
**APPENDIX 4-3**

# Tailings Leach Study Report


***GRAEME CAMPBELL & ASSOCIATES PTY LTD***
***Specialists in Materials Characterisation***

*Integrated Geochemical and Physical Testing Service for Bedrocks, Regoliths and Soils of Diverse Lithological, Alteration and Weathering Assemblages*

HASTINGS Technology Metals Limited

# Hastings Technology Metals Limited

# Yangibana Rare Earths Project

# Tailings Leach Study Report

## June 2018

| Version Number | Issue Date | Prepared by | Reviewed by | Approved by |
|---|---|---|---|---|
| Revision 0 | 21st June 2018 | R. Haymont (Trajectory) and G. Campbell (Graeme Campbell and Associates) | Emily Clements | Lara Jefferson |

## EXECUTIVE SUMMARY

Trajectory, in partnership with Graeme Campbell and Associates (GCA), has been engaged to conduct a Tailings Leach Study to support the development of the Hastings Technology Metals Limited Yangibana Rare Earths Project (the Project). This review has involved the development and execution of a range of leach tests and analysis procedures for the Project tailings solids for tailings streams one and two. The leach testing was undertaken with reference to industry standards of measurement and personally conducted by Dr. Graeme Campbell with leachate analyses undertaken according to NATA-endorsed procedures. This report compiles and interprets the data and outcomes of the Tailings Leach Study. In brief, the following summarises the outcomes of this review.

### Tailings Storage Facility 1

#### TSF 1 Solids

#### TSF 1 Slurry Water

Review of the TSF 1 slurry water analysis indicated it is alkaline, brackish and enriched in fluoride (F) and molybdenum (Mo) against the ANZECC Stock Quality Guideline (ANZECC, 2000) (See Appendix 01 – Yangibana Tailings Characterisation Study – Trajectory/GCA 2017). Radionuclides concentrations in the TSF 1 Slurry Water are below 1Bq/g and not considered radioactive. The results of the leach study for TSF 1 tailings solids (generated by a pilot plant) showed that, upon leaching with either High Pressure Deionised Water (HPDW) or locally acquired groundwater under saturated conditions, soluble-F and soluble-Mo concentrations rapidly decreased and continued not to be radioactive. Approximately 6-7 pore volumes were passed through the test columns over a period of 15 weeks. In the case of leaching with HPDW, the leachate-F and leachate-Mo concentrations were below the ANZECC stock-water quality guideline values of 2 mg/L and 150 µg/L, respectively. In the case of leaching with groundwater, the leachate-F concentrations matched that of the groundwater at 1-2 mg/L, and leachate-Mo concentrations were near the ANZECC guideline value. These findings confirmed that the recorded soluble-F and soluble-F elevations were chiefly associated with tailings process water, and thus would diminish with flushing.

### Tailing Storage Facility 2

#### TSF 2 Slurry Water

Review of the TSF 2 slurry water analysis indicates it is alkaline, brackish and likely to be enriched in both soluble-F and soluble-Mo against the ANZECC Stock Quality Guideline. Radionuclides concentrations in the TSF 2 Slurry Water are below 1Bq/g and not considered radioactive. The results of the leach tests using TSF 2 tailings solids (generated by a pilot plant) have been generated at a much slower pace due to the very low permeability of the more clay-enriched TSF 2 solids and the consequent very slow rate of drainage / leaching. Approximately 2-3 pore volumes have been passed through the test columns over a period of

15 weeks. The trajectory of the leachate-F and leachate-Mo concentrations is similar to the TSF 1 leach tests and radionuclide levels remained well below 1Bq/g. However, due to the slow nature of the leaching, F and Mo have not yet reached levels below the ANZECC Stock Quality Guideline, although the solubility trends clearly suggest that this will occur in time.

As was suggested during the static-testing programme the release of F and Mo to solution reflects the 'one-time' treatment of ore (i.e. crushing, grinding, agitation at alkaline-pH, etc.), then a swift 'run-down' type of solubility behaviour should be recorded, due to 'wash-out' of soluble F and Mo forms produced during processing. This indicates that the Mo and F elevations were largely dependent on 'operational time-scales' and are not a long term feature of the tailings leachate.

The concentrations of a wide range of minor-elements tested (e.g. Li, Y, etc.; Appendix 2) that were not elevated during the static tests remained below or swiftly trended to either below, or close to, the respective detection-limits (0.001-10 µg/L range typically).

# Contents



Appendix: 1: "Yangibana Project: Leaching and Weathering Testwork to Assess Solubility Behaviour of TSF1-Solids and TSF2-Solids Samples – Study Update", January 2018

Appendix 2: “Yangibana Project: Leaching and Weathering Testwork to Assess Solubility Behaviour of TSF1-Solids and TSF2-Solids Samples – Results & Comments” June 2018.

Appendix 3: ANSTO, Certificate of Analysis, Tailings Column Leachates Testwork, HAST-130318-1 to 22, May 2018

## 1. INTRODUCTION

Hastings Technology Metals Limited (Hastings) is developing the Yangibana Rare Earths Project (the Project), located in the Gascoyne region of Western Australia. The Project will

consist of a number of pits and associated waste rock landforms, tailings storage facilities, processing plant and associated support infrastructure. The current mine life is ten years.

Trajectory, in partnership with Graeme Campbell and Associates completed a tailings characterisation program for the project in support of the preparation of government approvals and the Mine Closure Plan. The static phase of the testing and analysis, "171121 - Yangibana Tailings Characterisation Report - R0" November 2017, has identified some specific issues, which would be best approached via a focused program of leach testing to address some geochemistry questions in a targeted way.

A leach testing programme was undertaken to better understand the degree to which some of the element elevations identified in the static resting phase were temporary features of the process water component of the initial pore water condition. Based on feedback from the regulator (EPA) via the work program in the EPA approved Environmental Scoping Document (ESD), which stated:

*57. Characterise wastes, including intermediate processing wastes, effluents and tailings according to contaminant and leachable concentrations including base metals present in the deposits to allow for waste processing and tailings seepage issues to be addressed. Leach test studies should include the use of onsite water and the characterisation of the leaching potential of all waste materials under a range of pH conditions and varying solid-liquid ratios,*

the leach testing was undertaken with both deionised water and local groundwater. The specific approach to the leach test was developed by GCA as a fit for purpose approach most suited to resolve the uncertainties raised by the static testing.

## 2. SCOPE AND OBJECTIVES

### Objectives

The study will be used to ascertain the longevity of Mo and F reporting to leachate for TSF 1 and TSF 2 tailings for the Yangibana Project.

This information will assist in and satisfy Project approval documentation, and inform the further development of the Mine Closure Plan, TSF Operating Manual and Landform Design, Cover specifications and Environmental Management Plan.

### Aims

Characterise leachate from tailings TSF1 and TSF2 samples generated from **saturated leaching** where the cumulative leaching corresponds to the passage of up to several equivalent pore-volumes of leaching medium;

- Analyse the influence of local water inputs by utlising both (a) high-purity deionised-water (HPDW) and (b) filtered local groundwater. (The use of groundwater for leaching reflects comments previously made by regulators assessing the Yangibana Project. Perth scheme-water was used in the pilot-plant programme of metallurgical testing, which generated the slurry samples of TSF1 and TSF2 tailings. Leaching the TSF1 and TSF2 solids with groundwater therefore allows retrospective assessment, albeit approximately, of any specific chemical interactions between the tailings-solids and solutes within the groundwater that will be sourced for processing operations).

- Assess the transience, or longevity, of release of F and Mo to solution through tailings-water interactions.

- Radionuclide (RN) analysis by ANSTO will be generated to provide further factual information for interpretation (by others) of the geochemical stability of the various RNs in the TSF1 and TSF2 solids.

- Provide specialised technical support to Hastings with liaison with regulators and TSF consultants

## 3. CHARACTERISATION APPROACH

The methodology and approach are set forth in considerable detail in Appendix 1 (Graeme Campbell and Associates, 2018, "Yangibana Project: Leaching and Weathering Testwork to Assess Solubility Behaviour of TSF1-Solids and TSF2-Solids Samples – Study Update", dated 3rd January 2018).

## 4. SUMMARY OF RESULTS AND MANAGEMENT IMPLICATIONS

The results obtained for the leaching study are presented and discussed in Appendix 2 “Yangibana Project: Leaching and Weathering Testwork to Assess Solubility Behaviour of TSF1-Solids and TSF2-Solids Samples – Results & Comments” June 2018.

The following general management and design guidance is inferred from the characterisation studies to date.

The static-testing programme has shown that the slurry-waters of the ex-mill streams of TSF1 and TSF2 slurries had F and Mo concentrations above stock-water guidelines. It was suggested as a conclusion of the static testing phase of the study that if the release of F and Mo to solution reflects the 'one-time' treatment of ore (i.e. crushing, grinding, agitation at alkaline-pH, etc.), then a swift 'run-down' type of solubility behaviour should be recorded, due to 'wash-out' of soluble F and Mo forms produced during processing. This indicates that the Mo and F elevations were largely due to 'operational time-scales' and are not a long term feature of the tailings leachate.

### 4.1 TSF 1

These “Rougher” tailings and associated leachate are generally benign geochemically (Table 1), however they are alkaline and sodic with mild to moderate salinity. The leachate has the potential for elevated fluoride (F) and molybdenum (Mo), however leach testing has demonstrated that these elevations are only temporary. The radionuclide concentrations in these tailings are below 1 Bq/g, specifically 0.7 Bq/g. No radionuclides were recorded in the leachate samples to-date (ANSTO 2018; Appendix 3). Radionuclides concentrations in the TSF 1 Slurry Water is below 1 Bq/g and not considered radioactive.

*Table 1: Tailings for TSF 1 Characterisation Summary*

| Characterisation | Solids | Solutions |
|---|---|---|
| AMD testing | NAF | Circum Neutral/Saline |
| Suite of multi-elements | No significant elevations | Elevated F and Mo |
| Physical characteristics | Sodic | N/A |
| Fibrous materials testing | None detected | N/A |
| Radionuclide concentrations | 0.7 Bq/g | None detected |

### 4.2 TSF 2

Geochemically, TSF 2 tailings and associated leachate (Table 2) are similar to TSF 1 tailings. Initially Mo and F levels are somewhat higher in the TSF 2 leachate. Like TSF 1 leachate, the Mo and F elevations reduce sharply with multiple flushings, this process takes longer however due to the very low permeability of this material. Radionuclide concentrations in TSF 2 solids are elevated (4 Bq/g). As with TSF 1, radionuclide levels did not exceed 1Bq/g in the associated leachate tested to-date (ANSTO 2018; Appendix 3). Radionuclides concentrations in the TSF 2 Slurry Water is below 1Bq/g and not considered radioactive.

*Table 2: Tailings for TSF 2 Characterisation Summary*

| Characterisation | Solids | Solutions |
|---|---|---|
| AMD testing | NAF | Circum Neutral/Saline |

| | | |
|---|---|---|
| Suite of multi-elements | No significant elevations | Elevated F and Mo |
| Physical characteristics | Sodic | N/A |
| Fibrous materials testing | None detected | N/A |
| Radionuclide concentrations | 4 Bq/g | None detected |

## 5 CONCLUSIONS AND RECOMMENDATIONS

### 5.1 Conclusions

As was suggested during the static-testing programme the release of F and Mo to solution reflects the 'one-time' treatment of ore (i.e. crushing, grinding, agitation at alkaline-pH, etc.), then a swift 'run-down' type of solubility behaviour should be recorded, due to 'wash-out' of soluble F and Mo forms produced during processing. This indicates that the Mo and F elevations were largely due to 'operational time-scales' and are not a long-term feature of the tailings leachate. It is noted that the low transmissivity of the tailings will retard seepage in real terms at the field scale.

In brief, except for the initial solutes contained within the ex-mill tailings-slurry-waters, hydro geochemically, the TSF1-Solids and TSF2-Solids both have no significant enrichments in terms of solute liberation through mineral-water-air interactions during weathering.

### 5.2 Recommendations

The findings of this Study have been conclusive and there are no recommendations for further work or study with respect to the temporary Mo or F elevation for the Yangibana tails.

## 6. REFERENCES

ANSTO, Certificate of Analysis, Tailings Column Leachates Testwork, HAST-130318-1 to 22, May 2018

Australian and New Zealand Environment Conservation Council (ANZECC, 2000), Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

Department of Mines and Petroleum (2016), Draft guidance materials characterisation baseline data requirements for mining proposals.

Graeme Campbell and Associates (2017), Yangibana Project: Geochemical Characterisation of Tailings-Slurry (TSF1 and TSF2) Samples – Implications for Process-Tailings Management.

Graeme Campbell and Associates (2016), Yangibana Project: Geochemical and Physical Characterisation of Mine-Waste Samples and Implications for Mine-Waste Management Waste Rock Characterisation.

Hastings Technology Metals Limited (2017), Yangibana Definitive Feasibility Study Technical File Note: Tailings sample generation for testwork.

Landloch (2016b), Yangibana Project Soil Assessment, 2274.16a.

## 7. ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ANZECC | Australian and New Zealand Environment Conservation Council |
| AMD | Acid Mine Drainage |
| DITR | Department of Tourism and Industry |
| DMP | Department of Mines and Petroleum |
| EC | Electrical Conductivity |
| EPA | Environmental Protection Agency |
| ESP | Exchangeable Sodium Percentage |
| GARD | Global Acid Rock Drainage |
| ha | Hectares |
| HPDW ICMM | High Pressure Deionised Water |
| ICMM | International Council on Mining and Metals |
| m | Metres |
| $m^3$ | Cubic metres |
| mg/l | Milligrams per Litre |
| mm | Millimetres |
| mtpa | Million tonnes per annum |
| NAF | Non Acid Forming |
| NEMP | National Environment Protection (Assessment of Site Contamination) Measure |
| NORM | Naturally occurring radioactive material |
| PAF | Potentially Acid Forming |
| pH | Hydrogen Potential |
| ppm | parts per million |
| PSD | particle size distribution |
| RN | Radionuclide |
| ROM | Run of Mine |
| TDS | Total Dissolved Solids |
| TSF | Tailings Storage Facility |
| TSS | Total suspended solids |

## 8. GLOSSARY

| | |
|---|---|
| Acidic and metalliferous drainage | AMD is inclusive of: acidic / metalliferous drainage (encompassing all metals / metalloids / non-metals which may be potential solutes of concern). Drainage may also be variously saline. |
| Dispersive material | Dispersive materials are structurally unstable. They disperse into basic particles sand, silt and clay in fresh water. |
| Fibrous material | A mineral with an aspect ratio of 5:1<br><br>(http://www.dmp.wa.gov.au/documents/Guidelines/MSH_G_<br><br>ManagementOfFibrousMineralsInWaMiningOperations.pdf) |
| Kinetic Testing | Kinetic testing encompasses a group of tests where the acid generation characteristics of a sample are measured with respect to time. |
| Metalliferous drainage | Metalliferous drainage (encompassing all metals/metalloids/non-metals, which may be contaminants of concern) |
| Mineralogy | The mineral assemblage of the rock. There are several methods for determining this including X-Ray powder diffraction. |
| Silicate Material | A compound containing an anionic silicon compound. |
| Static geochemical testing | Static geochemical tests provide information on the bulk geochemical characteristics of material at a point in time. They do not provide information on rates of chemical processes or the rates of release of weathering products. Static tests include acid base accounting tests where measurements are made over a short fixed period of time. |

## 9. APPENDICES

Appendix: 1: "Yangibana Project: Leaching and Weathering Testwork to Assess Solubility Behaviour of TSF1-Solids and TSF2-Solids Samples – Study Update", January 2018

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1706/2

COMPANY: Trajectory Pty Ltd

ATTENTION: Rory Haymont

FROM: Graeme Campbell

SUBJECT: Yangibana Project: Leaching and Weathering Testwork to Assess Solubility Behaviour of **TSF1-Solids** and **TSF2-Solids** Samples – Study Update

NO. PAGES (including this page): 7 DATE: 3rd January 2018

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Rory,

The following presents an update of this study.

## 1.0 SAMPLES

### 1.1 TSF1-Solids

From the static-testing study (GCA 2017), *ca.* 8.5 kg of moist-TSF1-solids were available for the current testwork. With a gravimetric-water content (GWC) of 14.7 % (w/w), this corresponds to *ca.* 6.5 kg (dry-solids basis).

The TSF1-solids sample was pushed through a nylon-sieve with a mesh-sizing of *ca.* 5 mm.

## 1.2 TSF2-Solids

From the static-testing study (GCA 2017), *ca.* 5.5 kg of moist-TSF2-solids were available for the current testwork. With a gravimetric-water-content (GWC) value of 32.4 % (w/w), this corresponds to *ca.* 3.3 kg (dry-solids basis).

The above amount of TSF2-solids was insufficient for use in this study.

A follow-up sample of TSF2-solids was therefore provided by Hastings, and when hand-mixed with the sample above, *ca.* 7.7 kg of moist-TSF2-solids was available for testing herein. With a GWC value of 27.8 % (w/w), this corresponds to *ca.* 5.1 kg (dry-solids basis).

The resulting final TSF2-solids sample was pushed through a nylon-sieve with a mesh-sizing of *ca.* 5 mm.

## 1.3 Site-Groundwater

Bulk borewater samples from bores YWWB01 and PCMB02 were provided by Hastings.

An equal-weight shandy of the above borewaters was prepared as the 'groundwater-feed' in the current study.


The filtered-GW added to the columns had a pH value of 8.41+, and an Electrical-Conductivity (EC) value of 1,520 µS/cm.

## 2.0 SATURATED-LEACHING COLUMNS

### 2.1 Column Packing

Sludges of the TSF1-solids and TSF2-solids samples were prepared by adding high-purity-deionised-water (HPDW), and 'working-up' via hand-mixing.

The resulting 'tailings-slops' corresponded to *ca.* 1.6 kg dry-solids, and 0.64 kg of water (0.40 kg HPDW added) for the TSF1-solids sample, and 1.6 kg dry-solids and 1.00 kg of water (0.55 kg HPDW added) for the TSF2-solid sample.

## 2.2 Packed Columns

The columns were made of acrylic (Perspex®) with an inside-diameter of 90 mm, and wall-thickness of 5 mm. The base of each column was a glued-tight cut-off section of a plastic Büchner funnel. A Whatman-No.-2, coarse filter-paper for rapid filtration uses was placed on top of the perforated column-base.

Two (2) columns were packed with the TSF1-solids, and likewise for the TSF2-solids. The columns for the TSF1-solids samples was 300 mm in length, whereas those for the TSF2-solids samples were 400 mm in length.

The heights of the tailings-beds in the columns were *ca.* 200 mm for TSF-solids and *ca.* 270 mm for TSF-solids.



## 2.3 Leaching @ 30 $^{o}$C in Incubator

Following column packing either groundwater (GW) or HPDW was added to the columns to produce a standing-head of GW or HPDW.

The GW added to the columns was filtered (0.45µm-membrane) groundwater.

The column assemblies were placed in an incubator @ 30 $^{o}$C.

The tops of the columns were covered with watchglasses to minimise evaporation.

Bowls and beakers containing Bridgetown tapwater were also placed in the incubator to raise the relative-humidity, again to minimise evaporative water losses from the test-columns.

Periodically, either GW or HPDW is added to the columns to maintain the standing-head in the columns.

Leachates are collected in 1 L glass beakers positioned beneath each column.

The leachates are collected in lots of *ca.* 800-900 mL each, since 500 mL is required by ANSTO for the radiological determinations.


## 3.0 HUMIDITY-CELLS

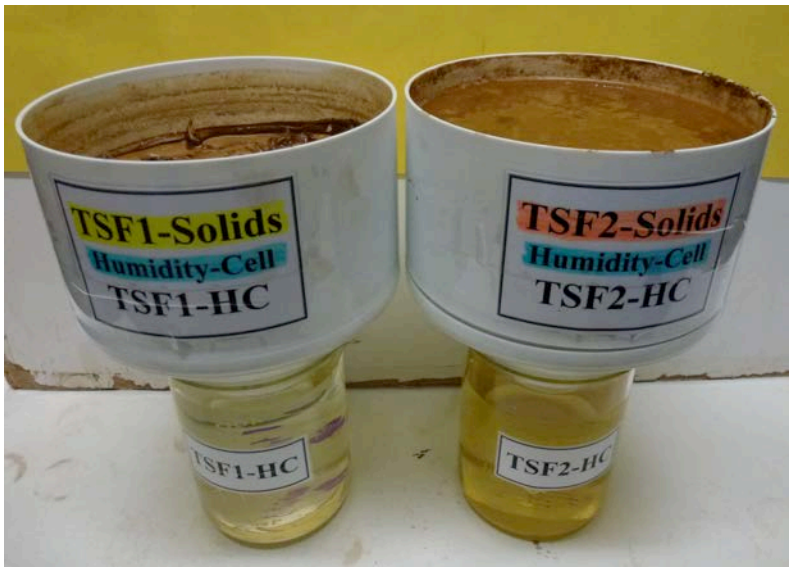
### 3.1 Cells and Initial Pre-Rinsing

The humidity-cell (HC) testing is based on ASTM D5744D (2013) for Option B (i.e. no forced-air-flow).

Each HC was packed with 1.50 kgs (dry-solids-equivalent) of TSF1-solids and TSF2-solids.


1.3 kg of HPDW was initially added to each HC as a pre-rinsing step, and the leachates collected in 1 L glass beakers.

This addition of HPDW produced leachates of 800-900 mL, as required for analysis.




## 2.2 Cell Dewatering and Ageing in Incubator

Following completion of draining from the pre-rinsing step, the HCs were placed under 80 W flood-lamps in order to dewater / desaturate the tailings-beds in the cells.

Under the drying conditions employed, the daily heat-loads applied from the flood-lamps correspond to a pan-evaporation rate within the range 10-20 mm/day.

Dewatering with the flood-lamps will continue until the tailings-beds shrink / crack, and allow breaking-up into clumps with a stainless-steel spatula. The GWC attained at this stage will be estimated from weighing the HCs, etc.



The HCs with desaturated tailings-beds will then be aged in an incubator at 30 $^{o}$C.

The first weathering-cycle will correspond to 2 weeks of ageing in a unsaturated sate followed by flushing with HPDW in a manner similar to that above for the pre-rinsing step.

…….

I trust the above is useful to your current needs.

Regards,

**Dr GD Campbell**
**Director**

Appendix 2: “Yangibana Project: Leaching and Weathering Testwork to Assess Solubility Behaviour of TSF1-Solids and TSF2-Solids Samples – Results & Comments” June 2018.

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|---|---|
| COMPANY: | Trajectory Pty Ltd |
| ATTENTION: | Rory Haymont |
| FROM: | Graeme Campbell |
| SUBJECT: | Yangibana Project: Leaching and Weathering Testwork to Assess Solubility Behaviour of **TSF1-Solids** and **TSF2-Solids** Samples – Results & Comments |

NO. PAGES (including this page): 43 DATE: 18th June 2018

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Rory,

The testwork approach employed in this study is summarised in our earlier **Study Update** dated 3rd January 2018.

The leachate-analysis results obtained for this study are presented in **Table 1**, and shown on **Figures 1-3**.

Copies of the laboratory reports are presented in **Attachment I**.

## 1.0 TSF1-SOLIDS

### 1.1 Saturated-Leaching Columns (SLCs)

1.1.2 Deionised-Water

The SLC corresponding to leaching with high-purity-deionised-water (HPDW) was characterised by a swift elution of 'resident-solutes' associated with the wet tailings-sludge (**Table 1** and **Figure 1**).

Leachate-**F** and leachate-**Mo** concentrations each within the mg/L range initially rapidly dropped during leaching approaching 'of-the-order' 100 µg/L for F (**Figure 2**), and 10 µg/L for Mo (**Figure 3**).

The concentrations of a wide range of minor-elements (e.g. Li, Y, etc.) swiftly trended to either below, or close to, the respective detection-limits (0.001-10 µg/L range typically).

1.1.3 Groundwater

The SLC corresponding to leaching with groundwater essentially showed the same 'leaching/solubility-profile' observed above for HPDW, save for trending to the chemistry of the 'feed-solution' (i.e. groundwater) [**Table 1**, and **Figures 1-3**].

The leachate-**Mo** concentration trended to be 'of-the-order' 100 µg/L (cf. 10 µg/L for HPDW) [**Figure 3**], and may reflect a combination of effects arising from greater ionic-strength, and competitive-sorption reactions, associated with the chemistry of the groundwater.

## 1.2 Humidity-Cell

The readily elution of 'resident-solutes', as shown above, was also exhibited by the humidity-cell testing (**Table 1**).

## 2.0 TSF2-SOLIDS

## 2.1 Saturated-Leaching Columns (SLCs)

2.1.2 Deionised-Water

Although the flushing of the TSF2-Solids is much slower than that for the 'less-clay-enriched' TSF1-Solids, the overall 'trend-lines' in solubility behaviour are nonetheless similar (**Table 1**, and **Figures 1-3**).

2.1.3 Groundwater

The 'trend-lines' in solubility behaviour are similar to those for the TSF1-Solids above, though with a much slower rate of development (**Table 1** and **Figures 1-3**).

## 2.2 Humidity-Cell

The readily elution of 'resident-solutes' observed for the TSF1-Solids was also exhibited for the humidity-cell testing of the TSF2-Solids (**Table 1**).

## 3.0 CONCLUSIONS

Apart from being characterised by differences in permeability, the TSF1-Solids and TSF2-Solids samples possess very similar chemistries in terms of their ability to buffer the quality of 'contact-waters', whether the 'feed-solution' is either HPDW (broadly mimicking rainwater), or groundwater.

This chiefly reflects:

- maintenance of circum-neutral-pH to perpetuity, due to 'zero-sulphides', and hydrolysis of silicates and sesquioxides, together with some buffering by dissociated fatty-acids added during flotation

- high stability of bound-element forms – both metal-hydroxo and oxyanionic species – courtesy of abundant Fe(III)-oxyhydroxides ($Fe_{total}$ contents of *ca.* 8-10 %) typified by sorption reactions of the 'high-

affinity / poorly-reversible' type (e.g. 'inner-sphere' surface-complexes, etc.).[1]

In brief, save for the initial solutes contained within the ex-mill tailings-slurry-waters, hydrogeochemically, the TSF1-Solids and TSF2-Solids both have "little to give" in terms of solute liberation through mineral-water-air interactions during weathering.

I trust that the above is useful to your current needs.

Regards,

**Dr GD Campbell**
**Director**

encl. Table 1 Figures 1-3
Attachment I

[1] The ferruginous state of the TSF1-Solids and TSF2-Solids largely reflects ironstone hosting mineralisation.

**TABLE**

## Table 1: Leachate-Analysis Results

| | Leachate Weight (kg) | Pore-Volumes (cumulative) | pH | pH (GCA) | EC (µS/cm) | EC (GCA, µS/cm) | HCO3 (as mg CaCO3/L) | CO3 (as mg CaCO3/L) | Cl | SO4 | Ca | Mg | K | Na | Al | Fe | Si | F | P | As | Sb | Se | Mo | B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | mg/L | | mg/L | | | | | | | mg/L | | µg/L | | | | |
| ***Saturated-Leaching-Columns (SLCs)*** | | | | | | | | | | | | | | | | | | | | | | | | |
| **TSF1-Solids** | | | | | | | | | | | | | | | | | | | | | | | | |
| TSF1-SLC-HPDW-1 | 0.92 | 1.1 | 8.5 | 8.92+ | 2,281 | 2,340 | 626 | 11 | 258 | 110 | 1.13 | 0.16 | 10.8 | 497.9 | 0.04 | <0.01 | 12.98 | 7.4 | 1.9 | 29.9 | 0.98 | 3.9 | 1,105.13 | 400 |
| TSF1-SLC-HPDW-2 | 0.95 | 2.2 | 8.4 | 9.52+ | 815 | 832 | 315 | 86 | 4 | 2 | | | | | 0.10 | <0.01 | 23.19 | 3.9 | 3.8 | 59.9 | | 1.1 | 36.21 | 200 |
| TSF1-SLC-HPDW-3 | 0.96 | 3.3 | 7.6 | 9.58+ | 551 | 563 | 274 | <1 | <2 | 1 | | | | | 0.14 | <0.01 | 31.87 | 1.5 | 1.8 | 36.3 | | 1.0 | 13.15 | 80 |
| TSF1-SLC-HPDW-4 | 0.95 | 4.3 | 8.4 | 9.51+ | 433 | 422 | 150 | 63 | <2 | <1 | | | | | 0.15 | 0.01 | 33.79 | 0.9 | 1.0 | 19.2 | | 0.8 | 9.55 | 30 |
| TSF1-SLC-HPDW-5 | 0.95 | 5.4 | 7.0 | 9.34+ | 320 | 316 | 156 | <1 | <2 | <1 | | | | | 0.18 | <0.01 | 29.73 | 0.6 | 0.6 | 11.3 | | 0.5 | 7.33 | 10 |
| TSF1-SLC-HPDW-6 | 0.95 | 6.5 | 7.8 | 8.92+ | 225 | 224 | 117 | <1 | <2 | <1 | 0.66 | 0.01 | 2.9 | 50.9 | 0.18 | <0.01 | 23.84 | 0.4 | 0.3 | 7.9 | 0.12 | <0.5 | 6.93 | <10 |
| TSF1-SLC-GW-1 | 0.93 | 1.1 | 7.1 | 8.89+ | 2,700 | 2,760 | 589 | <1 | 368 | 149 | 1.26 | 0.14 | 12.5 | 577.4 | 0.10 | <0.01 | 11.68 | 7.2 | 1.3 | 31.7 | 0.82 | 5.4 | 1,072.79 | 400 |
| TSF1-SLC-GW-2 | 0.96 | 2.2 | 8.4 | 9.07+ | 1,773 | 1,785 | 317 | 19 | 253 | 81 | | | | | 0.08 | <0.01 | 15.22 | 3.3 | 1.9 | 27.2 | | 2.3 | 44.06 | 430 |
| TSF1-SLC-GW-3 | 0.95 | 3.3 | 8.5 | 9.12+ | 1,633 | 1,617 | 245 | 27 | 255 | 81 | | | | | 0.06 | <0.01 | 15.42 | 1.4 | 1.5 | 20.4 | | 2.3 | 28.40 | 400 |
| TSF1-SLC-GW-4 | 0.95 | 4.4 | 7.6 | 9.11+ | 1,586 | 1,559 | 238 | <1 | 270 | 80 | | | | | 0.06 | 0.01 | 15.24 | 1.0 | 0.8 | 14.4 | | 2.1 | 69.48 | 380 |
| TSF1-SLC-GW-5 | 0.94 | 5.4 | 7.4 | 8.59+ | 1,457 | 1,489 | 180 | <1 | 263 | 78 | | | | | 0.05 | <0.01 | 11.54 | 0.9 | 0.2 | 5.7 | | 1.2 | 96.51 | 400 |
| TSF1-SLC-GW-6 | 0.93 | 6.5 | 7.8 | 8.39+ | 1,415 | 1,458 | 176 | <1 | 275 | 78 | 24.88 | 26.28 | 40.0 | 199.6 | 0.01 | <0.01 | 10.86 | 1.4 | <0.1 | 2.4 | 0.05 | 1.3 | 117.15 | 450 |
| **TSF2-Solids** | | | | | | | | | | | | | | | | | | | | | | | | |
| TSF2-SLC-HPDW-1 | 0.95 | 0.78 | 8.5 | 8.81+ | 5,840 | 6,090 | 1,749 | 48 | 1,325 | 228 | 7.09 | 0.11 | 18.7 | 1,559 | <0.01 | 0.07 | 68.35 | 10.5 | 5.0 | 101.3 | 2.69 | 25.1 | 1,768.29 | 400 |
| TSF2-SLC-HPDW-2 | 0.98 | 1.6 | 9.0 | 8.32+ | 1,677 | 1,698 | 727 | 154 | 22 | 7 | 0.92 | 0.04 | 5.5 | 460.3 | <0.01 | <0.01 | 76.08 | 11.3 | 11.8 | 119.7 | 2.62 | 5.3 | 61.58 | 630 |
| TSF2-SLC-HPDW-3 | 1.01 | 2.4 | 9.1 | 8.89+ | 1,141 | 1,163 | 472 | 156 | 5 | 3 | 0.43 | <0.01 | 2.8 | 259.6 | <0.01 | <0.01 | 65.63 | 4.3 | 7.7 | 36.9 | 1.11 | 3.0 | 31.97 | 210 |
| TSF2-SLC-GW-1 | 0.96 | 0.79 | 8.8 | 8.71+ | 6,210 | 6,550 | 1,740 | 160 | 1,463 | 255 | 7.53 | 0.18 | 19.4 | 1,656 | <0.01 | <0.01 | 65.44 | 9.8 | 4.1 | 93.2 | 2.47 | 25.7 | 1,953.09 | 400 |
| TSF2-SLC-GW-2 | 1.01 | 1.6 | 8.7 | 8.52+ | 2,840 | 2,930 | 720 | 125 | 325 | 104 | 1.66 | <0.01 | 7.3 | 615.4 | <0.01 | <0.01 | 62.14 | 10.9 | 7.5 | 125.1 | 2.93 | 10.5 | 185.55 | 590 |
| TSF2-SLC-GW-3 | 0.99 | 2.4 | 8.9 | 8.83+ | 2,234 | 2,350 | 374 | 192 | 305 | 76 | 1.07 | <0.01 | 4.6 | 413.5 | 0.02 | <0.01 | 79.40 | 4.3 | 6.0 | 36.0 | 1.12 | 5.2 | 168.81 | 350 |
| **Feed-Solutions** | | | | | | | | | | | | | | | | | | | | | | | | |
| GW | | | 8.3 | 8.46+ | **1,496** | **1,576** | 207 | <1 | **265** | **83** | 67.87 | 45.86 | 6.9 | 184.5 | <0.01 | <0.01 | 19.44 | **1.7** | <0.1 | 2.9 | 0.11 | 1.3 | 18.40 | **470** |
| HPDW | | | 5.2 | | <10 | | 2 | <1 | <2 | <1 | <0.01 | <0.01 | <0.1 | <0.01 | <0.01 | <0.01 | <0.05 | <0.1 | <0.1 | <0.1 | <0.01 | <0.5 | <0.05 | 110 |
| ***Humidity-Cells (HCs)*** | | | | | | | | | | | | | | | | | | | | | | | | |
| **TSF1-Solids** | | | | | | | | | | | | | | | | | | | | | | | | |
| TSF1-HC-0 | 0.91 | | 9.2 | 9.37+ | 2,430 | 2,630 | 397 | 249 | 310 | 135 | 1.44 | 0.19 | 11.3 | 553.7 | 0.05 | <0.01 | 13.75 | 5.8 | 1.6 | 39.2 | 0.50 | 5.4 | 1,154.82 | 340 |
| TSF1-HC-1 | 0.92 | | 8.1 | 8.88+ | 751 | 816 | 400 | <1 | 7 | 7 | | | | | 0.11 | 0.02 | 17.60 | 4.0 | 2.1 | 24.7 | | 1.0 | 136.28 | 220 |
| TSF1-HC-2 | 0.91 | | 8.4 | 8.82+ | 525 | 566 | 240 | 41 | 3 | 2 | 0.59 | 0.04 | 3.7 | 127.8 | 0.05 | 0.10 | 14.11 | 2.3 | 1.7 | 25.8 | 0.22 | 0.8 | 27.97 | 70 |
| TSF1-HC-3 | 0.93 | | 8.2 | 7.76+ | 429 | 441 | 226 | <1 | 6 | 2 | | | | | 0.04 | 0.08 | 11.96 | 1.7 | | 12.5 | | 0.5 | 19.01 | 30 |
| TSF1-HC-4 | 0.89 | | 8.1 | 7.93+ | 348 | 359 | 182 | <1 | <2 | 1 | | | | | 0.12 | 0.30 | 11.51 | 1.3 | | 77.3 | | <0.5 | 14.02 | 10 |
| **TSF2-Solids** | | | | | | | | | | | | | | | | | | | | | | | | |
| TSF2-HC-0 | 0.88 | | 8.4 | 8.62+ | 4,440 | 4,800 | 1,356 | 67 | 535 | 167 | 5.12 | 0.17 | 14.4 | 1,163 | <0.01 | 0.01 | 52.77 | 5.4 | 5.5 | 46.4 | 0.85 | 14.9 | 1,231.92 | 360 |
| TSF2-HC-1 | 0.91 | | 7.5 | 7.73+ | 2,141 | 2,420 | 918 | <1 | 300 | 54 | | | | | 0.01 | <0.01 | 54.69 | 4.1 | 4.1 | 37.2 | | 4.7 | 413.48 | 220 |
| TSF2-HC-2 | 0.92 | | 7.8 | 8.71+ | 1,030 | 1,106 | 469 | <1 | 45 | 16 | 1.54 | 0.05 | 4.0 | 273.7 | <0.01 | <0.01 | 37.80 | 1.8 | 1.9 | 23.0 | 0.32 | 1.4 | 120.20 | 80 |
| TSF2-HC-3 | 0.93 | | 8.0 | 7.53+ | 737 | 770 | 339 | <1 | 15 | 10 | | | | | 0.02 | <0.01 | 29.66 | 1.3 | | 15.1 | | 0.9 | 77.46 | 50 |
| TSF2-HC-4 | 0.90 | | 8.2 | 7.62+ | 647 | 590 | 310 | <1 | 17 | 7 | | | | | 0.06 | <0.01 | 30.16 | 1.2 | | 12.4 | | 0.8 | 62.02 | 40 |

| | Leachate Wt. (kg) | Pore-Volumes (cumulative) | Cu | Zn | Cd | Pb | Hg | Ni | Cr | Co | Mn | Ag | Bi | Sr | Ba | Sn | Tl | V | Th | U | Li | Be | Ce | Dy | Eu | Gd | La | Pr | Nd | Sm | Y | Zr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | µg/L | | | | | | | | | | | | | | | | | | | µg/L | | | | | | | | | | |
| ***Saturated-Leaching-Columns (SLCs)*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TSF1-Solids** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TSF1-SLC-HPDW-1 | 0.92 | 1.1 | <10 | 0.03 | <0.5 | <2 | <0.1 | <10 | 0.01 | 0.4 | <10 | 0.05 | 0.019 | 9.88 | 7.5 | <0.1 | 0.06 | 180 | <0.005 | 302.1 | 11.74 | 0.1 | 0.008 | 0.003 | 0.008 | 0.015 | 0.006 | 0.003 | 0.028 | <0.002 | 0.028 | <0.02 |
| TSF1-SLC-HPDW-2 | 0.95 | 2.2 | | | | <2 | | | | | | | | | | | | | | | 4.07 | | | | | | | | | | 0.009 | |
| TSF1-SLC-HPDW-3 | 0.96 | 3.3 | | | | <2 | | | | | | | | | | | | | | | 2.56 | | | | | | | | | | 0.009 | |
| TSF1-SLC-HPDW-4 | 0.95 | 4.3 | | | | <2 | | | | | | | | | | | | | | | 2.14 | | | | | | | | | | 0.006 | |
| TSF1-SLC-HPDW-5 | 0.95 | 5.4 | | | | <2 | | | | | | | | | | | | | | | 1.99 | | | | | | | | | | <0.005 | |
| TSF1-SLC-HPDW-6 | 0.95 | 6.5 | <10 | <10 | <0.5 | <2 | <0.1 | <10 | <10 | <0.1 | <10 | 0.01 | <0.005 | 2.22 | 1.34 | <0.1 | 0.02 | 70 | <0.005 | 2.371 | 1.83 | <0.1 | 0.009 | <0.002 | <0.001 | <0.001 | 0.005 | 0.002 | 0.011 | 0.007 | <0.005 | <0.02 |
| TSF1-SLC-GW-1 | 0.93 | 1.1 | <10 | 30 | <0.5 | <2 | <0.1 | <10 | 10 | 0.6 | <10 | 0.04 | 0.017 | 11.22 | 7.03 | 0.3 | 0.06 | 130 | <0.005 | 319.97 | 12.54 | <0.1 | 0.029 | 0.006 | 0.006 | 0.019 | 0.013 | 0.002 | 0.083 | <0.002 | 0.017 | <0.02 |
| TSF1-SLC-GW-2 | 0.96 | 2.2 | | | | <2 | | | | | | | | | | | | | | | 8.18 | | | | | | | | | | 0.020 | |
| TSF1-SLC-GW-3 | 0.95 | 3.3 | | | | <2 | | | | | | | | | | | | | | | 7.46 | | | | | | | | | | 0.047 | |
| TSF1-SLC-GW-4 | 0.95 | 4.4 | | | | <2 | | | | | | | | | | | | | | | 8.53 | | | | | | | | | | 0.017 | |
| TSF1-SLC-GW-5 | 0.94 | 5.4 | | | | <2 | | | | | | | | | | | | | | | 52.52 | | | | | | | | | | 0.007 | |
| TSF1-SLC-GW-6 | 0.93 | 6.5 | <10 | <10 | <0.5 | <2 | <0.1 | <10 | <10 | <0.1 | 10 | 0.05 | 0.006 | 218.53 | 131.4 | 0.1 | 0.23 | <10 | <0.005 | 97.69 | 82.96 | <0.1 | <0.002 | <0.002 | <0.001 | <0.001 | 0.006 | <0.001 | <0.002 | <0.002 | <0.005 | <0.02 |
| **TSF2-Solids** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TSF2-SLC-HPDW-1 | 0.95 | 0.78 | 70 | <10 | <0.5 | <2 | 0.2 | <10 | 20 | 3.8 | 10 | 0.67 | <0.005 | 48.57 | 12.78 | 0.1 | 0.13 | 770 | 0.014 | 186.36 | 12.11 | <0.1 | 0.083 | 0.068 | 0.042 | 0.154 | 0.020 | 0.058 | 0.40 | 0.133 | 0.102 | 0.09 |
| TSF2-SLC-HPDW-2 | 1.0 | 1.6 | 10 | <10 | <0.5 | <2 | <0.1 | 20 | <10 | 0.8 | <10 | <0.01 | <0.005 | 3.74 | 0.58 | <0.1 | 0.04 | 2,100 | 0.024 | 6.500 | 2.94 | <0.1 | 0.077 | 0.007 | 0.003 | | 0.044 | 0.021 | | 0.015 | 0.026 | 0.05 |
| TSF2-SLC-HPDW-3 | 1.0 | 2.4 | <10 | <10 | <0.5 | <2 | <0.1 | <10 | <10 | 0.4 | <10 | <0.01 | <0.005 | 1.76 | 0.25 | <0.1 | 0.03 | 440 | <0.005 | 1.260 | 2.25 | <0.1 | 0.070 | <0.002 | <0.001 | | 0.029 | 0.011 | | <0.002 | <0.005 | 0.06 |
| TSF2-SLC-GW-1 | 1.0 | 0.8 | 60 | 10 | <0.5 | <2 | 0.2 | <10 | 40 | 4.0 | 20 | 0.03 | <0.005 | 53.85 | 13.63 | 0.1 | 0.12 | 640 | 0.01 | 170.16 | 12.93 | 0.2 | 0.076 | 0.054 | 0.041 | 0.138 | 0.024 | 0.034 | 0.435 | 0.089 | 0.125 | 0.03 |
| TSF2-SLC-GW-2 | 1.0 | 1.6 | 10 | <10 | <0.5 | <2 | <0.1 | 10 | <10 | 1.2 | <10 | 0.02 | <0.005 | 10.36 | 1.42 | <0.1 | 0.07 | 1,630 | 0.006 | 14.356 | 4.32 | <0.1 | 0.059 | 0.006 | <0.001 | | 0.024 | 0.004 | | 0.003 | 0.020 | <0.02 |
| TSF2-SLC-GW-3 | 1.0 | 2.4 | <10 | <10 | <0.5 | <2 | <0.1 | <10 | <10 | 0.6 | <10 | <0.01 | <0.005 | 7.08 | 0.80 | <0.1 | 0.05 | 480 | <0.005 | 4.704 | 3.43 | <0.1 | 0.065 | 0.004 | <0.001 | | 0.013 | 0.005 | | 0.006 | <0.005 | <0.02 |
| **Feed-Solutions** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GW | | | <10 | <10 | <0.5 | <2 | <0.1 | <10 | <10 | <0.1 | <10 | 0.69 | 0.217 | 678.23 | 64.7 | 0.3 | 0.03 | <10 | <0.005 | 15.70 | 17.99 | 0.2 | 0.015 | <0.002 | <0.001 | <0.001 | 0.014 | <0.001 | 0.018 | <0.002 | 0.037 | 0.19 |
| HPDW | | | <10 | <10 | <0.5 | <2 | <0.1 | <10 | <10 | <0.1 | <10 | <0.01 | <0.005 | 0.07 | 0.08 | <0.1 | <0.01 | <10 | <0.005 | 0.195 | <0.05 | <0.1 | <0.002 | <0.002 | <0.001 | <0.001 | <0.002 | <0.001 | 0.004 | <0.002 | <0.005 | <0.02 |
| ***Humidity-Cells (HCs)*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TSF1-Solids** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TSF1-HC-0 | 0.91 | | <10 | 50 | <0.5 | <2 | <0.1 | <10 | 10 | 0.7 | <10 | 0.18 | 0.072 | 11.43 | 13.62 | 0.2 | 0.07 | 180 | 0.008 | 322.36 | 9.48 | <0.1 | 0.097 | 0.003 | 0.002 | 0.005 | 0.021 | 0.018 | 0.046 | 0.007 | 0.050 | <0.02 |
| TSF1-HC-1 | 0.92 | | | | | <2 | | | | | | | | | | | | | | | 5.57 | | | | | | | | | | | |
| TSF1-HC-2 | 0.91 | | <10 | <10 | <0.5 | <2 | <0.1 | <10 | <10 | 0.1 | <10 | <0.01 | 0.005 | 3.64 | 2.77 | <0.1 | 0.03 | 150 | 0.046 | 115.10 | 6.17 | <0.1 | 0.360 | 0.013 | 0.002 | 0.011 | 0.058 | 0.044 | 0.167 | 0.023 | 0.021 | 0.03 |
| TSF1-HC-3 | 0.93 | | | | | | | | | | | | | | | | | 100 | | | 4.95 | | | | | | | | | | 0.014 | |
| TSF1-HC-4 | 0.89 | | | | | | | | | | | | | | | | | 80 | | | 5.80 | | | | | | | | | | 0.039 | |
| **TSF2-Solids** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TSF2-HC-0 | 0.88 | | 40 | <10 | <0.5 | <2 | <0.1 | <10 | 60 | 2.4 | <10 | 0.04 | 0.011 | 31.84 | 8.96 | <0.1 | 0.05 | 330 | 0.031 | 322.9 | 9.44 | <0.1 | 0.079 | 0.0510 | 0.024 | 0.075 | 0.033 | 0.038 | 0.295 | 0.048 | 0.104 | <0.02 |
| TSF2-HC-1 | 0.91 | | | | | <2 | | | | | | | | | | | | | | | 9.14 | | | | | | | | | | 0.064 | |
| TSF2-HC-2 | 0.92 | | <10 | <10 | <0.5 | <2 | <0.1 | <10 | <10 | 0.3 | <10 | 0.01 | <0.005 | 8.12 | 2.47 | <0.1 | 0.04 | 150 | 0.012 | 41.25 | 5.06 | <0.1 | 0.427 | 0.0100 | 0.005 | 0.040 | 0.027 | 0.017 | 0.132 | 0.005 | 0.020 | <0.02 |
| TSF2-HC-3 | 0.93 | | | | | | | | | | | | | | | | | 80 | | | 6.13 | | | | | | | | | | 0.028 | |
| TSF2-HC-4 | 0.90 | | | | | | | | | | | | | | | | | 70 | | | 6.46 | | | | | | | | | | 0.019 | |

**FIGURES**

**Figure 1**

**Variation in Leachate-EC Values for Saturated-Leaching Columns**

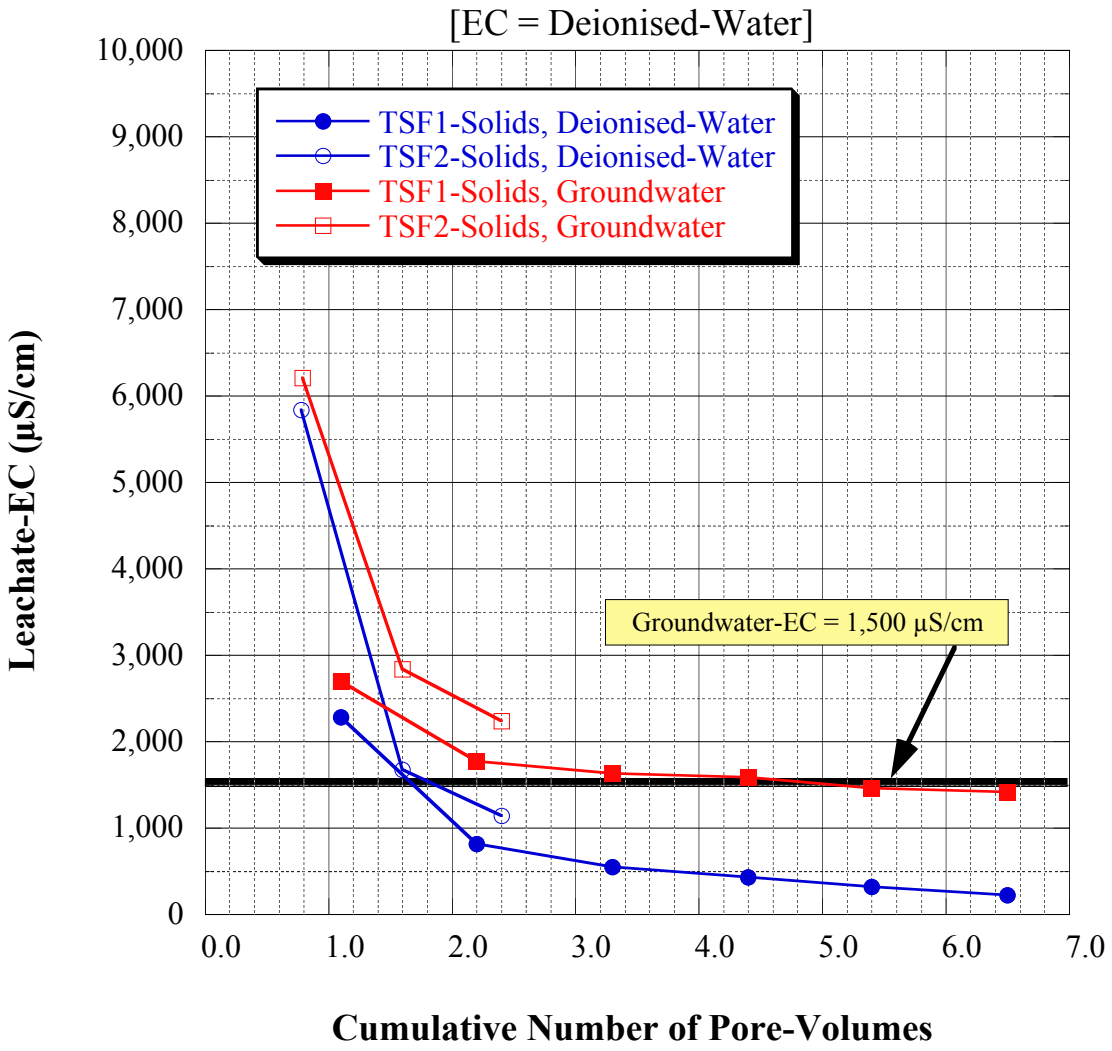


**Figure 2**

**Variation in Leachate-F Concentrations for Saturated-Leaching Columns**

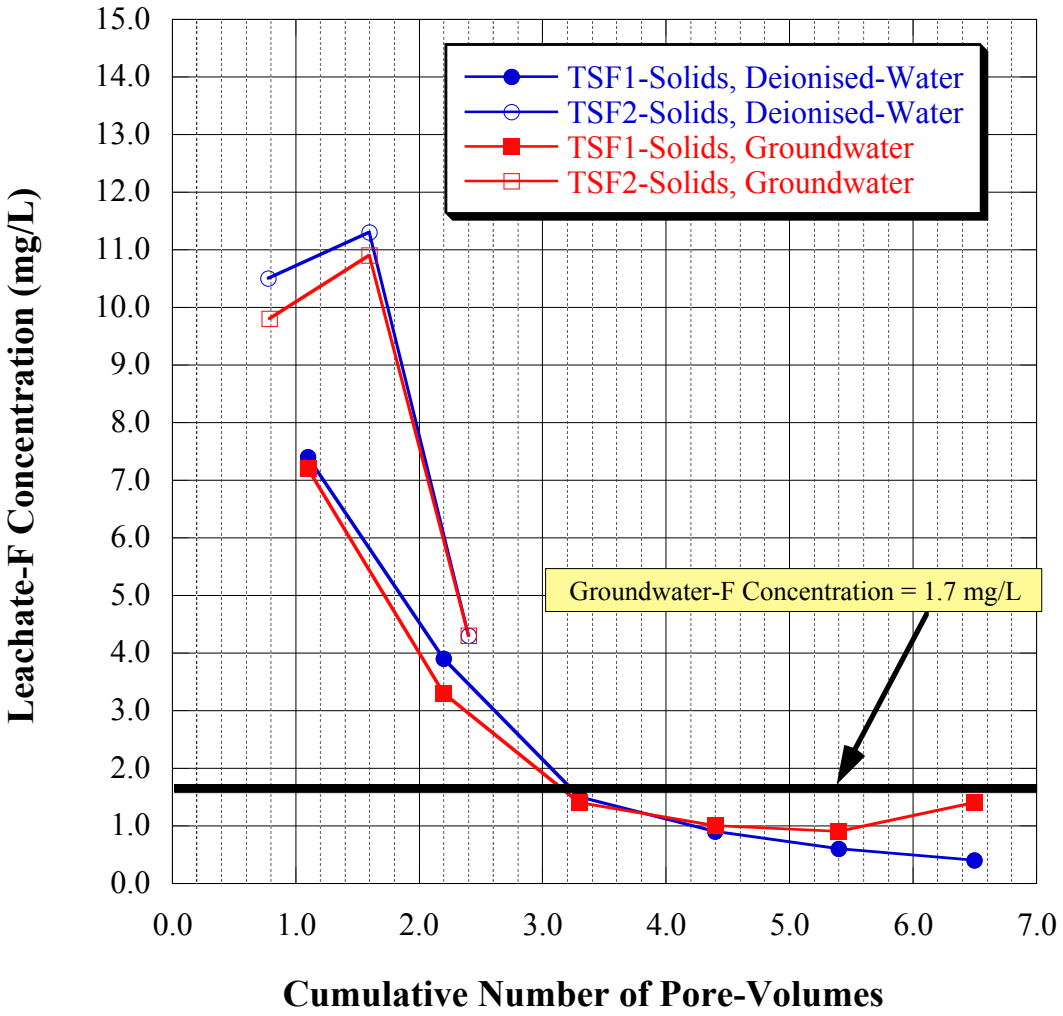
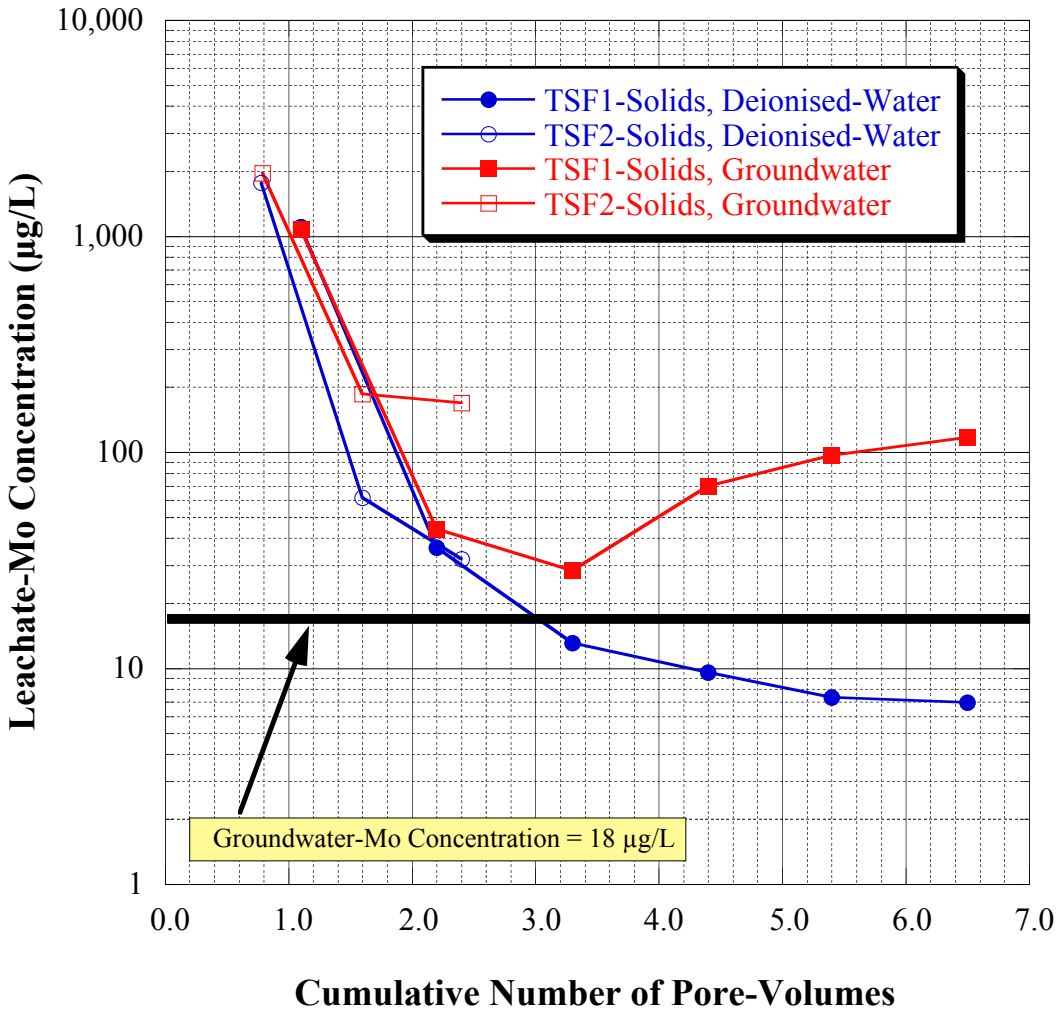


**Figure 3**

**Variation in Leachate-Mo Concentrations for Saturated-Leaching Columns**



# ATTACHMENT I

# LABORATORY REPORTS

# MINERALS
# TEST REPORT

**CLIENT**

**CAMPBELL, GRAEME and ASSOCIATES**
PO Box 247
BRIDGETOWN, W.A. 6255
AUSTRALIA

**JOB INFORMATION**

| | |
|---|---|
| JOB CODE | : 143.0/1801803 |
| NO. SAMPLES | : 50 |
| NO. ELEMENTS | : 50 |
| CLIENT ORDER NO. | : GCA1706/2 (Job 1 of 1) |
| SAMPLE SUBMISSION NO. | : |
| PROJECT | : YANGIBANA |
| SAMPLE TYPE | : Solutions |
| DATE RECEIVED | : 09/02/2018 |
| DATE REPORTED | : 23/05/2018 |
| DATE PRINTED | : 23/05/2018 |

**REPORT NOTES**

**TESTED BY**

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**SIGNIFICANT FIGURES**

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that figures beyond the least significant digit have significance.

For more information on the uncertainty on individual reported values, please contact the laboratory.

**SAMPLE STORAGE**

All solid samples (assay pulps, bulk pulps and residues will be stored for 60 days without charge. Following this samples will be stored at a daily rate until clients written advice regarding return, collection or disposal is received. If storage information is not supplied on the submission, or arranged with the laboratory in writing the default will be to store the samples with the applicable charges. Storage is charged at $4.00 per m3 per day, expenses related to the return or disposal of samples will be charged at cost. Current disposal cost is charged at $150.00 per m3.

Samples received as liquids, waters or solutions will be held for 60 days free of charge then disposed of, unless written advice fo return or collection is received.

| | | | | | |
|---|---|---|---|---|---|
| **LEGEND** | X | = Less than Detection Limit | NA | = | Not Analysed |
| | SNR | = Sample Not Received | UA | = | Unable to Assay |
| | * | = Result Checked | > | = | Value beyond Limit of Method |
| | DTF | = Result still to come | + | = | Extra Sample Received Not Listed |
| | IS | = Insufficient Sample for Analysis | | | |

| ELEMENTS | Ag | Al | As | B | Ba | Be |
|---|---|---|---|---|---|---|
| UNITS | ug/l | mg/l | ug/l | mg/l | ug/l | ug/l |
| DETECTION LIMIT | 0.01 | 0.01 | 0.1 | 0.01 | 0.05 | 0.1 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /OE | /MS | /OE | /MS | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | | | | | |
| 0002 TSF1-SLC-HPDW-2 RAW | | | | | | |
| 0003 TSF1-SLC-HPDW-3 RAW | | | | | | |
| 0004 TSF1-SLC-HPDW-4 RAW | | | | | | |
| 0005 TSF1-SLC-HPDW-5 RAW | | | | | | |
| 0006 TSF1-SLC-HPDW-6 RAW | | | | | | |
| 0007 TSF1-SLC-GW-1 RAW | | | | | | |
| 0008 TSF1-SLC-GW-2 RAW | | | | | | |
| 0009 TSF1-SLC-GW-3 RAW | | | | | | |
| 0010 TSF1-SLC-GW-4 RAW | | | | | | |
| 0011 TSF1-SLC-GW-5 RAW | | | | | | |
| 0012 TSF1-SLC-GW-6 RAW | | | | | | |
| 0013 TSF2-SLC-HPDW-1 RAW | | | | | | |
| 0014 TSF2-SLC-GW-1 RAW | | | | | | |
| 0015 HPDW RAW | | | | | | |
| 0016 GW RAW | | | | | | |
| 0017 TSF1-HC-0 RAW | | | | | | |
| 0018 TSF1-HC-1 RAW | | | | | | |
| 0019 TSF1-HC-2 RAW | | | | | | |
| 0020 TSF2-HC-0 RAW | | | | | | |
| 0021 TSF2-HC-1 RAW | | | | | | |
| 0022 TSF2-HC-2 RAW | | | | | | |
| 0023 TSF1-SLC-HPDW-1 HNO3 | 0.05 | 0.04 | 29.9 | 0.40 | 7.50 | 0.1 |
| 0024 TSF1-SLC-HPDW-2 HNO3 | | 0.10 | 59.9 | 0.20 | | |
| 0025 TSF1-SLC-HPDW-3 HNO3 | | 0.14 | 36.3 | 0.08 | | |
| 0026 TSF1-SLC-HPDW-4 HNO3 | | 0.15 | 19.2 | 0.03 | | |
| 0027 TSF1-SLC-HPDW-5 HNO3 | | 0.18 | 11.3 | 0.01 | | |
| 0028 TSF1-SLC-HPDW-6 HNO3 | 0.01 | 0.18 | 7.9 | X | 1.34 | X |
| 0029 TSF1-SLC-GW-1 HNO3 | 0.04 | 0.10 | 31.7 | 0.40 | 7.03 | X |
| 0030 TSF1-SLC-GW-2 HNO3 | | 0.08 | 27.2 | 0.43 | | |
| 0031 TSF1-SLC-GW-3 HNO3 | | 0.06 | 20.4 | 0.40 | | |
| 0032 TSF1-SLC-GW-4 HNO3 | | 0.06 | 14.4 | 0.38 | | |
| 0033 TSF1-SLC-GW-5 HNO3 | | 0.05 | 5.7 | 0.40 | | |
| 0034 TSF1-SLC-GW-6 HNO3 | 0.05 | 0.01 | 2.4 | 0.45 | 131.35 | X |
| 0035 TSF2-SLC-HPDW-1 RAW | 0.67 | X | 101.3 | 0.40 | 12.78 | X |
| 0036 TSF2-SLC-GW-1 RAW | 0.03 | X | 93.2 | 0.40 | 13.63 | 0.2 |
| 0037 HPDW HNO3 | X | X | X | 0.11 | 0.08 | X |
| 0038 GW HNO3 | 0.69 | X | 2.9 | 0.47 | 64.70 | 0.2 |
| 0039 TSF1-HC-0 HNO3 | 0.18 | 0.05 | 39.2 | 0.34 | 13.62 | X |
| 0040 TSF1-HC-1 HNO3 | | 0.11 | 24.7 | 0.22 | | |

| ELEMENTS | Bi | CO3 | Ca | Cd | Ce | Cl |
|---|---|---|---|---|---|---|
| UNITS | ug/l | mgCaCO3/L | mg/l | ug/l | ug/l | mg/l |
| DETECTION LIMIT | 0.005 | 1 | 0.01 | 0.5 | 0.002 | 2 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /VOL | /OE | /MS | /MS | /COL |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | 11 | | | | 258 |
| 0002 TSF1-SLC-HPDW-2 RAW | | 86 | | | | 4 |
| 0003 TSF1-SLC-HPDW-3 RAW | | X | | | | X |
| 0004 TSF1-SLC-HPDW-4 RAW | | 63 | | | | X |
| 0005 TSF1-SLC-HPDW-5 RAW | | X | | | | X |
| 0006 TSF1-SLC-HPDW-6 RAW | | X | | | | X |
| 0007 TSF1-SLC-GW-1 RAW | | X | | | | 368 |
| 0008 TSF1-SLC-GW-2 RAW | | 19 | | | | 253 |
| 0009 TSF1-SLC-GW-3 RAW | | 27 | | | | 255 |
| 0010 TSF1-SLC-GW-4 RAW | | X | | | | 270 |
| 0011 TSF1-SLC-GW-5 RAW | | X | | | | 263 |
| 0012 TSF1-SLC-GW-6 RAW | | X | | | | 275 |
| 0013 TSF2-SLC-HPDW-1 RAW | | 48 | | | | 1325 |
| 0014 TSF2-SLC-GW-1 RAW | | 160 | | | | 1463 |
| 0015 HPDW RAW | | X | | | | X |
| 0016 GW RAW | | X | | | | 265 |
| 0017 TSF1-HC-0 RAW | | 249 | | | | 310 |
| 0018 TSF1-HC-1 RAW | | X | | | | 7 |
| 0019 TSF1-HC-2 RAW | | 41 | | | | 3 |
| 0020 TSF2-HC-0 RAW | | 67 | | | | 535 |
| 0021 TSF2-HC-1 RAW | | X | | | | 300 |
| 0022 TSF2-HC-2 RAW | | X | | | | 45 |
| 0023 TSF1-SLC-HPDW-1 HNO3 | 0.019 | | 1.13 | X | 0.008 | |
| 0024 TSF1-SLC-HPDW-2 HNO3 | | | | | | |
| 0025 TSF1-SLC-HPDW-3 HNO3 | | | | | | |
| 0026 TSF1-SLC-HPDW-4 HNO3 | | | | | | |
| 0027 TSF1-SLC-HPDW-5 HNO3 | | | | | | |
| 0028 TSF1-SLC-HPDW-6 HNO3 | X | | 0.66 | X | 0.009 | |
| 0029 TSF1-SLC-GW-1 HNO3 | 0.017 | | 1.26 | X | 0.029 | |
| 0030 TSF1-SLC-GW-2 HNO3 | | | | | | |
| 0031 TSF1-SLC-GW-3 HNO3 | | | | | | |
| 0032 TSF1-SLC-GW-4 HNO3 | | | | | | |
| 0033 TSF1-SLC-GW-5 HNO3 | | | | | | |
| 0034 TSF1-SLC-GW-6 HNO3 | 0.006 | | 24.88 | X | X | |
| 0035 TSF2-SLC-HPDW-1 RAW | X | | 7.09 | X | 0.083 | |
| 0036 TSF2-SLC-GW-1 RAW | X | | 7.53 | X | 0.076 | |
| 0037 HPDW HNO3 | X | | X | X | X | |
| 0038 GW HNO3 | 0.217 | | 67.87 | X | 0.015 | |
| 0039 TSF1-HC-0 HNO3 | 0.072 | | 1.44 | X | 0.097 | |
| 0040 TSF1-HC-1 HNO3 | | | | | | |

| ELEMENTS | Co | Cr | Cu | Dy | EC | Eu |
|---|---|---|---|---|---|---|
| UNITS | ug/l | mg/l | mg/l | ug/l | uS/cm | ug/l |
| DETECTION LIMIT | 0.1 | 0.01 | 0.01 | 0.002 | 10 | 0.001 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /OE | /OE | /MS | /MTR | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | | | | 2281 | |
| 0002 TSF1-SLC-HPDW-2 RAW | | | | | 815 | |
| 0003 TSF1-SLC-HPDW-3 RAW | | | | | 551 | |
| 0004 TSF1-SLC-HPDW-4 RAW | | | | | 433 | |
| 0005 TSF1-SLC-HPDW-5 RAW | | | | | 320 | |
| 0006 TSF1-SLC-HPDW-6 RAW | | | | | 225 | |
| 0007 TSF1-SLC-GW-1 RAW | | | | | 2700 | |
| 0008 TSF1-SLC-GW-2 RAW | | | | | 1773 | |
| 0009 TSF1-SLC-GW-3 RAW | | | | | 1633 | |
| 0010 TSF1-SLC-GW-4 RAW | | | | | 1586 | |
| 0011 TSF1-SLC-GW-5 RAW | | | | | 1457 | |
| 0012 TSF1-SLC-GW-6 RAW | | | | | 1415 | |
| 0013 TSF2-SLC-HPDW-1 RAW | | | | | 5840 | |
| 0014 TSF2-SLC-GW-1 RAW | | | | | 6210 | |
| 0015 HPDW RAW | | | | | X | |
| 0016 GW RAW | | | | | 1496 | |
| 0017 TSF1-HC-0 RAW | | | | | 2430 | |
| 0018 TSF1-HC-1 RAW | | | | | 751 | |
| 0019 TSF1-HC-2 RAW | | | | | 525 | |
| 0020 TSF2-HC-0 RAW | | | | | 4440 | |
| 0021 TSF2-HC-1 RAW | | | | | 2141 | |
| 0022 TSF2-HC-2 RAW | | | | | 1030 | |
| 0023 TSF1-SLC-HPDW-1 HNO3 | 0.4 | 0.01 | X | 0.003 | | 0.008 |
| 0024 TSF1-SLC-HPDW-2 HNO3 | | | | | | |
| 0025 TSF1-SLC-HPDW-3 HNO3 | | | | | | |
| 0026 TSF1-SLC-HPDW-4 HNO3 | | | | | | |
| 0027 TSF1-SLC-HPDW-5 HNO3 | | | | | | |
| 0028 TSF1-SLC-HPDW-6 HNO3 | X | X | X | X | | X |
| 0029 TSF1-SLC-GW-1 HNO3 | 0.6 | 0.01 | X | 0.006 | | 0.006 |
| 0030 TSF1-SLC-GW-2 HNO3 | | | | | | |
| 0031 TSF1-SLC-GW-3 HNO3 | | | | | | |
| 0032 TSF1-SLC-GW-4 HNO3 | | | | | | |
| 0033 TSF1-SLC-GW-5 HNO3 | | | | | | |
| 0034 TSF1-SLC-GW-6 HNO3 | X | X | X | X | | X |
| 0035 TSF2-SLC-HPDW-1 RAW | 3.8 | 0.02 | 0.07 | 0.068 | | 0.042 |
| 0036 TSF2-SLC-GW-1 RAW | 4.0 | 0.04 | 0.06 | 0.054 | | 0.041 |
| 0037 HPDW HNO3 | X | X | X | X | | X |
| 0038 GW HNO3 | X | X | X | X | | X |
| 0039 TSF1-HC-0 HNO3 | 0.7 | 0.01 | X | 0.003 | | 0.002 |
| 0040 TSF1-HC-1 HNO3 | | | | | | |

| ELEMENTS | F | Fe-Sol | Gd | HCO3 | Hg | K |
|---|---|---|---|---|---|---|
| UNITS | mg/l | mg/l | ug/l | mgCaCO3/L | ug/l | mg/l |
| DETECTION LIMIT | 0.1 | 0.01 | 0.001 | 2 | 0.1 | 0.1 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /SIE | /OE | /MS | /VOL | /MS | /OE |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | 7.4 | | | 626 | | |
| 0002 TSF1-SLC-HPDW-2 RAW | 3.9 | | | 315 | | |
| 0003 TSF1-SLC-HPDW-3 RAW | 1.5 | | | 274 | | |
| 0004 TSF1-SLC-HPDW-4 RAW | 0.9 | | | 150 | | |
| 0005 TSF1-SLC-HPDW-5 RAW | 0.6 | | | 156 | | |
| 0006 TSF1-SLC-HPDW-6 RAW | 0.4 | | | 117 | | |
| 0007 TSF1-SLC-GW-1 RAW | 7.2 | | | 589 | | |
| 0008 TSF1-SLC-GW-2 RAW | 3.3 | | | 317 | | |
| 0009 TSF1-SLC-GW-3 RAW | 1.4 | | | 245 | | |
| 0010 TSF1-SLC-GW-4 RAW | 1.0 | | | 238 | | |
| 0011 TSF1-SLC-GW-5 RAW | 0.9 | | | 180 | | |
| 0012 TSF1-SLC-GW-6 RAW | 1.4 | | | 176 | | |
| 0013 TSF2-SLC-HPDW-1 RAW | 10.5 | | | 1749 | | |
| 0014 TSF2-SLC-GW-1 RAW | 9.8 | | | 1740 | | |
| 0015 HPDW RAW | X | | | 2 | | |
| 0016 GW RAW | 1.7 | | | 207 | | |
| 0017 TSF1-HC-0 RAW | 5.8 | | | 397 | | |
| 0018 TSF1-HC-1 RAW | 4.0 | | | 400 | | |
| 0019 TSF1-HC-2 RAW | 2.3 | | | 240 | | |
| 0020 TSF2-HC-0 RAW | 5.4 | | | 1356 | | |
| 0021 TSF2-HC-1 RAW | 4.1 | | | 918 | | |
| 0022 TSF2-HC-2 RAW | 1.8 | | | 469 | | |
| 0023 TSF1-SLC-HPDW-1 HNO3 | | X | 0.015 | | X | 10.8 |
| 0024 TSF1-SLC-HPDW-2 HNO3 | | X | | | | |
| 0025 TSF1-SLC-HPDW-3 HNO3 | | X | | | | |
| 0026 TSF1-SLC-HPDW-4 HNO3 | | 0.01 | | | | |
| 0027 TSF1-SLC-HPDW-5 HNO3 | | X | | | | |
| 0028 TSF1-SLC-HPDW-6 HNO3 | | X | X | | X | 2.9 |
| 0029 TSF1-SLC-GW-1 HNO3 | | X | 0.019 | | X | 12.5 |
| 0030 TSF1-SLC-GW-2 HNO3 | | X | | | | |
| 0031 TSF1-SLC-GW-3 HNO3 | | X | | | | |
| 0032 TSF1-SLC-GW-4 HNO3 | | 0.01 | | | | |
| 0033 TSF1-SLC-GW-5 HNO3 | | X | | | | |
| 0034 TSF1-SLC-GW-6 HNO3 | | X | X | | X | 40.0 |
| 0035 TSF2-SLC-HPDW-1 RAW | | 0.07 | 0.154 | | 0.2 | 18.7 |
| 0036 TSF2-SLC-GW-1 RAW | | X | 0.138 | | 0.2 | 19.4 |
| 0037 HPDW HNO3 | | X | X | | X | X |
| 0038 GW HNO3 | | X | X | | X | 6.9 |
| 0039 TSF1-HC-0 HNO3 | | X | 0.005 | | X | 11.3 |
| 0040 TSF1-HC-1 HNO3 | | 0.02 | | | | |

| ELEMENTS | La | Li | Mg | Mn | Mo | Na |
|---|---|---|---|---|---|---|
| UNITS | ug/l | ug/l | mg/l | mg/l | ug/l | mg/l |
| DETECTION LIMIT | 0.002 | 0.05 | 0.01 | 0.01 | 0.05 | 0.1 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /MS | /OE | /OE | /MS | /OE |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | | | | | |
| 0002 TSF1-SLC-HPDW-2 RAW | | | | | | |
| 0003 TSF1-SLC-HPDW-3 RAW | | | | | | |
| 0004 TSF1-SLC-HPDW-4 RAW | | | | | | |
| 0005 TSF1-SLC-HPDW-5 RAW | | | | | | |
| 0006 TSF1-SLC-HPDW-6 RAW | | | | | | |
| 0007 TSF1-SLC-GW-1 RAW | | | | | | |
| 0008 TSF1-SLC-GW-2 RAW | | | | | | |
| 0009 TSF1-SLC-GW-3 RAW | | | | | | |
| 0010 TSF1-SLC-GW-4 RAW | | | | | | |
| 0011 TSF1-SLC-GW-5 RAW | | | | | | |
| 0012 TSF1-SLC-GW-6 RAW | | | | | | |
| 0013 TSF2-SLC-HPDW-1 RAW | | | | | | |
| 0014 TSF2-SLC-GW-1 RAW | | | | | | |
| 0015 HPDW RAW | | | | | X | |
| 0016 GW RAW | | | | | | |
| 0017 TSF1-HC-0 RAW | | | | | | |
| 0018 TSF1-HC-1 RAW | | | | | | |
| 0019 TSF1-HC-2 RAW | | | | | | |
| 0020 TSF2-HC-0 RAW | | | | | | |
| 0021 TSF2-HC-1 RAW | | | | | | |
| 0022 TSF2-HC-2 RAW | | | | | | |
| 0023 TSF1-SLC-HPDW-1 HNO3 | 0.006 | 11.74 | 0.16 | X | 1105.13 | 497.9 |
| 0024 TSF1-SLC-HPDW-2 HNO3 | | 4.07 | | | 36.94 | |
| 0025 TSF1-SLC-HPDW-3 HNO3 | | 2.56 | | | 13.15 | |
| 0026 TSF1-SLC-HPDW-4 HNO3 | | 2.14 | | | 9.55 | |
| 0027 TSF1-SLC-HPDW-5 HNO3 | | 1.99 | | | 7.33 | |
| 0028 TSF1-SLC-HPDW-6 HNO3 | 0.005 | 1.83 | 0.01 | X | 6.93 | 50.9 |
| 0029 TSF1-SLC-GW-1 HNO3 | 0.013 | 12.54 | 0.14 | X | 1072.79 | 577.4 |
| 0030 TSF1-SLC-GW-2 HNO3 | | 8.18 | | | 44.06 | |
| 0031 TSF1-SLC-GW-3 HNO3 | | 7.46 | | | 28.40 | |
| 0032 TSF1-SLC-GW-4 HNO3 | | 8.53 | | | 69.48 | |
| 0033 TSF1-SLC-GW-5 HNO3 | | 52.52 | | | 96.51 | |
| 0034 TSF1-SLC-GW-6 HNO3 | 0.006 | 82.96 | 26.28 | 0.01 | 117.15 | 199.6 |
| 0035 TSF2-SLC-HPDW-1 RAW | 0.020 | 12.11 | 0.11 | 0.01 | 1768.29 | 1559.2 |
| 0036 TSF2-SLC-GW-1 RAW | 0.024 | 12.93 | 0.18 | 0.02 | 1953.09 | 1656.4 |
| 0037 HPDW HNO3 | X | X | X | X | X | X |
| 0038 GW HNO3 | 0.014 | 17.99 | 45.86 | X | 18.40 | 184.5 |
| 0039 TSF1-HC-0 HNO3 | 0.021 | 9.48 | 0.19 | X | 1154.82 | 553.7 |
| 0040 TSF1-HC-1 HNO3 | | 5.57 | | | 136.28 | |

| ELEMENTS | Nd | Ni | P | Pb | pH | Pr |
|---|---|---|---|---|---|---|
| UNITS | ug/l | mg/l | mg/l | ug/l | NONE | ug/l |
| DETECTION LIMIT | 0.002 | 0.01 | 0.1 | 2 | 0.1 | 0.001 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /OE | /OE | /MS | /MTR | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | | | | 8.5 | |
| 0002 TSF1-SLC-HPDW-2 RAW | | | | | 8.4 | |
| 0003 TSF1-SLC-HPDW-3 RAW | | | | | 7.6 | |
| 0004 TSF1-SLC-HPDW-4 RAW | | | | | 8.4 | |
| 0005 TSF1-SLC-HPDW-5 RAW | | | | | 7.0 | |
| 0006 TSF1-SLC-HPDW-6 RAW | | | | | 7.8 | |
| 0007 TSF1-SLC-GW-1 RAW | | | | | 7.1 | |
| 0008 TSF1-SLC-GW-2 RAW | | | | | 8.4 | |
| 0009 TSF1-SLC-GW-3 RAW | | | | | 8.5 | |
| 0010 TSF1-SLC-GW-4 RAW | | | | | 7.6 | |
| 0011 TSF1-SLC-GW-5 RAW | | | | | 7.4 | |
| 0012 TSF1-SLC-GW-6 RAW | | | | | 7.8 | |
| 0013 TSF2-SLC-HPDW-1 RAW | | | | | 8.5 | |
| 0014 TSF2-SLC-GW-1 RAW | | | | | 8.8 | |
| 0015 HPDW RAW | | | | | 5.2 | |
| 0016 GW RAW | | | | | 8.3 | |
| 0017 TSF1-HC-0 RAW | | | | | 9.2 | |
| 0018 TSF1-HC-1 RAW | | | | | 8.1 | |
| 0019 TSF1-HC-2 RAW | | | | | 8.4 | |
| 0020 TSF2-HC-0 RAW | | | | | 8.4 | |
| 0021 TSF2-HC-1 RAW | | | | | 7.5 | |
| 0022 TSF2-HC-2 RAW | | | | | 7.8 | |
| 0023 TSF1-SLC-HPDW-1 HNO3 | 0.028 | X | 1.9 | X | | 0.003 |
| 0024 TSF1-SLC-HPDW-2 HNO3 | | | 3.8 | X | | |
| 0025 TSF1-SLC-HPDW-3 HNO3 | | | 1.8 | X | | |
| 0026 TSF1-SLC-HPDW-4 HNO3 | | | 1.0 | X | | |
| 0027 TSF1-SLC-HPDW-5 HNO3 | | | 0.6 | X | | |
| 0028 TSF1-SLC-HPDW-6 HNO3 | 0.011 | X | 0.3 | X | | 0.002 |
| 0029 TSF1-SLC-GW-1 HNO3 | 0.083 | X | 1.3 | X | | 0.002 |
| 0030 TSF1-SLC-GW-2 HNO3 | | | 1.9 | X | | |
| 0031 TSF1-SLC-GW-3 HNO3 | | | 1.5 | X | | |
| 0032 TSF1-SLC-GW-4 HNO3 | | | 0.8 | X | | |
| 0033 TSF1-SLC-GW-5 HNO3 | | | 0.2 | X | | |
| 0034 TSF1-SLC-GW-6 HNO3 | X | X | X | X | | X |
| 0035 TSF2-SLC-HPDW-1 RAW | 0.396 | X | 5.0 | X | | 0.058 |
| 0036 TSF2-SLC-GW-1 RAW | 0.435 | X | 4.1 | X | | 0.034 |
| 0037 HPDW HNO3 | 0.004 | X | X | X | | X |
| 0038 GW HNO3 | 0.018 | X | X | X | | X |
| 0039 TSF1-HC-0 HNO3 | 0.046 | X | 1.6 | X | | 0.018 |
| 0040 TSF1-HC-1 HNO3 | | | 2.1 | X | | |

| ELEMENTS | S | Sb | Se | Si | Sm | Sn |
|---|---|---|---|---|---|---|
| UNITS | mg/l | ug/l | ug/l | mg/l | ug/l | ug/l |
| DETECTION LIMIT | 0.1 | 0.01 | 0.5 | 0.05 | 0.002 | 0.1 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /OE | /MS | /MS | /OE | /MS | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | | | | | |
| 0002 TSF1-SLC-HPDW-2 RAW | | | | | | |
| 0003 TSF1-SLC-HPDW-3 RAW | | | | | | |
| 0004 TSF1-SLC-HPDW-4 RAW | | | | | | |
| 0005 TSF1-SLC-HPDW-5 RAW | | | | | | |
| 0006 TSF1-SLC-HPDW-6 RAW | | | | | | |
| 0007 TSF1-SLC-GW-1 RAW | | | | | | |
| 0008 TSF1-SLC-GW-2 RAW | | | | | | |
| 0009 TSF1-SLC-GW-3 RAW | | | | | | |
| 0010 TSF1-SLC-GW-4 RAW | | | | | | |
| 0011 TSF1-SLC-GW-5 RAW | | | | | | |
| 0012 TSF1-SLC-GW-6 RAW | | | | | | |
| 0013 TSF2-SLC-HPDW-1 RAW | | | | | | |
| 0014 TSF2-SLC-GW-1 RAW | | | | | | |
| 0015 HPDW RAW | | | | | | |
| 0016 GW RAW | | | | | | |
| 0017 TSF1-HC-0 RAW | | | | | | |
| 0018 TSF1-HC-1 RAW | | | | | | |
| 0019 TSF1-HC-2 RAW | | | | | | |
| 0020 TSF2-HC-0 RAW | | | | | | |
| 0021 TSF2-HC-1 RAW | | | | | | |
| 0022 TSF2-HC-2 RAW | | | | | | |
| 0023 TSF1-SLC-HPDW-1 HNO3 | 36.7 | 0.98 | 3.9 | 12.98 | X | X |
| 0024 TSF1-SLC-HPDW-2 HNO3 | 0.8 | | 1.1 | 23.19 | | |
| 0025 TSF1-SLC-HPDW-3 HNO3 | 0.3 | | 1.0 | 31.87 | | |
| 0026 TSF1-SLC-HPDW-4 HNO3 | 0.2 | | 0.8 | 33.79 | | |
| 0027 TSF1-SLC-HPDW-5 HNO3 | 0.2 | | 0.5 | 29.73 | | |
| 0028 TSF1-SLC-HPDW-6 HNO3 | 0.1 | 0.12 | X | 23.84 | 0.007 | X |
| 0029 TSF1-SLC-GW-1 HNO3 | 49.6 | 0.82 | 5.4 | 11.68 | X | 0.3 |
| 0030 TSF1-SLC-GW-2 HNO3 | 26.9 | | 2.3 | 15.22 | | |
| 0031 TSF1-SLC-GW-3 HNO3 | 26.9 | | 2.3 | 15.42 | | |
| 0032 TSF1-SLC-GW-4 HNO3 | 26.5 | | 2.1 | 15.24 | | |
| 0033 TSF1-SLC-GW-5 HNO3 | 26.1 | | 1.2 | 11.54 | | |
| 0034 TSF1-SLC-GW-6 HNO3 | 25.9 | 0.05 | 1.3 | 10.86 | X | 0.1 |
| 0035 TSF2-SLC-HPDW-1 RAW | 75.9 | 2.69 | 25.1 | 68.35 | 0.133 | 0.1 |
| 0036 TSF2-SLC-GW-1 RAW | 84.9 | 2.47 | 25.7 | 65.44 | 0.089 | 0.1 |
| 0037 HPDW HNO3 | X | X | X | X | X | X |
| 0038 GW HNO3 | 27.6 | 0.11 | 1.3 | 19.44 | X | 0.3 |
| 0039 TSF1-HC-0 HNO3 | 44.9 | 0.50 | 5.4 | 13.75 | 0.007 | 0.2 |
| 0040 TSF1-HC-1 HNO3 | 2.3 | | 1.0 | 17.60 | | |

| ELEMENTS | Sr | Th | Tl | U | V | Y |
|---|---|---|---|---|---|---|
| UNITS | ug/l | ug/l | ug/l | ug/l | mg/l | ug/l |
| DETECTION LIMIT | 0.02 | 0.005 | 0.01 | 0.005 | 0.01 | 0.005 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /MS | /MS | /MS | /OE | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | | | | | |
| 0002 TSF1-SLC-HPDW-2 RAW | | | | | | |
| 0003 TSF1-SLC-HPDW-3 RAW | | | | | | |
| 0004 TSF1-SLC-HPDW-4 RAW | | | | | | |
| 0005 TSF1-SLC-HPDW-5 RAW | | | | | | |
| 0006 TSF1-SLC-HPDW-6 RAW | | | | | | |
| 0007 TSF1-SLC-GW-1 RAW | | | | | | |
| 0008 TSF1-SLC-GW-2 RAW | | | | | | |
| 0009 TSF1-SLC-GW-3 RAW | | | | | | |
| 0010 TSF1-SLC-GW-4 RAW | | | | | | |
| 0011 TSF1-SLC-GW-5 RAW | | | | | | |
| 0012 TSF1-SLC-GW-6 RAW | | | | | | |
| 0013 TSF2-SLC-HPDW-1 RAW | | | | | | |
| 0014 TSF2-SLC-GW-1 RAW | | | | | | |
| 0015 HPDW RAW | | | | | | |
| 0016 GW RAW | | | | | | |
| 0017 TSF1-HC-0 RAW | | | | | | |
| 0018 TSF1-HC-1 RAW | | | | | | |
| 0019 TSF1-HC-2 RAW | | | | | | |
| 0020 TSF2-HC-0 RAW | | | | | | |
| 0021 TSF2-HC-1 RAW | | | | | | |
| 0022 TSF2-HC-2 RAW | | | | | | |
| 0023 TSF1-SLC-HPDW-1 HNO3 | 9.88 | X | 0.06 | 302.120 | 0.18 | 0.028 |
| 0024 TSF1-SLC-HPDW-2 HNO3 | | | | | 0.78 | 0.009 |
| 0025 TSF1-SLC-HPDW-3 HNO3 | | | | | 0.60 | 0.009 |
| 0026 TSF1-SLC-HPDW-4 HNO3 | | | | | 0.25 | 0.006 |
| 0027 TSF1-SLC-HPDW-5 HNO3 | | | | | 0.13 | X |
| 0028 TSF1-SLC-HPDW-6 HNO3 | 2.22 | X | 0.02 | 2.371 | 0.07 | X |
| 0029 TSF1-SLC-GW-1 HNO3 | 11.22 | X | 0.06 | 319.969 | 0.13 | 0.017 |
| 0030 TSF1-SLC-GW-2 HNO3 | | | | | 0.24 | 0.020 |
| 0031 TSF1-SLC-GW-3 HNO3 | | | | | 0.20 | 0.047 |
| 0032 TSF1-SLC-GW-4 HNO3 | | | | | 0.18 | 0.017 |
| 0033 TSF1-SLC-GW-5 HNO3 | | | | | 0.05 | 0.007 |
| 0034 TSF1-SLC-GW-6 HNO3 | 218.53 | X | 0.23 | 97.685 | X | X |
| 0035 TSF2-SLC-HPDW-1 RAW | 48.57 | 0.014 | 0.13 | 186.357 | 0.77 | 0.102 |
| 0036 TSF2-SLC-GW-1 RAW | 53.85 | 0.010 | 0.12 | 170.157 | 0.64 | 0.125 |
| 0037 HPDW HNO3 | 0.07 | X | X | 0.195 | X | X |
| 0038 GW HNO3 | 678.23 | X | 0.03 | 15.703 | X | 0.037 |
| 0039 TSF1-HC-0 HNO3 | 11.43 | 0.008 | 0.07 | 322.358 | 0.18 | 0.050 |
| 0040 TSF1-HC-1 HNO3 | | | | | 0.30 | 0.021 |

| ELEMENTS | Zn | Zr |
|---|---|---|
| UNITS | mg/l | ug/l |
| DETECTION LIMIT | 0.01 | 0.02 |
| DIGEST | | |
| ANALYTICAL FINISH | /OE | /MS |
| SAMPLE NUMBERS | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | |
| 0002 TSF1-SLC-HPDW-2 RAW | | |
| 0003 TSF1-SLC-HPDW-3 RAW | | |
| 0004 TSF1-SLC-HPDW-4 RAW | | |
| 0005 TSF1-SLC-HPDW-5 RAW | | |
| 0006 TSF1-SLC-HPDW-6 RAW | | |
| 0007 TSF1-SLC-GW-1 RAW | | |
| 0008 TSF1-SLC-GW-2 RAW | | |
| 0009 TSF1-SLC-GW-3 RAW | | |
| 0010 TSF1-SLC-GW-4 RAW | | |
| 0011 TSF1-SLC-GW-5 RAW | | |
| 0012 TSF1-SLC-GW-6 RAW | | |
| 0013 TSF2-SLC-HPDW-1 RAW | | |
| 0014 TSF2-SLC-GW-1 RAW | | |
| 0015 HPDW RAW | | |
| 0016 GW RAW | | |
| 0017 TSF1-HC-0 RAW | | |
| 0018 TSF1-HC-1 RAW | | |
| 0019 TSF1-HC-2 RAW | | |
| 0020 TSF2-HC-0 RAW | | |
| 0021 TSF2-HC-1 RAW | | |
| 0022 TSF2-HC-2 RAW | | |
| 0023 TSF1-SLC-HPDW-1 HNO3 | 0.03 | X |
| 0024 TSF1-SLC-HPDW-2 HNO3 | | |
| 0025 TSF1-SLC-HPDW-3 HNO3 | | |
| 0026 TSF1-SLC-HPDW-4 HNO3 | | |
| 0027 TSF1-SLC-HPDW-5 HNO3 | | |
| 0028 TSF1-SLC-HPDW-6 HNO3 | X | X |
| 0029 TSF1-SLC-GW-1 HNO3 | 0.03 | X |
| 0030 TSF1-SLC-GW-2 HNO3 | | |
| 0031 TSF1-SLC-GW-3 HNO3 | | |
| 0032 TSF1-SLC-GW-4 HNO3 | | |
| 0033 TSF1-SLC-GW-5 HNO3 | | |
| 0034 TSF1-SLC-GW-6 HNO3 | X | X |
| 0035 TSF2-SLC-HPDW-1 RAW | X | 0.09 |
| 0036 TSF2-SLC-GW-1 RAW | 0.01 | 0.03 |
| 0037 HPDW HNO3 | X | X |
| 0038 GW HNO3 | X | 0.19 |
| 0039 TSF1-HC-0 HNO3 | 0.05 | X |
| 0040 TSF1-HC-1 HNO3 | | |

| ELEMENTS | Ag | Al | As | B | Ba | Be |
|---|---|---|---|---|---|---|
| UNITS | ug/l | mg/l | ug/l | mg/l | ug/l | ug/l |
| DETECTION LIMIT | 0.01 | 0.01 | 0.1 | 0.01 | 0.05 | 0.1 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /OE | /MS | /OE | /MS | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0041 TSF1-HC-2 HNO3 | X | 0.05 | 25.8 | 0.07 | 2.77 | X |
| 0042 TSF2-HC-0 RAW | 0.04 | X | 46.4 | 0.36 | 8.96 | X |
| 0043 TSF2-HC-1 RAW | | 0.01 | 37.2 | 0.22 | | |
| 0044 TSF2-HC-2 RAW | 0.01 | X | 23.0 | 0.08 | 2.47 | X |
| 0045 RB-1 HNO3 | | X | 0.9 | X | | |
| 0046 RB-2 HNO3 | | 0.15 | 0.6 | X | | |
| 0047 RB-3 HNO3 | | 0.02 | 0.4 | X | | |
| 0048 RB-4 HNO3 | | 0.05 | 0.3 | X | | |
| 0049 RB-5 HNO3 | | 0.06 | 0.4 | X | | |
| 0050 RB-6 HNO3 | | X | 0.7 | X | | |
| CHECKS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | | | | | |
| 0002 TSF2-HC-1 RAW | | | | | | |
| 0003 TSF1-HC-2 HNO3 | X | 0.06 | 23.8 | 0.07 | 2.67 | X |
| STANDARDS | | | | | | |
| 0001 GWS-1 | | | | | | |
| 0002 GWS-1 | | | | | | |
| 0003 TMDW | 2.02 | | 79.7 | | 48.11 | 20.2 |
| 0004 TMDW | | 0.11 | | X | | |
| 0005 Control Blank | | | | | | |
| 0006 GWS-1 | | | | | | |
| 0007 TMDW | 2.13 | | 80.0 | | 48.45 | 21.5 |
| 0008 TMDW | | 0.15 | | X | | |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | X | X | X | X |

| ELEMENTS | Bi | CO3 | Ca | Cd | Ce | Cl |
|---|---|---|---|---|---|---|
| UNITS | ug/l | mgCaCO3/L | mg/l | ug/l | ug/l | mg/l |
| DETECTION LIMIT | 0.005 | 1 | 0.01 | 0.5 | 0.002 | 2 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /VOL | /OE | /MS | /MS | /COL |
| SAMPLE NUMBERS | | | | | | |
| 0041 TSF1-HC-2 HNO3 | 0.005 | | 0.59 | X | 0.360 | |
| 0042 TSF2-HC-0 RAW | 0.011 | | 5.12 | X | 0.079 | |
| 0043 TSF2-HC-1 RAW | | | | | | |
| 0044 TSF2-HC-2 RAW | X | | 1.54 | X | 0.427 | |
| 0045 RB-1 HNO3 | | | | | | |
| 0046 RB-2 HNO3 | | | | | | |
| 0047 RB-3 HNO3 | | | | | | |
| 0048 RB-4 HNO3 | | | | | | |
| 0049 RB-5 HNO3 | | | | | | |
| 0050 RB-6 HNO3 | | | | | | |
| CHECKS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | 64 | | | | 252 |
| 0002 TSF2-HC-1 RAW | | X | | | | 300 |
| 0003 TSF1-HC-2 HNO3 | X | | 0.61 | X | 0.358 | |
| STANDARDS | | | | | | |
| 0001 GWS-1 | | | | | | 32 |
| 0002 GWS-1 | | X | | | | |
| 0003 TMDW | 9.749 | | | 9.5 | 0.036 | |
| 0004 TMDW | | | 35.54 | | | |
| 0005 Control Blank | | X | | | | |
| 0006 GWS-1 | | | | | | 32 |
| 0007 TMDW | 9.626 | | | 9.7 | 0.040 | |
| 0008 TMDW | | | 35.24 | | | |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | X | X | X | X |

| ELEMENTS | Co | Cr | Cu | Dy | EC | Eu |
|---|---|---|---|---|---|---|
| UNITS | ug/l | mg/l | mg/l | ug/l | uS/cm | ug/l |
| DETECTION LIMIT | 0.1 | 0.01 | 0.01 | 0.002 | 10 | 0.001 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /OE | /OE | /MS | /MTR | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0041 TSF1-HC-2 HNO3 | 0.1 | X | X | 0.013 | | 0.002 |
| 0042 TSF2-HC-0 RAW | 2.4 | 0.06 | 0.04 | 0.051 | | 0.024 |
| 0043 TSF2-HC-1 RAW | | | | | | |
| 0044 TSF2-HC-2 RAW | 0.3 | X | X | 0.010 | | 0.005 |
| 0045 RB-1 HNO3 | | | | | | |
| 0046 RB-2 HNO3 | | | | | | |
| 0047 RB-3 HNO3 | | | | | | |
| 0048 RB-4 HNO3 | | | | | | |
| 0049 RB-5 HNO3 | | | | | | |
| 0050 RB-6 HNO3 | | | | | | |
| CHECKS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | | | | 2280 | |
| 0002 TSF2-HC-1 RAW | | | | | 2160 | |
| 0003 TSF1-HC-2 HNO3 | 0.1 | X | X | 0.006 | | 0.004 |
| STANDARDS | | | | | | |
| 0001 GWS-1 | | | | | | |
| 0002 GWS-1 | | | | | | |
| 0003 TMDW | 24.8 | | | 0.003 | | 0.002 |
| 0004 TMDW | | 0.01 | 0.02 | | | |
| 0005 Control Blank | | | | | | |
| 0006 GWS-1 | | | | | | |
| 0007 TMDW | 24.8 | | | X | | 0.001 |
| 0008 TMDW | | 0.02 | 0.02 | | | |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | X | X | X | X |

| ELEMENTS | F | Fe-Sol | Gd | HCO3 | Hg | K |
|---|---|---|---|---|---|---|
| UNITS | mg/l | mg/l | ug/l | mgCaCO3/L | ug/l | mg/l |
| DETECTION LIMIT | 0.1 | 0.01 | 0.001 | 2 | 0.1 | 0.1 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /SIE | /OE | /MS | /VOL | /MS | /OE |
| SAMPLE NUMBERS | | | | | | |
| 0041 TSF1-HC-2 HNO3 | | 0.10 | 0.011 | | X | 3.7 |
| 0042 TSF2-HC-0 RAW | | 0.01 | 0.075 | | X | 14.4 |
| 0043 TSF2-HC-1 RAW | | X | | | | |
| 0044 TSF2-HC-2 RAW | | X | 0.040 | | X | 4.0 |
| 0045 RB-1 HNO3 | | X | | | | |
| 0046 RB-2 HNO3 | | X | | | | |
| 0047 RB-3 HNO3 | | X | | | | |
| 0048 RB-4 HNO3 | | X | | | | |
| 0049 RB-5 HNO3 | | X | | | | |
| 0050 RB-6 HNO3 | | X | | | | |
| CHECKS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | 7.3 | | | 583 | | |
| 0002 TSF2-HC-1 RAW | 4.1 | | | 882 | | |
| 0003 TSF1-HC-2 HNO3 | | 0.11 | 0.008 | | X | 3.8 |
| STANDARDS | | | | | | |
| 0001 GWS-1 | | | | | | |
| 0002 GWS-1 | | | | 100 | | |
| 0003 TMDW | | | 0.014 | | X | |
| 0004 TMDW | | 0.09 | | | | 2.2 |
| 0005 Control Blank | | | | 2 | | |
| 0006 GWS-1 | | | | | | |
| 0007 TMDW | | | 0.006 | | X | |
| 0008 TMDW | | 0.09 | | | | 2.3 |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | X | 3 | X | X |

| ELEMENTS | La | Li | Mg | Mn | Mo | Na |
|---|---|---|---|---|---|---|
| UNITS | ug/l | ug/l | mg/l | mg/l | ug/l | mg/l |
| DETECTION LIMIT | 0.002 | 0.05 | 0.01 | 0.01 | 0.05 | 0.1 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /MS | /OE | /OE | /MS | /OE |
| SAMPLE NUMBERS | | | | | | |
| 0041 TSF1-HC-2 HNO3 | 0.058 | 6.17 | 0.04 | X | 27.97 | 127.8 |
| 0042 TSF2-HC-0 RAW | 0.033 | 9.44 | 0.17 | X | 1231.92 | 1163.4 |
| 0043 TSF2-HC-1 RAW | | 9.14 | | | 413.48 | |
| 0044 TSF2-HC-2 RAW | 0.027 | 5.06 | 0.05 | X | 120.20 | 273.7 |
| 0045 RB-1 HNO3 | | 0.07 | | | 1.88 | |
| 0046 RB-2 HNO3 | | X | | | 0.37 | |
| 0047 RB-3 HNO3 | | X | | | 0.30 | |
| 0048 RB-4 HNO3 | | X | | | 0.20 | |
| 0049 RB-5 HNO3 | | X | | | 0.12 | |
| 0050 RB-6 HNO3 | | 0.05 | | | 0.22 | |
| CHECKS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | | | | | |
| 0002 TSF2-HC-1 RAW | | | | | | |
| 0003 TSF1-HC-2 HNO3 | 0.052 | 6.00 | 0.04 | X | 26.72 | 129.6 |
| STANDARDS | | | | | | |
| 0001 GWS-1 | | | | | | |
| 0002 GWS-1 | | | | | | |
| 0003 TMDW | 0.040 | 19.56 | | | 105.42 | |
| 0004 TMDW | | | 9.20 | 0.04 | | 6.2 |
| 0005 Control Blank | | | | | | |
| 0006 GWS-1 | | | | | | |
| 0007 TMDW | 0.045 | 20.01 | | | 100.78 | |
| 0008 TMDW | | | 9.11 | 0.04 | | 6.1 |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | X | X | X | X |

| ELEMENTS | Nd | Ni | P | Pb | pH | Pr |
|---|---|---|---|---|---|---|
| UNITS | ug/l | mg/l | mg/l | ug/l | NONE | ug/l |
| DETECTION LIMIT | 0.002 | 0.01 | 0.1 | 2 | 0.1 | 0.001 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /OE | /OE | /MS | /MTR | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0041 TSF1-HC-2 HNO3 | 0.167 | X | 1.7 | X | | 0.044 |
| 0042 TSF2-HC-0 RAW | 0.295 | X | 5.5 | X | | 0.038 |
| 0043 TSF2-HC-1 RAW | | | 4.1 | X | | |
| 0044 TSF2-HC-2 RAW | 0.132 | X | 1.9 | X | | 0.017 |
| 0045 RB-1 HNO3 | | | X | X | | |
| 0046 RB-2 HNO3 | | | X | X | | |
| 0047 RB-3 HNO3 | | | X | X | | |
| 0048 RB-4 HNO3 | | | X | X | | |
| 0049 RB-5 HNO3 | | | X | X | | |
| 0050 RB-6 HNO3 | | | X | X | | |
| CHECKS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | | | | 8.6 | |
| 0002 TSF2-HC-1 RAW | | | | | 7.4 | |
| 0003 TSF1-HC-2 HNO3 | 0.189 | X | 1.7 | X | | 0.040 |
| STANDARDS | | | | | | |
| 0001 GWS-1 | | | | | | |
| 0002 GWS-1 | | | | | | |
| 0003 TMDW | 0.011 | | | 39 | | X |
| 0004 TMDW | | 0.06 | X | | | |
| 0005 Control Blank | | | | | | |
| 0006 GWS-1 | | | | | | |
| 0007 TMDW | 0.004 | | | 39 | | 0.002 |
| 0008 TMDW | | 0.06 | X | | | |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | X | X | 5.6 | X |

| ELEMENTS | S | Sb | Se | Si | Sm | Sn |
|---|---|---|---|---|---|---|
| UNITS | mg/l | ug/l | ug/l | mg/l | ug/l | ug/l |
| DETECTION LIMIT | 0.1 | 0.01 | 0.5 | 0.05 | 0.002 | 0.1 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /OE | /MS | /MS | /OE | /MS | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0041 TSF1-HC-2 HNO3 | 0.6 | 0.22 | 0.8 | 14.11 | 0.023 | X |
| 0042 TSF2-HC-0 RAW | 55.5 | 0.85 | 14.9 | 52.77 | 0.048 | X |
| 0043 TSF2-HC-1 RAW | 17.9 | | 4.7 | 54.69 | | |
| 0044 TSF2-HC-2 RAW | 5.2 | 0.32 | 1.4 | 37.80 | 0.005 | X |
| 0045 RB-1 HNO3 | X | | X | X | | |
| 0046 RB-2 HNO3 | X | | X | X | | |
| 0047 RB-3 HNO3 | X | | X | X | | |
| 0048 RB-4 HNO3 | X | | X | X | | |
| 0049 RB-5 HNO3 | X | | X | X | | |
| 0050 RB-6 HNO3 | X | | X | X | | |
| CHECKS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | | | | | |
| 0002 TSF2-HC-1 RAW | | | | | | |
| 0003 TSF1-HC-2 HNO3 | 0.6 | 0.25 | 0.7 | 14.31 | 0.027 | X |
| STANDARDS | | | | | | |
| 0001 GWS-1 | | | | | | |
| 0002 GWS-1 | | | | | | |
| 0003 TMDW | | 10.43 | 9.6 | | X | X |
| 0004 TMDW | X | | | X | | |
| 0005 Control Blank | | | | | | |
| 0006 GWS-1 | | | | | | |
| 0007 TMDW | | 10.07 | 9.4 | | 0.004 | X |
| 0008 TMDW | X | | | X | | |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | X | X | X | X |

| ELEMENTS | Sr | Th | Tl | U | V | Y |
|---|---|---|---|---|---|---|
| UNITS | ug/l | ug/l | ug/l | ug/l | mg/l | ug/l |
| DETECTION LIMIT | 0.02 | 0.005 | 0.01 | 0.005 | 0.01 | 0.005 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /MS | /MS | /MS | /OE | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0041 TSF1-HC-2 HNO3 | 3.64 | 0.046 | 0.03 | 115.101 | 0.15 | 0.026 |
| 0042 TSF2-HC-0 RAW | 31.84 | 0.031 | 0.05 | 322.880 | 0.33 | 0.104 |
| 0043 TSF2-HC-1 RAW | | | | | 0.31 | 0.064 |
| 0044 TSF2-HC-2 RAW | 8.12 | 0.012 | 0.04 | 41.251 | 0.15 | 0.020 |
| 0045 RB-1 HNO3 | | | | | X | 0.006 |
| 0046 RB-2 HNO3 | | | | | X | 0.008 |
| 0047 RB-3 HNO3 | | | | | X | X |
| 0048 RB-4 HNO3 | | | | | X | 0.008 |
| 0049 RB-5 HNO3 | | | | | X | X |
| 0050 RB-6 HNO3 | | | | | X | X |
| | | | | | | |
| CHECKS | | | | | | |
| 0001 TSF1-SLC-HPDW-1 RAW | | | | | | |
| 0002 TSF2-HC-1 RAW | | | | | | |
| 0003 TSF1-HC-2 HNO3 | 3.57 | 0.038 | 0.03 | 112.752 | 0.15 | 0.026 |
| | | | | | | |
| STANDARDS | | | | | | |
| 0001 GWS-1 | | | | | | |
| 0002 GWS-1 | | | | | | |
| 0003 TMDW | 246.13 | X | 9.73 | 9.756 | | 0.007 |
| 0004 TMDW | | | | | 0.03 | |
| 0005 Control Blank | | | | | | |
| 0006 GWS-1 | | | | | | |
| 0007 TMDW | 249.68 | 0.015 | 9.84 | 9.762 | | 0.006 |
| 0008 TMDW | | | | | 0.02 | |
| | | | | | | |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | X | X | X | X |

| ELEMENTS | Zn | Zr |
|---|---|---|
| UNITS | mg/l | ug/l |
| DETECTION LIMIT | 0.01 | 0.02 |
| DIGEST | | |
| ANALYTICAL FINISH | /OE | /MS |
| SAMPLE NUMBERS | | |
| 0041 TSF1-HC-2 HNO3 | X | 0.03 |
| 0042 TSF2-HC-0 RAW | X | X |
| 0043 TSF2-HC-1 RAW | | |
| 0044 TSF2-HC-2 RAW | X | X |
| 0045 RB-1 HNO3 | | |
| 0046 RB-2 HNO3 | | |
| 0047 RB-3 HNO3 | | |
| 0048 RB-4 HNO3 | | |
| 0049 RB-5 HNO3 | | |
| 0050 RB-6 HNO3 | | |

| CHECKS | | |
|---|---|---|
| 0001 TSF1-SLC-HPDW-1 RAW | | |
| 0002 TSF2-HC-1 RAW | | |
| 0003 TSF1-HC-2 HNO3 | 0.01 | 0.03 |

| STANDARDS | | |
|---|---|---|
| 0001 GWS-1 | | |
| 0002 GWS-1 | | |
| 0003 TMDW | | 0.05 |
| 0004 TMDW | 0.07 | |
| 0005 Control Blank | | |
| 0006 GWS-1 | | |
| 0007 TMDW | | 0.06 |
| 0008 TMDW | 0.07 | |

| BLANKS | | |
|---|---|---|
| 0001 Control Blank | X | X |

**METHOD CODE DESCRIPTION**

| Method Code | Analysing Laboratory |
|---|---|
| **/COL** | Intertek Genalysis Perth<br>No digestion or other pre-treatment undertaken. Analysed by UV-Visible Spectrometry. |
| **/MS** | Intertek Genalysis Perth<br>No digestion or other pre-treatment undertaken. Analysed by Inductively Coupled Plasma Mass Spectrometry. |
| **/MTR** | Intertek Genalysis Perth<br>No digestion or other pre-treatment undertaken. Analysed with Electronic Meter Measurement |
| **/OE** | Intertek Genalysis Perth<br>Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry. |
| **/SIE** | Intertek Genalysis Perth<br>No digestion or other pre-treatment undertaken. Analysed by Specific Ion Electrode. |
| **/VOL** | Intertek Genalysis Perth<br>No digestion or other pre-treatment undertaken. Analysed by Volumetric Technique. |

# MINERALS
# TEST REPORT

**CLIENT**

**CAMPBELL, GRAEME and ASSOCIATES**
PO Box 247
BRIDGETOWN, W.A. 6255
AUSTRALIA

**JOB INFORMATION**

| | |
|---|---|
| JOB CODE | : 143.0/1805285 |
| NO. SAMPLES | : 16 |
| NO. ELEMENTS | : 49 |
| CLIENT ORDER NO. | : GCA1706/2 (Job 1 of 1) |
| SAMPLE SUBMISSION NO. | : |
| PROJECT | : YANGIBANA |
| SAMPLE TYPE | : Solutions |
| DATE RECEIVED | : 20/04/2018 |
| DATE REPORTED | : 23/05/2018 |
| DATE PRINTED | : 23/05/2018 |

**REPORT NOTES**

**TESTED BY**

Intertek
15 Davison Street, Maddington 6109, Western Australia
PO Box 144, Gosnells 6990, Western Australia
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Email: min.aus.per@intertek.com

**SIGNIFICANT FIGURES**

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that figures beyond the least significant digit have significance.

For more information on the uncertainty on individual reported values, please contact the laboratory.

**SAMPLE STORAGE**

All solid samples (assay pulps, bulk pulps and residues will be stored for 60 days without charge. Following this samples will be stored at a daily rate until clients written advice regarding return, collection or disposal is received. If storage information is not supplied on the submission, or arranged with the laboratory in writing the default will be to store the samples with the applicable charges. Storage is charged at $4.00 per m3 per day, expenses related to the return or disposal of samples will be charged at cost. Current disposal cost is charged at $150.00 per m3.

Samples received as liquids, waters or solutions will be held for 60 days free of charge then disposed of, unless written advice fo return or collection is received.

| | | | | | |
|---|---|---|---|---|---|
| **LEGEND** | X | = Less than Detection Limit | | NA | = Not Analysed |
| | SNR | = Sample Not Received | | UA | = Unable to Assay |
| | * | = Result Checked | | > | = Value beyond Limit of Method |
| | DTF | = Result still to come | | + | = Extra Sample Received Not Listed |
| | IS | = Insufficient Sample for Analysis | | | |

| ELEMENTS | Ag | Al | As | B | Ba | Be |
|---|---|---|---|---|---|---|
| UNITS | ug/l | mg/l | ug/l | mg/l | ug/l | ug/l |
| DETECTION LIMIT | 0.01 | 0.01 | 0.1 | 0.01 | 0.05 | 0.1 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /OE | /MS | /OE | /MS | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | | | | | | |
| 0002 TSF2-SLC-HPDW-3 RAW | | | | | | |
| 0003 TSF2-SLC-GW-2 RAW | | | | | | |
| 0004 TSF2-SLC-GW-3 RAW | | | | | | |
| 0005 TSF1-HC-3 RAW | | | | | | |
| 0006 TSF1-HC-4 RAW | | | | | | |
| 0007 TSF2-HC-3 RAW | | | | | | |
| 0008 TSF2-HC-4 RAW | | | | | | |
| 0009 TSF2-SLC-HPDW-2 RAW | X | X | 119.7 | 0.63 | 0.58 | X |
| 0010 TSF2-SLC-HPDW-3 RAW | X | X | 36.9 | 0.21 | 0.25 | X |
| 0011 TSF2-SLC-GW-2 RAW | 0.02 | X | 125.1 | 0.59 | 1.42 | X |
| 0012 TSF2-SLC-GW-3 RAW | X | 0.02 | 36.0 | 0.35 | 0.80 | X |
| 0013 TSF1-HC-3 HNO3 | | 0.04 | 12.5 | 0.03 | | |
| 0014 TSF1-HC-4 HNO3 | | 0.12 | 77.3 | 0.01 | | |
| 0015 TSF2-HC-3 HNO3 | | 0.02 | 15.1 | 0.05 | | |
| 0016 TSF2-HC-4 HNO3 | | 0.06 | 12.4 | 0.04 | | |
| CHECKS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | | | | | | |
| STANDARDS | | | | | | |
| 0001 GWS-2 | | | | | | |
| 0002 TMDW | 2.14 | | 80.7 | | 50.33 | 20.7 |
| 0003 TMDW | | 0.12 | | X | | |
| BLANKS | | | | | | |
| 0001 Control Blank | X | 0.01 | X | 0.02 | X | X |

| ELEMENTS | Bi | CO3 | Ca | Cd | Ce | Cl |
|---|---|---|---|---|---|---|
| UNITS | ug/l | mgCaCO3/L | mg/l | ug/l | ug/l | mg/l |
| DETECTION LIMIT | 0.005 | 1 | 0.01 | 0.5 | 0.002 | 2 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /VOL | /OE | /MS | /MS | /COL |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | | 154 | | | | 22 |
| 0002 TSF2-SLC-HPDW-3 RAW | | 156 | | | | 5 |
| 0003 TSF2-SLC-GW-2 RAW | | 125 | | | | 325 |
| 0004 TSF2-SLC-GW-3 RAW | | 192 | | | | 305 |
| 0005 TSF1-HC-3 RAW | | X | | | | 6 |
| 0006 TSF1-HC-4 RAW | | X | | | | X |
| 0007 TSF2-HC-3 RAW | | X | | | | 15 |
| 0008 TSF2-HC-4 RAW | | X | | | | 17 |
| 0009 TSF2-SLC-HPDW-2 RAW | X | | 0.92 | X | 0.077 | |
| 0010 TSF2-SLC-HPDW-3 RAW | X | | 0.43 | X | 0.070 | |
| 0011 TSF2-SLC-GW-2 RAW | X | | 1.66 | X | 0.059 | |
| 0012 TSF2-SLC-GW-3 RAW | X | | 1.07 | X | 0.065 | |
| 0013 TSF1-HC-3 HNO3 | | | | | | |
| 0014 TSF1-HC-4 HNO3 | | | | | | |
| 0015 TSF2-HC-3 HNO3 | | | | | | |
| 0016 TSF2-HC-4 HNO3 | | | | | | |
| CHECKS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | | 189 | | | | 22 |
| STANDARDS | | | | | | |
| 0001 GWS-2 | | | | | | 23 |
| 0002 TMDW | 9.875 | | | 9.7 | 0.050 | |
| 0003 TMDW | | | 32.83 | | | |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | X | X | 0.006 | X |

| ELEMENTS | Co | Cr | Cu | Dy | EC | Eu |
|---|---|---|---|---|---|---|
| UNITS | ug/l | mg/l | mg/l | ug/l | uS/cm | ug/l |
| DETECTION LIMIT | 0.1 | 0.01 | 0.01 | 0.002 | 10 | 0.001 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /OE | /OE | /MS | /MTR | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | | | | | 1677 | |
| 0002 TSF2-SLC-HPDW-3 RAW | | | | | 1141 | |
| 0003 TSF2-SLC-GW-2 RAW | | | | | 2840 | |
| 0004 TSF2-SLC-GW-3 RAW | | | | | 2234 | |
| 0005 TSF1-HC-3 RAW | | | | | 429 | |
| 0006 TSF1-HC-4 RAW | | | | | 348 | |
| 0007 TSF2-HC-3 RAW | | | | | 737 | |
| 0008 TSF2-HC-4 RAW | | | | | 647 | |
| 0009 TSF2-SLC-HPDW-2 RAW | 0.8 | X | 0.01 | 0.007 | | 0.003 |
| 0010 TSF2-SLC-HPDW-3 RAW | 0.4 | X | X | X | | X |
| 0011 TSF2-SLC-GW-2 RAW | 1.2 | X | 0.01 | 0.006 | | X |
| 0012 TSF2-SLC-GW-3 RAW | 0.6 | X | X | 0.004 | | X |
| 0013 TSF1-HC-3 HNO3 | | | | | | |
| 0014 TSF1-HC-4 HNO3 | | | | | | |
| 0015 TSF2-HC-3 HNO3 | | | | | | |
| 0016 TSF2-HC-4 HNO3 | | | | | | |
| CHECKS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | | | | | 1678 | |
| STANDARDS | | | | | | |
| 0001 GWS-2 | | | | | | |
| 0002 TMDW | 25.2 | | | 0.004 | | X |
| 0003 TMDW | | 0.02 | 0.02 | | | |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | X | X | X | X |

| ELEMENTS | F | Fe-Sol | HCO3 | Hg | K | La |
|---|---|---|---|---|---|---|
| UNITS | mg/l | mg/l | mgCaCO3/L | ug/l | mg/l | ug/l |
| DETECTION LIMIT | 0.1 | 0.01 | 5 | 0.1 | 0.1 | 0.002 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /SIE | /OE | /VOL | /MS | /OE | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | 11.3 | | 727 | | | |
| 0002 TSF2-SLC-HPDW-3 RAW | 4.3 | | 472 | | | |
| 0003 TSF2-SLC-GW-2 RAW | 10.9 | | 720 | | | |
| 0004 TSF2-SLC-GW-3 RAW | 4.3 | | 374 | | | |
| 0005 TSF1-HC-3 RAW | 1.7 | | 226 | | | |
| 0006 TSF1-HC-4 RAW | 1.3 | | 182 | | | |
| 0007 TSF2-HC-3 RAW | 1.3 | | 339 | | | |
| 0008 TSF2-HC-4 RAW | 1.2 | | 310 | | | |
| 0009 TSF2-SLC-HPDW-2 RAW | | X | | X | 5.5 | 0.044 |
| 0010 TSF2-SLC-HPDW-3 RAW | | X | | X | 2.8 | 0.029 |
| 0011 TSF2-SLC-GW-2 RAW | | X | | X | 7.3 | 0.024 |
| 0012 TSF2-SLC-GW-3 RAW | | X | | X | 4.6 | 0.013 |
| 0013 TSF1-HC-3 HNO3 | | 0.08 | | | | |
| 0014 TSF1-HC-4 HNO3 | | 0.30 | | | | |
| 0015 TSF2-HC-3 HNO3 | | X | | | | |
| 0016 TSF2-HC-4 HNO3 | | X | | | | |
| CHECKS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | 11.4 | | 697 | | | |
| STANDARDS | | | | | | |
| 0001 GWS-2 | | | | | | |
| 0002 TMDW | | | | X | | 0.039 |
| 0003 TMDW | | 0.10 | | | 2.2 | |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | | X | X | X |

| ELEMENTS | Li | Mg | Mn | Mo | Na | Ni |
|---|---|---|---|---|---|---|
| UNITS | ug/l | mg/l | mg/l | ug/l | mg/l | mg/l |
| DETECTION LIMIT | 0.05 | 0.01 | 0.01 | 0.05 | 0.1 | 0.01 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /OE | /OE | /MS | /OE | /OE |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | | | | | | |
| 0002 TSF2-SLC-HPDW-3 RAW | | | | | | |
| 0003 TSF2-SLC-GW-2 RAW | | | | | | |
| 0004 TSF2-SLC-GW-3 RAW | | | | | | |
| 0005 TSF1-HC-3 RAW | | | | | | |
| 0006 TSF1-HC-4 RAW | | | | | | |
| 0007 TSF2-HC-3 RAW | | | | | | |
| 0008 TSF2-HC-4 RAW | | | | | | |
| 0009 TSF2-SLC-HPDW-2 RAW | 2.94 | 0.04 | X | 61.58 | 460.3 | 0.02 |
| 0010 TSF2-SLC-HPDW-3 RAW | 2.25 | X | X | 31.97 | 259.6 | X |
| 0011 TSF2-SLC-GW-2 RAW | 4.32 | X | X | 185.55 | 615.4 | 0.01 |
| 0012 TSF2-SLC-GW-3 RAW | 3.43 | X | X | 168.81 | 413.5 | X |
| 0013 TSF1-HC-3 HNO3 | 4.95 | | | 19.01 | | |
| 0014 TSF1-HC-4 HNO3 | 5.80 | | | 14.02 | | |
| 0015 TSF2-HC-3 HNO3 | 6.13 | | | 77.46 | | |
| 0016 TSF2-HC-4 HNO3 | 6.46 | | | 62.02 | | |
| CHECKS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | | | | | | |
| STANDARDS | | | | | | |
| 0001 GWS-2 | | | | | | |
| 0002 TMDW | 20.34 | | | 103.80 | | |
| 0003 TMDW | | 8.73 | 0.04 | | 5.8 | 0.06 |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | X | X | X | X |

| ELEMENTS | P | Pb | pH | Pr | S | Sb |
|---|---|---|---|---|---|---|
| UNITS | mg/l | ug/l | NONE | ug/l | mg/l | ug/l |
| DETECTION LIMIT | 0.1 | 2 | 0.1 | 0.001 | 0.1 | 0.01 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /OE | /MS | /MTR | /MS | /OE | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | | | 9.0 | | | |
| 0002 TSF2-SLC-HPDW-3 RAW | | | 9.1 | | | |
| 0003 TSF2-SLC-GW-2 RAW | | | 8.7 | | | |
| 0004 TSF2-SLC-GW-3 RAW | | | 8.9 | | | |
| 0005 TSF1-HC-3 RAW | | | 8.2 | | | |
| 0006 TSF1-HC-4 RAW | | | 8.1 | | | |
| 0007 TSF2-HC-3 RAW | | | 8.0 | | | |
| 0008 TSF2-HC-4 RAW | | | 8.2 | | | |
| 0009 TSF2-SLC-HPDW-2 RAW | 11.8 | X | | 0.021 | 2.2 | 2.62 |
| 0010 TSF2-SLC-HPDW-3 RAW | 7.7 | X | | 0.011 | 0.9 | 1.11 |
| 0011 TSF2-SLC-GW-2 RAW | 7.5 | X | | 0.004 | 34.4 | 2.93 |
| 0012 TSF2-SLC-GW-3 RAW | 6.0 | X | | 0.005 | 28.5 | 1.12 |
| 0013 TSF1-HC-3 HNO3 | | | | | 0.4 | |
| 0014 TSF1-HC-4 HNO3 | | | | | 0.2 | |
| 0015 TSF2-HC-3 HNO3 | | | | | 3.3 | |
| 0016 TSF2-HC-4 HNO3 | | | | | 2.2 | |
| CHECKS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | | | 9.0 | | | |
| STANDARDS | | | | | | |
| 0001 GWS-2 | | | | | | |
| 0002 TMDW | | 39 | | 0.003 | | 10.24 |
| 0003 TMDW | X | | | | 0.6 | |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | 5.4 | X | X | X |

| ELEMENTS | Se | Si | Sm | Sn | Sr | Th |
|---|---|---|---|---|---|---|
| UNITS | ug/l | mg/l | ug/l | ug/l | ug/l | ug/l |
| DETECTION LIMIT | 0.5 | 0.05 | 0.002 | 0.1 | 0.02 | 0.005 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /OE | /MS | /MS | /MS | /MS |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | | | | | | |
| 0002 TSF2-SLC-HPDW-3 RAW | | | | | | |
| 0003 TSF2-SLC-GW-2 RAW | | | | | | |
| 0004 TSF2-SLC-GW-3 RAW | | | | | | |
| 0005 TSF1-HC-3 RAW | | | | | | |
| 0006 TSF1-HC-4 RAW | | | | | | |
| 0007 TSF2-HC-3 RAW | | | | | | |
| 0008 TSF2-HC-4 RAW | | | | | | |
| 0009 TSF2-SLC-HPDW-2 RAW | 5.3 | 76.08 | 0.015 | X | 3.74 | 0.024 |
| 0010 TSF2-SLC-HPDW-3 RAW | 3.0 | 65.63 | X | X | 1.76 | X |
| 0011 TSF2-SLC-GW-2 RAW | 10.5 | 62.14 | 0.003 | X | 10.36 | 0.006 |
| 0012 TSF2-SLC-GW-3 RAW | 5.2 | 79.40 | 0.006 | X | 7.08 | X |
| 0013 TSF1-HC-3 HNO3 | 0.5 | 11.96 | | | | |
| 0014 TSF1-HC-4 HNO3 | X | 11.51 | | | | |
| 0015 TSF2-HC-3 HNO3 | 0.9 | 29.66 | | | | |
| 0016 TSF2-HC-4 HNO3 | 0.8 | 30.16 | | | | |
| CHECKS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | | | | | | |
| STANDARDS | | | | | | |
| 0001 GWS-2 | | | | | | |
| 0002 TMDW | 9.8 | | X | 0.1 | 252.63 | 0.007 |
| 0003 TMDW | | 0.08 | | | | |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | X | X | X | X |

| ELEMENTS | Tl | TotAlk | U | V | Y | Zn |
|---|---|---|---|---|---|---|
| UNITS | ug/l | mgCaCO3/L | ug/l | mg/l | ug/l | mg/l |
| DETECTION LIMIT | 0.01 | 5 | 0.005 | 0.01 | 0.005 | 0.01 |
| DIGEST | | | | | | |
| ANALYTICAL FINISH | /MS | /CALC | /MS | /OE | /MS | /OE |
| SAMPLE NUMBERS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | | 882 | | | | |
| 0002 TSF2-SLC-HPDW-3 RAW | | 628 | | | | |
| 0003 TSF2-SLC-GW-2 RAW | | 845 | | | | |
| 0004 TSF2-SLC-GW-3 RAW | | 566 | | | | |
| 0005 TSF1-HC-3 RAW | | 226 | | | | |
| 0006 TSF1-HC-4 RAW | | 182 | | | | |
| 0007 TSF2-HC-3 RAW | | 339 | | | | |
| 0008 TSF2-HC-4 RAW | | 310 | | | | |
| 0009 TSF2-SLC-HPDW-2 RAW | 0.04 | | 6.500 | 2.10 | 0.026 | X |
| 0010 TSF2-SLC-HPDW-3 RAW | 0.03 | | 1.260 | 0.44 | X | X |
| 0011 TSF2-SLC-GW-2 RAW | 0.07 | | 14.356 | 1.63 | 0.020 | X |
| 0012 TSF2-SLC-GW-3 RAW | 0.05 | | 4.704 | 0.48 | X | X |
| 0013 TSF1-HC-3 HNO3 | | | | 0.10 | 0.014 | |
| 0014 TSF1-HC-4 HNO3 | | | | 0.08 | 0.039 | |
| 0015 TSF2-HC-3 HNO3 | | | | 0.08 | 0.028 | |
| 0016 TSF2-HC-4 HNO3 | | | | 0.07 | 0.019 | |
| CHECKS | | | | | | |
| 0001 TSF2-SLC-HPDW-2 RAW | | 886 | | | | |
| STANDARDS | | | | | | |
| 0001 GWS-2 | | | | | | |
| 0002 TMDW | 9.76 | | 9.690 | | X | |
| 0003 TMDW | | | | 0.04 | | 0.06 |
| BLANKS | | | | | | |
| 0001 Control Blank | X | X | X | X | X | X |

| ELEMENTS | Zr |
|---|---|
| UNITS | ug/l |
| DETECTION LIMIT | 0.02 |
| DIGEST | |
| ANALYTICAL FINISH | /MS |
| SAMPLE NUMBERS | |
| 0001 TSF2-SLC-HPDW-2 RAW | |
| 0002 TSF2-SLC-HPDW-3 RAW | |
| 0003 TSF2-SLC-GW-2 RAW | |
| 0004 TSF2-SLC-GW-3 RAW | |
| 0005 TSF1-HC-3 RAW | |
| 0006 TSF1-HC-4 RAW | |
| 0007 TSF2-HC-3 RAW | |
| 0008 TSF2-HC-4 RAW | |
| 0009 TSF2-SLC-HPDW-2 RAW | 0.05 |
| 0010 TSF2-SLC-HPDW-3 RAW | 0.06 |
| 0011 TSF2-SLC-GW-2 RAW | X |
| 0012 TSF2-SLC-GW-3 RAW | X |
| 0013 TSF1-HC-3 HNO3 | |
| 0014 TSF1-HC-4 HNO3 | |
| 0015 TSF2-HC-3 HNO3 | |
| 0016 TSF2-HC-4 HNO3 | |

| CHECKS |
|---|
| 0001 TSF2-SLC-HPDW-2 RAW |

| STANDARDS | |
|---|---|
| 0001 GWS-2 | |
| 0002 TMDW | 0.03 |
| 0003 TMDW | |

| BLANKS | |
|---|---|
| 0001 Control Blank | X |

**METHOD CODE DESCRIPTION**

| Method Code | Analysing Laboratory |
|---|---|
| **/CALC** | Intertek Genalysis Perth<br>No digestion or other pre-treatment undertaken. Results Determined by calculation from other reported data. |
| **/COL** | Intertek Genalysis Perth<br>No digestion or other pre-treatment undertaken. Analysed by UV-Visible Spectrometry. |
| **/MS** | Intertek Genalysis Perth<br>No digestion or other pre-treatment undertaken. Analysed by Inductively Coupled Plasma Mass Spectrometry. |
| **/MTR** | Intertek Genalysis Perth<br>No digestion or other pre-treatment undertaken. Analysed with Electronic Meter Measurement |
| **/OE** | Intertek Genalysis Perth<br>Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry. |
| **/SIE** | Intertek Genalysis Perth<br>No digestion or other pre-treatment undertaken. Analysed by Specific Ion Electrode. |
| **/VOL** | Intertek Genalysis Perth<br>No digestion or other pre-treatment undertaken. Analysed by Volumetric Technique. |

Appendix 3: ANSTO, Certificate of Analysis, Tailings Column Leachates Testwork, HAST-130318-1 to 22, May 2018

Consulting and Process Development Specialists
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# CERTIFICATE OF ANALYSIS

| | |
|---|---|
| **Certificate Number:** | 18GAM032 |
| **Company / Organisation:** | Narelle Marriott, Hastings Technology Metals |
| **AM Request Number:** | 1800465 |
| **Sample Identification:** | Tailings Column Leachates Testwork |
| **AM Identification:** | HAST-130318-1 to 22 |
| **Analysis Requested:** | Natural Radioactivity |

Twenty two (22) liquors containing 500 mL of sample were received. Samples designated as TSF1 were acidified to pH 1[1] and then filtered through a 0.45 µm filter paper prior to assay. Samples designated as TSF2 were only filtered through a 0.45 µm filter paper prior to assay. Addition of acid to sample TSF-2-SLC-HPDW-1 resulted in precipitation of a white solid. The client informed ANSTO Minerals that this was due to the presence of fatty acids in the TSF-2 samples[2]. The precipitate in this sample was redissolved using 0.1 M sodium hydroxide prior to filtration.

The samples were analysed for U-238 (Th-230, Ra-226, Pb-210), Th-232 (Ra-228, Th 228) and U-235 (U-235, Pa-231, Ac-227) decay chain progeny using gamma spectrometry according to AM-I-052-002 Preparation of Solutions for Gamma Ray Analysis, AM-I-052-004 Counting Procedure using Maestro and AM-I-052-006 Gamma Spectrum Analysis of Liquid Samples using GammaVision.

The samples were analysed for parent U-238 and Th-232 using inductively coupled plasma mass spectrometry (ICPMS) according to G-5913 Analytical Methods Manual.

The samples were analysed for Po-210 using alpha spectrometry according to I-4303 Radiochemical Analysis for U, Th, Pb and Po.

**Results**:
Table 1 - Saturated Leaching Columns (SLC)
Table 2 - Groundwater Series (GW)
Table 3 - Humidity Cells (HC)

**Dr Sue Brown, Senior Radiochemist** **Date: 8 May 2018**

[1] 1.5 mL of concentrated nitric acid per 500 mL of sample is equivalent to pH ~1.
[2] Email dated 13 March 2018 from N. Marriott to S. Brown.

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# Table 1 Radionuclide Results (Bq/L) – Saturated Leaching Columns (SLC)

| Column Type | Saturated Leaching Columns - High Purity Deonised Water (HPDW) Series | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| TSF Number | - | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| Sample ID | Feed - HPDW | SLC-HPDW-1 | SLC-HPDW-2 | SLC-HPDW-3 | SLC-HPDW-4 | SLC-HPDW-5 | SLC-HPDW-6 | SLC-HPDW-1 |
| Sample Date | - | 05-Jan-18 | 09-Jan-18 | 13-Jan-18 | 17-Jan-18 | 21-Jan-18 | 25-Jan-18 | 25-Jan-18 |
| ANSTO ID | HAST-130318-15 | HAST-130318-1 | HAST-130318-2 | HAST-130318-3 | HAST-130318-4 | HAST-130318-5 | HAST-130318-6 | HAST-130318-7 |
| U (mg/L) (a) | < 0.01 | 0.22 ± 0.02 | 0.08 ± 0.02 | 0.02 ± 0.01 | < 0.01 | < 0.01 | < 0.01 | 0.17 ± 0.02 |
| Th (mg/L) (a) | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 |
| *U-238 Decay Chain* | | | | | | | | |
| U-238 (a) | < 0.12 | 2.7 ± 0.3 | 1.0 ± 0.2 | 0.3 ± 0.1 | < 0.12 | < 0.12 | < 0.12 | 2.1 ± 0.2 |
| Th-230 (b) | < 3.3 | < 5.2 | < 4.6 | < 3.1 | < 2.9 | < 2.3 | < 2.2 | < 5.7 |
| Ra-226 (b) | < 0.07 | < 0.11 | < 0.07 | < 0.07 | < 0.11 | < 0.07 | < 0.07 | < 0.15 |
| Pb-210 (b) | < 0.67 | < 0.96 | < 1.0 | < 0.89 | < 1.2 | < 0.88 | < 0.69 | < 1.4 |
| Po-210 (c) | < 0.020 | < 0.020 | 0.10 ± 0.04 | < 0.020 | < 0.020 | 0.6 ± 0.1 | 0.14 ± 0.05 | 0.19 ± 0.06 |
| Po-210 Count Date | 27-Mar-18 | 20-Mar-18 | 20-Mar-18 | 20-Mar-18 | 20-Apr-18 | 23-Mar-18 | 23-Mar-18 | 29-Mar-18 |
| *U-235 Decay Chain* | | | | | | | | |
| U-235 (b) | < 0.15 | 0.13 ± 0.01 (e) | 0.05 ± 0.01 (e) | 0.012 ± 0.006 (e) | < 0.31 | < 0.19 | < 0.27 | 0.10 ± 0.01 (e) |
| Pa-231 (b) | < 0.52 | < 0.90 | < 0.58 | < 0.61 | < 0.84 | < 0.47 | < 0.57 | < 0.50 |
| Ac-227 (b) | < 0.10 | < 0.16 | < 0.10 | < 0.10 | < 0.16 | < 0.08 | < 0.12 | < 0.19 |
| *Th-232 Decay Chain* | | | | | | | | |
| Th-232 (a) | < 0.04 | < 0.04 | < 0.04 | < 0.04 | < 0.04 | < 0.04 | < 0.04 | < 0.04 |
| Ra-228 (b) | < 0.10 | < 0.17 | < 0.09 | < 0.11 | < 0.17 | < 0.09 | < 0.12 | < 0.19 |
| Th-228 (b) | < 0.04 | < 0.05 | < 0.04 | < 0.04 | < 0.05 | < 0.04 | < 0.04 | < 0.06 |
| K-40 (b) | < 0.85 | < 1.9 | < 0.80 | < 1.0 | < 1.9 | < 0.77 | < 1.0 | < 2.4 |
| Total Contained Activity (d) | 0.00 | 11.1 | 4.2 | 1.0 | 0.00 | 0.60 | 0.14 | 8.8 |

(a) ICPMS.

(b) Gamma spectrometry.

(c) Alpha spectrometry.

(d) Contribution of all radionuclides, both long- and short-lived in sample. Calculation assumes zero concentration for less than values.

(e) Below gamma spectrometry detection limit. Calculated from the measured U-238 concentration.

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# Table 2 Radionuclide Results (Bq/L) – Groundwater Series (GW)

| Column Type | Saturated Leaching Columns - Groundwater (GW) Series | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| TSF Number | - | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| Sample ID | Feed - GW | SLC-GW-1 | SLC-GW-2 | SLC-GW-3 | SLC-GW-4 | SLC-GW-5 | SLC-GW-6 | SLC-GW-1 |
| Sample Date | - | 05-Jan-18 | 09-Jan-18 | 13-Jan-18 | 17-Jan-18 | 21-Jan-18 | 25-Jan-18 | 02-Feb-18 |
| ANSTO ID | HAST-130318-16 | HAST-130318-8 | HAST-130318-9 | HAST-130318-10 | HAST-130318-11 | HAST-130318-12 | HAST-130318-13 | HAST-130318-14 |
| U (mg/L) (a) | < 0.01 | 0.26 ± 0.03 | 0.11 ± 0.01 | 0.06 ± 0.01 | 0.05 ± 0.01 | 0.04 ± 0.02 | 0.09 ± 0.02 | 0.07 ± 0.01 |
| Th (mg/L) (a) | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 |
| *U-238 Decay Chain* | | | | | | | | |
| U-238 (a) | < 0.12 | 3.3 ± 0.3 | 1.3 ± 0.2 | 0.8 ± 0.2 | 0.6 ± 0.1 | 0.5 ± 0.1 | 1.1 ± 0.1 | 0.8 ± 0.1 |
| Th-230 (b) | < 5.6 | < 5.6 | < 2.1 | < 2.8 | < 2.8 | < 4.5 | < 3.2 | < 3.1 |
| Ra-226 (b) | < 0.12 | < 0.09 | < 0.11 | < 0.14 | < 0.10 | < 0.09 | < 0.09 | < 0.07 |
| Pb-210 (b) | < 1.1 | < 1.2 | < 1.0 | < 1.2 | < 1.3 | < 1.1 | < 0.85 | < 0.74 |
| Po-210 (c) | < 0.020 | < 0.020 | 0.14 ± 0.04 | 0.50 ± 0.08 | < 0.020 | < 0.020 | < 0.020 | 0.12 ± 0.04 |
| Po-210 Count Date | 27-Mar-18 | 23-Mar-18 | 04-May-18 | 04-May-18 | 27-Mar-18 | 27-Mar-18 | 27-Mar-18 | 04-Apr-18 |
| *U-235 Decay Chain* | | | | | | | | |
| U-235 (b) | < 0.13 | 0.15 ± 0.02 (e) | 0.06 ± 0.01 (e) | 0.04 ± 0.01 (e) | 0.03 ± 0.01 (e) | 0.02 ± 0.01 (e) | 0.05 ± 0.01 (e) | 0.04 ± 0.01 (e) |
| Pa-231 (b) | < 1.2 | < 0.58 | < 0.82 | < 0.96 | < 0.75 | < 0.77 | < 0.36 | < 0.58 |
| Ac-227 (b) | < 0.14 | < 0.11 | < 0.13 | < 0.16 | < 0.13 | < 0.15 | < 0.12 | < 0.09 |
| *Th-232 Decay Chain* | | | | | | | | |
| Th-232 (a) | < 0.04 | < 0.04 | < 0.04 | < 0.04 | < 0.04 | < 0.04 | < 0.04 | < 0.04 |
| Ra-228 (b) | < 0.23 | < 0.13 | < 0.15 | < 0.24 | < 0.12 | < 0.15 | < 0.17 | < 0.08 |
| Th-228 (b) | < 0.06 | < 0.04 | < 0.05 | < 0.06 | < 0.05 | < 0.05 | < 0.04 | 0.51 0.( 0.07 |
| K-40 (b) | < 2.3 | < 0.99 | < 1.2 | < 2.3 | < 0.97 | < 1.2 | < 1.7 | < 0.70 |
| Total Contained Activity (d) | 0.00 | 13.5 | 5.5 | 3.8 | 2.5 | 2.0 | 4.5 | 7.0 |

(a) ICPMS.

(b) Gamma spectrometry.

(c) Alpha spectrometry.

(d) Contribution of all radionuclides, both long- and short-lived in sample. Calculation assumes zero concentration for less than values.

(e) Below gamma spectrometry detection limit. Calculated from the measured U-238 concentration.

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# Table 3 Radionuclide Results (Bq/L) – Humidity Cells (HC)

| Column Type | Humidity Cells (HC) Series | | | | | |
|---|---|---|---|---|---|---|
| TSF Number | 1 | 1 | 1 | 2 | 2 | 2 |
| Sample ID | HC-0 | HC-1 | HC-2 | HC-0 | HC-1 | HC-2 |
| Sample Date | 03-Jan-18 | 16-Jan-18 | 28-Jan-18 | 03-Jan-18 | 17-Jan-18 | 29-Jan-18 |
| ANSTO ID | HAST-130318-17 | HAST-130318-18 | HAST-130318-19 | HAST-130318-20 | HAST-130318-21 | HAST-130318-22 |
| U (mg/L) (a) | 0.16 ± 0.02 | 0.16 ± 0.02 | 0.11 ± 0.01 | 0.24 ± 0.01 | 0.03 ± 0.02 | < 0.01 |
| Th (mg/L) (a) | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 |
| *U-238 Decay Chain* | | | | | | |
| U-238 (a) | 1.9 ± 0.2 | 2.0 ± 0.2 | 1.3 ± 0.1 | 2.9 ± 0.3 | 0.4 ± 0.2 | < 0.12 |
| Th-230 (b) | < 5.1 | < 2.9 | < 3.0 | < 4.3 | < 2.6 | < 4.9 |
| Ra-226 (b) | < 0.10 | < 0.10 | < 0.11 | < 0.09 | < 0.08 | < 0.07 |
| Pb-210 (b) | < 1.3 | < 0.82 | < 0.93 | < 1.0 | < 0.90 | < 1.0 |
| Po-210 (c) | 0.9 ± 0.1 | 0.34 ± 0.08 | 0.13 ± 0.04 | 0.11 ± 0.04 | < 0.020 | < 0.020 |
| Po-210 Count Date | 07-May-18 | 04-May-18 | 04-Apr-18 | 29-Mar-18 | 29-Mar-18 | 07-May-18 |
| *U-235 Decay Chain* | | | | | | |
| U-235 (b) | 0.089 ± 0.009 (e) | 0.093 ± 0.009 (e) | 0.061 ± 0.005 (e) | 0.14 ± 0.01 (e) | 0.019 ± 0.009 (e) | < 0.26 |
| Pa-231 (b) | < 0.72 | < 0.86 | < 0.64 | < 0.45 | < 0.56 | < 0.53 |
| Ac-227 (b) | < 0.12 | < 0.14 | < 0.16 | < 0.09 | < 0.11 | < 0.12 |
| *Th-232 Decay Chain* | | | | | | |
| Th-232 (a) | < 0.04 | < 0.04 | < 0.04 | < 0.04 | < 0.04 | < 0.04 |
| Ra-228 (b) | < 0.13 | < 0.14 | < 0.17 | < 0.10 | < 0.12 | < 0.10 |
| Th-228 (b) | < 0.05 | < 0.05 | < 0.05 | < 0.04 | < 0.04 | < 0.04 |
| K-40 (b) | < 0.98 | < 1.2 | < 1.9 | < 0.82 | < 1.2 | < 0.82 |
| Total Contained Activity (d) | 8.7 | 8.5 | 5.5 | 12.0 | 1.6 | 0.0 |

(a) ICPMS.

(b) Gamma spectrometry.

(c) Alpha spectrometry.

(d) Contribution of all radionuclides, both long- and short-lived in sample. Calculation assumes zero concentration for less than values.

(e) Below gamma spectrometry detection limit. Calculated from the measured U-238 concentration.