Envirolab Services (WA) Pty Ltd, 16-18 Hayden Court, Myaree, WA, 6154

Sample Details

Your Reference	**T2500**
Number of Samples	1 Soil, 9 Soil Tailings Eluate Analysis
Date samples received	27/03/2018
Date completed instructions received	27/03/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	01/05/2018
Date of Issue	01/05/2018
Reissue Details	This report replaces R00 created on 01/05/2018 due to: Sample ID amended (Client request)
NATA Accreditation Number 2901. This document shall not be reproduced except in full.	
Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***	

Results Approved By
Leon Ow, Chemist
Simon Mills, Group R&D Manager

Authorised By

Jacinta Hurst, Laboratory Manager

Metals in Eluates						
Our Reference		188206-2	188206-3	188206-4	188206-5	188206-6
Your Reference	UNITS	Tailings Comp B Enviro Testing B-T01	Tailings Comp B Enviro Testing B-T02	Tailings Comp B Enviro Testing B-T03	Tailings Comp B Enviro Testing B-T04	Tailings Comp B Enviro Testing B-T05
Type of sample		Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis
Date extracted	-	12/04/2018	12/04/2018	12/04/2018	12/04/2018	18/04/2018
Date analysed	-	13/04/2018	13/04/2018	13/04/2018	13/04/2018	18/04/2018
Arsenic in Eluate	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Beryllium in Eluate	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium in Eluate	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium in Eluate	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Lead in Eluate	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03
Mercury in Eluate	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Molybdenum in Eluate	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03
Nickel in Eluate	mg/L	0.04	<0.02	<0.02	<0.02	<0.02
Selenium in Eluate	mg/L	<0.12	<0.12	<0.12	<0.12	<0.12
Silver in Eluate	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Aluminium in Eluate	mg/L	0.7	<0.1	<0.1	<0.1	<0.1
Barium in Eluate	mg/L	0.05	<0.01	<0.01	<0.01	<0.01
Boron in Elaute	mg/L	0.3	<0.2	<0.2	<0.2	<0.2
Cobalt in Eluate	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Copper in Eluate	mg/L	0.02	0.01	<0.01	<0.01	<0.01
Manganese in Eluate	mg/L	0.4	<0.01	<0.01	<0.01	<0.01
Vanadium in Eluate	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Zinc in Eluate	mg/L	0.06	<0.02	<0.02	<0.02	<0.02

Metals in Eluates					
Our Reference		188206-7	188206-8	188206-9	188206-10
Your Reference	UNITS	Tailings Comp B Enviro Testing B-T06	Tailings Comp B Enviro Testing B-T07	Tailings Comp B Enviro Testing B-T08	Tailings Comp B Enviro Testing B-T09
Type of sample		Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis
Date extracted	-	18/04/2018	18/04/2018	24/04/2018	24/04/2018
Date analysed	-	18/04/2018	18/04/2018	24/04/2018	24/04/2018
Arsenic in Eluate	mg/L	<0.05	<0.05	<0.05	<0.05
Beryllium in Eluate	mg/L	<0.01	<0.01	<0.01	<0.01
Cadmium in Eluate	mg/L	<0.01	<0.01	<0.01	<0.01
Chromium in Eluate	mg/L	<0.01	<0.01	<0.01	<0.01
Lead in Eluate	mg/L	<0.03	<0.03	<0.03	<0.03
Mercury in Eluate	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
Molybdenum in Eluate	mg/L	<0.03	<0.03	<0.03	<0.03
Nickel in Eluate	mg/L	<0.02	<0.02	<0.02	<0.02
Selenium in Eluate	mg/L	<0.12	<0.12	<0.12	<0.12
Silver in Eluate	mg/L	<0.02	<0.02	<0.02	<0.02
Aluminium in Eluate	mg/L	<0.1	<0.1	<0.1	<0.1
Barium in Eluate	mg/L	<0.01	<0.01	<0.01	<0.01
Boron in Elaute	mg/L	<0.2	<0.2	<0.2	<0.2
Cobalt in Eluate	mg/L	<0.02	<0.02	<0.02	<0.02
Copper in Eluate	mg/L	<0.01	<0.01	<0.01	<0.01
Manganese in Eluate	mg/L	<0.01	<0.01	0.01	0.03
Vanadium in Eluate	mg/L	<0.02	<0.02	<0.02	<0.02
Zinc in Eluate	mg/L	<0.02	<0.02	<0.02	<0.02

Hexavalent Cr in Eluates						
Our Reference		188206-2	188206-3	188206-4	188206-5	188206-6
Your Reference	UNITS	Tailings Comp B Enviro Testing B-T01	Tailings Comp B Enviro Testing B-T02	Tailings Comp B Enviro Testing B-T03	Tailings Comp B Enviro Testing B-T04	Tailings Comp B Enviro Testing B-T05
Type of sample		Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis
Date prepared	-	10/04/2018	10/04/2018	13/04/2018	13/04/2018	17/04/2018
Date analysed	-	10/04/2018	10/04/2018	13/04/2018	13/04/2018	17/04/2018
Hexavalent Cr in Eluate	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05

Hexavalent Cr in Eluates					
Our Reference		188206-7	188206-8	188206-9	188206-10
Your Reference	UNITS	Tailings Comp B Enviro Testing B-T06	Tailings Comp B Enviro Testing B-T07	Tailings Comp B Enviro Testing B-T08	Tailings Comp B Enviro Testing B-T09
Type of sample		Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis
Date prepared	-	17/04/2018	17/04/2018	26/04/2018	26/04/2018
Date analysed	-	17/04/2018	17/04/2018	26/04/2018	26/04/2018
Hexavalent Cr in Eluate	mg/L	<0.05	<0.05	<0.05	<0.05

SW846-1314 LEAF						
Our Reference		188206-2	188206-3	188206-4	188206-5	188206-6
Your Reference	UNITS	Tailings Comp B Enviro Testing B-T01	Tailings Comp B Enviro Testing B-T02	Tailings Comp B Enviro Testing B-T03	Tailings Comp B Enviro Testing B-T04	Tailings Comp B Enviro Testing B-T05
Type of sample		Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis
Date prepared	-	10/04/2018	10/04/2018	10/04/2018	10/04/2018	10/04/2018
Particle Size used	mm	10/04/2018	10/04/2018	10/04/2018	10/04/2018	10/04/2018
Packed Column Bed Dimensions	mm D x mm H	50mm x 300mm	50mm x 300mm	50mm x 300mm	50mm x 300mm	50mm x 300mm
Mass Used	g	697g	697g	697g	697g	697g
Moisture	%(w/w)	0	0	0	0	0
Fractional pH	pH units	4.7	6.4	6.6	6.7	6.7
Fraction EC	µS/cm	450	55	22	17	13
Percolation Time	hrs	5.8	8.7	14.5	14.5	14.5
Percolation Volume (approx.)	mL	139	209	349	349	349
Average Temperature	°C	21	21	20	22	21

SW846-1314 LEAF					
Our Reference		188206-7	188206-8	188206-9	188206-10
Your Reference	UNITS	Tailings Comp B Enviro Testing B-T06	Tailings Comp B Enviro Testing B-T07	Tailings Comp B Enviro Testing B-T08	Tailings Comp B Enviro Testing B-T09
Type of sample		Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis	Soil Tailings Eluate Analysis
Date prepared	-	10/04/2018	10/04/2018	10/04/2018	10/04/2018
Particle Size used	mm	10/04/2018	10/04/2018	10/04/2018	10/04/2018
Packed Column Bed Dimensions	mm D x mm H	50mm x 300mm	50mm x 300mm	50mm x 300mm	50mm x 300mm
Mass Used	g	697g	697g	697g	697g
Moisture	%(w/w)	0	0	0	0
Fractional pH	pH units	6.7	6.6	6.6	6.4
Fraction EC	µS/cm	11	10	20	14
Percolation Time	hrs	72.6	14.5	130.7	14.5
Percolation Volume (approx.)	mL	1,743	349	3,137	349
Average Temperature	°C	20	21	21	21

Method ID	Methodology Summary
Inorg-024	Hexavalent Chromium (Cr6+) - determined colourimetrically.
INORG-125	Leaching Environment Assessment Framework (LEAF) methods of leaching using USEPA methods SW846 1313, 1314, 1315 or 1316. All eluates are filtered through 0.45um prior to analysis unless otherwise noted. Please note the 1315 is not currently designed for Organic Analyses, however, we understand that the method is being used for SVOCs in the US at present.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.

QUALITY CONTROL: Metals in Eluates						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			12/04/2018	7	18/04/2018	18/04/2018		12/04/2018	[NT]
Date analysed	-			13/04/2018	7	18/04/2018	18/04/2018		13/04/2018	[NT]
Arsenic in Eluate	mg/L	0.05	Metals-020 ICP-AES	<0.05	7	<0.05	<0.05	0	101	[NT]
Beryllium in Eluate	mg/L	0.01	Metals-020 ICP-AES	<0.01	7	<0.01	<0.01	0	107	[NT]
Cadmium in Eluate	mg/L	0.01	Metals-020 ICP-AES	<0.01	7	<0.01	<0.01	0	109	[NT]
Chromium in Eluate	mg/L	0.01	Metals-020 ICP-AES	<0.01	7	<0.01	<0.01	0	107	[NT]
Lead in Eluate	mg/L	0.03	Metals-020 ICP-AES	<0.03	7	<0.03	<0.03	0	105	[NT]
Mercury in Eluate	mg/L	0.0005	Metals-021 CV-AAS	<0.0005	7	<0.0005	<0.0005	0	92	[NT]
Molybdenum in Eluate	mg/L	0.03	Metals-020 ICP-AES	<0.03	7	<0.03	<0.03	0	110	[NT]
Nickel in Eluate	mg/L	0.02	Metals-020 ICP-AES	<0.02	7	<0.02	<0.02	0	105	[NT]
Selenium in Eluate	mg/L	0.12	Metals-020 ICP-AES	<0.12	7	<0.12	<0.12	0	101	[NT]
Silver in Eluate	mg/L	0.02	Metals-020 ICP-AES	<0.02	7	<0.02	<0.02	0	100	[NT]
Aluminium in Eluate	mg/L	0.1	Metals-020 ICP-AES	<0.1	7	<0.1	<0.1	0	107	[NT]
Barium in Eluate	mg/L	0.01	Metals-020 ICP-AES	<0.01	7	<0.01	<0.01	0	109	[NT]
Boron in Elaute	mg/L	0.2	Metals-020 ICP-AES	<0.2	7	<0.2	<0.2	0	98	[NT]
Cobalt in Eluate	mg/L	0.02	Metals-020 ICP-AES	<0.02	7	<0.02	<0.02	0	106	[NT]
Copper in Eluate	mg/L	0.01	Metals-020 ICP-AES	<0.01	7	<0.01	<0.01	0	106	[NT]
Manganese in Eluate	mg/L	0.01	Metals-020 ICP-AES	<0.01	7	<0.01	<0.01	0	111	[NT]
Vanadium in Eluate	mg/L	0.02	Metals-020 ICP-AES	<0.02	7	<0.02	<0.02	0	107	[NT]
Zinc in Eluate	mg/L	0.02	Metals-020 ICP-AES	<0.02	7	<0.02	<0.02	0	107	[NT]

QUALITY CONTROL: Metals in Eluates						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	[NT]
Date extracted	-			[NT]	[NT]	[NT]	[NT]	[NT]	18/04/2018	[NT]
Date analysed	-			[NT]	[NT]	[NT]	[NT]	[NT]	18/04/2018	[NT]
Arsenic in Eluate	mg/L	0.05	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	96	[NT]
Beryllium in Eluate	mg/L	0.01	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	97	[NT]
Cadmium in Eluate	mg/L	0.01	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	100	[NT]
Chromium in Eluate	mg/L	0.01	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	98	[NT]
Lead in Eluate	mg/L	0.03	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	99	[NT]
Mercury in Eluate	mg/L	0.0005	Metals-021 CV-AAS	[NT]	[NT]	[NT]	[NT]	[NT]	87	[NT]
Molybdenum in Eluate	mg/L	0.03	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	95	[NT]
Nickel in Eluate	mg/L	0.02	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Selenium in Eluate	mg/L	0.12	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	96	[NT]
Silver in Eluate	mg/L	0.02	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	97	[NT]
Aluminium in Eluate	mg/L	0.1	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	95	[NT]
Barium in Eluate	mg/L	0.01	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	105	[NT]
Boron in Elaute	mg/L	0.2	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	101	[NT]
Cobalt in Eluate	mg/L	0.02	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	97	[NT]
Copper in Eluate	mg/L	0.01	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	95	[NT]
Manganese in Eluate	mg/L	0.01	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	99	[NT]
Vanadium in Eluate	mg/L	0.02	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	97	[NT]
Zinc in Eluate	mg/L	0.02	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	97	[NT]

QUALITY CONTROL: Metals in Eluates						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	[NT]
Date extracted	-			[NT]	[NT]	[NT]	[NT]	[NT]	24/04/2018	[NT]
Date analysed	-			[NT]	[NT]	[NT]	[NT]	[NT]	24/04/2018	[NT]
Arsenic in Eluate	mg/L	0.05	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	103	[NT]
Beryllium in Eluate	mg/L	0.01	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	103	[NT]
Cadmium in Eluate	mg/L	0.01	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	111	[NT]
Chromium in Eluate	mg/L	0.01	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	107	[NT]
Lead in Eluate	mg/L	0.03	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	104	[NT]
Mercury in Eluate	mg/L	0.0005	Metals-021 CV-AAS	[NT]	[NT]	[NT]	[NT]	[NT]	93	[NT]
Molybdenum in Eluate	mg/L	0.03	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	112	[NT]
Nickel in Eluate	mg/L	0.02	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	106	[NT]
Selenium in Eluate	mg/L	0.12	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	103	[NT]
Silver in Eluate	mg/L	0.02	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	98	[NT]
Aluminium in Eluate	mg/L	0.1	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	108	[NT]
Barium in Eluate	mg/L	0.01	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	110	[NT]
Boron in Elaute	mg/L	0.2	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	98	[NT]
Cobalt in Eluate	mg/L	0.02	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	106	[NT]
Copper in Eluate	mg/L	0.01	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	108	[NT]
Manganese in Eluate	mg/L	0.01	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	112	[NT]
Vanadium in Eluate	mg/L	0.02	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	108	[NT]
Zinc in Eluate	mg/L	0.02	Metals-020 ICP-AES	[NT]	[NT]	[NT]	[NT]	[NT]	106	[NT]

QUALITY CONTROL: Hexavalent Cr in Eluates						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	188206-3
Date prepared	-			10/04/2018	2	10/04/2018	10/04/2018		10/04/2018	10/04/2018
Date analysed	-			10/04/2018	2	10/04/2018	10/04/2018		10/04/2018	10/04/2018
Hexavalent Cr in Eluate	mg/L	0.05	Inorg-024	<0.05	2	<0.05	<0.05	0	110	108

QUALITY CONTROL: Hexavalent Cr in Eluates						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	[NT]
Date prepared	-			[NT]	6	17/04/2018	17/04/2018		11/04/2018	[NT]
Date analysed	-			[NT]	6	17/04/2018	17/04/2018		11/04/2018	[NT]
Hexavalent Cr in Eluate	mg/L	0.05	Inorg-024	[NT]	6	<0.05	<0.05	0	108	[NT]

QUALITY CONTROL: Hexavalent Cr in Eluates						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	[NT]
Date prepared	-			[NT]	[NT]	[NT]	[NT]	[NT]	17/04/2018	[NT]
Date analysed	-			[NT]	[NT]	[NT]	[NT]	[NT]	17/04/2018	[NT]
Hexavalent Cr in Eluate	mg/L	0.05	Inorg-024	[NT]	[NT]	[NT]	[NT]	[NT]	108	[NT]

QUALITY CONTROL: SW846-1314 LEAF						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			10/04/2018	[NT]	[NT]	[NT]	[NT]	10/04/2018	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

MISC_INORG_CRVI: Sample #3, Hexavalent Chromium PQL has been raised due to matrix interference. Samples were diluted and reanalysed however same results were achieved.

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CERTIFICATE OF ANALYSIS 208544

Client Details

Client	Nagrom
Attention	Rain Lewis
Address	

Sample Details

Your Reference	**T2500**
Number of Samples	1 Tailings
Date samples received	26/03/2018
Date completed instructions received	26/03/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	17/04/2018
Date of Issue	12/04/2018

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Results Approved By
Joshua Lim, Operations Manager

Authorised By

Todd Lee, Laboratory Manager

SW846-1313 LEAF pH variation						
Our Reference		208544-1	208544-2	208544-3	208544-4	208544-5
Your Reference	UNITS	QA/QC7	QA/QC2	QA/QC13	Tailings Comp B Enviro Testing B pH13	Tailings Comp B Enviro Testing B pH12
Type of sample		Tailings	Tailings	Tailings	Tailings	Tailings
Date prepared	-	03/04/2018	03/04/2018	03/04/2018	03/04/2018	03/04/2018
Mass Used	g	20	20	20	20	20
Particle Size as recieved	mm	0.3	0.3	0.3	0.3	0.3
Volume/Type water used	mL	200	199	170	170	197
Volume/Normality Acid	mL	0	1	0	0	0
Volume/Normality Base	mL	0	0	30	30	3
Initial pH	pH units	7.1	2.1	13	13	12
Final pH	pH units	6.8	2.1	13	13	12
Initial EC	µS/cm	17	3,900	26,000	22,000	2,500
Final EC	µS/cm	15	3,900	25,000	24,000	2,500
Extraction Time	hrs/days	24	24	24	24	24
Moisture	%(w/w)	0	0	0	0	0
Average Temperature	°C	22	22	22	22	22
Arsenic-Dissolved	mg/L	<0.001	<0.001	<0.001	0.087	0.060
Beryllium-Dissolved	mg/L	<0.0005	<0.0005	<0.0005	0.0070	0.0026
Cadmium-Dissolved	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.0002
Lead-Dissolved	mg/L	<0.001	<0.001	0.002	0.004	0.012
Mercury-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	0.00006	<0.00005
Molybdenum-Dissolved	mg/L	<0.001	<0.001	<0.001	0.002	0.001
Nickel-Dissolved	mg/L	<0.001	0.001	<0.001	<0.001	<0.001
Selenium-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminium-Dissolved	mg/L	<0.01	0.01	0.07	53	38
Barium-Dissolved	mg/L	<0.001	<0.001	0.006	<0.001	0.005
Boron-Dissolved	mg/L	<0.02	<0.02	0.06	0.09	0.03
Cobalt-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.003	0.008	0.007	0.048	0.027
Manganese-Dissolved	mg/L	<0.005	<0.005	<0.005	0.021	0.18
Vanadium-Dissolved	mg/L	<0.001	<0.001	<0.001	0.002	<0.001
Zinc-Dissolved	mg/L	0.004	0.011	0.012	0.098	0.018
Dissolved CrVI	mg/L	<0.001	<0.001	<0.001	0.004	0.001

SW846-1313 LEAF pH variation						
Our Reference		208544-6	208544-7	208544-8	208544-9	208544-10
Your Reference	UNITS	Tailings Comp B Enviro Testing B pH10.5	Tailings Comp B Enviro Testing B pH9	Tailings Comp B Enviro Testing B pH8	Tailings Comp B Enviro Testing B pH7	Tailings Comp B Enviro Testing B pH5.5
Type of sample		Tailings	Tailings	Tailings	Tailings	Tailings
Date prepared	-	03/04/2018	03/04/2018	03/04/2018	03/04/2018	03/04/2018
Mass Used	g	20	20	20	20	20
Particle Size as recieved	mm	0.3	0.3	0.3	0.3	0.3
Volume/Type water used	mL	200	200	200	200	200
Volume/Normality Acid	mL	0	0	0	0	0
Volume/Normality Base	mL	0	0	0	0	0
Initial pH	pH units	11	9.2	8.1	6.7	5.1
Final pH	pH units	10	8.9	7.8	6.8	5.5
Initial EC	µS/cm	98	11	14	18	18
Final EC	µS/cm	190	52	45	24	36
Extraction Time	hrs/days	24	24	24	24	24
Moisture	%(w/w)	0	0	0	0	0
Average Temperature	°C	22	22	22	22	22
Arsenic-Dissolved	mg/L	0.017	0.003	0.002	0.002	0.001
Beryllium-Dissolved	mg/L	0.0007	<0.0005	<0.0005	<0.0005	<0.0005
Cadmium-Dissolved	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.0001
Lead-Dissolved	mg/L	0.003	<0.001	<0.001	<0.001	<0.001
Mercury-Dissolved	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	0.001
Selenium-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminium-Dissolved	mg/L	9.2	0.71	0.20	0.14	0.02
Barium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	<0.02	<0.02	<0.02	<0.02
Cobalt-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.007	0.003	0.003	0.003	0.004
Manganese-Dissolved	mg/L	0.060	0.017	0.076	0.079	0.27
Vanadium-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.008	0.007	0.008	0.004	0.015
Dissolved CrVI	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001

SW846-1313 LEAF pH variation			
Our Reference		208544-11	208544-12
Your Reference	UNITS	Tailings Comp B Enviro Testing B pH4	Tailings Comp B Enviro Testing B pH2
Type of sample		Tailings	Tailings
Date prepared	-	03/04/2018	03/04/2018
Mass Used	g	20	20
Particle Size as recieved	mm	0.3	0.3
Volume/Type water used	mL	200	198
Volume/Normality Acid	mL	0	2
Volume/Normality Base	mL	0	0
Initial pH	pH units	3.9	2.1
Final pH	pH units	4.1	2.2
Initial EC	µS/cm	75	3,600
Final EC	µS/cm	110	3,100
Extraction Time	hrs/days	24	24
Moisture	%(w/w)	0	0
Average Temperature	°C	22	22
Arsenic-Dissolved	mg/L	<0.001	0.022
Beryllium-Dissolved	mg/L	0.0021	0.036
Cadmium-Dissolved	mg/L	0.0005	0.0032
Lead-Dissolved	mg/L	<0.001	0.011
Mercury-Dissolved	mg/L	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	<0.001	0.004
Nickel-Dissolved	mg/L	0.004	0.011
Selenium-Dissolved	mg/L	<0.001	<0.001
Silver-Dissolved	mg/L	<0.001	<0.001
Aluminium-Dissolved	mg/L	0.54	31
Barium-Dissolved	mg/L	0.008	0.066
Boron-Dissolved	mg/L	<0.02	0.03
Cobalt-Dissolved	mg/L	<0.001	0.003
Copper-Dissolved	mg/L	0.018	0.12
Manganese-Dissolved	mg/L	0.95	7.0
Vanadium-Dissolved	mg/L	<0.001	0.003
Zinc-Dissolved	mg/L	0.12	0.40
Dissolved CrVI	mg/L	<0.001	<0.001

Method ID	Methodology Summary
INORG-118	Hexavalent Chromium by Ion Chromatographic separation and colourimetric determination.
INORG-125	Leaching Environment Assessment Framework (LEAF) methods of leaching using USEPA methods SW846 1313, 1314, 1315 or 1316.
METALS-021	Determination of Mercury by Cold Vapour AAS.
METALS-022	Determination of various metals by ICP-MS.

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.